

# RESEARCH, DEVELOPMENT INNOVATION AND EXTENSION AGENDA 2020-2025

Republic of the Philippines  
**CARAGA STATE UNIVERSITY**  
Ampayon, Butuan City 8600, Philippines  
**C**ompetence **S**ervice **U**prightness



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# FOREWORD

The document is a testimony of commitment of the Caraga State University (CSU) to deliver its mandated service to the people as stipulated in RA 9854 in two (2) key functions: Research and Innovation Services and Extension Services. These functions interconnect with the other key university functions in instruction and production since research provides the basic inputs for all the other areas. The RDIE Agenda is a product of rigorous deliberation between and among stakeholders of the university to provide directions in identifying the specific programs, projects and activities considering its resources. In view of the university's commitments to provide support to regional development and the challenges it may face in the future, it has laid down these agenda to streamline its Research, Development, Innovation, and Extension programs in the next five (5) years with respect to its mandate. Though CSU is still young and still learning, it has a forward-looking and focused RDIE Agenda. With inspired management and supportive policies, it is not impossible for the University to be productive and to soar higher as it pursues its mission of delivering quality outputs in research and innovation for applications in the region and the country, in general.

The University recognizes that due to limited resources, it needs to expand and nurture its linkages to pursue its mission. The need to improve its infrastructure system and human resources is also crucial to RDIE. The delivery of programs and services of the university for competitive academic and RDIE performance has always been challenged by the lack of adequate infrastructure and human resource management system. The university, however, believes in responsible management as a major factor in ensuring institutional success. In the pursuit to make a difference, CSU endeavors to strengthen its management capability to institute the necessary mechanisms to stimulate active RDIE participation of the faculty to provide science-based information, technologies and knowledge products that would help address the needs of the communities and industries in the region and beyond. Thus the Research, Development, Innovation, and Extension Agenda 2020-2025 have been put together to be the basis for all these developmental efforts.

**ANTHONY M. PENASO, Ph.D.**  
President

# CHAPTER 1

## INTRODUCTION

The Caraga State University (CSU) is a state-funded academic institution mandated to primarily provide advanced education, higher technological, professional instruction and training in the fields of agriculture and environmental studies, fishery, engineering, forestry, industrial technology, education, law, medicine and other health related programs, information technology, arts and sciences and other related courses. It shall undertake research and extension services, and provide progressive leadership in its areas of specialization in the Caraga Region (RA 9854). Thus it is committed to contribute to the socioeconomic transformation of the region by providing the needed R&D support in addressing the pressing needs of the region, particularly on poverty alleviation, food security, and environmental management for sustainable countryside economic development. To attain this noble mission, the University needs to develop a sound Research, Development, Innovation, and Extension (RDIE) Agenda to be the basis for the smooth implementation of programs and delivery of outputs, adhering to the development goals of the country and the region for eco-friendly, gender-sensitive, and disaster-resilient communities towards achieving a lasting inclusive economic growth.

Caraga Region is one of the areas in the Philippines most threatened by Climate Change due to its location in the Pacific Seaboard. It is regarded as the *'Timber Corridor of the Philippines'* and as the de facto *'Mining Capital of the Philippines'* since it is the key source of wood supply and mineral resources in the country, respectively. The timber supply in the region is mainly generated from planted forests, which are raw materials in large-scale integrated sawmills and veneer/plywood plants and medium-scale wood processing plants that operate in Butuan City and in bigger towns in the region. The region also houses over half of the country's registered mining companies due to its rich mineral resources (MGB 2018). Mining companies mine nickel and chromite in Surigao, Agusan del Norte, and Dinagat. Large-scale gold mining is also seen in Agusan del Sur and Surigao del Norte. The existence of Lake Mainit and Agusan Marsh also contribute to the fishing area of the region. In addition, Caraga Region is also home to some of the unique ecosystems which have been developed into ecotourism destinations. The Agusan Marsh, the pristine Siargao Islands Protected Landscape and Seascape (SIPLAS), Tinuy-an Falls are among the important tourist destinations in the region. Hence, the Regional Development Council (RDC) identified Fishery, Agro-Forestry, Mineral and Ecotourism (FAME) as the regional banner program for socioeconomic development.

## CHAPTER 2

### THE ENVIRONMENT OF CSU RESEARCH, DEVELOPMENT, AND INNOVATION

Caraga Region is located in the northeastern part of Mindanao Island. It has a Type 2 climate which favors the growth of tropical trees thus it has the widest remaining dipterocarp forest in the Philippines and a rapidly expanding planted forest (Forest Statistics, 2018). It supplies about 70% of timber in the Philippines, mainly generated from planted forests. Large-scale integrated sawmills and veneer/plywood plants and medium-scale wood processing plants operate in Butuan City and in bigger towns in the region because of this vast raw material supply. Thus the region is tagged as the '*Timber Corridor of the Philippines*'. The region houses over half of the country's registered mining companies due to its rich mineral resources (MGB 2018). Large-scale mining of nickel and chromite, as well as artisanal and small-scale gold mining are widespread in the region, although two (2) large scale gold mining (Philsaga Mining Corporation and Greenstone Resources Corporation) also operate in the region. In Agriculture, the region has suitable lands for agriculture, particularly cacao and coffee, coconut and other crops with high economic value. Aquaculture has become one of the livelihood sources for people in Surigao. In addition, Caraga Region is also home to some of the unique ecosystems which have been developed into ecotourism destinations. Because of these natural economic assets, the Regional Development Council (RDC) identified Fishery, Agro-Forestry, Mineral and Ecotourism (FAME) as the regional banner program for socioeconomic development.

With these resources and economic opportunities available, employment generation is increasing which lures people from other regions to come to Caraga. This, however, makes the natural resource base of the region vulnerable inasmuch as the increasing population in the region relies mainly on these resources, which may eventually cause the depletion of non-renewable resources. This, therefore, poses tremendous challenge for researchers, planners and policy makers, considering that sustainable development is about striking balance between economic development and environmental conservation. For these natural resources to be utilized optimally for sustainable development, educating the people to engage in proper management of resources and formulation of evidence-based policies are critical. To ensure sustainable development utilizing the natural resources in the various local government units (LGUs) in the region, ICT-enabled governance is important. The Smart City, which is anchored on ICT-based planning, has become the trend in Europe. A smart city (or smarter city) uses digital technologies or information and communication technologies (ICT) to enhance quality and performance of urban services, to reduce costs and resource consumption, and to engage more effectively and actively with its citizens. Likewise, geo-informatics and spatial information to guide planners and implementers in disaster risk reduction, smart agriculture and smart urban planning are vital in the development of Caraga and the rest of Mindanao.

The challenges to bring the communities and industries in Caraga Region to contribute significantly to the sustainable socioeconomic development of the region are tremendous. The need for integrated approaches, combined with increased demands for new types of knowledge and innovations to respond to the call of the Fourth Industrial Revolution (FIRe), and limited resources, is among the major challenges the university is facing to effectively deliver and support the regional development priorities. However, the opportunities for development are also vast, provided that the stakeholders are working harmoniously with each other to maximize the available resources. Furthermore, a well-designed and proactive Research, Development, and Innovation Agenda can also make a difference because this will

be the basis in undertaking the specific programs, projects and activities to be effective, affordable, and sustainable for the long-term.

## **SWOT Analysis**

To identify areas of focus in RDIE as well as the strategies to implement the various programs, a SWOT Analysis was conducted to assess the internal and external environments. In the analysis of the internal environments, the major strengths and weaknesses, opportunities and threats were identified.

### ***Internal Environment: Major Strengths and Weaknesses***

#### **Major Strengths**

##### *1) Stronger Faculty Force in the University*

Every year, since 2005, the university sends faculty members for advanced studies in their fields of specialization/discipline. The Faculty Training and Development Committee (FTDC) prescribes that faculty-scholars must enroll in delivering institutions identified by the Commission on Higher Education (CHED) if within the country or in universities abroad. This practice helps ensure that the faculty scholars receive quality professional and research training when they return to the university. With the return of the faculty scholars trained in leading universities such as the University of the Philippines (UP), Ateneo de Manila University (ADMU), De La Salle University, Visayas State University (VSU), Central Mindanao University and Mindanao State University-Iligan Institute of Technology (MSU-IIT), the delivery of the various academic services at CSU considerably improved. As of 2018, the faculty at CSU Main Campus is composed of 34% Ph.D. holders, 58% MS degree holders and only 8% BS degree holders, with Mathematics having the most Ph.D. holders, while Engineering has the lowest at 2 (Figure 1a). In the Cabadbaran Campus, the faculty force is continually improved by sending faculty members for graduate education. As of 2018, the CSUCC faculty is composed of 14% Ph.D. holders, 47% MS degree holders and only 39% BS degree holders (Figure 1b). Most of the faculty members with BS degrees are now enrolled in their MS/MA programs under the CHED Scholarship.

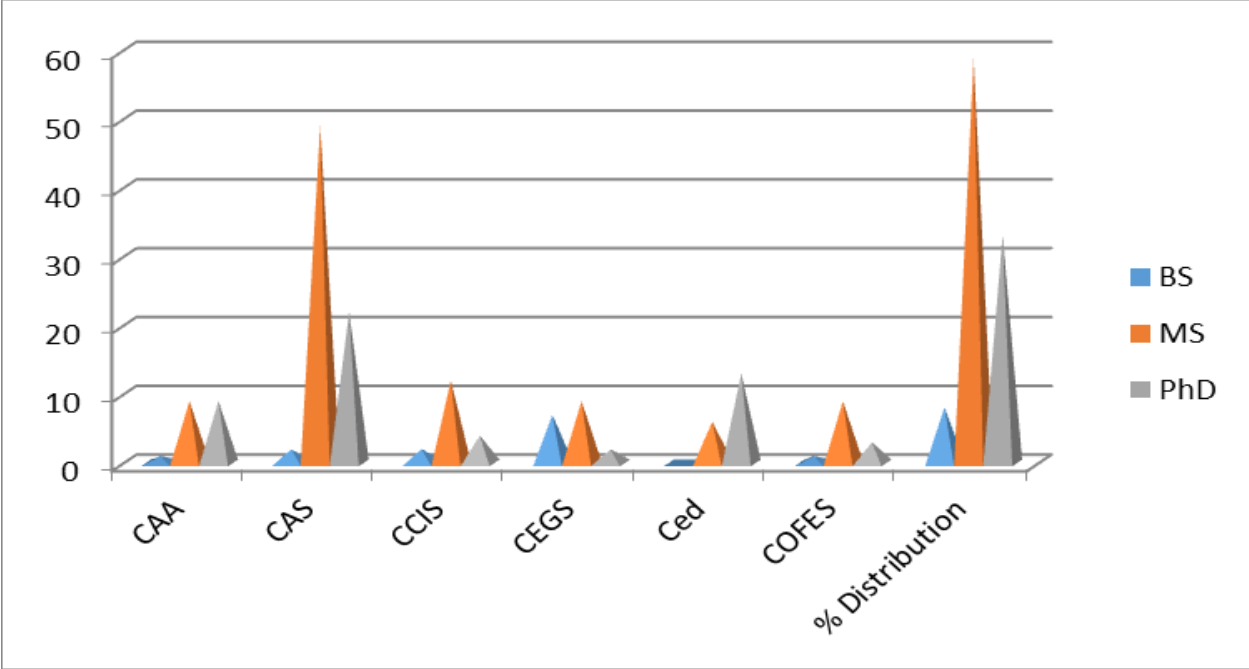


Figure 1a. Faculty distribution by highest educational attainment in the Main Campus of CSU, as of 2018.

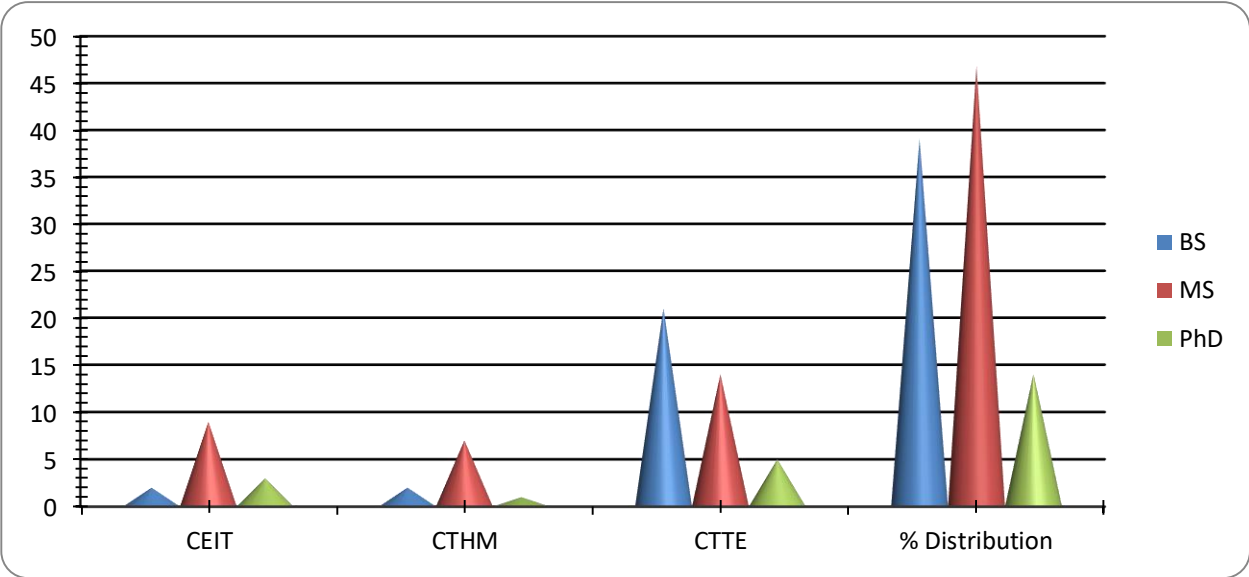


Figure 1b. Faculty distribution by highest educational attainment in the Cabadbaran Campus of CSU, as of 2018.



Since 2014 onwards, the number of faculty engaging in RDIE increased considerably, with the coverage of research and innovation areas becoming wider. The increase in the RDE productivity and the number of faculty researchers is highly visible in the areas of Geo-informatics, Environment and Eco-governance, ICT, Agriculture Productivity Enhancement, and Responsible Mining. There are also a growing number of researchers in the areas of Mathematics, Resource Assessment and Emerging Technology, and Knowledge Management (Figure 2). A big leap in the number of faculty-researchers is noted in the areas of ICT and Environment and Eco-governance. This is due largely to the capable returning scholars who packaged proposals and got funding from DOST and other funding institutions (GIZ, industry). In the CSU-Cabadbaran City, the number of researchers has slowly increased particularly in the areas of food innovation, energy management, and education. The slow growth is due largely to the demands of the instruction function for the faculty to give attention inasmuch as the total faculty number is only small.

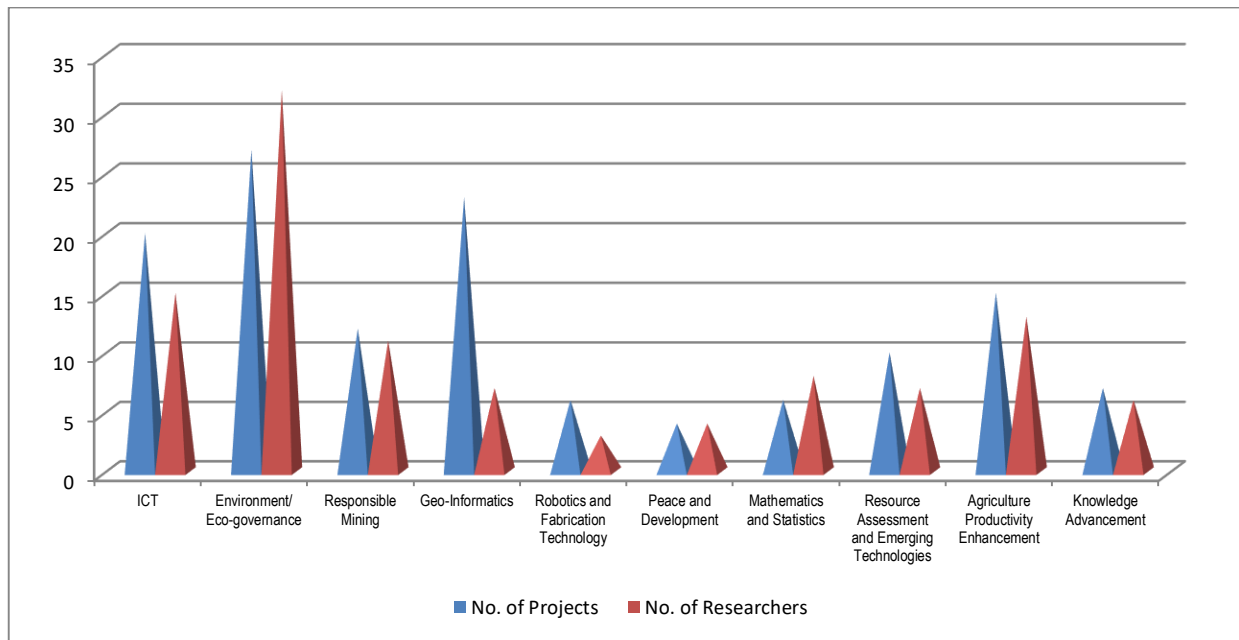


Figure 2. RDE productivity and the number of faculty researchers in the various focused areas based on CSU RDE Agenda, as of 2014-2018

## 2) CSU's Identification with Science, Technology, Engineering, and Mathematics (STEAM) Track

Aligning to the development issues and agenda in the region and in the country has also made the university RDE programs fine-tuned to the core of addressing the major barriers of sustainable development. The university has identified a holistic paradigm of delivering science-based interventions to influence today's utilization of natural resources that are mostly non-renewable and to ensure sustainability of these resources for future generations and for reducing climate change impacts. The University's RDE model captures the elements to which the interventions are aimed to institute the desired changes in societies' practices not friendly to the environment in particular.

The university believes that ensuring the environmental integrity and economic productivity could sustain socioeconomic development in the Caraga Region and the whole of Mindanao. With this belief, it is committed to impart to the region the science, technology and engineering on how sustainable development can be pursued. Since then, the Caraga State University (CSU) has adopted the STEM-focused curricula, following the schools and universities throughout the United States, China, Australia, the United Kingdom, and Taiwan. The specific STEM disciplines include engineering, natural and applied sciences (e.g. biology, chemistry, physics, geology, and environmental science), mathematics, economics, agricultural sciences, psychology, and other behavioral sciences. The STEM-educated workforce is essential to the generation of new ideas, flexibility, and critical thinking. However, there are real-world models that demonstrate that a STEAM (Science, Technology, Engineering, ARTS, and Mathematics) education can provide a student with a well-rounded knowledge base. This is well suited with the goal of many other agencies (public and private), thereby inviting them to join forces with the University to rally behind similar cause. The mounting interest on Climate Change and the associated issues and concerns (e.g. Disaster Risk Reduction, Food Security and Safety, Poverty) have particularly made the CSU's STEAM track programs well assimilated to today's concern not only in the region, in the country, but all over the world.

### *3) Expanding Linkages/Partnerships*

The participation of the university constituents in various local and international human development activities (eg. short-term training, study tours, formal education) as well as in collaborative researches resulted to expansion of its linkages. Over the years, the University forged partnership with a considerable number of agencies across the country and with other nations. This has helped a lot in pushing further the frontier of the university in terms of capability building and facilities development to respond to pressing concerns in academic and R&D responsibilities. In fact, linkages have been credited in improving the status of the university. The major RDE projects of the University are funded by partners (e.g. DOST-PCIEERD, DOST-PCAARRD, DA-BAR, CHED, NRCP, UN-FAO, and the mining industry). As CSU initiated its internationalization and global engagement program, it has also expanded its international network by increasing the number of its sister universities. It has signed Memorandum of Understanding/Cooperation with universities and research institution in many countries, which include Japan, Australia, Taiwan, Malaysia, Indonesia, Portugal, and France. It also registered as a member of international organizations for specific causes, such as the International Partnership for Satoyama Initiative (IPSI), Wetland Link International–Asia (WLI-Asia).

## **Major Weaknesses**

While some indicators point to the successful delivery of research, innovation, and extension services, the University is still trapped by the vicious cycle of budget deficits every year. The limited budget allotted to the University is the root cause of some of the University's major weaknesses:

### *1) Meager budget for R&D infrastructure and facility modernization*

The meager budget results to unavailable funds for new buildings and even renovation of aging buildings and other facilities necessary in the conduct of quality research and innovation. The present

stock of resources seems not to allow the university to provide easily the excellent services sought to support the flagship programs. To date, the university has very limited means for backstopping the growing demand for laboratories to house the increasing number of R&D facilities derived from previous funded R&D engagements. Housing these facilities and making these more useful in addressing the needs for knowledge generation and innovations are crucial to position the University as the S&T prime mover in Caraga Region and in Mindanao.

A number of science laboratory facilities are unavailable for faculty in the engineering, sciences and mathematics to embark on basic and applied researches. On the whole, if the university is left on itself, the likelihood of performing those researches is very low. The university thrust in basic research and innovation is a competitive advantage, because such efforts can lead to the production of new products and technologies, which will eventually provide the university more markets for its knowledge products and services. On the other hand, innovations in the areas of Engineering, Geo-informatics and Information Technology have started coming; however, laboratory and idea space is always the challenge for researchers and innovators.

Current linkages are practically of little help to address the inadequacy of laboratories in the university; all the more with the limited government appropriation (GAA), which is the root cause of all current constraints. The dearth in budget coupled with the inability of the university's resource generation to cope with the financial requirement of the desired academic services proves to be the biggest thing to hurdle ahead. However, with the growing confidence of funders in the University's capacity, there are already alternative approaches through which the university can address the budget issue.

## *2) Alignment of CSU to out-dated policies of DBM and CSC limits administrative support to RDIE*

The faculty-researchers of the university have already adequate training to implement research, development, and innovation (RDIE). Their academic training from universities that demonstrated 'Research Culture' has prepared them for the rigors in undertaking RDIE. However, their spirit can be dampened by the administrative protocols that are not responsive to the changing demands of time. These administrative protocols are implemented by the university corresponding to policies of the Department of Budget and Management (DBM) and the Civil Service Commission (CSC) which are out-of-date and not responsive to present scenarios resulting to administrative policies not supportive to RDIE initiatives. With innovation added to the targets of the university to be at par with the standards set to be ready for Industry 4.0 or the Fourth Industrial Revolution (FIRe), policies need to be re-shaped to support the recent developments.

## ***External Environment: Major Opportunities and Threats***

CSU is surrounded with opportunities brought about by the presence of agencies (both local and international) that invite RDIE proposals and collaboration. For years, the University has partnered with these agencies (funding and co-implementing agencies) to continually undertake RDIE projects in the region that allowed the University to surpass resource constraints. Some of these agencies have been tapped in the faculty development program as source of scholarships for overseas training along the agencies' priority research and development agenda. The presence of these agencies has provided substantial leverage and confidence for the University to continue with its research and innovation pursuits which are important inputs in community engagement and extension services.

The university's identification of the STEAM track has ushered in more opportunities for the University because of the need for RDIE in the region along these areas. The RDIE focus of CSU is aligned to the Caraga Regional Development Framework 2017-2022 (Figure 3), where its directions are to implement research and innovation supporting Fishery, Agri-Forestry, Minerals and Ecotourism (FAME). This regional development framework is also aligned to the Philippine Development Plan 2017-2022. In CSU, the alignment of its agenda to the FAME development goal is essential because more opportunities for research, innovation and extension services can benefit the region and the communities. Along the FAME, the University has the opportunity to lead in environmental advocacy, co-implementing various projects with other agencies to pursue efforts to strike balance between economic development and environmental conservation. Moreover, the advent of Climate Change has resulted to growing concerns related to disasters such as floods and storm surges. Thus proper planning to ensure disaster risk reduction is another challenge. With GIS mapping using LiDAR data, more meaningful planning is feasible. The need to give attention to the basic needs for food makes agriculture and fishing very important. The same goes for Forestry, considering that tree farming and wood-based industry have become a major source of livelihood for people and is among the foundations for Caraga's development. The growing interest in tourism (e.g. ecotourism, food tourism, and mining tourism) has also given CSU vast opportunities for research, innovation and community engagement.

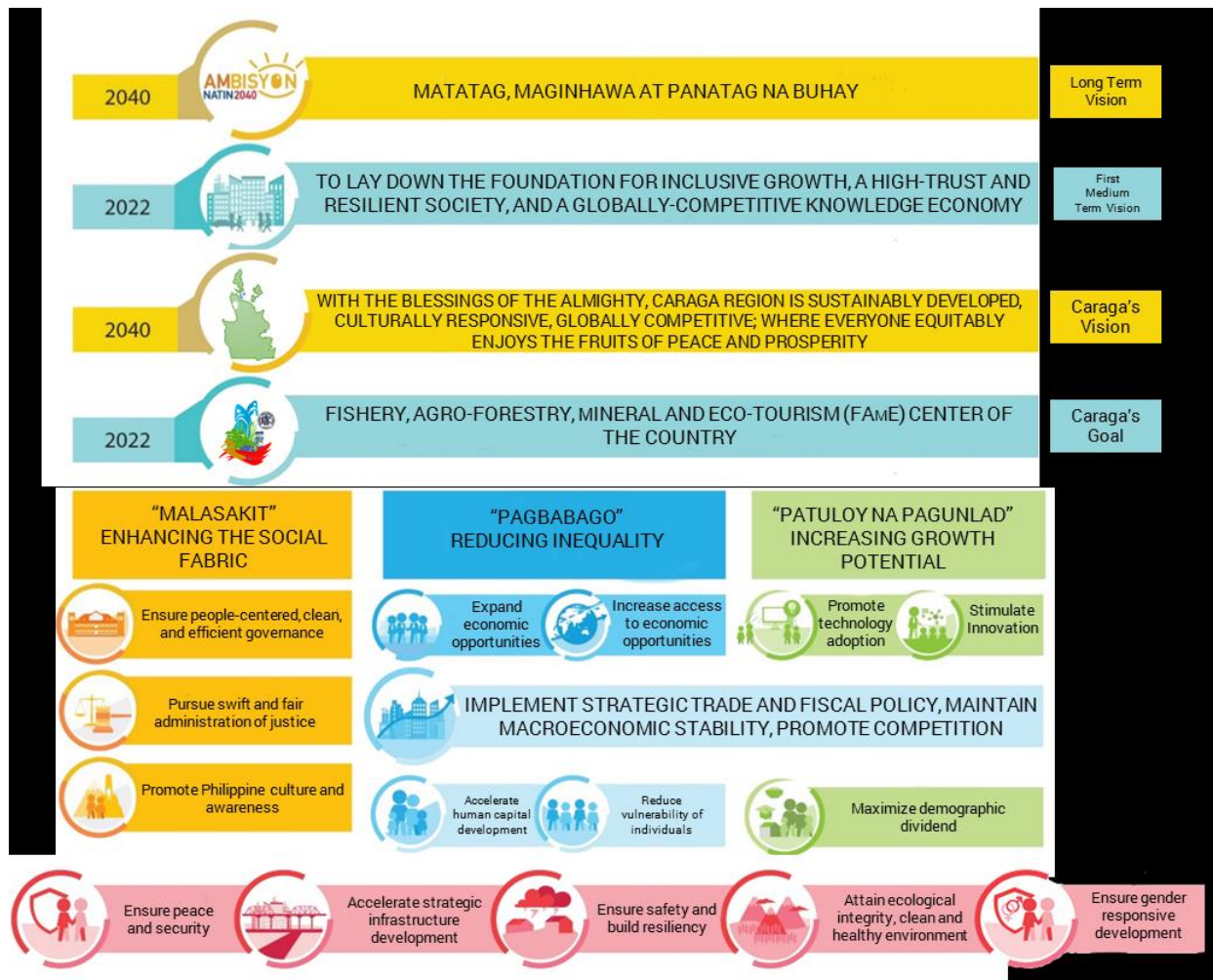


Figure 3. The Caraga Regional Development Framework 2017-2022

## CHAPTER 3

### PROCESSES IN SETTING THE CSU RESEARCH, DEVELOPMENT & EXTENSION AGENDA

#### *The Basis of the CSU RDE Agenda*

Guided by its institutional mandate and its Vision, Mission, Goal and Objectives, the CSU Research, Development, Innovation and Extension Agenda was crafted. The institution's RDIE agenda is aligned with the Philippine Development Plan 2017-2022 (PDP), National Science and Technology Plan of the Department of Science and Technology (DOST-NSTP), National Higher Education Research Agenda of the Commission of Higher Education (CHED-NHERA), Caraga Regional Development Plan 2017-2022, Sustainable Development Goals (SDG) and the regional and national priorities of government agencies such as the Harmonized National R&D Agenda (HNRDA) espoused by the Department of Science and Technology (DOST), Regional Research and Development Agenda and Programs (RRDEAP) of the Department of Agriculture (DA), and the National Unified Health Research Agenda (NUHRA) led by the Department of Health (DOH). All R&D needs stipulated in the above-mentioned plans and programs were used as inputs and the foundation for the revision to come up with the **Caraga State University RDE Agenda for 2020-2025**.

#### *Consultative meetings and workshops with the various stakeholders*

Consultative meetings and workshops were conducted among CSU faculty, staff, students, alumni, regional line agencies, industry, civil societies and other stakeholders to obtain inputs important in making necessary revisions on the CSU RDIE Agenda. The revisions are intended to make the RDE Agenda consistent with the emerging development policies of the national government in the era of the Fourth Industrial Revolution (FIRE). The specific objectives of the meetings and workshops are:

- a) to validate the identified needs in the Caraga Region for Science and Technology interventions;
- b) to establish a system for technology transfer and the management of intellectual property; and
- c) strengthen networking and community relations with industry, NGAs, POs, other Higher Education Institutions (HEIs) and other stakeholders

#### *Participation of the various stakeholders in consultative meetings*

Representatives from various sectors were invited to participate in the consultative meetings. This is intended to gain greater involvement in crafting the University RDE Agenda, thereby making the RDE direction of the University more relevant to the needs of the region. Regional representatives from Government and Non-Government Agencies and various stakeholders presented issues and concerns related to the current programs and priorities in their agencies. The representatives likewise provided a list of projects that require RDE to support the formulation and/or reform of policies and the development of S&T-based interventions to improve productivity in their sectors.

### ***Strategic Planning***

The University is still working hard for the strengthening of its research capability to build a credible track record for Caraga Region at least. It has to work from the inside by addressing what needs to be done to stimulate interest and develop attitudinal change among the faculty members to engage in Research, Development, Innovation, and Extension. The process has been difficult during the initiation stage, however, it has taken off bit by bit. However, there are some necessary reforms in the way the operations related to RDIE should be done for the academic community of CSU to flourish. Conscious of the fact that resources available for research in the University are limited, obtaining external funding to finance RDIE activities is indeed a necessary. This can be done by hitting precisely the priority thrusts of funding agencies in which the possibility of strengthening research linkages in acquiring excellent research facilities and in producing commendable outputs become stronger.

In all these aspects, enthusiasm of the faculty for research is considered crucial. Sustaining this enthusiasm is necessary and must be secured by means of judicious benefits, incentives, tenure, reward system, logistical support and providing an atmosphere conducive for research and innovative efforts. Keeping the enthusiasm of faculty-researchers and innovators ablaze would also require more effective and efficient administrative support for the delivery of research services.

## **CHAPTER 4**

### **STRATEGIC DIRECTIONS**

#### **Vision and Mission for University Research, Development, Innovation and Extension**

Vision:

***CSU as 'The Research and Innovation Hub of Caraga' supporting a socially-sensitive, environment-friendly, ecologically sound, and inclusive economic growth in the area***

Mission:

***Generation of knowledge, technologies, and innovations supporting the lasting inclusive economic growth, peace and disaster-resiliency in Caraga Region***

#### **Objectives, Key Result Areas and Performance Measures**

The Strategic Plan was developed by matching the strengths with opportunities, strengths and threats, and opportunities and weaknesses. Having identified the issues and concerns confronting Caraga Region, as well as after analyzing the strengths, weaknesses, opportunities and threats (SWOT), the RDE Agenda of CSU was formulated. The Plan is aimed at increasing quality performance in research; hence, the crucial point is on how to encourage faculty members to actively engage in research and innovation. At present, the University's productivity in terms of research published is only about 25 papers, with 10-15 papers cited by other authors annually. Sending these faculty-researchers to obtain their Ph.D. in reputable universities is critical inasmuch as these are the core contributor to the RDIE productivity. The best strategy is to send them to Universities with a research culture to prevent erosion of RDE outputs and outcomes in the next 5-10 years. Hence, several areas have to be addressed in order to stimulate the interest of the faculty members in research and innovation and sustain their enthusiasm.

A dynamic environment is essential in promoting research excellence. If the environment in the University is not conducive to analytical and innovative thinking, migration of capable but less motivated people most likely happens. Thus the administration has to review policies and provide the much-needed support to hold the capable faculty members, thereby preventing the so-called 'brain drain'. The support that needs to be provided to prevent 'brain drain' can be in the form of providing idea space and well-equipped laboratory for the capable faculty members to stay in the University. For CSU, a number of young and budding researchers exist, thus a little effort to provide research facilities can make these faculty members stay and become productive in RDIE.



## Specific Strategies

To achieve the Vision, Mission and Objectives of the University R&D Division, strategies were identified. The Action Plan 2020-2025 matrix is shown in Tables 2-10. The specific strategies are as follows:

### **1. *Capacitate faculty-researchers in developing proposals to attract external funding or research grants and to expand research collaborations***

Tap scholarship opportunities from national and international sponsors to build/enhance capabilities among faculty and other personnel doing R&D activities. The Office of the Vice President for Research, Innovation and Extension (OVPRIE) and the Faculty Training and Development Committee (FTDC) shall work closely to determine the gaps in human resource capability to prioritize the specialized fields which are wanting.

Collaboration can play a key role in the capability building of qualified personnel, for example through the co-supervision of Ph.D. students from other countries. The cost of research, especially in disciplines requiring specialized instrumentation or facilities, tend to make collaboration an imperative. Partnership with international institutes in the form of joint research projects, allow sharing of research facilities and major infrastructure, allowing access to research data and discoveries, and the linking of research centers and virtual networks. Issues, such as climate change transcends national borders and demand international collaboration which can enrich the capability of the University faculty-researchers.

### **Action Plan**

- a. Annual review of the Human Resource Development Program as part of the Learning and Development Program to capacitate faculty and staff to do research relevant to national issues in food crisis, poverty reduction, disaster resiliency, smart city, and environmental degradation.
- b. Strengthen linkages with sponsoring institutions on scholarships/ fellowships for faculty-researchers training (either degree or non-degree).
- c. Collaborate with mentors from established research institutions (local and international) to improve research capability of faculty through actual research implementation

### **2. *Create Research Groups to Encourage Collaborative and Interdisciplinary Research and Innovation***

In the R&D arena, the principle “*No man is an island*” shall be adopted. Thus research groups will be created to work together in 1 program. In the Research Groups, affiliated faculty members will be learning from one another and their collaborative efforts can improve R&D productivity. The team approach in R&D activities may encourage newcomers to engage in research and learn the ropes, while allowing the old researchers to learn new techniques and methods from the new ones, especially those who just graduated from their MS and Ph.D. degrees. This strategy is also aimed to encourage maximum participation in R&D activities to keep the *Research Culture* aflame.

For RDIE activities to respond to problems on technological and/or information needs of society, a multi-disciplinary research shall be adopted. This approach minimizes the span of time required to address multi-faceted problems, while optimizing the budget to carry out R&D activities.

### **Action Plan**

- Create Research Groups that relate with the various Research and Innovation Centers of CSU
- Re-focus the direction of the various RDIE centers towards integrated and interdisciplinary programs to address the needs of society utilizing the outputs of research

### **3. Sustain the enthusiasm of faculty-researchers in Research, Development, Innovation, and Extension**

Researchers require a place and scientific tools to do some critical thinking and apply the ideas using some tools. Equipped research laboratories and idea spaces connected to the Internet shall be provided to give researchers an atmosphere where they could think critically and act logically. Researchers shall be accorded 'flexi-time' to give them freedom to work in times when the mind is active and full of bright ideas.

To sustain the enthusiasm of the faculty-researchers, provision of incentives and support in terms of travel grants to attend and/or present papers in scientific fora/gatherings, publication support and time release to efficiently work on their research through teaching load reduction.

### **Action Plan**

- a) Implement the provision of incentives & other fringe benefits as stipulated in the RDE Operation Manual and Consultancy and Contract Research Policy
- b) Implement reward system for outstanding performance in research and innovation
- c) Ensure adequate laboratory support for CSU RDE personnel
- d) Formulate and/or amend policies to be more conducive to the nature of work of faculty-researchers to enhance research productivity

### **4. Provide efficient and effective administrative support for research productivity enhancement**

Hiring of faculty members shall also give emphasis on the research background and/or potential of the applicants for research and innovation. Hiring of personnel who have some backgrounds in research from universities and research institutions recognized for their prolific research and development outputs can greatly expand the researchers' pool in CSU.

Support the endeavors and efforts of researchers to keep their interests in RDE ablaze. This can be in the form of facilitating procurement of supplies and materials, equipment and other important inputs in the conduct of the RDE activities.

### **Action Plan**

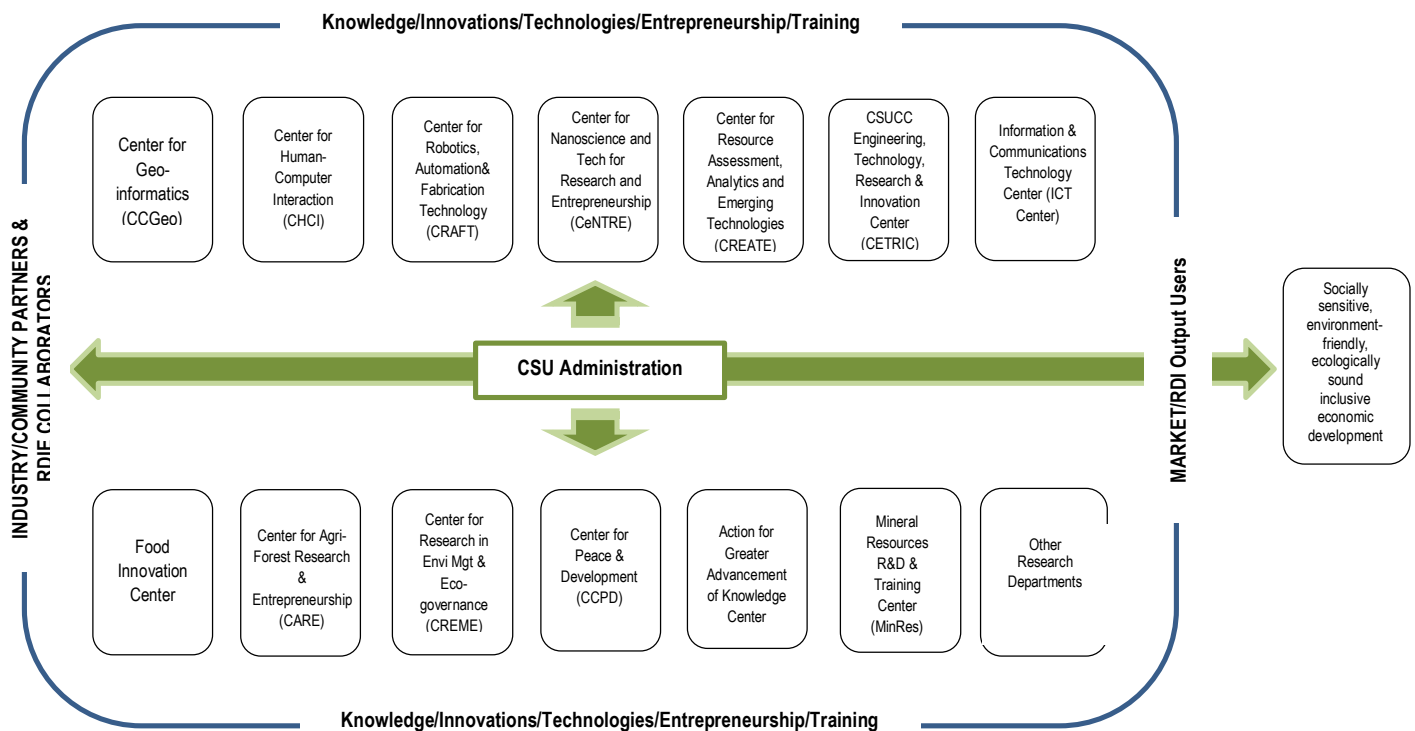
- a) Establish a foundation to handle research fund management and procurement system
- b) Improve the library collection specifically subscription of research journals to sustain the knowledge support to CSU RDIE system

- c) Improve administrative support for efficient repairs and maintenance of laboratories and associated facilities
- d) Support the efforts of faculty-researchers by providing funds for publication, paper presentation, and research or innovation-related workshops.

In parallel with the institutional, regional and national R&D priorities of government agencies, the CSU RDIE Framework was formulated. It presents the **CSU Office of the Vice President for Research, Innovation and Extension (OVPRIE)** as the umbrella for all research, development, innovation, and extension programs of the university. The office is created to oversee the Research, Development, Innovation, and Extension Services of CSU to contribute in the sustainable management of the region's natural resources towards developing technologies and innovations to contribute to improving livelihood, public health and socio-cultural aspects through the provision of basic knowledge, information, innovations and technology. With this framework, the CSU RDIE Programs are aimed at addressing to the needs of the region through: utilizing and developing the lowland and upland resources sustainably; managing the mineral resources responsibly; developing and maintaining the natural endowments for ecotourism and for conservation; smart regional development planning using ICT; disaster preparedness using geo-informatics; upgrading human capacity through the understanding and appreciation of science, technology, engineering, and mathematics; and cultivating values and culture through basic and functional literacy programs and the appreciation of the socio-cultural backgrounds of every sector of society.

## The Research, Development, Innovation and Extension Implementation Framework

The implementation framework is shown in Fig. 4. The various lines represent the interconnectivity of the different programs. These lines likewise show the interrelatedness and interdependence of the programs in terms of human resources, facilities, capability building and other relevant areas of collaboration. The semi-circular line connecting the various research and innovation centers to the innovation and commercialization center, market and the partners (eg. industry, LGUs, other stakeholders) indicate the interrelationships of the various components in the system, while the uni-directional arrows signify the strong direction of the various Research and Innovation Centers to generate knowledge, technologies and innovations to support the achievement of socially-sensitive inclusive economic growth and disaster resiliency. The CSU Administration is linked with the various partners and the market, which is also shown to point out the feedback mechanism as part of the system. The open lines indicate the flow of information and feedbacks between the CSU Administration and partners and between the Innovation and Technology Commercialization Center (ITCC).



**Fig. 4. Model of the CSU Research, Development, Innovation and Extension System**

The description of the various Research, Development and Innovation Centers are presented in the below.

- a) Mineral Resources Management Research and Training Center (MinRes) - The Center is the lead convener of the **Provide National and Regional Gains through Responsible Mining** R&D program. It focuses on: environmental management in mining, use of Social Development Management Program (SDMP) to prepare host communities for the life-after-mine; socio-cultural and economic aspects of mining; mining technology; geological aspects; material science and value-adding to minerals; basic literacy for mining communities; and science and mathematics education for would-be miners. Innovative solutions such as nanotechnology, molecular biology and biotechnology (MBB) will be used to hasten mine rehabilitation and management of contamination. Utilization of mine tailings and other wastes for socioeconomic development will be done through the applications of Green Chemistry towards industrial symbiosis and circular economy. Research projects shall be directed towards finding solutions to contamination due to mining and rehabilitation of mined-out areas to benefit humankind. Restoration of the ecosystem to support biodiversity and natural cultural heritage shall also be another focused area for research and innovation.
- b) Center for Robotics, Automation and Fabrication Technology (CRAFT) - This Center is the co-convener of the RDIE Program on '**Strengthening Climate Change and Disaster Resilience of Smarter Communities**' that covers: Smart economy, Smart governance, Smart mobility, Smart and sustainable environment, Smart populace, and Smart living. The CRAFT is responsible in the development of sensors and fabrication of innovative solutions supporting the creation of Smart City. It will provide technological solutions to **Smart Economy** that focuses on a) productivity (Smart Agriculture, Smart Energy Generation, Smart Water Management); b) local and global connections (e-market linkage, global and local business partner); and c) enterprise and innovation culture (Start-ups, MSME, Industrial park). **Smart Governance** on a) online services (for ease in doing business, Internet of services); b) well-planned ICT infrastructure; c) open data networking; and d) administration (e-HRM, e-budgeting, e-planning, e-meeting). The **Smart Mobility** that tackles a) traffic management (strategic parking, e-traffic violation management, sensor-based monitoring); and b) smart transport system (smart route planning, e-vehicles). The **Smart and Sustainable Environment** deals with a) smart waste management (circular economy, industrial symbiosis); b) smart water management (strategic water production and consumption); and c) smart urban planning (green buildings, green highway, balance between covered and uncovered spaces, ecosystem interconnectivity). The **Smart Populace** focuses on a) inclusivity (no one is left behind, EOP); b) creativity (communities create their own traffic mgt system, create peace and order system); and c) training (people are smart service providers).
- c) Center for Research in Environmental Management and Eco-governance (CRÈME) - This Center is the lead convener of the RDE program on **Eco-Governance and Environmental Management**. This program focuses on the management of the land, air and water to ensure sustainability such that the next generation can partake of the resources available for the present generation. Studies on water shall be directed towards appropriate watershed and wetland management, effective and efficient water management, water treatment technologies and water budget studies to optimize the use of available safe water. RDE activities on the environmental and conservation, preservation and management shall focus on finding better ways of managing non-renewable natural resources (land, water, minerals, and biodiversity) for sustainable economic development. Specifically, it shall look for possible solutions to the environmental alterations resulting from climate change in order to minimize hazardous environmental effects and reduce natural and human-induced disasters/risks. The science-based information generated from research shall be used as basis in formulating/revising policies to make these reflect the real needs of the communities and of the

nation. The basic information about the environment and natural resources shall also be the basis for planning ecotourism and learning centers for students concerning environmental conservation.

- d) Information and Communication Technology Center (ICT Center) - This Center is the lead convenor of the RDIE Program on 'Strengthening Climate Change and Disaster Resilience of Smarter Communities' will cover: Smart economy, Smart governance, Smart mobility, Smart and sustainable environment, Smart populace, and Smart living. **Smart Economy** that focuses on a) productivity (Smart Agriculture, Smart Energy Generation, Smart Water Management); b) local and global connections (e-market linkage, global and local business partner); and c) enterprise and innovation culture (Start-ups, MSME, Industrial park). **Smart Governance** on a) online services (for ease in doing business, Internet of services); b) well-planned ICT infrastructure; c) open data networking; and d) administration (e-HRM, e-budgeting, e-planning, e-meeting). The **Smart Mobility** that tackles a) traffic management (strategic parking, e-traffic violation management, sensor-based monitoring); and b) smart transport system (smart route planning, e-vehicles). The **Smart and Sustainable Environment** deals with a) smart waste management (circular economy, industrial symbiosis); b) smart water management (strategic water production and consumption); and c) smart urban planning (green buildings, green highway, balance between covered and uncovered spaces, ecosystem interconnectivity). The **Smart Populace** focuses on a) inclusivity (no one is left behind, EOP); b) creativity (communities create their own traffic mgt system, create peace and order system); and c) training (people are smart service providers). Then **Smart Living** caters to a) health and wellness (zumba spaces provided, gyms for free, healthy greeneries); b) safety (alarm system provided, SMS-based weather forecast dissemination); and c) culture (museums, ecotourism sites, historical parks, libraries).
- e) Mathematical and Statistical Computing and Research Center (MSCRC) - The Center is the primary convenor of the R&D program on Promoting the Learning of Basic and Applied Mathematics. It focuses on the development of mathematical theories; socio-cultural aspects of mathematics appreciation; science and mathematics teaching strategies; social, ecological and economic applications of mathematics and statistics; modelling to predict future phenomena in agriculture, wood-based industries, mining industry, and ecotourism; and mathematical applications to ICT and Engineering. This will also make use of pure mathematical concepts for application in modeling sustainable tourism, traffic management, disease spread, waste management, biodiversity, climate change, among others.
- f) Caraga Center of Peace and Development (CCPD) - This Center is the lead convenor of the R&D Program to **Ensure Healthy, Happy and Peaceful Population**. This program focuses on conflict resolution and just dealing with the various sectors of society; development support to various ethnic groups and disadvantaged groups in Caraga Region; observance of values, traditions, practices, mores among various sectors for sustainable rural development; development of education strategies for skills enhancement and livelihood program. The program shall likewise consider studies on financial literacy, home management, and local enterprise development to allow women to gain income while nurturing their children. The program also focuses on preserving the artefacts and the distinctive and irreplaceable elements of a society, the intangible attributes of a society that are inherited from past generations. The **cultural heritage** is a crucial element in the fabric of the peoples of the world (UNESCO). Caraga Region, being a region with rich history, has a lot of past information that need to be studied to contribute to the existing body of information, and be part of how the different generations in a society can relate with each other with pride. The

program shall include studies about relics from towns and the various cities need to be recorded, studied and be interwoven into the culture of the people for the young generation to appreciate and hold dear in their hearts. Cultural grounding is necessary to humanize the scientific and technological advancements in addressing the day-to-day activities of people which are nowadays done using machines, and the Internet of Things, among others.

- g) Caraga Center for Agricultural Research and Entrepreneurship (Caraga-CARE) - The Center is the lead convenor of the CSU's RDE program on **Adaptive Smart Agri-Aqua-Forest Industries**. The R&D program focuses on: socio-cultural aspects of agriculture and forestry; agricultural development technology such as sustainable and organic agriculture; sustainable development of wood-based industry; environmental issues on agriculture and tree farming including the studies on conservation of agrobiodiversity; literacy for upland farming and wood-based communities; and science and mathematics education for would-be agriculturists and foresters towards making agriculture and forestry the core contributors of Caraga Region's economic development. Development of innovative food products, nutraceuticals and cosmeceuticals using food items with antioxidants such as polyphenols will be tackled. Research and innovations shall also include the use of ICT resources for smart farming, precision agriculture and sustainable forest management. The promotion of Good Management Practices (GMP) to promote food security and food safety shall be part of the program. Innovative technologies such as nanotechnology, molecular biology and biotechnology, life cycle thinking and circular economy will also be applied to promote industrialization of agriculture and forestry, making these adaptive to the changing demands of society.
  
- h) Caraga Center for Geo-informatics (CCGeo) - The Center is the lead convenor of CSU's RDE program on **Strengthening Governance towards Inclusive Development amidst Changing Demographics**. This Research and Innovation Program involves the applications of cutting edge technology in image processing, digital photogrammetry, remote sensing, satellite-based global positioning, geographic information systems, LiDAR-based mapping, surveying and digital mapping. Geo-informatics will involve work in land development, construction surveying, hydrographic surveying and spatial data analysis that will aid local government units (LGUs) and developmental planners in making informed decisions related to investments (roads, infrastructure, drainage system). The R&D program will also include design, development and operation of systems for mapping information about the land, the oceans, natural resources and manmade features. The outputs will be an important input in environmental management planning, investment planning, disaster risk reduction planning, and strategic agriculture and forestry development planning among others.
  
- i) Food and Innovation Center (FIC) - This Center is the co-convenor of CSU's RDE program on **Adaptive Smart Agri-Aqua-Forest Industries**. Development of innovative food products, nutraceuticals and cosmeceuticals using food items with antioxidants such as polyphenols will be tackled. Research and innovations shall also include the use of ICT resources for smart farming, precision agriculture and sustainable forest management. The promotion of Good Management Practices (GMP) to promote food security and food safety shall be part of the program. Innovative technologies such as nanotechnology, molecular biology and biotechnology, life cycle thinking and circular economy will also be applied to promote industrialization of agriculture and forestry, making these adaptive to the changing demands of society.

- j) Center for Resource Assessment, Analytics and Emerging Technologies (CREATE) - This Center is the co-convenor of the R&D program on **Strengthening Governance towards Inclusive Development amidst Changing Demographics**. The R&D program employs cutting edge technology in image processing, digital photogrammetry, remote sensing, satellite-based global positioning, geographic information systems, LiDAR-based mapping, surveying and digital mapping. This will also include design, development and operation of systems for mapping information about the land, the oceans, natural resources and manmade features. The outputs will be an important input in environmental management planning, investment planning, disaster risk reduction planning, and strategic agriculture and forestry development planning among others.
- k) Action towards Greater Advancement of Knowledge Center (AGAK Center) - **Preparing Caraga for the 4th Industrial Revolution through Smart Education** The R&D program shall focus on smart education and the applications of smart pedagogies for learners to master knowledge and skills of the 21<sup>st</sup> century learning. The smart pedagogy includes class-based differentiated instruction, group-based collaborative learning, individual-based personalized learning and mass-based generative learning. It shall also focus on developing instructional materials for in-school and out-of-school learning which are aligned with the concepts of innovative teaching and learning (blended learning, MOOC, industry-driven learning); and education towards disaster preparedness and emergency response in times of calamity. The program shall also include socio-cultural studies of various communities including the ethnic groups and disadvantaged groups in Caraga Region; nurture appropriate values, traditions, practices, mores, among others for sustainable development; ecological and economic implications of indigenous knowledge system (IKS); development of education strategies and pedagogy for basic and functional literacy.



## CHAPTER 5

### FIVE-YEAR RESEARCH, DEVELOPMENT, INNOVATION AND EXTENSION AGENDA

To realize the vision and mission of the CSU-RDIE, the five-year RDIE Agenda covering 2020-2025 is laid down. Specific action programs have been identified to be the basis for research investment plans every year. In attaining the objective of improving research productivity of the university to be at par with global standards, the action programs include the following:

- a) Annual review of the human resource development program;
- b) Strengthen linkages on scholarships/ fellowships for R&D workers training (either degree or non-degree);
- c) Collaborate with mentors to improve capability of faculty through research implementation.

These programs have specific activities and tasks as well as resources necessary for the attainment of the objectives. The following **Research, Development, Innovation, and Extension Agenda** are the University's focus for 2020-2025.

#### I. Adaptive Smart Agri-Aqua-Forest Industries

The R&D program shall focus on: socio-cultural aspects of agriculture and forestry including the indigenous knowledge system (IKS) and gender participation in development; agricultural development technology such as sustainable and organic agriculture; sustainable development of wood-based industry; environmental issues on agriculture and tree farming taking in the studies on conservation of agrobiodiversity; literacy for upland farming and wood-based communities; and science and mathematics education for would-be agriculturists and foresters towards making agriculture and forestry the core contributors of Caraga Region's economic development. Development of innovative food products, nutraceuticals and cosmeceuticals using food items with antioxidants such as polyphenols will be tackled. Research and innovations shall also include the use of ICT resources for smart farming, precision agriculture and sustainable forest management. The promotion of Good Management Practices (GMP) to promote food security and food safety shall be part of the program. Innovative technologies such as nanotechnology, molecular biology and biotechnology, life cycle thinking and circular economy will also be applied to promote industrialization of agriculture and forestry, making these adaptive to the changing demands of society. This area will also consider the contribution to the recovery after the COVID-19 health emergency. The **Center for Agri-Forestry Research and Entrepreneurship (CARE)**, **Food Innovation Center**, **Center for Nanoscience and Technology for Research and Entrepreneurship (CeNTRE)**, **College of Forestry and Environmental Science**, the **College of Agriculture and Agri-Industries (CAA)**, and the **Department of Agricultural Engineering of the College of Engineering and Geo-Sciences (CEGS)** are the lead convenors.

#### II. Preparing Caraga for the 4th Industrial Revolution through Smart Education

The R&D program shall focus on smart education and the applications of smart pedagogies for learners to master knowledge and skills of the 21<sup>st</sup> century learning. The smart pedagogy includes class-based differentiated instruction, group-based collaborative learning, individual-based personalized learning and mass-based generative learning. It shall also focus on developing instructional materials for in-

school and out-of-school learning which are aligned with the concepts of innovative teaching and learning (blended learning, MOOC, industry-driven learning); and education towards disaster preparedness and emergency response in times of calamity. The program shall also include socio-cultural studies of various communities including the ethnic groups and disadvantaged groups in Caraga Region; nurture appropriate values, traditions, practices, mores, among others for sustainable development; ecological and economic implications of indigenous knowledge system (IKS); development of education strategies and pedagogy for basic and functional literacy. This area will also consider the contribution to the recovery after the COVID-19 health emergency. The **Action towards Greater Advancement of Knowledge Center (AGAK Center), College of Education (CEd), and the Social and Languages Department, Department of Natural Sciences of the College of Arts and Sciences (CAS), College of Computing and Information Sciences, the Virtual Learning Facility and the College of Industrial Technology and Teacher Education (CITTE) of the CSU-Cabadbaran City** are the lead convenors.

### **III. Strengthening Governance towards Inclusive Development amidst Changing Demographics**

This Research and Innovation Program shall involve the applications of cutting edge technology in image processing, digital photogrammetry, remote sensing, satellite-based global positioning, geographic information systems, LiDAR-based mapping, surveying and digital mapping. Geo-informatics will involve work in land development, construction surveying, hydrographic surveying and spatial data analysis that will aid local government units (LGUs) and developmental planners in making informed decisions related to investments (roads, infrastructure, drainage system). The R&D program will also include design, development and operation of systems for mapping information about the land, the oceans, natural resources and manmade features. The outputs will be an important input in environmental management planning, investment planning, disaster risk reduction planning, and strategic agriculture and forestry development planning among others. This area will also consider the contribution to the recovery after the COVID-19 health emergency. The **Center for Geo-informatics, the Geodetic Engineering Program of the College of Engineering and Geo-Sciences (CEGS), Center for Resource Assessment, Analytics and Emerging Technologies (CREATE), and the ICT Center** are the lead convenors.

### **IV. Environmental Management and Eco-Governance**

This program shall focus on the management of the land, air and water to ensure sustainability such that the next generation can partake of the resources available for the present generation. Studies on water shall be directed towards appropriate watershed and wetland management, effective and efficient water management, water treatment technologies and water budget studies to optimize the use of available safe water. RDE activities on the environmental and conservation, preservation and management shall focus on finding better ways of managing non-renewable natural resources (land, water, minerals, and biodiversity) for sustainable economic development. Specifically, it shall look for possible solutions to the environmental alterations resulting from climate change in order to minimize hazardous environmental effects and reduce natural and human-induced disasters/risks. Also, applications of material science and nanotechnology for the development of new technologies for water and wastewater treatment, air pollution control, among other fields will be tackled. The science-based information generated from research shall be used as basis in formulating/revising policies to make these reflect the real needs of the communities and of the nation. The basic information about the environment and natural resources shall also be the basis for planning ecotourism and learning centers for students concerning environmental conservation. This area will also consider the contribution to the

recovery after the COVID-19 health emergency. The **Center for Research in Environmental Management and Eco-governance (CRÈME)**, **Center for Nanoscience and Technology for Research and Entrepreneurship (CeNTRE)**, **Faculty of Environmental Sciences and the College of Agriculture and Agri-Industries (CAA)**, **College of Forestry and Environmental Science**, and the **College of Tourism and Hotel Management of CSU-Cabadbaran City** are the lead convenors.

## V. Adapting to Climate Change and Building Smart and Sustainable Cities and Towns

The RDIE Program on ‘Strengthening Climate Change and Disaster Resilience of Smarter Communities’ will cover: Smart economy, Smart governance, Smart mobility, Smart and sustainable environment, Smart populace, and Smart living. **Smart Economy** will focus on a) productivity (Smart Agriculture, Smart Energy Generation, Smart Water Management); b) local and global connections (e-market linkage, global and local business partner); and c) enterprise and innovation culture (Start-ups, MSME, Industrial park). **Smart Governance** will center on a) online services (for ease in doing business, Internet of services); b) well-planned ICT infrastructure; c) open data networking; and d) administration (e-HRM, e-budgeting, e-planning, e-meeting). The **Smart Mobility** will tackle a) traffic management (strategic parking, e-traffic violation mgt, sensor-based monitoring); and b) smart transport system (smart route planning, e-vehicles). The **Smart and Sustainable Environment** will be dealing with a) smart waste management (circular economy, industrial symbiosis); b) smart water management (strategic water production and consumption); and c) smart urban planning (green buildings, green highway, balance between covered and uncovered spaces, ecosystem interconnectivity). The **Smart Populace** will focus on a) inclusivity (no one is left behind, EOP); b) creativity (communities create their own traffic mgt system, create peace and order system); and c) training (people are smart service providers). Then **Smart Living** will cater to a) health and wellness (zumba spaces provided, gyms for free, healthy greeneries); b) safety (alarm system provided, SMS-based weather forecast dissemination); and c) culture (museums, ecotourism sites, historical parks, libraries). This area will also consider the contribution to the recovery after the COVID-19 health emergency. The **Information and Communication Technology Center (ICT Center)**, **Center for Robotics, Automation and Fabrication Technology (CRAFT)**, **the Information Technology Program of the College of Computing and Information System (CCIS)**, and the **College of Engineering and Information Technology (CEIT) of the CSU-Cabadbaran City** shall be the lead convenors.

## VI. Provide National and Regional Gains Through Responsible Mining

The R&D program shall focus on: environmental management in mining, use of Social Development Management Program (SDMP) to prepare host communities for the life-after-mine; socio-cultural and economic aspects of mining; mining technology; geological aspects; material science and value-adding to minerals; basic literacy for mining communities; and science and mathematics education for would-be miners. Innovative solutions such as nanotechnology, molecular biology and biotechnology (MBB) will be used to hasten mine rehabilitation and management of contamination. Utilization of mine tailings and other wastes for socioeconomic development will be done through the applications of Green Chemistry towards industrial symbiosis and circular economy. Research projects shall be directed towards finding solutions to contamination due to mining and rehabilitation of mined-out areas to benefit humankind. Restoration of the ecosystem to support biodiversity and natural cultural heritage shall also be another focused area for research and innovation. This area will also consider the contribution to the recovery after the COVID-19 health emergency. The **Mineral Resources Management Research and Training Center (MinRes)**, **the Department of Mining Engineering of the**

**College of Engineering and Geo-Sciences (CEGS), and the Center for Nanoscience and Technology for Research and Entrepreneurship through the Material Science and Polymer Chemistry Laboratory** will be the lead convenors.

#### **VII. Ensure Healthy, Happy and Peaceful Population**

This R&D program shall focus on conflict resolution and just dealing with the various sectors of society; development support to various ethnic groups and disadvantaged groups in Caraga Region; observance of values, traditions, practices, mores among various sectors for sustainable rural development; development of education strategies for skills enhancement and livelihood program. The program shall likewise consider studies on financial literacy, home management, and local enterprise development to allow women to gain income while nurturing their children. This area will also consider the contribution to the recovery after the COVID-19 health emergency. The **Center for Peace and Development (CPD), Social and Languages Department of the College of Arts and Sciences (CAS), College of Tourism and Hotel Management and the College of Industrial Technology and Teacher Education of CSU-Cabadbaran City** are the lead convenors.

#### **VIII. Preserving the Cultural Heritage of Caraga**

This R&D program focuses on preserving the artefacts and the distinctive and irreplaceable elements of a society, the intangible attributes of a society that are inherited from past generations. The **cultural heritage** is a crucial element in the fabric of the peoples of the world (UNESCO). Caraga Region, being a region with rich history, has a lot of past information that need to be studied to contribute to the existing body of information, and be part of how the different generations in a society can relate with each other with pride. The program shall include studies about relics from towns and the various cities need to be recorded, studied and be interwoven into the culture of the people for the young generation to appreciate and hold dear in their hearts. Cultural grounding is necessary to humanize the scientific and technological advancements in addressing the day-to-day activities of people which are nowadays done using machines, and the Internet of Things, among others. The **Center for Peace and Development (CPD), Social and Languages Department of the College of Arts and Sciences (CAS), College of Tourism and Hotel Management of CSU-Cabadbaran City** are the lead convenors.

#### **IX. Basic and Applied Research in Mathematics**

The R&D program shall focus on the development of mathematical theories; socio-cultural aspects of mathematics appreciation; science and mathematics teaching strategies; social, ecological and economic applications of mathematics and statistics; modelling to predict future phenomena in agriculture, wood-based industries, mining industry and ecotourism; and mathematical applications to ICT and Engineering. This will also make use of pure mathematical concepts for application in sustainable tourism, traffic management, among others. This area will also consider the contribution to the recovery after the COVID-19 health emergency. The **Mathematical and Statistical Computing and Research Center (MSCRC) and the Mathematics Department of the College of Arts and Sciences (CAS) and the Mathematics Education Program of the College of Education (CE)** are the lead convenors.

## **The Key Tangible Performance Metrics of CSU RDIE**

The key tangible performance metrics are a range of primarily quantifiable indicators of research and innovation performance. In leading universities abroad, these include: numerical measures of publication quality based on peer review, citations of publications and impact factor of journals where the research papers are published, counts of joint publications with overseas and industry partners, research income (amount and source), completion rates for PhD students, alternative metrics (measures of social media engagement), indicators of national and international esteem, which are also the ones used in the Times Higher Education (THE) and Quacquarelli Symonds (QS) World University Rankings. Many universities use metrics to understand how they are progressing towards achieving their strategic goals. On the other hand, researchers and innovators use metrics to help them understand the standing of their work relative to other research and innovation.

At CSU, the **Key Tangible Performance Metrics of RDIE** will be used for the purpose of measuring progress that redound to institutional capability to contribute to regional development and nation building. The metrics, therefore, include:

1. Faculty Capital Development
2. Student Development
3. Instruction and Institutional Infrastructure
4. Academe-Industry Partnership
5. Community Engagement
6. Publication Prestige
7. Intellectual Property
8. Productivity
9. Internationalization
10. Research Capability Building
11. Policy Output/Outcomes
12. Funding

## **The Key Intangible Performance Metrics of CSU RDIE**

Key Performance Indicators (KPIs) which are tangible are very important measures of organization success. However, in the present highly competitive settings, these are no longer enough to provide organizations with a complete illustration of their performance. Looking into the intangible indicators and integrating these into the organizational performance analysis can help in assessing the organization's transactions, its challenges and its real potential. The matrix in Table 1 shows how the Key Intangible Performance of CSU RDIE will be measured.

Table 1. Key intangible performance metrics to assess the CSU RDIE business, challenges, and potentials.

<b>Key intangible performance metrics</b>	<b>Indicators</b>	<b>MOVs</b>
Collaboration/Networking	No. of linkages/partners	MOA with active partners/linkages
Creativity	Patents/Utility Models for innovations	Patents/Utility Models for innovations
Critical Thinking	No. of research and innovation grants	Approved research funding
Communication	No. of policies formulated	Policy brief
Computer-Thinking	ICT-based innovations	Information systems
Culture	Increase in the number of active researchers	HRMS inventory of researchers
Service to community	No. of clients	List of clients/client satisfaction form
Life-long learning	Capability building activities	Activity designs/Program
Interdisciplinary thinking	No. of disciplines/project	Special Order of Project Personnel
Intellectual risk taking	Projects on high-end science submitted	Approved high-end RDIE proposal
Innovativeness	Innovative ideas	Projects with innovative ideas
Information seeking	Access to Elsevier/WOS journals	Literature Cited in RDIE proposals
Integrity	Publications in Q1 journals	Articles in Q1 journals
Work-life balance	Absences of researchers	Sick leave/Vacation Leave Filed
Commitment to research	Annual research productivity	OVPRIE Annual Report
Adaptability to change	Research PAPs aligned to current issues	Approved high-end RDIE proposal
Responsiveness to opportunities	No. of research and innovation grants	Approved research funding

**CHAPTER 6**  
**ACTION PLAN 2020-2025**

**Table 2. Adaptive Smart Agri-Aqua-Forest Industries**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
<b>Development and Innovation for a Resilient Agri-fishery, Infrastructure and Environment</b>							
Design and fabrication of building materials for animal housing, processing infrastructures, and agricultural storage facilities			x	x	x	x	Designs and Fabricated Building Materials
Design and construction of a local-based and climate-resilient infrastructures for animal housing, processing and agricultural storage facilities		x	x	x	x	x	Local-based and climate-resilient infrastructures
Assessment and profiling of agriculture/fishery resources	x	x					Agriculture/fishery resources profiles
Biophysical characterization of agricultural and other natural resources		x	x				Agriculture/fishery resources Biophysical profile
Development of production, processing, post-production handling and storage technologies for agriculture commodities	x	x	x	x			Handling and storage technologies for agriculture commodities
Optimization of agricultural by-product into potential utilization		x	x	x	x	x	Optimized Agricultural By-Products
Impact assessment of transferred agricultural technologies			x	x	x	x	Impact Assessment Reports
Modeling the organic farming practices of IP communities in Butuan City”		x	x	x			2 faculty trained; 5 students trained, 2 publications
Salinity response of sweet corn ( <i>Zea mays</i> ) hybrid macho F1 seedlings			x	x			2 faculty trained; 3 students trained, 1 publications
Knowledge-based greening as a new bio-economy strategy for development			x	x	x		5 faculty trained; 5 students trained, 2 publication

Improving the yield of high value crops in Caraga Region		x	x	x			3 faculty trained; 5 students trained, 2 publications
Agri-waste utilization	x	x	x	x	x		3 faculty trained; 5 students trained, 2 publications
Renewable energy in the agricultural sector		x	x	x			2 faculty trained; 5 students trained, 5 publications
Soil and plant health related problems	x	x	x	x	x		3 faculty trained; 5 students trained, 5 publications
Animal nutrition and production problems		x	x	x			2 faculty trained; 5 students trained, 2 publications
Disease management of economically important crops	x	x	x	x			3 faculty trained; 5 students trained, 3 publications
Mapping strategic areas for industrial plantation crops and potential crop processing enterprises for sustainable production-market linkage	x	x	x	x	x	x	5 faculty trained; 10 students trained, 3 publications, maps
The use of biotechnology to modernize production of high-value crops	x	X	x	x	x	x	3 faculty trained; 5 students trained, 5 publications, innovative products
Enhancement of the Food Innovation Center (FIC) for women empowerment to encourage food-based enterprises	x	x	x	x	x	x	3 faculty trained; 10 students trained, 2 publications, innovative products
Improving the Physico-Chemical Properties of Sago Starch in Butuan City	x	x	x	x			2 publications; 3 students trained; 3 young faculty trained, innovative solutions
Product Development, Shelf-life Enhancement and Packaging of Palagsing and other Sago-based Products	x	x	x	x	x	x	2 publications; 3 students trained; 3 young faculty trained, innovative solutions
Life Cycle Assessment (LCA) of food products available locally available in Caraga Region		x	x	x			2 publications; 3 students trained; 3 young faculty trained, innovative solutions
Integration of robotics concept and processes to agriculture and mineral production		x	x	x	x		Agricultural/mineral production processes applied with robotics concept
Improvement of existing fisheries, agriculture, and mineral industry machineries using automation			x	x	x		Methodologies and Protocols for Automation of Machineries
Improving agricultural production using modeling and simulation of pest management and irrigation system	x	x	x	x	x	x	Innovation for modeling and simulation for pest management and irrigation system



Fabrication of Machineries and Equipment to Support Development of MSMEs and the Agriculture and Mining Industries	x	x	x	x	x	x	Developed technologies adapted by stakeholders
Rapid bioassay for detection of Pesticide residues	x	x	x	x			3 faculty trained; 3 students trained, 1 publication
Gold nanoparticles for pesticides detection	x	x	x	x			3 faculty trained; 3 students trained, 1 publication
<b>Industrial Tree Plantation Species Program for the Upgrading of the Wood-based Industry</b>							
ITPS database development for market projections, economic forecast models in relation to climate change scenarios, and for other purposes requiring wood industry-based information	x	x	x	x	x	x	7 faculty trained; 7 students trained, 5 publications, innovative solutions
Assessment of productivity of tree farms by utilizing interrows for agricultural production adopting the agro-forestry system and different crop production practices		x	x	x			3 faculty trained; 7 students trained, 2 publications, innovative solutions
Wood waste utilization for the development of innovative products with potential for industrial scale production	x	x	x				3 faculty trained; 3 students trained, 2 publications, innovative solutions
Innovative and contemporary furniture designs that fit to the demands of small spaces	x	x	x	x	x	x	3 faculty trained; 2 students trained, 1 publications, innovative solutions
Evaluation of the potentials of ITPS wood in bioenergy production		x	x	x			3 faculty trained; 3 students trained, 1 publications, innovative solutions
Improving the performance of the ITPS supply chain for policy formulation/reforms	x	x	x				2 faculty trained; 1 students trained, 1 publications, innovative solutions
Simulation of various ITPS-based production systems using mathematical algorithms as guides in business feasibility studies.			x	x	x	x	3 faculty trained; 3 students trained, 2 publications, innovative solutions
Transformative Agriculture through Nanotechnology in Mindanao: Promoting Climate Change-Resilient Agriculture towards Sustainable Food Production			x	x	x		Nano-based Products for agricultural use, Publications, Patents
Soil quality monitoring and control system			x	x	x		3 faculty trained; 3 students trained, 1 publications, innovative solutions

Rainwater harvesting and irrigation for climate resilient farming				x	x	x	3 faculty trained; 3 students trained, 2 publications, innovative solutions
Feasibility of rainwater harvest				x	x	x	3 faculty trained; 3 students trained, 1 publication, innovative solutions
Mixed rainwater harvest and ground water analysis				x	x	x	3 faculty trained; 3 students trained, 2 publications, innovative solutions

**Table 3. Preparing Caraga Region for the 4th Industrial Revolution (FIRE) through Education**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
Capacitate the DepEd Teachers of Bislig City and Sibagat on biological laboratory and field techniques	x	x	x	x	x	x	20 more competent HS teachers
Development of outcomes based instructional materials in physics	x	x					10 IMs in Physics
Case Study in the offering of Physics 20 (Physics for Engineers)		x					1 case study
Assessment on career interest of post-millennial on automated and digital world of work		x					3 faculty trained; 3 students trained, 1 publication
The 4th Industrial Revolution: issues and implications to career practice, interest, skills, and satisfaction among SUCs Personnel in Caraga		x	x				5 faculty trained; 5 students trained, 2 publications
First principles calculation of potential superconducting materials			x	x			5 faculty trained; 5 students trained, 2 publications
Molecular dynamics simulation of semi-conducting materials			x	x			5 faculty trained; 5 students trained; 2 publications
Level of adaption to lifelong learning models in aligning students' capability in the era of fourth industrial revolution		x	x	x			3 faculty trained; 5 students trained; 2 publications
Status of the HEIs and SUCs in Butuan City vis-à-vis Preparation for Smart City		x	x	x			2 faculty trained; 5 students trained; 2 publications
How effective is the professional development in the delivery of the K-12 program?	x	x	x				3 faculty trained; 5 students trained; 2 publications
How is the delivery of the pre-service teacher education in relation to their preparedness to K-12 curriculum?		x	x	x			3 faculty trained; 5 students trained; 2 publications
How is the teacher's capability in research-based instructional materials development in relation to K-12 delivery and their professional development?			x	x	x	x	5 faculty trained; 5 students trained; 2 publications
Best practices in the delivery of K-12 Program			x	x	x	x	3 faculty trained; 5 students trained; 2 publications

Effectiveness of inclusive education in the rural school in Caraga .			x	x	x	x	3 faculty trained; 5 students trained; 2 publications
Analysis of research based on inclusive education on the STEM track in Caraga Region	x	x					2 faculty trained; 5 students trained; 2 publications
Technological, Pedagogical and Content Knowledge ( TPACK) assessment of grade 10 physics teachers : basis for the development and validation of technology-based module			x	x	x	x	5 faculty trained; 5 students trained; 2 publications
Research on inclusive educational programs, practice and outcomes for STEM students in Caraga		x	x	x			3 faculty trained; 5 students trained; 2 publications
Development and validation of instructional materials in least learned competencies in Pre-Calculus in STEM students in Caraga		x	x				2 faculty trained; 5 students trained; 2 publications
Course improvement evaluation: a framework towards curriculum development			x	x			2 faculty trained; 5 students trained; 2 publications
Development and adoption of innovative teaching-learning modes and mechanisms to promote the love for agriculture and forestry in basic education	x	x	x	x	x	x	3 faculty trained; 5 students trained; 5 publications
Gulayan sa Paaralan Program (GPP) of the public elementary schools	x	x	x				3 faculty trained; 5 students trained, 1 publication; 10 teachers trained
Modeling the gulayan sa paaralan program(GPP) in IP elementary school of division of Butuan City ”	x	x	x				5 faculty trained; 5 students trained, 2 publications, 1 Elementary School
The impact of forest management of Manobo communities to the pupils of IP elementary schools in Butuan City “		x	x	X			3 faculty trained; 5 students trained, 2 publications
Makerspaces impact on Junior High Schools cognition and creativity		x	x	X			2 publications, 3 young faculty trained
A case study on the impact of dyslexia to student’s learning	x	x	x				3 faculty trained; 3 students trained, 1 publication
Impacts of the use of mother tongue as medium of instruction in the academic achievement of students in English		x	x				2 publications, 3 young faculty trained
Professionalism, governance and inclusive education teachers in Caraga			x	X			2 publications, 3 young faculty trained

Contextualized learning materials for senior high school science : meeting challenges for non-science majors	x	x	x	X			2 publications; 5 students trained; 4 young faculty trained
Effects of <b>No Plastic Policy</b> to the solid waste management of the public elementary schools	x	x	x	X			2 publications; 5 students trained; 4 young faculty trained, innovative solutions
Yes-O Project of the Intermediate Grade Pupils	x	x	x	X	x		2 publications; 5 students trained; 4 young faculty trained
Improving the Instruction and Learning of Engineering and Technology Programs through Upgrading of Facilities to produce Graduates with Technical Skills Aligned with the Requirements of Industry 4.0: Interdisciplinary Engineering and Applied Sciences Laboratory (IDEAS Lab)	x	x	x				Upgraded facilities (Computational Lab and Geotechnical Lab), Publications, 5 faculty trained
Development of Instructional Materials			x	X	x		3 faculty trained; 2 students trained, 1 publications, innovative solutions
Pedagogy in Industrial Technology			x	X	x		3 faculty trained; 2 students trained, 1 publications, innovative solutions
New approaches & new technologies adopting effective models of education			x	X	x	x	3 faculty trained; 2 students trained, 1 publications, innovative solutions
Design and Fabrication of IR 4.0 Ready Technology		x	x	X	x		3 faculty trained; 2 students trained, 1 publications, innovative solutions
SUCs Readiness and Challenges for University 4.0		x	x	X	x		3 faculty trained; 2 students trained, 1 publications, innovative solutions
Skills training for the 21 <sup>st</sup> Century	x	x	x				3 faculty trained; 2 students trained, 1 publications, innovative solutions
Economic Impacts and Sustainable Development	x	x	x				3 faculty trained; 2 students trained, 1 publications, innovative solutions
Efficient use of resources	x	x	x				3 faculty trained; 2 students trained, 1 publications, innovative solutions
Customers Satisfaction /Loyalty	x	x	x				3 faculty trained; 2 students trained, 1 publications, innovative solutions
Product development, shelf life and nutritive value, and commercialization	x	x	x				3 faculty trained; 2 students trained, 1 publications, innovative solutions
Design of smart solar pumping system	x	x	x				3 faculty trained; 2 students trained, 1 publications, innovative solutions

Performance analysis of smart solar pumping system		x	x	X			3 faculty trained; 2 students trained, 1 publications, innovative solutions
Limited distances remote control sensors		x	x	X			3 faculty trained; 2 students trained, 1 publications, innovative solutions
Piezoelectric Energy Harvesting System in Traffic Congested Roads		x	x	X			3 faculty trained; 2 students trained, 1 publications, innovative solutions

**Table 4. Strengthening Governance towards Inclusive Socioeconomic Development amidst Changing Demographics**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
Ascertaining the role of the Agusan Marsh ecosystem during extreme flood events: a remote sensing, GIS and numerical modeling approach		x	x				Hydrodynamic model of Agusan Marsh
Use of Unmanned Aerial Systems (UAS) for mapping and monitoring of environment and resources		x	x	x			UAS Technologies and Mapping Methodologies and Protocols
Land Use/Land Cover change modeling and the prediction of subsequent changes in ecosystem service values in Caraga Region using RS, GIS and Cellular Automata-Markov Models				x	x	x	Land-use/Land-cover Change Models of Caraga Region
Upgrading of the Laboratory Facilities and Equipment in support for Research and Development of Caraga State University	x	x	x	x			Lab facilities and equipment
Mainstreaming the FabLab-Industry Innovations towards Industrial Development	x	x	x	x	x	x	Developed technologies adapted by stakeholders
Establishment of Institute of Advanced Research in Science and Mathematics		x	x	x			Institute of Advanced Research in Science and Mathematics Building
Expansion of the Navigatu Techno-Hub to Promote Enterprise Development through Start-ups and Spin-Off Projects	x	x	x	x	x	x	Developed start –ups

**Table 5. Eco-Governance and Eco-Management**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
<b>RDI Program: <u>Geo-Informatics and Space Technology Applications Research for Mapping, Monitoring and Modeling of Environment and Resources in Caraga Region (GeoSTARM<sup>3</sup>ER)</u></b>							
Development of a geodatabase of industrial tree plantations in Caraga Region using Remote Sensing and GIS (Component project of the “Industrial Tree Plantation Species Research and Innovation Center” NICER Program)	x	x					Online Geodatabase of ITPs
R&D on the use of Unmanned Aerial Systems (UAS) for mapping and monitoring of environment and resources		x	x	x			UAS Technologies and Mapping Methodologies and Protocols
Land Use/Land cover change modeling and the prediction of subsequent changes in ecosystem service values in Caraga Region using RS, GIS and Cellular Automata-Markov Models				x	x	x	Land-use/Land-cover Change Models of Caraga Region
Contract researches, training, continuing professional development programs, and consultancy services on GeoSTARM <sup>3</sup> ER	x	x	x	x	x	x	Contract Research Agreements, Training Programs, etc.
Program on Producing Alternative Clean Energy and Power in Partnership with LGUs in Caraga	x	x	x	x	x	x	3 faculty trained; 3 students trained, 1 publication, innovative solutions
Establishment of eco-informatics laboratory and museum of flora and fauna for knowledge management of the Eastern Mindanao Biodiversity Corridor	x	x	x				Eco-Informatics Laboratory and Museum of Flora and Fauna; 5 students trained
Evaluation of potential ecological risk and contamination assessment of heavy metals in various environmental sample matrices (sediment and soil) and its implication to water quality of Lake Mainit, Philippines	x	x	x	x			4 publications; 5 students trained; 4 young faculty trained, innovative solutions
Distribution of plastic debris in Philippine aquatic environment and marine micro-plastic in fish and exploration of relative biomarkers	x	x	x				3 publications; 3 students trained; 3 faculty trained, innovative solutions



Assessment and monitoring of flora and fauna in Pagatpatan Wetland	x	x	x	x	x		3 publications; 3 students trained; 3 faculty trained, innovative solutions
Developing the Pagatpatan Wetland Learning Center and Ecopark in Pagatpatan, Butuan City	x	x	x	x	x	x	4 publications; 6 students trained; 6 faculty trained
Development of biogas digester for household and small scale energy generation			x	x			2 publications; 5 students trained; 4 faculty trained, innovative solutions
Cellulose-based Polymers from Water Hyacinth		x	x				1 publication; 2 students trained; 2 faculty trained, innovative solutions
Assessment and monitoring of GHG emissions of local agricultural practices	x	x	x	x	x	x	2 publications; 5 students trained; 4 faculty trained
Physico-chemical analysis of bivalves for radiation shielding		x	x				3 faculty trained; 3 students trained, 1 publication
Assessing environmental awareness of eco – policies: The making of Smart City in Butuan	x	x	x	x			2 publications; 5 students trained; 4 faculty trained
Eco-governance and management among the coastal towns of Agusan Del Norte: Model generation for climate change adaptation	x	x	x	x			2 publications; 5 students trained; 4 faculty trained, innovative solutions
Performance of elementary schools in developing strategic ecological solid waste management program in Agusan del Norte	x	x	x	x	x		2 publications; 3 students trained; 4 faculty trained
Re-using, re-cycling and up-cycling in schools: best practices for waste minimization	x	x	x	x	x		1 publications; 3 students trained; 4 faculty trained, innovative solutions
Use of nanotechnology for waste management and pollution control	x	x	x	x	x	x	2 publications; 3 students trained; 3 faculty trained, innovative solutions
Developing the Cabadbaran Mangrove Ecopark for Livelihood, Environmental, Aesthetics and Disaster Reduction (CAME-LEAD)	x	x	x	x	x	x	2 publications; 3 students trained; 3 faculty trained, innovative solutions
Solid Waste Management policies and implementation in barangays : Foundation of intensified implementation in the schools	x	x	x	x	x	x	2 publications; 3 students trained; 3 faculty trained, innovative solutions
Development of Local Conservation Areas (LCAs) in Butuan City for Green Development	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions

Economic valuation of solid wastes generated in Butuan City	x	x					3 faculty trained; 3 students trained, 1 publication
Species Diversity, Biomass and Carbon Stock Assessment of Mangrove Forest	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Biology of Pigok ( <i>Mesopristes cancellatus</i> ) and Gingaw ( <i>Lutjanus argentimaculatus</i> ) and Notes on its Fishery in Agusan River Basin	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Assessment and Monitoring of GHG Emissions of Local Agricultural Practices	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Mapping on the Areas with Higher Deposits of Methane in Pagatpatan	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Design and Fabrication of Methane Gas Distribution System in Brgy. Pagatpatan, Butuan City, Agusan del Norte	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Taxonomy and Ecology of Lampyridae (Firefly) Species	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Herpetofaunal Diversity and Endemism of Caraga Region with Notes on Diet Composition and Endo-Ecto Parasites	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Reproductive Features of Shipworm Species from Pagatpatan, Butuan City	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Exploring the biological activities of <i>Inocarpus fagiler</i> (Parkinson Ex Zollinger) Fosberg	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Mapping of airborne pollutants in Butuan City	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained

Trapping Particulate Matters using Optical Vortices	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained
Design and Fabrication of Portable Water Distillation Device	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Design, Fabrication, and Characterization of Paper derived from Waste Sago Pulp and Kayam Fiber	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Synthesis and Characterization of Aluminum/ Aluminum Nanoparticles (Al/AlN) from Waste Cans as Anode for Galvanic Lamp Fabrication	x	x	x	x	x	x	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Green synthesis of magnetic nanoparticles for enrichment of metal ions	x	x	x	x	x	X	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Development and Fabrication of Portable Paper-based Sensor for Rapid Screening and Sensing of metals/inorganic ions in Aqueous solutions	x	x	x	x	x	X	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Designing and development of nano-filtration system for water purification using biochar-hydroxyapatite nanocomposites impregnated in bacterial cellulose membrane	x	x	x	x	x	X	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Ionic Liquids as a Novel solvent for Organic Synthesis and cellulose regeneration	x	x	x	x	x	X	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Utilization of Ionic Liquids as a Green Solvent in Extraction of High-Valued Minerals and other Contaminants							2 publications, faculty trained
Fabrication of recyclable magnetic nanophotocatalyst for effective sequestration and detoxification of organic contaminants and inorganic ions from contaminated water	x	x	x	x	x	X	3 publications; 3 students trained; 3 faculty trained, innovative solutions
Gold and Silver nanoparticles-based sensor for detection and analysis of toxic pollutants	x	x	x	x	x		3 publications; 3 students trained; 3 faculty trained, innovative solutions
Molecularly Imprinted polymers for sequestration of Toxic Metal Ions in Solutions	x	x	x	x	x		3 publications; 3 students trained; 3 faculty trained, innovative solutions

**Table 6. Strengthening Climate Change Adaptation/Mitigation and Creation of Smarter Cities and Communities**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
<b>Geo-Informatics and Applications of Space Science in Enabling Smart and Sustainable Cities (GeoASSESS)</b>							
Development of a 3-dimensional digital city model and a Smart City information system	x	x	x	x	x	X	3-Dimensional Digital City Model and a Smart City Information System
Contract researches, training, continuing professional development programs, and consultancy services on GeoASSESS	x	x	x	X	x	X	Contract Research Agreements, Training Programs, etc.
Development of exposure information database and tools for hazards, vulnerability and risk assessment	x	x					Exposure Information Database and Tools
Data analytics and predictive modeling for operational near-real time flood monitoring using synthetic aperture radar images			x	X	x	X	Operational Flood Monitoring System
Contract researches, training, continuing professional development programs, and consultancy services on GeoSTARTER	x	x	x	X	x	X	Contract Research Agreements, Training Programs, etc.
<b>Robotics, Automation and Fabrication Technologies for Smart Agriculture and Mining Industries</b>							
Integrating SMART Technologies in Infrastructure and Mining Industries		x	x	X	x		Pilot application of smart technology to mining industry; innovative solutions
Integrating SMART Technologies in Agriculture -based Industry		x	x	X	x		Pilot application of smart technology to agriculture and wood-based industry
Integrating SMART Technologies in Wood-based Industry		x	x	X	x		Pilot application of smart technology to agriculture and wood-based industry
Integrating SMART Technologies in Mining Industries		x	x	X	x		Pilot application of smart technology to mining industry; innovative solutions
Assessing environmental awareness of eco – policies: The making of Smart City Butuan		x	x	X	x	x	2 publications; 3 students trained; 3 faculty trained, innovative solutions
Energy recovery from solid wastes		x	x	X	x		3 publications; 3 students trained; 3 faculty trained, innovative solutions
Smart Farming through real-time monitoring of irrigation water			x	X	x		3 faculty trained; 3 students trained, 1 publication, innovative solutions

Promotion of gender responsive climate change and disaster resilient university service	x	x					1 publication; 2 students trained; 2 faculty trained
GIS-based GHG emission inventory of Caraga Region		x	x				1 publication; 2 students trained; 2 faculty trained
Resource assessment of flood-prone areas in Butuan City: implications to risk reduction and resiliency programs sustainability and management		x	x	x			2 publications; 1 Flood risk model; 5 students trained; 5 faculty trained
Frequency analysis of hydrologic extreme events (flood and drought) in Caraga		x	x	x			1 publication; 1 Mathematical Model; 2 students trained; 2 young faculty trained
Best leadership practices of HEIs towards DRRM concerns in Caraga: grounded theory			x	x	x		1 publication; 2 students trained; 2 faculty trained, innovative solutions
Disaster resilience approaches of vulnerable groups in the Caraga Region: basis for more relevant disaster response mechanisms		x	x	x			1 publication; 2 students trained; 2 faculty trained, innovative solutions
Engaging Caraga LGUs on the use of GeoSAFER hazard maps for building resilience and reducing vulnerability	x	x	x	x			2 publication; 4 students trained; 2 young faculty trained, innovative solutions
Establishment of agricultural bioprocessing, imaging, and sensing building		x	x	x			Agricultural Bioprocessing, Imaging, and Sensing Building
Towards building a model smart city and smart town in Caraga region	x	x	x	x	x	x	2 publication; 4 students trained; 2 faculty trained; innovative solutions
Developing mathematical models for Smart Tourism management	x	x	x	x			3 faculty trained; 6 students trained, 3 publication
Low – cost consumer electronics products	x	x	x				1 publication; 2 students trained; 2 faculty trained
Impact of the CITTE extension projects to the lives of the beneficiaries			x	x	x		1 publication; 2 students trained; 2 faculty trained
<b>Smart Economy</b> (Smart Agriculture, Smart Energy Generation, Smart Water Management); b) local and global connections (e-market linkage, global and local business partner); and c) enterprise and innovation culture (Start-ups, MSME, Industrial park)	x	x	x	x	x	x	2 publication; 4 students trained; 2 faculty trained; innovative solutions
<b>Smart Mobility</b> tackling a) traffic management (strategic parking, e-traffic violation mgt, sensor-based monitoring); and b) smart transport system (smart route planning, e-vehicles)	x	x	x	x	x	x	2 publication; 4 students trained; 2 faculty trained; innovative solutions
<b>Smart Governance</b> on a) online services (for ease in doing business, Internet of services); b) well-planned ICT infrastructure; c) open data networking; and d) administration (e-HRM, e-budgeting, e-planning)	x	x	x	x	x	x	2 publication; 4 students trained; 2 faculty trained; innovative solutions

<b>Smart Environment</b> dealing with a) smart waste management (circular economy, industrial symbiosis); b) smart water management (strategic water production and consumption); and c) smart urban planning (green buildings, green highway, balance between covered and uncovered spaces, ecosystem interconnectivity).	x	x	x	x	x	x	2 publication; 4 students trained; 2 faculty trained; innovative solutions
<b>Smart Populace</b> will focus on a) inclusivity (no one is left behind, EOP); b) creativity (communities create their own traffic mgt system, create peace and order system); and c) training (people are smart service providers).	x	x	x	x	x	X	2 publication; 4 students trained; 2 faculty trained; innovative solutions
<b>Smart Living</b> will cater to a) health and wellness (zumba spaces provided, gyms for free, healthy greeneries); b) safety (alarm system provided, SMS-based weather forecast dissemination); and c) culture (museums, ecotourism sites, historical parks, libraries).	x	x	x	x	x	X	2 publication; 4 students trained; 2 faculty trained; innovative solutions

**Table 7. Provide National and Regional Gains Through Responsible Mining**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
Mine Tailings Utilization for Socioeconomic and Environmental Sustainability in Host Mining Communities (Mine Tailings – USES)	x	x	x	X	x	x	2 innovative products; 2 designs; 5 students trained
Gold and silver nanoparticles-based sensor for detection and analysis of toxic pollutants in water	x	x					2 publications; 3 students trained; 4 young faculty trained
An eco-friendly strategy to clean the mine tailings: removal of metal ions from mine tailings using ionic liquids as a green solvent	x	x	x	X	x		2 publications; 1 design; 3 students trained; 3 young faculty trained
Development and Application of Ultrafine Magnetic Biochar (UMBio) for effective extraction and valorization of precious metals from technospheric ore deposits	x	x	x				2 publications; 1 innovative product; 5 students trained; 4 young faculty trained
Green and sustainable mineral extraction using nanotechnology		x	x	x			1 publication; 2 students trained; 2 faculty trained, innovative solutions
Women and children involvement in mining and mine- related activities in Caraga Region	x	x					2 publications, 3 faculty trained
Life cycle assessment of key mining areas in Caraga Region		x	x	x	x	x	3 publications, 6 faculty trained
Social responsiveness of mining industries in Caraga: Focus on SDMP Utilization		x	x				1 publication; 3 faculty trained
Economic empowerment of mining host communities towards readiness for the life-after-mine	x	x	x	x	x		1 publication; 2 students trained; 2 young faculty trained
Training-workshop on rehabilitation of nickel mine sites towards eco-restoration	x	x	x	x	x	x	2 mining industries; 5 students trained; 4 young faculty trained
Assessment of mining-related public health hazard, exposure and risk in Caraga Region for science-based interventions and policies		x	x	x	x	x	3 faculty trained; 3 students trained, 1 publication
Green mining technology for acid mine drainage management	x	x	x	x			3 faculty trained; 3 students trained, 3 publication
IoT in Mine Occupational Health and Safety		x	x	x			3 faculty trained; 3 students trained, 2 publication
Integrated landscape management in mine rehabilitation and restoration	x	x	x	x	x	x	4 faculty trained; 6 students trained, 4 publication
Public health management in host mining communities	x	x	x	x	x	x	3 faculty trained; 6 students trained, 3 publication
Circular economy and industrial symbiosis applications in the mining industry	x	x	x	x	x	x	3 faculty trained; 6 students trained, 3 publication

Bioremediation and Phytomining	x	x	x				3 faculty trained; 6 students trained, 3 publication
Assessment of mining-related public health hazard, exposure and risk in Caraga Region towards developing of science-based interventions and policies	x	x	x	x	x	x	3 faculty trained; 6 students trained, 3 publication
Enrichment and speciation mapping of mercury in sediments and water samples in gold mining areas in Caraga Region	x	x		x	x	x	3 faculty trained; 6 students trained, 3 publication
Heavy metal contamination in agricultural areas adjacent to mining areas	x	x	x	x	x	x	3 faculty trained; 6 students trained, 3 publication
Environmental ethics of the Responsible Mining Act of the Philippines	x	x	x	x			3 faculty trained; 3 students trained, 1 publication
Sustainable Mining Landscape Management in Philippine Communities	x	x	x	x			3 faculty trained; 6 students trained, 3 publication
Non-invasive geological and mining methods	x	x	x	x	x	x	3 faculty trained; 6 students trained, 3 publication
Biodiversity and bioindicators in mining areas	x	x	x	x	x	x	3 faculty trained; 6 students trained, 3 publication



**Table 8. Ensure Healthy, Happy and Peaceful Population**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
Promotion of the use of indigenous herbal practices in congruence with modern medicine	x	x	x				3 faculty trained; 3 students trained, 1 publication, 20 Barangay Health Workers
Establishment of Tuklas Lunas and Drug Discovery Center	x	x	x	x			Tuklas Lunas and Drug Discovery Center
Antibacterial screening of indigenous and endemic plants from Caraga Region, Mindanao against multi-drug resistant ESKAPE Pathogens			x	x	x		3 faculty trained; 3 students trained, 1 publication
Bioactivity-guided isolation and characterization of the bioactive components from the indigenous and endemic plants from Caraga Region, Mindanao		x	x	x	x		3 faculty trained; 3 students trained, 1 publication
Nanoparticle-based assay coupled with mass spectrometry for screening of antigenic protein biomarkers for immunodiagnostic of Schistosomiasis, Phase I – Development of Protein Library of potential biomarker candidates for early diagnosis of schistosomiasis by proteomic approach			x	x			5 faculty trained; 5 students trained, 2 publications
Ultra-sensitive analysis of disease protein biomarker by single-molecule affinity nanomicroscopy				x	x		5 faculty trained; 5 students trained, 2 publications
Conformational analysis by spectroscopic methods on BSA-conjugated nanoparticles in probing the non-specific binding of BSA protein				x	x	x	5 faculty trained; 5 students trained; 2 publications
Development of an Air Quality Monitoring model using chemometrics	x	x	x	x			3 faculty trained; 3 students trained, 1 publication
Nanomotors for biomedical applications				x	x	x	3 faculty trained; 3 students trained, 1 publication
Social impact assessment among tourist destinations of Caraga Region	x	x	x				3 faculty trained; 3 students trained, 1 publication
Psycho-social factors on the prevalence of teenage pregnancy in Caraga Region	x	x	x				3 faculty trained; 3 students trained, 1 publication
HIV Cases in Siargao: trends and emerging issues	x	x	x				3 faculty trained; 3 students trained, 1 publication

Role of women in peace-building and conflict management in the conflict zones of Caraga		x	x	x			3 faculty trained; 3 students trained, 1 publication
Spirituality, emotional and moral intelligences, and life skills of personnel and staff of drug treatment and rehabilitation centers across the country: a phenomenological study				x	x		2 publications, 3 young faculty trained
Impact assessment and evaluation on the life and family of former drug dependents		x	x				2 publications, 3 young faculty trained
Exploring the sporadic conflict in Surigao del Sur	x	x	x	x			3 faculty trained; 3 students trained, 1 publication
Internally displaced persons (IDP) situationer in Butuan City	x	x					3 faculty trained; 3 students trained, 1 publication
Determination of some antibiotic residues by HPLC method in poultry products (eggs, meat and liver) within Caraga Region	x	x					3 faculty trained; 3 students trained, 1 publication
Implication of solid wastes to public health in Butuan City	x	x					3 faculty trained; 3 students trained, 1 publication
Expansion of the barista for skills development in coffee mixing techniques and promotion of coffee drying and processing technology	x	x	x	x	x	x	3 faculty trained; 6 students trained, 3 publication
Ensuring healthy and happy employees of CSU: Zumba effect	x	x	x	x	x	x	3 faculty trained; 6 students trained, 3 publication
Inducement of sense of nationalism, spirituality, and continuing mental health: a framework towards program development		x	x	x			2 publications, 3 young faculty trained
Systems standards, productivity and effectiveness of drug treatment and rehabilitation centers: towards model formulation			x	x	x		2 publications, 3 faculty trained
School-based feeding program implementation of the public elementary schools in the Division of Butuan City			x	x	x		3 faculty trained; 3 students trained, 1 publication
What factors that ensure healthy, happy and peaceful learning environment among learners?	x	x	x				3 faculty trained; 3 students trained, 1 publication
Program evaluation of LGU-led poverty reduction programs among the cities of Caraga Region			x	x	x	x	2 publications, 3 faculty trained
Citizen Satisfaction Index System among municipalities of Agusan del Sur	x	x	x	x			2 publications, 3 faculty trained
Impact of food canteen regulation in the primary grade pupils	x	x					3 faculty trained; 3 students trained, 1 publication
Organizational culture in teaching profession	x	x	x				3 faculty trained; 3 students trained, 1 publication

The stress and de-stressing mechanisms of teachers in HEI's	x	x					3 faculty trained; 3 students trained, 1 publication
Extent of manifestation of social graces among teacher education students: implications towards becoming future educators	x	x	x				3 faculty trained; 3 students trained, 1 publication
Program Evaluation on the Implementation of the Expanded Senior Citizen Act	x	x	x	x			3 faculty trained; 3 students trained, 1 publication
Socioeconomic Impacts of Sustainable Livelihood Program Employment Facilitation Track (SLP-EF) on Pantawid Pamilya Participants in Caraga	x	x	x	x			3 faculty trained; 3 students trained, 1 publication
Ensuring healthy, happy and peaceful urban and rural barangays in the region	x	x	x	x			1 publication; 2 students trained; 2 faculty trained

**Table 9. Preserve the Cultural Heritage of Caraga**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
Assessment of Major Festival to the Cultural Identity of the Indigenous Cultural Communities / Indigenous Peoples (ICC/IP) in Caraga	x	x	x	x			1 publication; 2 students trained; 2 young faculty trained
Cultural Heritage Mapping among Selected Municipalities of Caraga		x	x	x			1 publication; 2 students trained; 2 young faculty trained
Level of awareness of Caraga State University's students on the cultural heritage of Caraga Region	x	x	x				1 publication; 2 students trained; 2 young faculty trained
How human cultures, customary ideas, actions and institutions shape individual and collective experience in the preservation of cultural heritage of Caraga?	x						1 publication; 2 students trained; 2 young faculty trained
Sense of nationalism and manifestation: concepts and reflections among students	x						1 publication; 2 students trained; 2 young faculty trained

**Table 10. Basic and Applied Research in Mathematics**

Programs/Projects/Activities	Implementation Period						Expected Outputs
	2020	2021	2022	2023	2024	2025	
<b>Climate, Landscape and its Impact to Ecosystem: a Mathematical Approach (CLIEMA) to a Sustainable Environment</b>	x	x	x	x	x		3 publications; 2 students trained; 2 young faculty trained
Climate Model Development and Forecasting		x	x	x	x		2 publications; 2 students trained; 2 young faculty trained
Watershed Characterization and Hydrological Modelling	x	x	x				2 publications; 2 students trained; 2 young faculty trained
Measuring Vulnerability and Resiliency of the Community using a Composite Index	x	x	x	x			2 publications; 2 students trained; 2 young faculty trained
Mainstreaming Recovery and Community-based Policy for Watershed Sustainability	x	x	x	x			2 publications; 2 students trained; 2 young faculty trained
<b>General Applications for Mathematical Modelling</b>							
Models on Conservation laws with applications to Natural Disasters, e.g. tsunamis, floods, or epidemics.	x	x	x	x			2 publications; 4 students trained; 2 young faculty trained
PDE that models hydrological processes, e.g. St. Venants equation, transport equations.	x	x	x	x			3 publications; 4 students trained; 2 young faculty trained
ODE-PDE Models in relation to but not limited with biological and ecological importance.	x	x	x	x			3 publications; 4 students trained; 2 young faculty trained
<b>Continuing Professional Education in Math and Science</b>	x	x	x	x	x	x	10 faculty trained

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