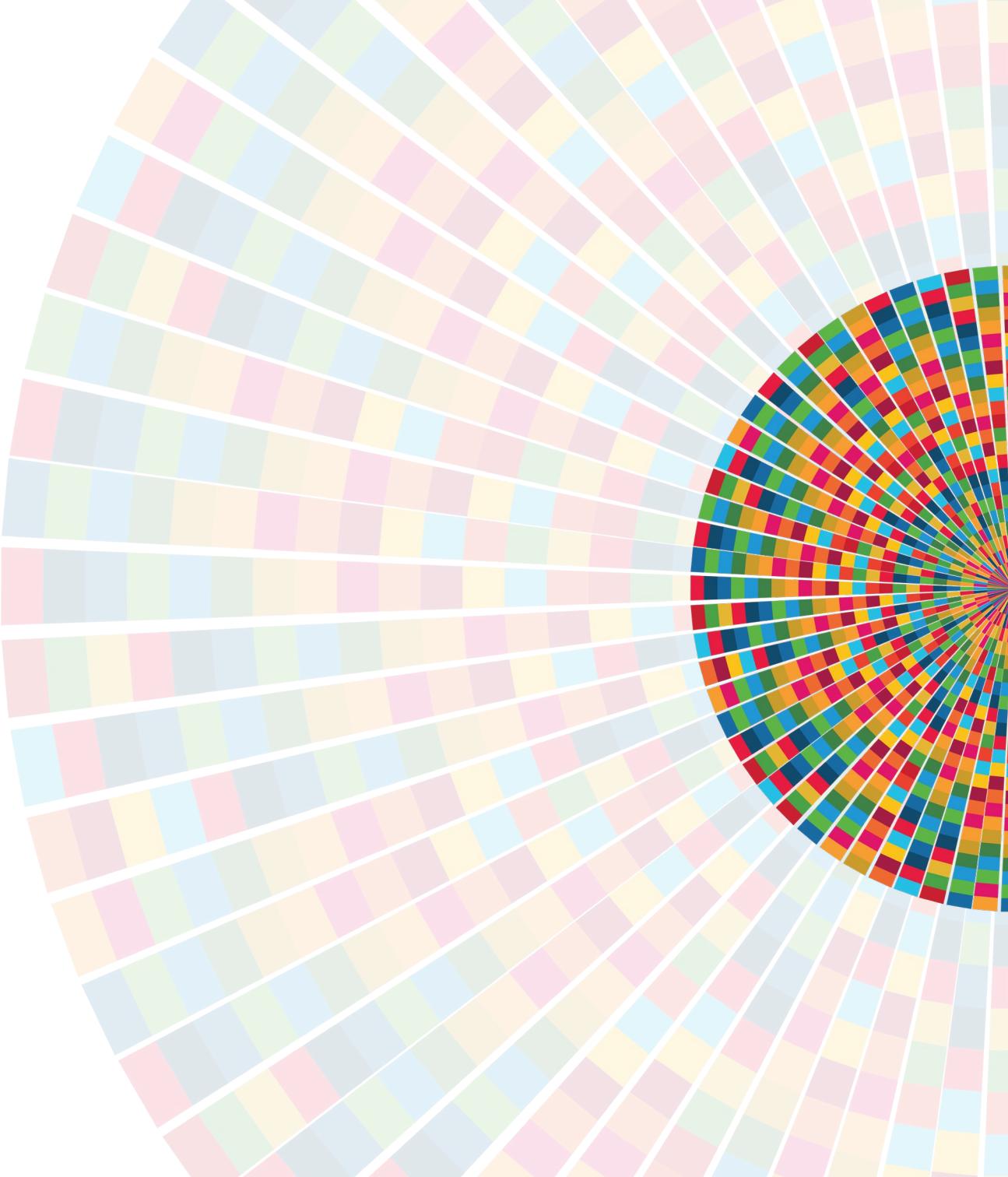


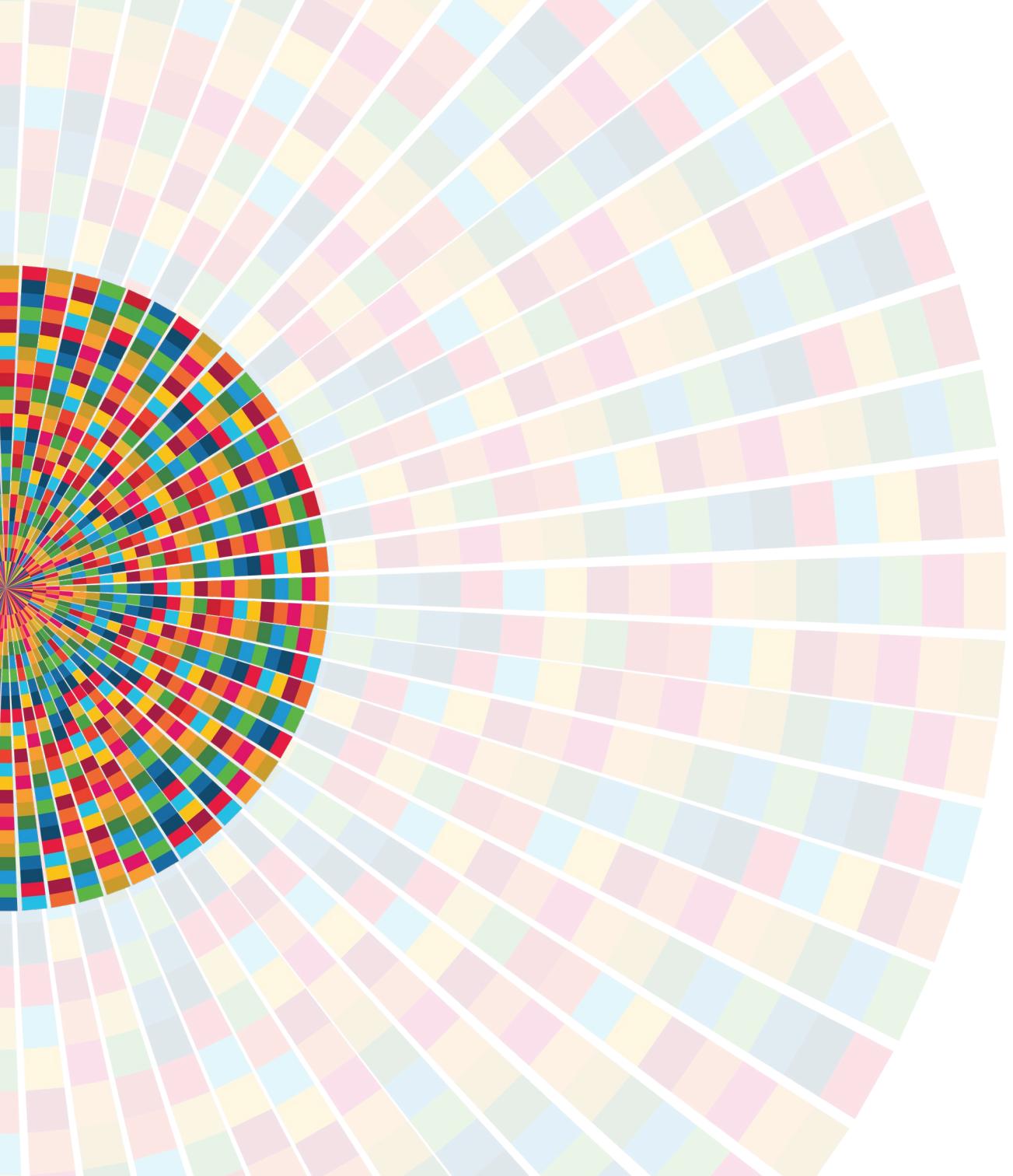


MINDANAO STATE UNIVERSITY
ILIGAN INSTITUTE OF TECHNOLOGY

research brief

2022 edition





INFLUENCING
the FUTURE



Mindanao State University
Iligan Institute of Technology

research**brief**

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chancellor's message

I am delighted to present to you the 2022 edition of our MSU-IIT Research Brief. This serves as a remarkable testament to the dedication, ingenuity, and relentless pursuit of knowledge that our faculty researchers possess.

Within the pages of this brief, you will find a myriad of research projects, groundbreaking innovations, and insightful scholarly works that highlight the diverse and exceptional research being conducted at MSU-IIT. From scientific breakthroughs to cultural preservation, from technological advancements to social progress, our researchers' contributions span across various disciplines, leaving an indelible mark on the academic landscape.

I would like to commend every researcher, faculty member, and student who has contributed to this brief. Your commitment to pushing the boundaries of knowledge, finding practical solutions, and addressing societal challenges is truly commendable. Through your passion, perseverance, and tireless efforts, you embody the core values of our University and showcase the intellectual prowess that MSU-IIT is renowned for.

To our esteemed readers, I encourage you to immerse yourselves in the remarkable research projects featured in this brief. Each study represents an amalgamation of countless hours of toil, meticulous attention to detail, and innovative thinking.

Furthermore, I invite you all to engage with our researchers, attend conferences, seminars, and workshops, and actively participate in the vibrant academic community that MSU-IIT is proud to foster. Your support, collaboration, and encouragement play an essential role in nurturing an environment conducive to groundbreaking research and intellectual growth.

Lastly, but certainly not least, I express my deepest gratitude to the Office of Research Management and the Office of Research Dissemination under the Office of the Vice Chancellor for Research and Enterprise, as well as all the individuals involved in the production of this brief. Your hard work has resulted in a publication that not only showcases our research excellence but also serves as a testament to the collaborative spirit that defines our campus.

May the MSU-IIT Research Brief inspire and empower us all to embark on new intellectual journeys, fueling the quest for knowledge and harnessing its potential to drive positive change in our society.

Continue pushing boundaries, transcending limitations, and influencing the future.

ALIZEDNEY M. DITUCALAN
Chancellor



Internally- Funded Research





SINGLE USE ONLY

12

applied &
theoretical
science

On Closed Geodetic Domination of Graphs Under Some Binary Operations

➤ *Imelda S. Aniversario, Ph.D.*

The impact of the COVID-19 pandemic on developing countries like the Philippines has been immense, exposing the vulnerabilities of their healthcare systems. Various non-pharmaceutical interventions have been implemented with varying degrees of success to combat the spread of the disease. With the focus now shifting towards achieving herd immunity through vaccination, it is essential to consider the unpredictable nature of the virus. This study aims to develop a stochastic mathematical model, unlike the deterministic models commonly used, to capture the random perturbations that can greatly influence the progression of the disease. By incorporating randomness into the model, valuable insights can be drawn for policy and decision-making, helping the country navigate through the uncertainties of the pandemic.

Implementation Period: January – December 2022

SDG 9: Industry, innovation, and infrastructure

$$\begin{aligned}
t \frac{\partial^\alpha}{\partial t^\alpha} u(t, x) &= \sum_{m=0}^{\infty} \sum_{n=0}^{\infty} \frac{u^m v^n}{m! n!} \frac{\partial^{m+n}}{\partial u^m \partial v^n} F(t, x, 0, 0) \\
&= \sum_{n=0}^{\infty} \frac{v^n}{n!} \frac{\partial^n}{\partial v^n} F(t, x, 0, 0) + \sum_{n=0}^{\infty} \frac{u v^n}{n!} \frac{\partial^{1+n}}{\partial u \partial v^n} F(t, x, 0, 0) \\
&\quad + \sum_{m=2}^{\infty} \sum_{n=0}^{\infty} \frac{u^m v^n}{m! n!} \frac{\partial^{m+n}}{\partial u^m \partial v^n} F(t, x, 0, 0) \\
&= \left[F(t, x, 0, 0) + v \frac{\partial}{\partial v} F(t, x, 0, 0) + \sum_{n=2}^{\infty} \frac{v^n}{n!} \frac{\partial^n}{\partial v^n} F(t, x, 0, 0) \right] \\
&\quad + \left[u \frac{\partial}{\partial u} F(t, x, 0, 0) + \sum_{n=1}^{\infty} \frac{u v^n}{n!} \frac{\partial^{1+n}}{\partial u \partial v^n} F(t, x, 0, 0) \right] \\
&\quad + \left[\sum_{m=2}^{\infty} \frac{u^m}{m!} \frac{\partial^m}{\partial u^m} F(t, x, 0, 0) + \sum_{m=2}^{\infty} \sum_{n=1}^{\infty} \frac{u^m v^n}{m! n!} \frac{\partial^{m+n}}{\partial u^m \partial v^n} F(t, x, 0, 0) \right] \\
&= F(t, x, 0, 0) + v \frac{\partial}{\partial v} F(t, x, 0, 0) \\
&\quad + \sum_{m=1}^{\infty} \frac{u^m}{m!} \frac{\partial^m}{\partial u^m} F(t, x, 0, 0) + \sum_{n=2}^{\infty} \frac{v^n}{n!} \frac{\partial^n}{\partial v^n} F(t, x, 0, 0) \\
&\quad + \sum_{n=1}^{\infty} \frac{u v^n}{n!} \frac{\partial^{1+n}}{\partial u \partial v^n} F(t, x, 0, 0) + \sum_{m=2}^{\infty} \sum_{n=1}^{\infty} \frac{u^m v^n}{m! n!} \frac{\partial^{m+n}}{\partial u^m \partial v^n} F(t, x, 0, 0)
\end{aligned}$$

(A₁) For any $t \in [0, T]$, and $x \in B_R$, $|a(t, x)| \leq At^{2-\alpha}\mu(t)^\beta$ and

$$\left| \frac{\partial a}{\partial x}(t, x) \right| \leq At^{2-\alpha}\mu(t)^\beta;$$

(A₂) For any $(t, x) \in [0, T] \times B_R$, $|b(t, x)| \leq Bt\mu(t)$;

(A₃) For any $(t, x, u, v) \in \Omega$, $\left| \frac{\partial^2 F}{\partial u \partial v}(t, x, u, v) \right| \leq C_{1,1}\mu(t)^{1-\beta}$ and $\left| \frac{\partial^2 F}{\partial v^2}(t, x, u, v) \right| \leq C_{0,2}\mu(t)^{1-\beta}$.

Theorem 4.1.1 (Main Theorem) Suppose (A₁)–(A₃) hold. Let $\beta \in [0, 1]$.

If T is sufficiently small, then there exists an $r > 0$ such that relations (4.1)

and (4.2) has a unique solution $u(t, x) \in X_0(W_r)$ that satisfies

$$|u(t, x)| \leq \frac{3A}{\Gamma(\alpha+1)} t\mu(t)^\beta \text{ and } \left| \frac{\partial u}{\partial x}(t, x) \right| \leq \rho \frac{t}{T} \left(\frac{\mu(t)}{\mu(T)} \right)^\beta.$$

Existence and Uniqueness of a Nonlinear Singular Partial Differential Equation with Fractional Time Derivative

➤ Randy L. Caga-anan, Ph.D.

Mathematical models have played a vital role in guiding decision-making during the COVID-19 pandemic. These models offer insights into the disease's future progression and intervention strategies, eliminating the need for unethical experiments on humans. However, the complexity of these models presents challenges in finding analytical solutions, making numerical approximations the preferred method. Establishing theorems regarding problem well-posedness is crucial to ensure these approximations' accuracy. While theorems exist for ordinary differential equations, they remain elusive for partial differential equations. This study concentrates on a nonlinear singular partial differential equation with a fractional derivative, aiming to establish an existence and uniqueness theorem. By proving the existence and uniqueness of a solution, this research lays the groundwork for accurate numerical approximations, avoiding fruitless efforts in pursuing non-existent solutions.

Implementation Period: January 1, 2022 - December 31, 2022

SDG 3: Good health and wellbeing

COVID-19 Investigations via a Stochastic Model

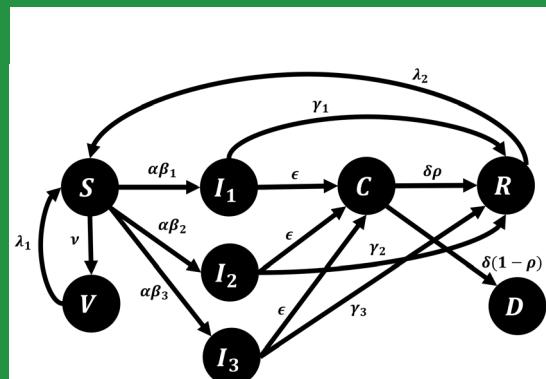
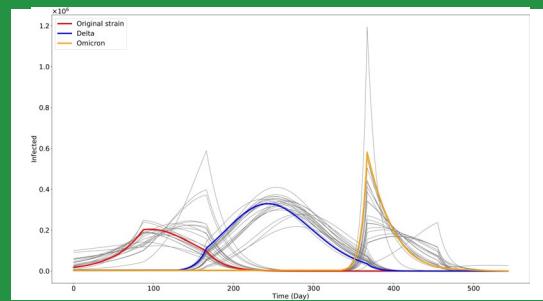
➤ Randy L. Caga-anan, Ph.D.

The COVID-19 pandemic has significantly impacted developing countries, including the Philippines, exposing vulnerabilities in their healthcare systems. Non-pharmaceutical interventions have been implemented with varying success to curb the spread of the virus. As efforts now focus on achieving herd immunity through vaccination, it is crucial to account for the unpredictable nature of the virus. This groundbreaking study aims to develop a stochastic mathematical model, distinct from deterministic models, to capture the random perturbations that greatly influence disease progression. By incorporating randomness into the model, valuable insights can be gleaned for policy and decision-making. This research will assist the country in navigating the uncertainties of the pandemic, guiding effective strategies to combat COVID-19.

Implementation Period: January 1, 2022 to December 31, 2022

Collaborators: Caraga State University

SDG 3: Good health and wellbeing



Differentiating-Hop Dominating Sets in Graphs

➤ Sergio R. Canoy, Jr., Ph.D.

The applications of domination-related concepts in graph theory extend beyond theoretical frameworks and find real-world significance. Domination has practical implications in facility location, representative selection, social network monitoring, and protection strategies. In this context, two variations of domination, locating-domination and differentiating-domination, offer valuable insights into the location-determination problem of monitoring devices for system safety. These concepts enable the precise identification of intruders or incidents in a facility. Building upon this, a groundbreaking study introduces differentiating-hop domination, a novel variation that models the positioning of monitoring devices, such as fire alarms or surveillance cameras, to identify the exact location of a burglar or threat. This research opens up new avenues for addressing location-based challenges and provides theoretical foundations for future explorations in the field.

Implementation Period: January – December 2022

SDG 9: Industry, innovation, and infrastructure

Experimental investigation on the durotaxis of the physarum polycephalum using 3D printed micromixer

➤ *Mark Nolan P. Confesor, Ph.D.*

The extracellular medium plays a vital role in cellular mechanotactic behavior, including durotaxis, where cells respond to substrate stiffness gradients. Understanding this phenomenon is crucial, as it influences pathological processes like cancer cell metastasis and tumor formation. However, studying cell migration, especially cancer metastasis, requires a highly controlled laboratory environment. In this research, we employ the slime mold *Physarum polycephalum* as a model organism to investigate potential durotaxis migration. This unique organism exhibits similar dynamical behavior to other cells, making it a valuable tool for understanding the basic interactions involved and exploring methods to inhibit cell aggregation. This study, combined with simulation results from a related project, aims to enhance our understanding of cancer metastasis and develop effective protocols to impede its progression.

Implementation Period: January to December 2022

SDG 3: Good health and wellbeing

Numerical study on a modified stiffness sensing model for *Physarum polycephalum* durotaxis

➤ *Mark Nolan P. Confesor, Ph.D.*

Understanding the directed migration of cells driven by external signals holds great promise for medical and biological applications. While chemotaxis has been extensively studied, recent focus has shifted to durotaxis, which plays a crucial role in comprehending cancer cell metastasis. In durotaxis, cells respond to spatial gradients in substrate rigidity, guiding their migration. In this program's first project, we employ the slime mold organism *Physarum polycephalum* to investigate durotaxis through experimental techniques. Additionally, we develop numerical simulations to gain insights and predict the experimental outcomes. This research will pave the way for a versatile numerical tool applicable to *Physarum* and other organisms, such as cancer cells, with tailored parameters for specific investigations.

Implementation Period: January to December 2022

SDG 3: Good health and wellbeing

Document Layout Analysis of Scholarly Articles via Density-based Clustering

➤ Rey R. Cuenca

The exponential growth of textual data due to the advancement of information technology and the Internet has fueled the need for automated text summarization (ATS). Researchers have been exploring the application of ATS to scientific papers in Portable Document Format (PDF), but face challenges in preserving reading order and extracting information effectively. A new approach under Document Layout Analysis (DLA) utilized Density-based Clustering to address this. This approach optimizes the segmentation of significant blocks in scholarly articles, followed by classification using Support Vector Machines (SVM). The output will be a structured XML file suitable for further Natural Language Processing, such as Automatic Text Summarization. This project pursues algorithm development, feature identification, and implementation in an end-to-end R program.

Implementation Period: January to December 2022

SDG 9: Industry, innovation, and infrastructure

On the independent Neighborhood polynomials of the Rooted Product of Two Trees

➤ Susan C. Dagondon, Ph.D.

Graphs find diverse applications in fields like architecture and computer science. In architecture, graphs aid in floor plan design and analysis, where rooms are represented as vertices and adjacency capture direct access. Computer science employs graphs for computer network modeling, with vertices symbolizing computers and edges denoting communication links. This project delves into the theory of trees, pioneered by Kirchoff in 1847, to solve linear operations in electrical networks. Electrical elements, like inductors and resistors, are modeled as edges, while vertices represent junctions. The project focuses on investigating the independent neighborhood polynomial, particularly in the rooted product of a tree and a rooted graph tree. Specifically, this work obtains a tree's independent neighborhood polynomial, exploring the rooted product's independent neighborhood set, and establishing the independent neighborhood polynomial of the rooted product. By advancing our understanding of graph structures, this study contributes to various applications and their implications across disciplines.

Implementation Period: January to December 2022

SDG 9: Industry, innovation, and infrastructure

On Hop Roman and Hop Italian Domination in Graphs

➤ Ferdinand P. Jamil, Ph.D.

A groundbreaking research project introduces a fascinating concept known as hop Italian domination in graphs, adding to the evolving field of graph theory. Building upon the history of Roman domination and its applications in various disciplines, the study explores the hop Roman domination and hop Italian domination parameters. Hop Roman domination focuses on vertex distances, while hop Italian domination extends the concept to include vertices at a distance of 2. This research project aims to investigate and delve deeper into the properties and applications of hop Italian domination in different graph structures. The study contributes valuable insights into graph theory and its practical implications by exploring this novel concept. This research opens up new avenues for future explorations and paves the way for further advancements in the field.

Implementation Period: January to December 2022

SDG 9: Industry, innovation, and infrastructure

On the independent Neighborhood polynomials of the Rooted Product of Two Trees

► Mhelmar A. Labendia, Ph.D.

In the field of option pricing, Liu introduced a definition of the European option price based on the classical price formula. Alternatively, another approach can be pursued, deriving the price formula through the framework of probability theory. This approach involves establishing a riskless portfolio in an arbitrage-free market, utilizing martingales and conditional expectations. This research paper focuses on defining the Liu-Henstock integral of an uncertain process with respect to a canonical Liu process. By employing the tools of probability theory, the study contributes to the derivation of price formulas for options. These advancements in option pricing offer valuable insights for financial markets and investors, providing a deeper understanding of pricing mechanisms and risk management strategies.

Implementation Period: January 2022 to June 2023

SDG 9: Industry, innovation, and infrastructure

Stochastic Fubini-Tonelli theorem

➤ Mhelmar A. Labendia, Ph.D.

The mathematical analysis explores the intricacies of iterated integrals, leading to significant conclusions such as Fubini's theorem. This theorem identifies conditions under which double integrals can be computed using iterated integrals, allowing for a change in the order of integration. Tonelli's theorem further extends this concept, stating that product measure integrals can be evaluated through iterated integrals, irrespective of finite integrals. In this groundbreaking work, researchers introduce two versions of the stochastic Fubini-Tonelli theorem. These theorems specifically pertain to the Itô-Henstock integral of a Hilbert-Schmidt-valued stochastic process with respect to a Hilbert space-valued Q-Wiener process. These advancements in mathematical analysis enhance the understanding and application of integrals, providing valuable insights for researchers and practitioners in various fields.

Implementation Period: January to December 2022

SDG 9: Industry, innovation, and infrastructure

COVID-19 Data Dashboard for Iligan City

➤ John Alfred M. Liwanag, MSc

A research project enhances the functionalities of MSU-IIT's data dashboard on COVID-19 cases in Iligan City. The project seeks to provide valuable insights into the outbreak dynamics and aid local governments in formulating data-driven policies and protocols to combat the disease. The improved data dashboard will include additional features, such as time series graphs displaying daily new cases by age group, visualization and analytics of daily new deaths and recoveries by age group, monitoring of the reproduction number, and tracking vaccination statistics in the city. These enhancements will enable a more comprehensive understanding of the COVID-19 situation in Iligan City and support the development of effective epidemiological models. The data dashboard will be regularly updated in real time with confirmed COVID-19 data from official sources.

Implementation Period: January 2022 to June 2023

SDG 3: Good health and wellbeing

Morphological identification and metabarcoding of freshwater nematode communities in two selected lakes of Mindanao, Philippines

➤ Ma. Reina Suzette B. Madamba, Ph.D.

Accurate species identification is crucial for biomonitoring and environmental conservation efforts. Traditional morphology-based methods are inadequate for many indicator species, leading to the exploration of molecular techniques. High-throughput next-generation DNA sequencing has emerged as a promising approach, revolutionizing biodiversity assessments. Nematodes, abundant and diverse roundworms inhabiting various ecosystems, serve as biological indicators of soil, sediment, and water quality. However, limited studies have focused on nematodes in aquatic environments, particularly in the Philippines. This project highlights the integration of DNA sequencing and morphology-based techniques for nematode identification. Challenges arise due to their minute size, phenotypic plasticity, and intraspecific variations. The project aims to develop standardized genetic markers for accurate species identification and robust biodiversity assessments. By expanding our understanding of nematode communities, this study contributes to assessing and preserving aquatic ecosystems.

Implementation Period: January to December 2022

SDG 6: Clean water and sanitation

SDG 14: Life below water

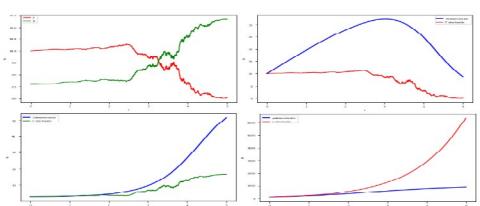
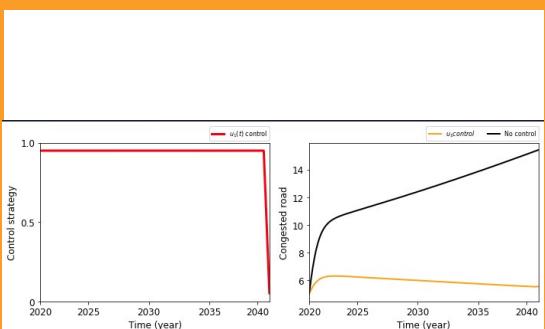


Figure 5.8: Simulation of the stochastic system (case 2) with $\sigma = 0.022$.



Modeling, Simulation, and Optimization of the Urban Traffic Network of Iligan City

► Gina M. Malacas, Ph.D.

Communication and transportation systems are vital to our economic and social well-being, with urban travel networks serving as their core. In Iligan City, Philippines, the combination of non-adaptive traffic control and diverse vehicle types, including bicycles, has resulted in severe rush-hour traffic congestion, significantly impacting the productivity of the working class. To tackle this pressing issue, a groundbreaking study is underway, employing Mathematical Graph Theory and cutting-edge optimization techniques to develop a model for Iligan City's traffic. By evaluating key factors such as signal timings, lane markings, and network travel times using a binary-mixed-integer-linear program (BMILP) approach, researchers aim to optimize traffic flow and minimize travel times. The outcomes of this research will be presented to the local government unit, providing a comprehensive roadmap for enhancing traffic management. The study's recommendations will guide necessary changes and offer insights into potential costs, ultimately revolutionizing urban mobility and improving the quality of life for residents of Iligan City.

Implementation Period: January 2022 to June 2022

SDG 11: Sustainable cities and communities

On Connected Co-independent Perfect Hop Domination in Graphs

➤ Helen M. Rara, Ph.D.

A groundbreaking study unveils the remarkable applications of hop domination in graph theory, particularly in modeling social networks and understanding complex relationships among individuals in diverse fields. Motivated by a real-world scenario in a factory setting, where a quality assurance team needs to be formed with minimal costs and unbiased inspection, the research delves into the concept of connected co-independent perfect hop domination. The study determined the minimum number of inspectors required to ensure comprehensive and unbiased inspections by constructing a social network graph and analyzing worker interactions. The findings offer valuable insights into optimizing inspection processes, protecting privacy, and maintaining efficient quality assurance measures. This research significantly contributes to the field of graph theory and its practical applications in modeling dynamic social networks.

Implementation Period: January to December 2022

SDG 9: Industry, innovation, and infrastructure

Morphological and Molecular Characterization of Entomopathogenic and Entomophilic Nematodes as Biopesticides of Insect Pests in Selected Agricultural Areas of Misamis Oriental, Surigao del Norte, and Sur

➤ Nanette Hope Sumaya, DSc.Agr

Harmful organisms pose a grave threat to global food security, perpetuating hunger, malnutrition, and poverty. While weeds and pathogens contribute significantly to crop losses, animal pests, particularly soil-dwelling ones, present a unique challenge in terms of control efficiency. Alternative methods are urgently needed as traditional soil disinfecting pesticides face bans due to health and environmental concerns. Enter entomopathogenic nematodes (EPNs), nature's secret weapon against pests. These parasitic nematodes have shown immense potential in suppressing insect populations, offering a safe and sustainable biocontrol solution. Recent studies have identified diverse EPNs in agricultural areas of the Philippines, providing an opportunity to harness their power in local crop protection. Effective plant protection measures are vital in boosting food crop productivity, eradicating poverty, and ensuring global food security. By embracing the potential of EPNs as biocontrol agents, the Philippines takes a significant step towards developing safer and more sustainable crop protection methods.

Implementation Period: January 2022 to June 2022

SDG 2: Zero Hunger
SDG 15: Life on land

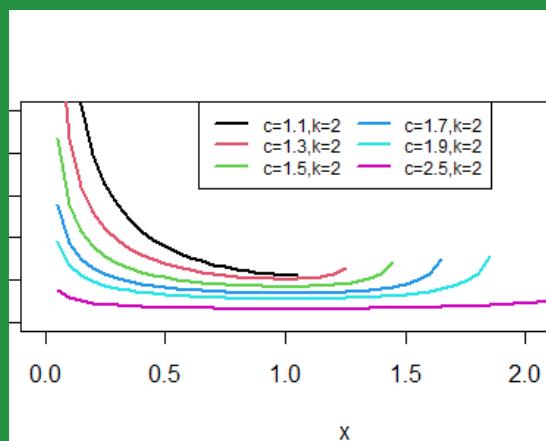
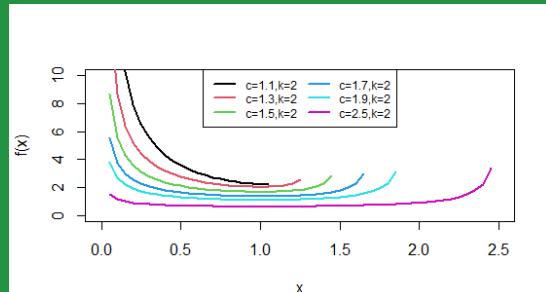
On the Asymptotic Behavior of the Parameters of the Burr Type IV Distribution for Lifetime Survival Data

➤ Bernadette F. Tubo, Ph.D.

A recent study has shed light on the characteristics and properties of the Burr Type IV (BT4) distribution, an extension of the well-known Burr Type 3 (BT3) distribution. The BT4 distribution, featuring two positive shape parameters, offers valuable insights into modeling lifetime data behavior. The research paper delves into the probability density, survival, and hazard functions of the BT4 distribution, providing a comprehensive understanding of its properties. Furthermore, graphical illustrations demonstrate the diverse behavior of the distribution, showcasing density plots that can take the form of J-shaped, U-shaped, or Reversed J-shaped curves. Simulation studies have highlighted the practical applications of the BT4 distribution in modeling lifetime or survival data, with its shape and structure effectively capturing the variations and complexities of real-world scenarios. This breakthrough research opens up new avenues for accurately modeling and analyzing lifetime data, supporting advancements in various fields such as healthcare, finance, and insurance.

Implementation Period: January to December 2022

SDG 3: Good health and wellbeing



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culture,
technology
& society



A Reference Grammar of Higaonon

➤ *Danilyn T. Abingosa, Ph.D.*

The Higaonon language, an established language in the Philippines, is set to receive preservation and protection measures to prevent it from becoming endangered or extinct. Through comprehensive language documentation and grammar description, linguistic research aims to ensure the stability and vitality of Higaonon. Using a descriptive approach in linguistics, the study delves into the structure and components of the language. Higaonon, like other Philippine languages, follows a predicate-initial pattern in basic clauses. It encompasses various word categories, including nouns, verbs, adjectives, adverbs, pronouns, and conjunctions. The Higaonon language boasts six vowel phonemes and sixteen consonant phonemes. Its syllable structure can be classified as open (CV) and closed (CVC) syllables. This initiative seeks to safeguard the rich cultural heritage embedded in the Higaonon language, ensuring its longevity for future generations.

Implementation Period: January 2022 to June 2023

Collaborators: Dulangan Ancestral Domain, Opol, Misamis Oriental
National Commission for Indigenous Peoples (NCIP) Region X

SDG 4: Quality Education

SDG 16: Peace, Justice, and Strong Institutions





To Vax or Not to Vax, that is the (herd immunity) question: A Vaccine Acceptability Study

➤ Jay Rey G. Alovera, Ph.D.

A comprehensive study assessing vaccine acceptability in Iligan City and Lanao del Norte has revealed high acceptance levels for immunization and vaccination among residents. The survey, with a particular focus on the Covid-19 vaccination program, indicated that a majority of the population had received their first vaccine dose. However, there was a gradual decline in the number of individuals returning for their second dose, with a significant drop in booster doses. The study identified complacency among residents as a key factor contributing to reduced inoculation rates. Cultural practices of self-medication, influenced by the similarity between common illnesses and Covid-19 symptoms, played a significant role. Additionally, a substantial proportion of asymptomatic cases may have impacted communities' perception of infection risk. This research emphasizes the importance of addressing complacency and fostering awareness about the necessity of complete vaccination. Efforts to educate and empower the population are crucial to ensuring the success of vaccination programs.

Implementation Period: January 2022 to December 2022

SDG 3: Good Health and Well-being

Economic, Cultural Utility, and Callus Culture Initiation of Different Chili Species

➤ Christina Barazona

Capsicum, a versatile plant with economic importance in local and international markets, serves as a vegetable, spice, medicinal ingredient, and more. This research focuses on surveying and documenting the cultural significance of chili across various communities, exploring its role in food, medicine, practices, beliefs, and other cultural factors. Additionally, the study aims to employ biotechnology techniques to establish an *in vitro* culture of native chili species in the province. This crucial research will lay the foundation for future investigations and extension initiatives, fostering connections between MSU-IIT, farmers, entrepreneurs, and consumers. This project strives to unlock new insights, promote sustainable practices, and enhance collaboration among key stakeholders by delving into the multifaceted uses of capsicum and harnessing biotechnology.

Implementation Period: January 2022 to June 2023

SDG 2: Zero Hunger

SDG 9: Industry, Innovation, and Infrastructure



Factors Affecting Academic Performance of CBAA Students: The Role of Bridging Program

➤ Joana Marie C. Edera, MBM

The implementation of the K to 12 programs in the Philippines brought about significant changes in the basic education system, including the introduction of specialized tracks in Senior High School (SHS). While these tracks offer students more career options, concerns arise regarding their readiness for college programs outside their chosen track. In response, the College of Business Administration and Accountancy (CBAA) at Mindanao State University - Iligan Institute of Technology (MSU-IIT) has launched an Enhancement Program for non-ABM (Accountancy, Business, and Management) SHS graduates enrolling in business-related programs. This five-week program aims to equip students with essential business skills and competencies for success in their chosen programs. By assessing the program's effectiveness and analyzing factors influencing student performance, this study ensures equal opportunities for success in academic pursuits. By bridging the gap between SHS and college, students will be better prepared to excel in their chosen business programs, making significant contributions to the future of the Philippine economy.

Implementation Period: July 2021 to March 2023

SDG 4: Quality Education

Increasing Pre-service Teachers' Multicultural Sensitivity

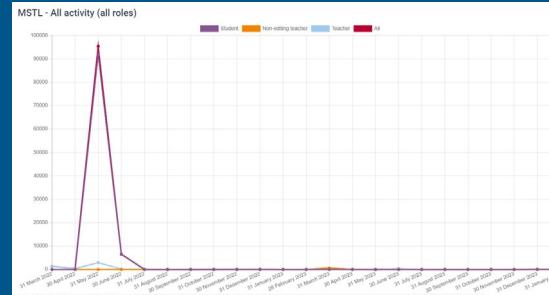
► Shelanee Theresa P. Ruales

Mindanao, renowned for its diverse cultural heritage, demands educators who possess the skills to navigate and embrace these differences. Recognizing the importance of teacher education that fosters multicultural sensitivity (MS), a groundbreaking research project has been launched to enhance the MS of pre-service teachers in the Philippines. With the scarcity of local studies focusing on multicultural sensitivity, particularly among pre-service teachers, this research aims to fill the gap by providing an online course dedicated to nurturing MS. The course aligns with the Sustainable Development Goal of providing inclusive, equitable, and quality education while supporting the Philippine government's commitment to preserving the nation's ethnic diversity. By equipping future teachers with multicultural sensitivity, we can create inclusively and accepting learning environments, promote positive self-image, encourage diverse historical perspectives, strengthen cultural awareness, and combat stereotypes and prejudice. The impact extends beyond the target population, fostering positive social change through the transformative power of education.

Implementation Period: January 2022 to February 2023

SDG 4: Quality Education

SDG 16: Peace, Justice, and Strong Institutions



A Literature Review on the Classification of eHealth Systems in the Philippines

► *Mia Amor C. Tinam-isan*

The healthcare industry is undergoing a paradigm shift, leveraging innovative strategies to revolutionize traditional healthcare delivery. The internet is at the forefront of this transformation, serving as a catalyst for change and paving the way for accessible and reliable healthcare resources. In the Philippines, where healthcare availability remains a concern, the development of an eHealth framework aims to address challenges such as high costs, limited accessibility, and inadequate patient data. This groundbreaking research proposes the development of a conceptual matrix that classifies eHealth implementations based on the context of care, system functionalities, and technology medium used. This matrix will facilitate effective alignment and evaluation of digital health initiatives by providing valuable insights and enhancing understanding of the existing eHealth landscape in the Philippines. However, the implementation of eHealth faces numerous barriers, including user resistance, skills gaps, regulatory compliance issues, and technological complexities. To overcome these challenges, collaborative efforts among stakeholders are vital. Through the effective integration of eHealth, the Philippines can harness the power of digital innovation to transform healthcare delivery, improve patient outcomes, and ensure equitable access to quality healthcare services.

Implementation Period: January 2022 - December 2022

SDG 3: Good Health and Well-being
SDG 9: Industry, Innovation, and Infrastructure



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disruptive
innovation
& smart nation

Tee Pump with Roaster Cutter Wheel – Fishpond Dredging and Plowing Equipment

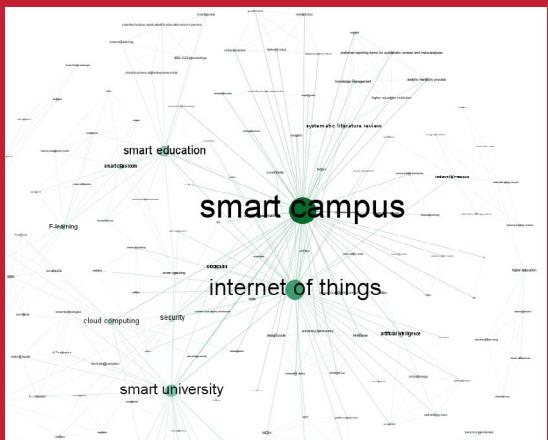
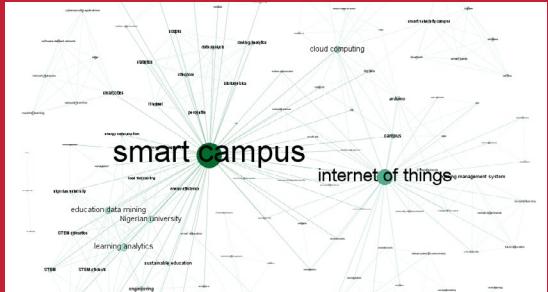
➤ *Danila C. Adlaon, Ph.D.*

Researchers have developed affordable and portable fishpond dredging and plowing equipment to revolutionize fishpond maintenance. The current manual upkeep of earthen dikes in small fishponds poses challenges for operators, hindering productivity and accessibility. The groundbreaking solution optimizes design, addressing manual maintenance issues and yielding numerous benefits. Deepening fishponds enhances stocking density, regulates temperature and salinity, and reduces pollution, resulting in increased productivity and sustainable farming practices. By combating affordability and accessibility barriers, this pioneering project aims to bolster food production and alleviate hunger and poverty in communities. The innovative equipment provides an alternative approach, enhancing food security and supporting sustainable farming practices.

Implementation Period: January 2022 to December 2022

SDG 2: Zero Hunger

SDG 9: Industry, Innovation, and Infrastructure



An empirical survey of smart campus' definitions, framework and implementation

➤ Apple Rose B. Alce, MSc

The Republic Act 11494, also known as the “Bayanihan to Recover as One Act,” has shed light on the significance of establishing smart campuses. Smart campus, as defined in CHED MO 9, series of 2020, refers to higher education institutions utilizing next-generation digital technologies seamlessly integrated into a well-structured infrastructure. This empowers teaching, learning, research, extension, and operational efficiency. Universities worldwide have harnessed the potential of digital technologies, particularly ICT, to transform into smart campuses. The integration of these technologies enables more effective learning strategies while fostering safe and efficient working environments. This study explores smart campuses’ empirical definition and implementation, serving as a benchmark and roadmap for digital transformation. The findings will guide higher education institutions in their journey towards comprehensive smart campuses.

Implementation Period: January 2022 - December 2022

SDG 4: Quality Education
SDG 9: Industry, Innovation, and Infrastructure

Explorative scoping review on Digital Transformation in the Public Sector and

➤ Adrian P. Galido, Ph.D.

Digital transformation in the public sector has significantly improved public service delivery, government effectiveness, and ease of doing business. However, the impact of digital transformation varies across countries, and understanding its role in different contexts is crucial. A groundbreaking study aims to analyze the E-Government Development Index (EGDI) and its sub-indices in the ASEAN region, focusing on the Philippines. The EGDI, which combines telecommunications infrastructure, human capital, and online service indexes, serves as a proxy for a country's readiness for public service delivery. Insights from this study will provide valuable information for policymakers in the trade and industry sector, enabling them to enhance the business environment through e-government initiatives. By shaping digital transformation to facilitate trade, including reforms for trading across borders, the study aims to contribute to the positive impact of digitalization on doing business in the ASEAN region.

Implementation Period: January 2022 to December 2022
Collaborators: DTI-Philippine Accreditation Bureau, Makati

SDG 9: Industry, Innovation, and Infrastructure
SDG 16: Peace, Justice, and Strong Institutions



Platform Workers During Pandemic: Examining the Effects of Pandemic to ICT-Enabled Gig Workers

► Rabby Q. Lavilles, Ph.D.

As Information and Communications Technology (ICT) continues to penetrate households, the gig economy has emerged, offering new employment opportunities and practices. This phenomenon, mediated by online platforms, has transformed the organization of work and employment relationships through technology. Previous research has focused on the precarity of gig work and the implementation of technological control over workers. To address labor issues, interventions such as the Fairwork Foundation have been introduced, aiming to improve the quality of work on online platforms. This new study shed light on the experiences and expectations of gig workers during the uncertainty brought on by the pandemic. Through thematic analysis of collected data, the research will examine how workers cope with associated changes and take advantage of opportunities facilitated by technology and the pandemic. By exploring different types of gig work, this research aims to contribute to the growing literature and provide insights into the evolving nature of work in the gig economy.

Implementation Period: January 2022 - December 2022

SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation, and Infrastructure

Technology on Renewable Energy and Energy Efficiency for MSME in Iligan City

► *Rennie Miculob*

As electricity prices continue to rise and the impacts of global warming become more evident, the need for reliable, clean, and environmentally friendly renewable energy sources becomes paramount. Solar power stands out as a promising alternative due to decreasing solar panel costs. A research study aims to design a 20 kW Hybrid Solar Photovoltaic (PV) system that will significantly increase renewable energy generation and reduce reliance on fossil fuels. This project aligns with the Department of Trade and Industry's goals of promoting energy efficiency in Micro, Small, and Medium Enterprises (MSMEs). By introducing energy-efficient technologies, the research aims to augment electricity needs, reduce energy consumption, and enhance cost competitiveness for MSMEs. The project also offers business opportunities for entrepreneurs and provides valuable research opportunities for students. With its focus on sustainable energy and innovative technologies, the research project supports the PCIEERD's vision of improving energy utilization and product cost competitiveness.

Implementation Period: January 2022 to December 2022

SDG 7: Affordable and Clean Energy
SDG 9: Industry, Innovation, and Infrastructure

The adoption of FinTech services during extreme disruptions and the CoViD-19 pandemic in Mindanao

➤ Atty. Eddie Bouy B. Palad

Extreme disruptions like pandemics have far-reaching effects, impacting various sectors and businesses. The COVID-19 pandemic serves as a prime example, prompting governments to enforce strict measures such as lockdowns and social distancing. While these measures led to the temporary shutdown of many industries, they also sparked a surge in the use of information systems, networks, and financial technologies (FinTech). As people adapt to the “new normal,” they increasingly rely on FinTech services to mitigate health risks and socioeconomic challenges. Recognizing the significance of this trend, this research project focuses on Mindanao, documenting the early impact of COVID-19 on FinTech adoption. Through qualitative data analysis, the study aims to uncover the factors influencing FinTech adoption among Mindanaoans, shedding light on the transformative power of technology in the face of adversity.

Implementation Period: January 2022 - December 2022

SDG 8: Decent Work and Economic Growth
SDG 9: Industry, Innovation, and Infrastructure

Development of a Vending Machine Monitoring Prototype: Toward Enabling Electronic Payment Support

➤ *Joel I. Miano, MSCA*

The demand for convenient access to drinking water has led to the development of electronic payment vending machines. These machines offer a solution to quench people's thirst with the added benefits of technological advancements. Portable water vending machines can now be found in public places such as supermarkets, bus terminals, workplaces, and schools. In a pioneering study, researchers have successfully developed and implemented the use of GCash as an electronic payment system for the prototype Limon Juice Fruit drink automatic vending machine. This cashless technology and a remote inventory monitoring system enable owners to track sales and receive alerts when water and juice containers fall below a certain threshold, ensuring efficient inventory management. The system prototype has met the initial requirements and undergone thorough assessment evaluations, including alpha and beta testing. This innovative vending machine solution provides convenience, cost-effectiveness, and optimal inventory management for food and beverage enterprises. With cashless technologies becoming more prevalent, this advancement sets a new standard for vending machines in the industry.

Implementation Period: January 2022 to December 2022
Collaborators: Limonero Fruit Drink Inc.

SDG 9: Industry, Innovation, and Infrastructure



Design and Development of System Prototypes: Addressing Local and National Problems in the Context of Emerging Technologies

 *Joel I. Miano, MScA*

Technology has become an essential component across different fields, including education, agriculture, transportation, and more. As advancements continue, the need for diverse and impactful innovations becomes increasingly vital in addressing global challenges. In agriculture, solar panels, monitoring systems, and automated processes have revolutionized the industry. Similarly, technological innovations play a crucial role in healthcare, tackling issues like the Covid-19 pandemic. Environmental development and protection also benefit from initiatives such as automated garbage segregation and real-time forest monitoring. Furthermore, technology can assist individuals affected by unforeseen events like floods by providing location systems and temporary aid. This study, aligned with the Harmonized National Research and Development Agenda, explores emerging technologies' potential in agriculture, food security, and monitoring applications, leveraging embedded systems, IoT, and AI for local and national progress.

Implementation Period: January 2022 - December 2022

SDG 9: Industry, Innovation, and Infrastructure
SDG 11: Sustainable Cities and Communities

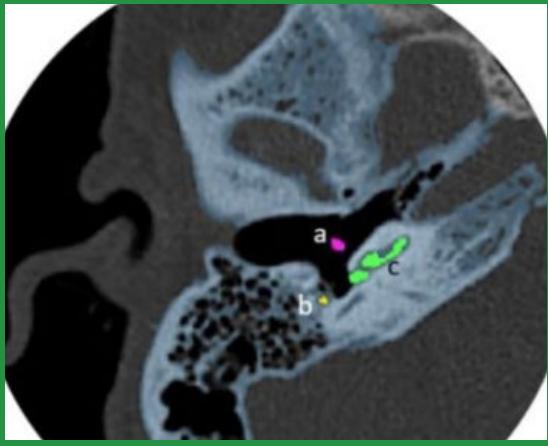
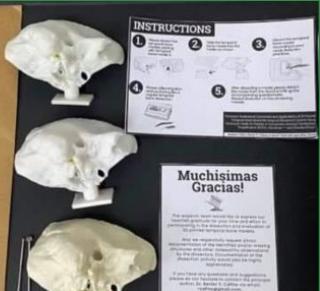
Serpent Robot for Search and Delivery of Vital Needs to a Trapped Person in a Collapsed Building

➤ Carl John Salaan, Ph.D.

Earthquakes pose significant risks to human life and infrastructure, causing extensive damage and casualties. Immediate assessment and rescue operations are crucial to saving lives. A research project aims to develop a serpent robot capable of navigating disaster sites to find and reach victims trapped under rubble. Victims in such situations face the challenge of isolation and limited access to essential resources like food, water, and air. Due to the unstable conditions, traditional search and rescue operations can be time-consuming and hazardous for both victims and rescuers. Serpent robots offer a versatile solution with their mobility and flexibility. These robots can climb, traverse various surfaces, and explore narrow spaces, enhancing search capabilities in disaster-stricken areas. The research project focuses on equipping the serpent robot to locate entrapped victims and deliver vital supplies. By providing necessary resources, the robot aims to support the survival and well-being of victims until rescue operations are completed.

Implementation Period: January 2022 to December 2022

SDG 11: Sustainable Cities and Communities



Creation of Synthetic Temporal Bone Models Produced Using Consumer Grade Fused Deposition Modeling (FDM) 3D Printers for Surgical Simulation: A Comparison Between Polyethylene terephthalate (PETG) and Nylon, Polyolefin, Cellulose Fiber Composite

➤ Lemuel Clark P. Velasco, MSc

Fused deposition modeling (FDM) and stereolithography (SLA) are widely used 3D printing techniques that offer cost-effective options for simulating surgical procedures. In a recent study, researchers characterize low-cost synthetic temporal bone models using desktop FDM and SLA 3D printers. The goal was to provide surgeons with standardized, reproducible, and potentially patient-specific non-cadaveric dissection tools. The study compared models created with Simubone™ (FDM), photopolymer resin (SLA), and polyethylene terephthalate glycol (PETG). Evaluators assessed the models based on anatomical accuracy, dissection expertise, and cost-effectiveness as a surgical training tool. The photopolymer resin outperformed PETG and Simubone™ in terms of anatomical accuracy and dissection experience. This research demonstrates the potential of inexpensive, 3D printed surgical models for training surgical residents, including the development of patient-specific models based on actual CT scans.

*Implementation Period: January 2022 - December 2022
 Collaborators: Zamboanga City Medical Center*

SDG 3: Good Health and Well-being

Development of Medispatch: A Technology-Enabled Startup on Medicine Delivery Service for Senior Citizens

➤ Lemuel Clark P. Velasco, MSc

The ongoing pandemic has posed significant challenges for senior citizens, particularly when it comes to accessing vital medications. With a senior citizen population of 24,162 individuals, the city of Iligan recognizes the need for a solution that addresses their healthcare concerns. A recent study shed light on the difficulties faced by seniors during the COVID-19 crisis, including limited access to essential needs and unfavorable perceptions. A dedicated medicine delivery startup tailored for Iligan City's senior citizens has been launched in response. This platform enables seniors to easily order their medications by providing their details, including prescription or non-prescription needs. Partnering with local pharmacies and dedicated riders, this innovative service ensures safe and efficient medicine delivery to seniors' doorsteps, alleviating their concerns and providing a convenient healthcare solution. By prioritizing the well-being of Iligan City's senior citizens, this initiative contributes to the government's efforts to protect vulnerable groups during the pandemic, ensuring accessible and reliable healthcare services.

Implementation Period: January 2022 to December 2022

SDG 3: Good Health and Well-being

SDG 9: Industry, Innovation, and Infrastructure

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British Put Option on Stocks Under Regime-Switching Model

➤ *Felipe R. Sumalpong, Jr., Ph.D.*

The classical Black-Scholes model has long been utilized to estimate the price of British call options in financial markets. However, this model fails to capture the stochastic characteristics of the market, particularly the variable parameters such as interest rates and volatility. To overcome these limitations, a groundbreaking study has been conducted to develop an alternative pricing approach. In this research, a regime-switching model was employed to account for the stochastic nature of both the drift rate and volatility in the financial market. By incorporating these dynamic variables, a more accurate pricing estimate for British call options is achieved, reflecting the true nature of the market's behavior. This study opens new possibilities for improving financial market modeling and enhancing investment decision-making. The findings provide valuable insights for traders, investors, and financial analysts seeking a comprehensive understanding of option pricing in a dynamic market environment.

Implementation Period: January 2022 - June 2023

SDG 8: Decent Work and Economic Growth

SDG 9: Industry, Innovation, and Infrastructure



integrative
resiliency &
sustainability
solutions

Disaster Preparedness Among Iligan City Nurses

➤ Amabelle A. Embornas, MA

The escalating occurrence of natural and human-induced disasters underscores the critical importance of emergency preparedness, especially among healthcare professionals. The devastating impact of disasters and the ongoing COVID-19 pandemic have emphasized the need to equip nurses with the necessary skills and knowledge to mitigate crisis effects. In this study, researchers assessed nurses' familiarity with disaster protocols and their confidence in handling emergency situations in Iligan City, Philippines. Factors influencing nurses' readiness for emergencies will also be explored. The study's findings will guide strategies to enhance disaster preparedness among nurses, ensuring they can provide safe and effective care during challenging circumstances. By strengthening the healthcare workforce's readiness, communities' resilience in Iligan City will be significantly improved in the face of disasters and public health emergencies.

Implementation Period: January 2022 to December 2022

SDG 3: Good health and well-being

SDG 13: Climate action

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Table 1. Respondents' EPIQ Summary

Dimension	Mean score	Qualitative meaning
1. Detection of and response to an event	2.21	Familiar
2. The Incident Command System (ICS) and your role within it	2.67	Not Familiar
3. Ethical issues in triage	2.52	Familiar
4. Epidemiology and surveillance	2.73	Not Familiar
5. Isolation/Quarantine	2.39	Familiar
6. Decontamination	2.27	Familiar
7. Communication/Connectivity	2.64	Not Familiar
8. Psychological issues	2.73	Not Familiar
9. Special populations	2.53	Familiar
10. Accessing critical resources	2.88	Not Familiar
Overall familiarity	2.74	Not Familiar

NOTES COMMENTS



Developing a mathematical model of soil rehabilitation success of mining areas in the southern Philippines using nematodes as bio-indicators

➤ Joey Genevieve T. Martinez, DSc

Surface mining has played a significant role in the Philippine economy, making the country a major global exporter of minerals. However, the environmental impact of mining, such as soil degradation, deforestation, and decline in biodiversity, cannot be ignored. Soil rehabilitation efforts have become crucial in restoring disturbed areas and mitigating these negative effects. While plant growth has traditionally been used as an indicator of rehabilitation success, it may not provide a comprehensive assessment, particularly in terms of heavy metal pollution. In this study, a novel approach is taken by using nematode communities as indicators of soil recovery. Nematodes play vital roles in soil ecosystems, and their response can shed light on the effectiveness of rehabilitation strategies. By understanding nematode dynamics over two years, this research aims to develop an ecological model that will provide valuable insights and parameters for efficient soil rehabilitation. This mathematical model can be used to simulate and guide future initiatives, accelerating the evaluation process and supporting sustainable mining practices.

Implementation Period: January 2022 - December 2022

SDG 15: Life on land
SDG 13: Climate action

The Effect of Genetic Variability in the caprine ghrelin gene on milk production performance in Dairy Goats

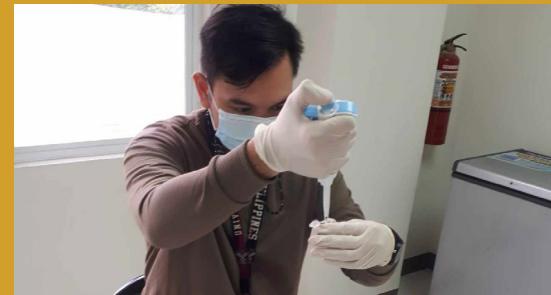
➤ Carlo Stephen O. Moneva, Ph.D.

Milk and dairy products are essential components of a healthy diet, providing a wealth of nutrients. As the demand for milk production grows, the need to improve milk traits becomes increasingly important. Goats have emerged as significant contributors to milk production, especially in developing countries. Despite their higher nutritional value and digestibility, goat milk remains underutilized, representing only a small fraction of total milk output in the Philippines. Molecular markers have revolutionized genetic research and are now poised to drive advancements in livestock breeding. In this study, researchers focus on the ghrelin gene, known for its role in milk synthesis and production. By identifying ghrelin gene polymorphisms in dairy goats and investigating their impact on milk production traits, the study aims to enhance breeding strategies and unlock the full potential of goat milk production. This research could revolutionize the dairy industry by providing a deeper understanding of the genetic mechanisms behind lactation and enabling more efficient breeding practices for increased milk productivity.

Implementation Period: January 2022 to December 2022

SDG 2: Zero hunger

SDG 8: Decent work and economic growth



Microplastic effects on selected soil-dwelling nematodes

➤ Joey Genevieve T. Martinez, DSc

The relentless surge in plastic production has emerged as a global crisis, causing ecological contamination and the release of hazardous pollutants. Approximately 20 to 40% of the world's plastics now reside in landfills, where their slow biodegradation poses a long-term threat (Zhang et al., 2020). With low recyclability, widespread use, inadequate waste management, and persistent presence in the environment, plastic pollution is one of our most pressing environmental challenges (UNEP, 2018). Among the concerning aspects of plastic pollution are microplastics—tiny particles measuring less than 5mm. In recent years, microplastics have garnered significant attention due to their potential for toxic exposure when ingested by organisms (David et al., 2009; Foley et al., 2018). These non-biodegradable particles accumulate in the environment, posing threats to both terrestrial and aquatic ecosystems (Schöpfer et al., 2020). While aquatic environments have received considerable research focus, investigations into the impact and remediation of microplastics in the terrestrial ecosystem remain scarce (Sarker et al., 2020). Among the organisms profoundly affected by microplastics are nematodes—a taxon that plays a crucial role in soil food webs and ecosystem processes (Yeates et al., 1993; Orgiazzi et al., 2016). Although the response of nematodes to environmental pollutants is well-documented, information on the effects of microplastics on soil nematode species remains limited. This study aims to bridge this knowledge gap by examining the potential impacts of microplastics on six nematode species, shedding light on the repercussions of plastic pollution.

Implementation Period: January 2022 - December 2022

SDG 12: Responsible consumption and production
SDG 15: Life on land

Prevalence and Predictors of Common Mental Health Concerns among Filipino Frontline Health Care Workers amid the COVID-19 Pandemic

➤ *Imelu G. Mordeno Ph.D.*

The COVID-19 pandemic has placed an unprecedented burden on healthcare systems worldwide. While numerous studies have explored the mental health experiences of Filipino healthcare workers during this challenging period, little is known about their psychological well-being. Addressing this critical gap, a groundbreaking study sheds light on the prevalence of common mental health disorders and associated risk factors among 390 Filipino healthcare professionals. The findings are concerning, with an overall prevalence estimate of 45.13% for psychological distress, 21.28% for depression, 15.90% for generalized anxiety, and 13.59% for post-traumatic stress. Younger professionals (\leq 33 years old), those with fewer years of employment (\leq 5 years), and individuals without partners were more likely to experience elevated mental health symptoms. Pandemic-related experiences further influenced mental health outcomes. Those with concerns about workplace interaction and relationships exhibited higher levels of psychological distress and generalized anxiety. Participants who reported greater severity of depression faced difficulties in their relationships and interactions with coworkers. Furthermore, healthcare professionals who lacked social activities and interactions and had experienced imposed quarantine were more vulnerable to post-traumatic stress symptoms. These alarming findings underscore the urgent need for psychosocial interventions to support the well-being of Filipino healthcare professionals. By addressing these risk factors and providing targeted support, we can enhance their ability to cope effectively with the ongoing challenges posed by the pandemic.

Implementation Period: January 2022 to December 2022

SDG 3: Good Health and Well-being

Prevalence and Associated Factors of Mental Health Concerns among Higher Education Teachers during COVID-19 pandemic

➤ Imelu G. Mordeno Ph.D.

The COVID-19 pandemic has brought unprecedented challenges to the academic world, affecting both students and teachers. While several studies have shed light on the psychological experiences of students during this time, few have focused on the mental health conditions of university teachers. Addressing this critical gap, a groundbreaking study examined the prevalence of psychological distress and common mental health disorders among 1110 Filipino university teachers. The findings are deeply concerning, with an overall prevalence of 55.6% for psychological distress, 17.0% for generalized anxiety, and 28.4% for major depression. Younger teachers (≤ 31 years old) and those with less than a year of teaching experience were more likely to exhibit symptoms across all measures. Additionally, teachers who had experienced pandemic-related adversities were particularly vulnerable to psychological distress, generalized anxiety, and depression. These results underscore the urgent need for psychosocial interventions tailored to support the mental health of university teachers during the ongoing pandemic. By addressing these risk factors and providing targeted support, we can help teachers effectively manage their distress and foster a healthier academic environment.

Implementation Period: January 2022 - December 2022

SDG 3: Good Health and Well-being

Biodiversity Assessment and Conservation of the Remnant Forests in Barangay Apos Kahoy and San Roque, Claveria, Misamis Oriental and Lunotan, Gingoog City, Philippines

➤ Olga M. Nuñez, Ph.D.

The Philippines, known for its exceptional biodiversity, faces significant environmental challenges due to rapid development, expansion of human settlements, and inadequate environmental protection measures. With only 3% of its forests remaining, the country's rich flora and fauna are under threat. A new research project conducted a comprehensive biodiversity assessment in the remnant forests of Apos Kahoy, San Roque, and Lunotan in Misamis Oriental. These forests, largely unexplored, harbor numerous endemic and threatened species. The study documented the existing flora and fauna, providing vital baseline data for conservation efforts and the formulation of sustainable environmental management plans, particularly in light of the area's emerging tourism industry. The project ensures the long-term preservation of this invaluable natural heritage.

Implementation Period: January 2022 to December 2022

SDG 15: Life on Land

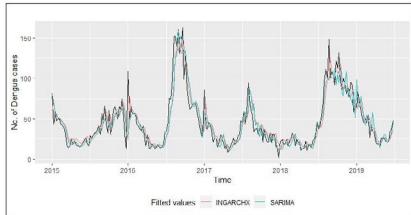


Figure 11. Training set observed data and fitted values for Cagayan de Oro: INGARCH(1,2) with seasonality (INGARCHX) vs. ARIMA(0,1,1)(0,0,2)₁₂ (SARIMA).

Development of an INGARCHX Model for Dengue Cases

➤ Daisy Lou L. Polestico, Ph.D.

The latest Disease Surveillance Report from the Department of Health (DOH) reveals an alarming increase in dengue cases in the Philippines. During the first quarter of 2023, there were already 31,459 reported cases, indicating a 94% rise compared to the same period in 2022. Dengue fever remains a significant threat, particularly during the rainy season when it is among the most prevalent water-borne infectious diseases. In response to this escalating issue, a pioneering study focused on modeling dengue cases' epidemiological features and trends. Researchers developed an innovative GLM-based Integer-Valued Generalized Autoregressive Conditional Heteroskedasticity (INGARCHX) model. By considering five meteorological variables - rainfall, average temperature, relative humidity, wind speed, and wind direction, the model identified significant factors impacting dengue cases in Cagayan de Oro and Malaybalay based on data from 2015 to 2019. The study's findings demonstrate the efficacy of the INGARCHX models in accurately forecasting dengue incidence levels. By avoiding outbreaks and reducing morbidity and deaths, these forecasts provide valuable insights for local policymakers in formulating informed decisions regarding dengue mitigation and control strategies.

Table 7. Candidate SARIMA models with covariate and corresponding AIC values and Ljung-Box test results, and maximum likelihood estimates.

Model	AIC	Ljung Box	P-value	Covariates	Est. (P-value)
Cagayan de Oro ARIMA(0,1,1)(0,0,2) ₁₂	165.07	39.44	0.659	-	0.004
+ rainfall	165.58	39.82	0.630	0.027	0.047
+ temperature	165.59	38.31	0.675	0.011	0.059
+ relative humidity	165.40	39.71	0.615	0.007	0.037
+ wind direction	166.93	39.35	0.639	0.002	0.112
+ wind speed	166.98	39.72	0.614	0.001	0.159
Malaybalay ARIMA(0,1,1)(0,0,1) ₁₂	278.44	45.35	0.074	-	0.003
+ rainfall	279.54	45.01	0.063	0.318	0.047
+ temperature	275.47	45.20	0.061	0.031	0.030
+ relative humidity	280.35	44.25	0.073	0.003	0.057
+ wind direction	278.75	46.65	0.050	0.1	0.187
+ wind speed	277.00	44.81	0.066	0.054	0.054

* significant at 5% level of significance

Implementation Period: January 2022 - June 2022
Collaborators: University of Southeastern University (USeP)

SDG 3: Good Health and Well-being

Impact Assessment of Housing and Resettlements of Sendong Survivors in Iligan City and Cagayan de Oro City: Its Implication to Sustainability

➤ *Sulpecia L. Ponce, Ph.D.*

Ten years have passed since the devastating flood brought by Sendong in December 2011, which claimed the lives of around 1268 individuals and displaced thousands of families in Cagayan de Oro and Iligan City. To gauge the conditions of the relocated survivors and evaluate their recovery progress, a comprehensive study was conducted, guided by the principle of building back better (BBB). Data collected from 571 respondents, including key informants, shed light on the current state of the resettled families. The findings indicate that while progress has been made, significant challenges remain to overcome. Some resettlement sites are located in vulnerable areas near river banks or mountain slopes, posing safety risks. The economic recovery remains a struggle, with many relying on seasonal jobs. The current sites are generally situated in rural areas with limited economic potential. On a positive note, the resettled families have demonstrated commendable social adaptation and environmental awareness, which serve as vital community resources for attaining sustainability in their new environment. The study's outcomes call for continued efforts to improve safety conditions, enhance economic opportunities, and ensure the long-term well-being of the relocated survivors. A more sustainable and resilient future can be achieved by addressing these challenges and building upon existing community strengths.

Implementation Period: January 2022 - December 2022
Collaborators: A Multidisciplinary Research Collaboration of the three researchers coming from the Political Science Department (Dr. M. S. Nanaman), Sociology Department (Dr. S.L. Ponce) and the University researcher from OVCRE with a doctoral degree in Sustainable Development Studies (Irene Estrada, DiSDS)

SDG 11: Sustainable Cities and Communities



Coral Rehabilitation Project in Barangay Fuentes, Ma. Cristina, Iligan City, Philippines, Phase 1: "Spatial and temporal variability of seawater chemistry"

➤ Angelo A. Responde, Ph.D.

The physico-chemical characteristics of seawater play a critical role in maintaining water quality and supporting marine life. Alarming changes in these properties have led to the deterioration of major marine ecosystems, particularly coral reefs. In an effort to address this issue, a comprehensive project was undertaken to monitor the physico-chemical characteristics of seawater surrounding the coral reefs in Fuentes, Maria Cristina, Iligan City over a period of 6 months during both low and high tide cycles. Potential reef sites suitable for coral transplantation and rehabilitation were identified by assessing water parameters essential for healthy coral growth. These sites, characterized by favorable water conditions, have been geographically tagged and recommended for future conservation efforts. This study provides valuable insights into preserving and restoring coral reefs, safeguarding the marine biodiversity and ecological balance crucial for our planet's sustainability.

Implementation Period: January 2022 - December 2022

SDG 14: Life below water
SDG 13: Climate action

Practices and Benefits of Urban Gardening: Their Contributions to Food Security During Covid 19 Pandemic

➤ Adelfa C. Silor, Ed.D

In the face of food insecurity caused by the COVID-19 pandemic and limited access to essential commodities, urban gardening has emerged as a vital solution. A recent scientific study highlights the significance of urban gardening in ensuring food security and its numerous benefits for individuals and communities. Urban gardening provides individuals with control over the food they grow and consume, guaranteeing a consistent supply of nutrient-rich food. With the ongoing migration of people to urban areas, interventions such as urban gardening are crucial in managing housing demands and addressing food needs. Even in small spaces, intensive cultivation methods used in home gardens can yield food and generate revenue. The study reveals that urban gardening has positively impacted vegetable consumption, irrespective of socioeconomic status or prior gardening experience. Beyond food security, urban gardening promotes emotional well-being, fosters a sense of connection and well-being, supports economic stability, benefits the environment, and enhances physical and cognitive health. Individuals and communities can enhance their food security by promoting urban gardening practices such as recycled containers, organic techniques, crop rotation, and rooftop farming, even in challenging times like the COVID-19 pandemic.

Implementation Period: January 2022 - December 2022

SDG 2: Zero Hunger
SDG 3: Good Health and Well-being



Gender Responsive Research and Development of Dragon Fruit Value Chain, Production and Processing: Basis for Training Program in Higher Education Institutions

➤ Adeffa C. Silor, Ed.D

Dragon fruit farming is gaining traction in the Philippines as a lucrative industry that can significantly increase farmers' income. Beyond its economic benefits, dragon fruit offers numerous health advantages, including cholesterol reduction, colon cancer prevention, improved bone and kidney health, and blood sugar control. A recent study aimed to assess the knowledge of dragon fruit farmers about the fruit's benefits, value chain, production and processing, agricultural practices, food safety, and business aspects. Findings from the study indicate that dragon fruit farming can be a valuable source of income for farmers while also promoting environmental sustainability. Dragon fruit is recognized for its exceptional nutritional value and medicinal properties, containing essential nutrients such as calcium, iron, magnesium, vitamin B, phosphorus, protein, and fiber. Moreover, dragon fruit is low in calories and high in fiber, making it a healthy dietary choice. To promote gender equality and achieve sustainable development goals, involving both men and women in dragon fruit farming is crucial. In line with this, an Information Education and Communication (IEC) program will be implemented to educate dragon fruit farmers in the LGUs of Lanao del Norte, highlighting dragon fruit's commercial viability and health benefits.



Implementation Period: January 2022 - December 2022

SDG 5: Gender equality
SDG 8: Decent work and economic growth
SDG 12: Responsible consumption and production

An Optimize Method for in vitro Propagation of Selected Ferns, Forest Trees, and Medicinal Plant Species in Lugait and Iligan City

➤ Nanette Hope Sumaya, DSc.Agr

Modern biotechnological methods have ushered in a new era for enhancing food and economic crops, plant-based medicine, rare species conservation, and the development of transgenic plants. Among these methods, in vitro micropropagation has emerged as a game-changer, providing a more efficient and precise approach compared to traditional breeding techniques. Ferns and fern allies, vital contributors to biodiversity conservation, face challenges due to habitat vulnerability and deforestation. To address these concerns, rehabilitation efforts are underway, highlighting the importance of obtaining high-quality seedlings for reforestation purposes. In addition, in vitro propagation offers a viable solution for mass-producing medicinal biomass, supporting pharmaceutical research and commercial production while addressing conservation needs. As a megadiverse country, the Philippines recognizes the significance of optimizing micropropagation techniques for the conservation and sustainable utilization of ferns, trees, and medicinal plants. This breakthrough method holds immense promise for safeguarding the nation's rich biodiversity and ensuring a greener and healthier future.

Implementation Period: January 2022 - June 2022

SDG 15: Life on Land

Technology Verification of Conservation Agricultural Practices for Land Restoration, Higher Productivity, Net Profitability, and Sustainability

➤ Peter D. Suson, DiSDS

The world's soil resources are facing severe degradation, driven by poor land-use management and unsustainable agricultural practices. These factors weaken the soil's ability to support life and contribute to poverty, food insecurity, and environmental challenges worldwide. Urgent action is needed to address these pressing issues and find sustainable solutions. Introducing the Land Conservation Practices project, a groundbreaking initiative to restore and enhance soil productivity, profitability, and sustainability in food production systems. By demonstrating the benefits of land conservation practices, this project offers a cost-effective and climate-smart approach to mitigate the impacts of soil degradation. Through the development of innovative models, this project will project the progressive, positive effects of land conservation practices, showcasing their role in promoting sustainable food production and addressing global challenges related to poverty, food security, and environmental health.

*Implementation Period: January 2022 - December 2022
Collaborators: University of Southeastern University (USeP)*

SDG 2: Zero Hunger
SDG 12: Responsible Consumption and Production

The Impact of COVID-19 Pandemic on the Amount of Solid Wastes in Iligan City

➤ Peter D. Suson, DiSDS

The COVID-19 pandemic has brought about significant challenges to human health and the economy and waste management systems. The increased usage of personal protective equipment (PPE) such as face masks, face shields, and gloves has led to a surge in special waste generation. Improper handling of these wastes not only enhances the spread of the virus but also poses a threat to the environment, as they are predominantly made of non-biodegradable plastic materials. Introducing a groundbreaking study aimed at quantifying the generation of special wastes in Iligan City. This research aims to provide essential data for formulating effective waste management strategies that reduce the environmental impact of these special wastes. By understanding the scale of special waste generation, this study will contribute to the development of sustainable waste management practices, ensuring the protection of human health and the ecosystem.

Implementation Period: January 2022 - June 2022

Collaborators: Local Government Unit of Iligan City

SDG 12: Responsible Consumption and Production

Diatoms



Ecology and Diversity of Net and Epilithic Diatom in the Intertidal Zone of Iligan Bay

➤ Annielyn D. Tampus, DiSDS

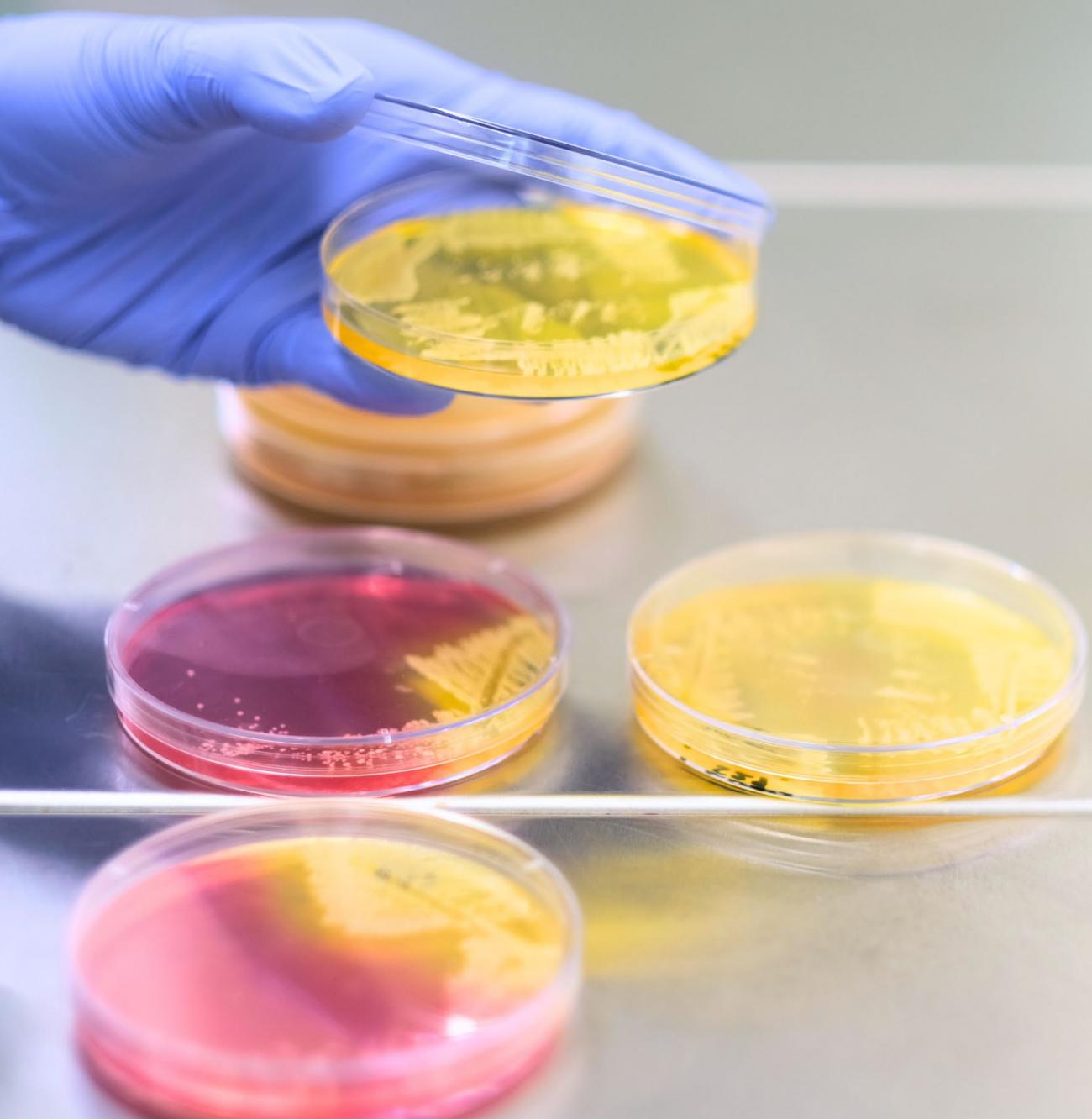
The intertidal zones boast a vibrant ecology and diverse diatom community, comprising both net (planktonic) and epilithic (attached to rocks) forms. As free-floating microalgae, net diatoms play a vital role as primary producers, converting sunlight and nutrients into organic matter and serving as the foundation of the intertidal food web. Epilithic diatoms, forming biofilms on rock surfaces, contribute to overall ecosystem biodiversity. Various environmental factors, including temperature, nutrient availability, tidal patterns, light exposure, and substrate characteristics, influence the composition and diversity of these diatoms. Understanding the intricate interplay between these diatoms and their environment is crucial for comprehending the functioning and resilience of intertidal ecosystems. This study delves into the complex dynamics between diatoms and their environment, shedding light on their role in intertidal ecosystems and contributing to our understanding of their functioning and resilience.

Implementation Period: January 2022 - December 2022

SDG 14: Life below water
SDG 13: Climate action

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material
science



Methylene Blue Removal from Aqueous Solution Using Calcium Alginate and Hydroxypropyl Cellulose-Based Hydrogel

➤ *Rodel D. Guerrero, Ph.D.*

Concerns over the discharge of nonbiodegradable compounds from industries such as textiles, paper, leather, and food, have raised alarming environmental issues. These include elevated biological and chemical oxygen demand in water and the presence of carcinogenic substances. Approximately 15% of global dyes are released into water bodies, posing a significant threat to aquatic ecosystems. To address this challenge, researchers are investigating efficient methods for dye removal, including adsorption techniques. Cellulose-based hydrogels, specifically those derived from hydroxypropyl cellulose (HPC) and calcium alginate (CA), have emerged as promising solution. These eco-friendly materials exhibit low cost and high adsorption capacity. By chemically cross-linking HPC with CA, a composite material is being developed to target the removal of methylene blue dye from wastewater. The outcomes of this study will benefit both researchers and industries, offering a cost-effective and sustainable solution for water treatment.

Implementation Period: January to December 2022

SDG 6: Clean Water and Sanitation
SDG 12: Responsible Consumption and Production



Eco-bricks and bio-composites from face-mask-derived fibers and microbiologically induced calcium carbonate precipitation (MICP): A promising sustainable building material production technology

➤ Mylah Villacorte-Tabelin, Ph.D.

The extensive use of personal protective equipment (PPE) such as face masks and shields. In response, a groundbreaking project is underway to repurpose disposable facemasks and transform them into valuable materials. Using an innovative approach, the project aims to recover plastic fibers from facemasks and produce refuse-derived fuel (RFD). The recovered fibers will be used to create fiber-reinforced eco-bricks and bio-composites, enhancing their strength through microbiologically induced carbonate precipitation (MICP). The project also focuses on effective sorting and purification techniques for the materials. This project offers innovative, cost-effective, and sustainable solutions to the plastic waste crisis by repurposing plastic waste and harnessing local bacteria for eco-bricks, bio-cement, and bio-composite production. This initiative aligns with the United Nations' sustainable development goals, promoting circular economy principles and contributing to a cleaner and healthier environment.

Implementation Period: January 2022 to December 2022

SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production

Development of Drying Strategies Using a Microwave System for Bamboo Pole Quality Improvement

➤ *Lilian T. Valencia*

Bamboo, a renewable material with various industrial applications, is prone to dimensional instability and damage by microorganisms and insects. Traditional drying methods are time-consuming and may not produce high-quality bamboo. In contrast, microwave drying offers faster and improved drying, uniformity, and fewer defects. In a recent study, researchers investigated the impact of microwave power levels, drying times, and moisture content on the quality of bamboo poles. The findings show that microwave drying reduces drying time by 85% at 110°C for two hours, achieving a moisture content comparable to conventional drying. Different bamboo species were considered, with Giant bamboo showing visible warping and shrinking, while Kawayan tinik and Buho demonstrated the shortest drying time. The study contributes to the development of an efficient microwave drying protocol for bamboo, improving its overall quality and usability.

Implementation Period: January to December 2022

Collaborators: Mindanao State University-Naawan (College of Agriculture, Environmental Science and Forestry)

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production





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natural
product &
biotechnology

Phenotypic Characterization of Antibiotic Resistance of Methicillin-Resistant Staphylococcus aureus from Covid-19 Vaccinated Individuals of MSU-IIT (Phase 1)

➤ *Lady Jane C. Fanuncio*

As the COVID-19 infection rate surges, there is a concerning increase in the injudicious use of antibiotics for co-infections and disease prevention. This amplified antibiotic usage in hospitals and home and community settings during the pandemic may intensify MRSA (Methicillin-resistant Staphylococcus aureus) infections among COVID-infected and non-infected individuals. While Asia has reported the highest prevalence rate of MRSA infections, there is limited epidemiological data available for Philippine healthcare facilities, particularly in Iligan City. A local baseline study is imperative to document the presence of MRSA and understand its prevalence and cultural characteristics. This research aims to identify the prevalence and cultural characteristics of MRSA isolates within the community, focusing on MSU-IIT employees and students. The findings of this study will contribute to the understanding of MRSA occurrence and inform strategies to address the rising trend of antibiotic resistance, ensuring effective treatment and prevention measures in the face of COVID-19 and beyond.

Implementation Period: January to December 2022

SDG 3: Good Health and Well-being

Antioxidant and anti-inflammatory activity of extracts from selected spice, fruit, and vegetable peels

➤ Chona D. Gelani, Ph.D.

Countless evidence has been presented, medically and scientifically, on how stress takes its toll on the lives of people. Stressors seem to multiply with the passing of time. Both stress and inflammation bring about undesirable health issues. These health concerns are not without remedies. Clearly, a healthy lifestyle is very crucial to one's well-being. A healthy diet, without a doubt, is an important component of a healthy lifestyle. A diet rich in antioxidant and anti-inflammatory-rich food is essential to remain healthy. The motivation of this study is to look for unconventional sources of antioxidant and anti-inflammatory compounds; hence waste utilization came into view. This study seeks to determine some waste products' antioxidant and anti-inflammatory activity, namely the peels of sayote, patola, sugar beets, and passion fruit. These peels have not been of interest to researchers in terms of developing a product for therapeutic use.

Implementation Period: January 2022 to December 2022
Collaborators: Center for Research and Technology Transfer, Vietnam Academy of Science and Technology, Hanoi, Vietnam

SDG 12: Responsible Consumption and Production
SDG 3: Good Health and Well-being

In vitro Acetylcholine Esterase and Angiotensin Converting Enzyme Activity Inhibition of Extracts from Selected Echinoderm Species

➤ Chona D. Gelani, Ph.D.

The vast Philippine seas harbor a wealth of marine organisms that possess a diverse range of biologically-active metabolites. While significant research has been conducted on these marine resources, numerous unexplored areas remain with immense potential. Exploring these untapped resources could lead to the discovery of new compounds that address health conditions like Alzheimer's disease and hypertension, providing valuable assistance to Filipinos. This research highlights the importance of our precious marine resources and emphasizes the need for marine environment preservation. Understanding the value of our marine ecosystems will inspire us to actively protect and conserve them for future generations. By delving deeper into the secrets of the Philippine seas, this study offers an exciting opportunity to unlock new health solutions. Harnessing the potential of marine organisms has the power to revolutionize healthcare and improve the well-being of Filipinos.

Implementation Period: January to December 2022

Collaborators: Center for Research and Technology Transfer (CRETECH), Vietnam Academy of Science and Technology, Hanoi, Vietnam, Hiroshima University, Higashihiroshima, Hiroshima, Japan

SDG 3: Good Health and Well-being

SDG 14: Life Below Water

TiO₂-Catalyzed Synthesis of a Primary Amine NONOate

➤ Joel H. Jorolan, Ph.D.

Nitroxyl (HNO) has gained recognition as a significant pharmacological agent. To further develop HNO pharmacology, a comprehensive understanding of HNO chemistry is crucial. The rapid dimerization of HNO limits its storage and necessitates the use of HNO donor compounds. Primary amine NONOates serve as HNO donors for studying the chemical properties and physiological effects of HNO. However, traditional NONOate synthesis requires high-pressure, low-temperature conditions, and specialized equipment. In a breakthrough study, researchers successfully synthesized a primary amine NONOate under ambient conditions by catalyzing the synthesis reaction with TiO₂. This innovative approach eliminates the need for extreme conditions and specialized glassware. The findings of this study will propel the development of HNO pharmacology, offering a more accessible and efficient method for NONOate synthesis and facilitating further research on the therapeutic potential of HNO.

Implementation Period: January 2022 to June 2023

SDG 9: Industry, innovation and infrastructure
SDG 12: Responsible consumption and production

Terrestrial And Marine Metabolites As Potential Agents To Improve Insulin Resistance In Skeletal Muscle Cells Under Metabolic Stress

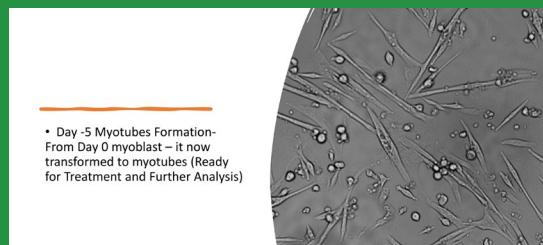
➤ Charlie A. Lavilla, Jr., Ph.D.

Diabetes has reached pandemic levels, posing a significant global health and economic threat. In the Philippines alone, it is projected that 7.8 million individuals will be affected by 2030. To address this escalating crisis, a research project has been introduced to explore the potential of marine sponge/plant extracts in protecting muscle cells against oxidative stress-induced insulin resistance. This study aims to identify potential food supplements that can enhance glucose uptake and improve insulin sensitivity by assessing the efficacy of selected natural products. The utilization of locally available and affordable natural sources as anti-diabetic agents could offer a cost-effective solution accessible to low-income families. Moreover, this research will contribute to the scientific evidence supporting the effectiveness of natural products, fostering the use of high-quality phytotherapeutics, and enhancing public confidence in their benefits. The success of this project holds the potential to transform the lives of numerous individuals, providing a ray of hope in the global fight against diabetes.

Implementation Period: January to December 2022

Collaborators: UCSI Malaysia, Nottingham Trent University, MSU-Marawi

SDG 3: Good Health and Well-being



Cardiotoxicity of alcoholic extract of selected echinoderms from Mindanao, Philippines to adult zebrafish (*Danio rerio*): Zebra Project Phase II

➤ Angelo A. Resonte, Ph.D.

The extraction of secondary metabolites from echinoderms has garnered significant interest in scientific research due to their bio-active properties. To assess the potential impact on human health, a groundbreaking project focused on evaluating the effects of sub-lethal concentrations of an alcoholic extract from the echinoderm species *Archaster typicus* on the heart rate of adult pink zebrafish. The study found that exposure to varying concentrations of the alcoholic extract, ranging from 25 ppm to 200 ppm, resulted in a significant decrease in the heart rate of zebrafish after 24 and 48 hours. While the lower concentrations did not show a significant difference in heart rate between 24 and 48 hours, higher concentrations exhibited a notable discrepancy. These findings contribute to our understanding of the effects of echinoderm compounds on biological systems. Further research will explore the mechanisms underlying these effects and their potential applications in drug discovery and toxicology studies.

Implementation Period: January 2022 to December 2022

SDG 3: Good Health and Well-being

Evaluation of Antioxidant Properties of Medicinal Plants Found in Mt. Pandayganan, Dinagat Islands, Philippines

➤ Mylah Villacorte-Tabelin, Ph.D.

The Philippines' Dinagat Islands, nestled in Mindanao, hold a treasure trove of undiscovered endemic medicinal plant species. These plants have long been recognized as valuable sources of pharmacologically active compounds for treating various diseases. Identifying bioactive compounds with antibiotic, antiviral, and anticancer properties is crucial in the pursuit of plant-derived drugs. Despite increasing studies on medicinal plants in the Philippines, ethnobotanical knowledge in Mindanao remains limited, underscoring the need for a deeper understanding of the bioactive compounds found in endemic plants. A new research endeavor aims to bridge this knowledge gap by documenting the endemic plant species found in the mountains of Dinagat Island, providing a valuable baseline for future studies. This study enhances people's health and well-being by discovering and developing natural supplements with antioxidant properties, particularly in the COVID-19 pandemic. Antioxidants play a vital role in combating the health issues caused by oxidative stress, such as cancer, cardiovascular ailments, and inflammation. By identifying endemic plants with antioxidant potential, this research aims to uncover more effective ways to combat human diseases. The findings of this study have the potential to revolutionize healthcare and contribute to the development of natural remedies that promote a healthier society.

Implementation Period: January to December 2022

SDG 3: Good Health and Well-being
SDG 15: Life on Land



Screening for Bioactivity of Crude extracts of selected Echinoderms species against select model organisms as a basis for future drug development

➤ Sharon Rose Tabugo, Ph.D.

Marine organisms, particularly those in the phylum Echinodermata, have emerged as valuable resources for the discovery of medically and economically important compounds. With approximately 7,000 living species, echinoderms offer unique chemical structures and significant biological activities, making them promising candidates for drug development. However, the bioactivity potential of echinoderms from different sites, particularly in Mindanao, remains unclear, and standardized protocols are needed. In an ambitious study, researchers aim to assess crude extracts' antimicrobial and antihelminthic activities from selected echinoderm species. Model organisms like *Caenorhabditis elegans* will be utilized to screen for potential antihelminthic compounds. By adopting established protocols and evaluating their effects on nematode behavior, locomotion, and reproduction, researchers can identify promising candidates for combating helminthic infections. The study will employ a high-throughput, solid agar-based assay to determine the Minimum Inhibitory Concentration (MIC) of compounds against fungi. These investigations will provide valuable insights into the bioactivity of crude extracts, paving the way for the identification of new alternatives in drug development and addressing helminthic infections. This research holds significant implications for the pharmaceutical industry and highlights the importance of marine biodiversity conservation and the untapped potential of marine organisms in finding solutions to global health challenges.

Implementation Period: January 2022 to December 2022
Collaborators: Sultan Kudarat State University (SKSU), San Agustin University, Iloilo City

SDG 3: Good Health and Well-being
SDG 14: Life Below Water

Targeting Reactive Carbonyl (4-Hydroxynonenal) And Peroxynitrite-Driven (3-Nitrotyrosine) Species with Potential Sequestering Agents from Marine/Terrestrial Sources

➤ Mylene M. Uy, D.Sc.

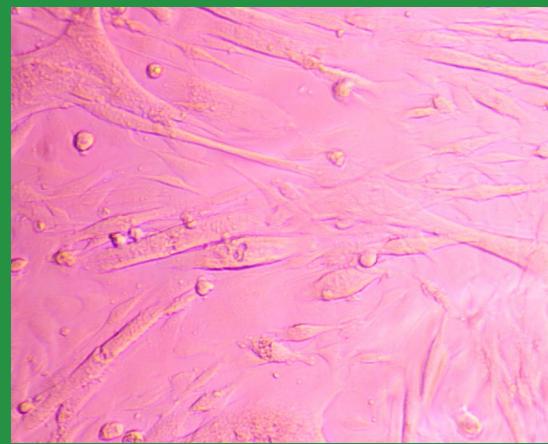
Type 2 diabetes has emerged as a global health concern, impacting both quality of life and lifespan. In a pioneering research endeavor, scientists are investigating marine and terrestrial sources to discover potent preventive measures against tissue dysfunction associated with diabetes. This groundbreaking study focuses on the harmful effects of oxidative stress and the role of two by-products, 3-nitrotyrosine (3-NT) and 4-hydroxynonenal (4-HNE), in diabetes complications. Researchers are exploring the potential of selected marine sponge/plant extracts to protect muscle cells from the damaging effects of high glucose and free fatty acid concentrations, aiming to identify novel antidiabetic agents that enhance insulin sensitivity and glucose uptake. By harnessing the power of natural products to counteract oxidative stress and prevent detrimental adduct formation, this research offers a promising therapeutic strategy in the battle against type 2 diabetes and its associated chronic diseases.

Implementation Period: January to December 2022

Collaborators: UCSI Malaysia, Hiroshima University, University of Florida

SDG 3: Good Health and Well-being

SDG 14: Life Below Water



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learning

the square for $x^2 - 2(\mu + \sigma^2 t)x$,

$$x^2 - 2(\mu + \sigma^2 t)x + (\mu + \sigma^2 t)^2 - (\mu + \sigma^2 t)^2$$
$$(x - (\mu + \sigma^2 t))^2 - (\mu + \sigma^2 t)^2$$
$$E(e^{tx}) = e^{\mu t} \int_{-\infty}^{\infty} \frac{1}{\sigma \sqrt{2\pi}} e^{-\frac{(x - (\mu + \sigma^2 t))^2}{2\sigma^2}} dx$$



Combining (*) and (**), we have

$$E(e^{tx}) = e^{\mu t} \int_{-\infty}^{\infty} \frac{1}{\sigma \sqrt{2\pi}} \exp\left(-\frac{1}{2\sigma^2}(x^2 - 2x\mu - \mu^2 - 2\sigma^2 t x)\right) dx$$

Simplifying (**), we have

$$= x^2 - 2x\mu + \mu^2 - 2\sigma^2 t x + 2\sigma^2 t \mu$$

$$= x^2 - 2(\mu + \sigma^2 t)x + \mu^2 + 2\sigma^2 t \mu$$

$$- [x^2 - 2(\mu + \sigma^2 t)x] + [\mu^2 + 2\sigma^2 t \mu]$$

$$\text{Then, } E(e^{tx}) = e^{\mu t} \int_{-\infty}^{\infty} \frac{1}{\sigma \sqrt{2\pi}} \exp\left(-\frac{1}{2\sigma^2}(x^2 - 2(\mu + \sigma^2 t)x)\right)$$

$$\exp\left(-\frac{1}{2\sigma^2}(\mu^2 + 2\sigma^2 t \mu)\right) dx$$

Development of Inclusive Learning Material for an Innovative Flexible Learning Environment

➤ *Amelia T. Buan, Ph.D.*

The COVID-19 pandemic forced educational institutions into rapid transitions to remote learning, relying heavily on technology. However, the effectiveness of distance education varies, and certain variables impact its outcomes. Acknowledging the unique challenges of online teaching, universities are prioritizing teacher training and preparation tailored to this new learning environment. Teacher involvement in online interactions with students is crucial for their success and satisfaction, as barriers can arise from external, internal, and social factors. To address these challenges, universities are increasingly focused on fostering inclusivity to meet the diverse needs of students. This study explores inclusive learning materials and examines learner-to-learner, learner-to-instructor, and learner-to-content interactions based on Moore's model. The findings will contribute to the development of innovative and flexible learning environments, enhancing pedagogy and instruction during remote learning and fostering active engagement among online students.

Implementation Period: January to December 2022

SDG 4: Quality Education

Analyzing Panoramic Views Of Stakeholders Needs And Experiences In Remote Teaching and Learning

➤ Roxan A. Consolacion

The COVID-19 pandemic has caused widespread school closures, necessitating a sudden shift to homeschooling. This transition has presented numerous challenges for students, teachers, and parents alike. Teachers have become essential responders, adapting courses to online, flexible, or modular formats while juggling caregiving responsibilities. Technical and pedagogical skills are vital, but the lack of immediate support and online resources can lead to increased stress and decreased motivation. Similarly, students face difficulties accessing technology and learning support at home. This project aims to examine institute-wide factors in designing comprehensive student and faculty support for remote teaching and learning. Ensuring equitable access to education, providing 24/7 learning backups, and involving parents are essential considerations. By exploring the experiences of parents, teachers, and students, this study seeks to improve the feasibility and efficiency of online courses, enhance student retention, and empower faculty in designing and implementing remote education.

Implementation Period: January 2022 to December 2022

SDG 4: Quality Education

A One-year Basic Research of An Investigation of Student Engagement in an Online Learning Management System in an InFLeX Modality

➤ Roxan A. Consolacion, Ph.D

The COVID-19 pandemic has brought about a significant shift in education worldwide, with schools closing and students transitioning to remote learning. In response, the Commission on Higher Education has initiated comprehensive online training programs to support teachers in adapting to this new modality. Flexible remote teaching and learning design requires careful consideration of students' capabilities and equitable access to education, regardless of their resources or internet connectivity. Effective pedagogy that fosters learning activities, interactions, and assessments is essential to ensure student engagement, completion, and motivation. In line with these needs, the Institute has conducted webinars focusing on syllabus upgrading and the development and packaging of learning guides. This study evaluated the quality of remote teaching and learning designs and their impact on student engagement. The results will enable teachers to reflect on their instructional approaches and enhance student engagement in the online learning environment.

Implementation Period: January to December 2022

SDG 4: Quality Education

Lived Experiences of Student-teachers during Practice Teaching through Remote Teaching Modality

➤ Rizalina G. Gomez, Ph.D

The Student Teaching Program plays a vital role in developing aspiring pre-service teachers' competence by providing them with real classroom experiences. However, the COVID-19 pandemic has disrupted traditional face-to-face learning, including practice teaching. In response, educational institutions are exploring alternative approaches to facilitate the transition to flexible teaching and learning options. A groundbreaking study aims to explore a pedagogical strategy for implementing practice teaching in a university context through remote teaching-based instruction. This strategy addresses the challenges posed by the pandemic and focuses on promoting student engagement during instructional practices. With the paradigm shift towards online and virtual education, the study seeks to describe the experiences and challenges faced by practice teachers in adapting to remote teaching methods. By examining innovative approaches, the study aims to maintain high academic standards and deliver quality education despite the limitations imposed by the pandemic.

Implementation Period: January 2022 to December 2022

SDG 4: Quality Education

Development and Implementation of Alumni Feedback System, Portal-Based Social Network for Curriculum Improvement of the College of Education

➤ Sotero O. Malayao, Jr.

Tracer studies play a vital role in universities, serving multiple purposes and needs. They provide valuable insights into the quality of graduates, career prospects, and the overall performance of higher education institutions. Recognizing the importance of reliable tracer studies, [University Name] is embarking on a pioneering project to design and create an innovative alumni tracking system. This system, to be implemented within a portal-based social network platform, will enable seamless interaction between the College of Education and alumni and facilitate connections among alumni. Going beyond a mere data-gathering site, this platform will foster a vibrant community that promotes ongoing engagement and collaboration. By harnessing alumni opinions and retrospective assessments, the tracking system will provide invaluable indicators of training quality. These insights will benefit current and prospective students, policymakers, and curriculum developers, allowing them to make informed decisions and enhance educational offerings. The project created a comprehensive and reliable alumni tracking system that contextualizes alumni careers and offers a clear view of career progression, employment status, and spatial distribution. It will serve as a powerful tool for the academic community to assess the effectiveness of their programs and strengthen their connections with alumni.

Implementation Period: January to December 2022

SDG 4: Quality Education

Implementation of Open-ended Tasks to Foster Students' Mathematical Creativity

➤ Alexis Michael B. Oledan

Teachers play a vital role in fostering an environment that encourages and rewards creative ideas, even within the realm of mathematics. To achieve this, teachers must carefully select teaching strategies, prepare instructional materials, and design activities that promote students' conceptual understanding and creativity. Amidst the challenges teachers and students face in the new education landscape, there is a growing focus on shifting towards a student-centered learning environment as a long-term educational goal. In this context, a pioneering project investigates teachers' perceptions as they depart from closed-ended problems and embrace open-ended tasks in mathematics. Student outputs on these tasks were assessed using a rubric. The study's findings have enhanced teachers' current teaching practices and fostered creativity among their students. By incorporating open-ended tasks, teachers empower students to think critically, encourage problem-solving skills, and nurture their overall mathematical abilities.

Implementation Period: January 2022 to December 2022

SDG 4: Quality Education

Development of Curriculum Framework for Technology and Livelihood Education in Education 4.0

➤ Rhea F. Confesor, Ph.D.

As rapid economic changes and the emergence of the Fourth Industrial Revolution (4IR) reshape the workforce, education plays a critical role in adapting to evolving knowledge and skills required for work. The scale and complexity of 4IR disruptions in the labor market call for educational systems to adapt. The Technical-Vocational-Livelihood Education (TLE) program in DepEd equips students with essential tertiary education, employment, and entrepreneurship competencies. To ensure graduates are prepared for the 4IR's flexible learning and career pathways, DepEd and educational institutions will review the TLE curriculum. This project aims to align the TLE curriculum with the competencies necessary for the 4IR and Education 4.0 framework, facilitating a smooth transition. Addressing research gaps, it emphasizes the employability of future TLE graduates.

Implementation Period: January to December 2022

SDG 4: Quality Education

Development of Curriculum Framework for K to 12 Science in Education 4.0

➤ Rhea F. Confesor, Ph.D.

In a bid to align the Philippine educational system with the requirements of Education 4.0 and the Fourth Industrial Revolution (4IR), the government initiated the K to 12 education program in 2013. However, it is essential to ensure that the current Science curriculum adequately addresses the demands of this transformative era. The ongoing advancements in Artificial Intelligence, Robotics, Big Data, Precision Medicine, and more are reshaping societies, necessitating a focus on Science and Technology Education. The pressing need for critical thinking and scientific literacy, as evident in reports of poor scientific literacy and misconceptions among students, underscores the significance of Science education in addressing current and future challenges. To bridge the gap between education and industry requirements, the Department of Education (DepEd) and educational institutions will investigate the alignment of the current DepEd Science curriculum with the competencies essential for the 4IR. The results will lay the groundwork for developing and validating a curriculum model that facilitates a seamless transition to Education 4.0. Furthermore, future projects will focus on the professional development of Science teachers and administrators and the exploration of education 4.0 learning constructs derived from this initiative. This undertaking emphasizes the government's commitment to producing graduates who can become innovators and fill intellectually intensive roles. Reviewing and enhancing the Science curriculum aims to equip students with the necessary skills to thrive in the 4IR and contribute to the nation's economic growth.

Implementation Period: January 2022 to December 2022

SDG 4: Quality Education

Identifying and Predicting Factors of MSU-IIT Students Information Security Risk-Taking Behaviors

➤ January D. Febro

As online courses and flexible learning continue to shape the educational landscape, students are increasingly exposed to risks associated with the digital environment. With the prevalence of internet usage among college students, it is crucial to equip them with knowledge and awareness of information security threats. A study conducted at MSU-IIT explored the relationship between user-centric factors and the security behavior of undergraduate students. By understanding their behaviors and practices, researchers developed a prediction model to assess students' security risks. The findings of this study provide valuable insights for the university and security administrators in enhancing security awareness and designing tailored solutions. Ultimately, this understanding will contribute to effective organizational security planning and risk management.

Implementation Period: January to December 2022

SDG 16: Peace, Justice, and Strong Institutions

Capacity Building on Information and Communication Technology (ICT): Building Physical Education Teachers' Capacity to Teach Online

➤ Leo N. Santillana

The global emergence of the coronavirus in December 2019 led to the declaration of a pandemic, profoundly impacting education worldwide. According to UNESCO, over 1.2 billion learners have been affected globally, with more than 28 million learners in the Philippines alone, leading to the closure of schools. In this new normal of remote learning, teachers across all disciplines face the challenge of adapting their teaching methods to online platforms while maintaining instructional standards and quality. Physical Education, in particular, poses unique complexities as it requires practical skills typically taught in face-to-face settings. This research project aligns with the Philippine educational system's goal of providing quality education amidst the pandemic. It enhances Physical Education teachers' competencies in online instruction, focusing on course design, communication, time management, and technical skills. By building teachers' capacity in information and communication technology (ICT), this initiative contributes to achieving Goal 4 of the UN Sustainable Development Goals: Quality Education.

Implementation Period: January 2022 to December 2022

SDG 4: Quality Education

Primer Design for Mini-barcodes for wildlife and conservation forensics to be implemented for Course and Outcome-based students' Research Experience (CORE) in remote and local set-up, especially during COVID -19 pandemic

➤ *Sharon Rose Tabugo, Ph.D.*

As the COVID-19 pandemic continues to shape remote learning, the development of protocols and activities that offer authentic research experiences is more important than ever. However, limited resources have hindered the implementation of such experiences, especially in schools located in the southern part of the Philippines. To overcome this challenge, researchers focus on molecular biology and incorporate molecular approaches, including DNA Barcoding, for species identification. Designing efficient and universal primers is crucial for successful amplification and downstream applications. Thankfully, software tools are now available to simplify the primer design process, making it accessible for both local and remote setups. In this groundbreaking research, custom primers will be designed for seahorses and pipefishes, supporting wildlife forensics and conservation efforts. The designed primers will undergo rigorous *in silico* testing, synthesis, and evaluation using techniques such as Polymerase Chain Reaction (PCR) and sequencing. By providing a streamlined primer design pipeline, this research aims to enhance the authentic research experience for students while contributing to real-life applications in wildlife forensics and conservation. This initiative not only equips students

Implementation Period: January to December 2022

Collaborators: Center for Genome and Metagenome Studies, James Madison, University, Harrisonburg, VA, USA Cold Spring Harbor Laboratory, DNA Learning Center, New York, USA

SDG 15: Life on Land

Mathematics Engagement Scale (MES)

Name: _____ Grade Level: _____ Date: _____

Instructions: Please rate how strongly you disagree or agree with each of the following statements relating to your Mathematics subject. Encircle only the corresponding number.

Item No.	Statement	Strongly Disagree				
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Math class is fun.	1	2	3	4	5
2	I am happy about this subject.	1	2	3	4	5
3	I find the subject interesting.	1	2	3	4	5
4	I like the subject.	1	2	3	4	5
5	The delivery of the lessons made me participate earnestly in this subject.	1	2	3	4	5
6	I listen to the teacher attentively.	1	2	3	4	5
7	I need to get a good grade in this subject.	1	2	3	4	5
8	I am eager to learn more in this subject.	1	2	3	4	5
9	Assignments make me active in this class.	1	2	3	4	5
10	The provided exercises make me actively participate in this subject.	1	2	3	4	5
11	Oral recitations keep me active in class.	1	2	3	4	5
12	I regularly attend the synchronous class.	1	2	3	4	5
13	I take notes during class.	1	2	3	4	5
14	My friends/classmates motivate me to participate in class.	1	2	3	4	5
15	The lessons are understandable.	1	2	3	4	5
16	I actively participate in this subject because I have personal goals to reach.	1	2	3	4	5
17	I actively participate in this subject because of my family.	1	2	3	4	5
18	I do not want to fail in this subject.	1	2	3	4	5
19	I motivate myself to participate in this subject.	1	2	3	4	5
20	The provided learning materials such as worksheets, videos, etc. makes me actively participate in this subject.	1	2	3	4	5
21	The subject challenges me to do better.	1	2	3	4	5
22	Interacting with my classmates makes me stay active in math class.	1	2	3	4	5
23	Deadlines keep me actively participating in this subject.	1	2	3	4	5
24	I only actively participate because this subject is required.	1	2	3	4	5
25	I find math applicable to real life.	1	2	3	4	5

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One Year Basic Research High School Mathematics Engagement in a Remote Teaching and Learning Modality

► Dante Joma P. Zabala

The Student Teaching Program plays a vital role in developing aspiring pre-service teachers' competence by providing them with real classroom experiences. However, the COVID-19 pandemic has disrupted traditional face-to-face learning, including practice teaching. In response, educational institutions are exploring alternative approaches to facilitate the transition to flexible teaching and learning options. A groundbreaking study aims to explore a pedagogical strategy for implementing practice teaching in a university context through remote teaching-based instruction. This strategy addresses the challenges posed by the pandemic and focuses on promoting student engagement during instructional practices. With the paradigm shift towards online and virtual education, the study seeks to describe the experiences and challenges faced by practice teachers in adapting to remote teaching methods. By examining innovative approaches, the study aims to maintain high academic standards and deliver quality education despite the limitations imposed by the pandemic.

Implementation Period: January 2022 to December 2022

SDG 4: Quality Education

Teaching Creativity through Collaborative Design Based STEM Education in Home Economics Courses

➤ *Vanessa B. Zabala, MISDS, MAEd*

The ongoing shift to remote teaching and learning (RTL) has presented significant challenges for educators, particularly in courses involving laboratory activities. Redesigning syllabi and lessons to suit the remote modality and promoting effective collaboration among tertiary-level students have emerged as key concerns. A research project on evaluating students' collaboration and creativity in Home Economics and other STEM courses has been initiated to tackle these issues. By implementing a design-based STEM Education through a Design Thinking approach, commonly used in Science, Mathematics, Technology, and Engineering (STEM) disciplines, this research aims to assess the effectiveness of collaborative activities within the RTL framework. The study findings will provide valuable insights for educators, aiding in the enhancement of remote teaching practices in higher education.

Implementation Period: January to December 2022

Collaborators: Faculty of Education, Kasetsart University Bangkok Thailand

SDG 4: Quality Education





Externally- Funded Research

Development of a paper-based colorimetric sensor utilizing varied sizes of gold nanoparticles for rapid and on-site detection of various meat products spoilage

➤ Arnold C. Alguno, DSc

Foodborne disease outbreaks are an all-too-common occurrence in the Philippines, often linked to meat-containing dishes. Recognizing the urgent need for improved food safety controls, a groundbreaking project aims to develop a paper-based colorimetric sensor for rapid and on-site detection of spoilage in pork, beef, and chicken products. Departing from the time-consuming methods currently employed, this new screening technique utilizes suspended solutions of gold nanoparticles and paper-based sensors to detect meat spoilage. By harnessing color changes in these nanomaterials, the presence and level of spoilage indicators are rapidly determined, enhancing both freshness and safety assessment. This transformative technology promises to protect the public and offers a training platform for aspiring nanotechnology enthusiasts. With the potential for market commercialization, this project holds the key to economic impact and unprecedented advancements in detecting food spoilage. In the quest for safer food, innovation takes center stage.

Implementation Period: January 2022 to June 2024

Research Funder: Commission on Higher Education - Leading the Advancement of Knowledge in Agriculture and Sciences (CHED-LAKAS)

Collaborators: MSU-Nawaan, Caraga State University, Butuan City, Pennsylvania State University, USA, King Saud University, Kingdom of Saudi Arabia

SDG 3: Good Health and Well-being

SDG 12: Responsible Consumption and Production



Development of Innovative Nanobiodevices Based on Hybrid Materials by Combination of Endemic South Asian Biomolecules and Nanocarbons

➤ Leo Cristobal C. Ambolode II, Ph.D.

In a collaborative research effort spanning Japan, Vietnam, Indonesia, and the Philippines, scientists are on a quest to create innovative hybrid materials by combining nanocarbons with biomolecules from Southeast Asian endemic plants. The project focuses on fabricating nanocarbons and biomolecule-nanocarbon hybrids to unlock enhanced bioactivity, sensing capabilities, and physical properties. The Philippine team, in particular, aims to optimize fabrication conditions through structural simulations, synthesize biomolecules from pineapples, and integrate them with carbon nanotubes. By characterizing and optimizing these hybrid materials, they aim to demonstrate their near-infrared sensing capability, pushing the boundaries of material science and paving the way for exciting advancements in the field.

Implementation Period: January 2020 to December 2023

Research Funder: Ce-Asia DOST – PCIEERD

Collaborators: Tokyo University of Science,

Islamic University of Indonesia,

Vietnam National University,

Hokkaido University of Education

SDG 9: Industry, Innovation, and Infrastructure

SDG 3: Good Health and Well-being

GCAP: Evaluation of Mechanical and Ballistic Properties of Glazed Ceramic Armor Plates

➤ Ivyleen B. Arugay, Ph.D.

The DOST Young Innovators Programme (YIP) has granted funding to a groundbreaking project at MSU-IIT. In collaboration with three talented students from the Bachelor of Science in Ceramic Engineering program, this project marks MSU-IIT's first successful DOST YIP endeavor out of hundreds of proposals nationwide. The study focuses on enhancing glazed ceramic tiles' ballistic and mechanical performance to meet specific NIJ standards for personnel armor. The project's success will revolutionize local manufacturing capabilities and pave the way for advanced, homegrown armor technology, empowering our nation's security forces with cutting-edge protection.

Implementation Period: March to December 2022

Research Funder: DOST-YIP

SDG 9: Industry, Innovation, and Infrastructure

SDG 16: Peace, Justice, and Strong Institutions

CAPPS: Development of Alternative Ceramic Armor Plates from Philippine Silicates for Philippine Armed Personnel

➤ Ivyleen B. Arugay, Ph.D.

This groundbreaking project emerged in response to growing concerns over homeland security and the need to protect civilians in the face of imminent threats. Recognizing the absence of local manufacturers of personnel armors and the nation's heavy reliance on imported alternatives, the project aims to develop ceramic armor using indigenous materials as a viable alternative for the Armed Personnel of the Philippines. Initial studies have shown promising results, with ceramic armor plates crafted from Mindanao's natural resources demonstrating resistance to certain ammunition penetration. Bolstered by funding from the Department of Science and Technology (DOST), the project strives to enhance the ballistic performance and properties of these ceramic armor plates, ensuring they meet rigorous NIJ standards. Collaboration with national and local agencies involved in national security underscores the project's commitment to safeguarding the nation.

Implementation Period: March 2021 to February 2023

Research Funder: Ce-Asia DOST – PCIEERD

Collaborators: Research and Development Center Philippine Army, Army Support Command (RDC PAASCOM), Philippine National Police main office (PNP main), Iligan City Police Office (ICPO), DOST suspended industry partners due to security concerns

SDG 9: Industry, Innovation, and Infrastructure

ILIGANiCE (Innovation thru Leveraging Industry, Government, Academe Networks, and inclusive Community Engagement)

➤ *Jinky B. Bornales, Ph.D.*

In a concerted effort to strengthen the innovation and entrepreneurial ecosystem in Northern Mindanao, the Mindanao State University- Iligan Institute of Technology (MSU-IIT) and the Department of Science and Technology (DOST) Region 10, in collaboration with the Department of Trade and Industry (DTI) Region 10, Chamber of Commerce and Industry Foundation of Iligan Inc (CCIFI), and USAID through the STRIDE Program, has officially launched the ILIGANiCE Program. This program aligns with the Regional Inclusive Innovation Center (RIIC) initiatives and the Philippine Innovation Act, aiming to promote an innovation mindset among stakeholders, support MSMSEs and startups, foster industry-academe collaborations, develop innovation policies, and build a sustainable innovation ecosystem through community engagements and partnerships. By promoting collaboration and strengthening linkages among government, industry, and academia, ILIGANiCE strives to advance science, technology, innovation, and entrepreneurship, paving the way for a knowledge-based and innovation-driven economy in the region.

Implementation Period: April 2021 to August 2022

Research Funder: DOST-10

Collaborators: DOST-10, DTI-10, Chamber of Commerce and Industry Foundation of Iligan Inc. (CCIFI), USAID-STRIDE, RTI International

SDG 9: Industry, innovation and infrastructure

SDG 12: Responsible consumption and production





Fabrication and characterization of plasma-sprayed nanostructured TiO₂-based coatings for photocatalytic applications

➤ *Rolando T. Candidato, Jr., Ph.D.*

This innovative research project focuses on fabricating TiO₂-based coatings using plasma spraying, paving the way for efficient photocatalytic applications in hydrogen production via water splitting. By developing nanostructured and porous TiO₂ coatings through cost-effective solution plasma spraying, the project aims to overcome limitations such as complex coating processes and limited photocatalytic activity of TiO₂. The goal is to enhance photocatalytic performance and explore alternative, low-cost deposition technologies, ultimately driving advancements in solar-powered hydrogen generation. This research holds tremendous potential for a sustainable and renewable energy future.

Implementation Period: February 2020 to March 2023

Research Funder: DOST-PCIEERD

Collaborators: Wroclaw University of Science and Technology

SDG 9: Industry, innovation and infrastructure

SDG 12: Responsible consumption and production

Morphological and genetic identification of crustacean larvae and juveniles in Panguil Bay

➤ Ivane P. Gerasmio, Ph.D.

Panguil Bay, a vital fishing ground in Mindanao, is facing a decline in its once-abundant crab and shrimp populations. Overexploitation, driven by efficient gear, juvenile harvesting, and habitat destruction, threatens the bay's marine resources. To better understand and protect these species, a pioneering study is underway. By utilizing DNA barcoding, the study aims to identify the larval and juvenile stages of crustaceans in Panguil Bay, providing essential data for resource management and conservation. This comprehensive assessment will shed light on the biodiversity of economically significant crustaceans, contributing to preserving Panguil Bay's fragile ecosystem and informing future conservation efforts throughout the Philippines.

Implementation Period: August 2022 to May 2023

Research Funder: DOST – NRCP

Collaborators: Local Government Units of Lanao del Norte (Kolambungan, Tubod and Lala), Misamis Occidental (Bonifacio and Tangub City)

SDG 14: Life below water

SDG 15: Life on land





Reproductive Biology of Common Commercial Fishes found along the Coastal Barangays of Iligan City

➤ Ivane P. Gerasmio, Ph.D.

The rich marine biodiversity of the Philippines is under threat as our marine resources face a decline due to overfishing and habitat loss. In Iligan City and neighboring areas, fishermen have noticed a decrease in the catch, signaling an urgent need for action. Measures like fishing bans during the new moon phase have been implemented to promote sustainable use and protection of these resources. However, there is a lack of scientific data to support these initiatives. This study aims to investigate the reproductive biology of commercially important fish species in Iligan Bay. By examining reproductive parameters over a year, including spawning seasons and moon phases, valuable insights will be gained to formulate science-based policies for the sustainable management of these resources, reinforcing existing ordinances and supporting the recovery of fish stocks.

Implementation Period: May 2022 to April 2003

Research Funder: Iligan City Government

Collaborators: City Environment and Natural Resources Office,
City Fisheries Aquatic Resources Management Council

SDG 14: Life below water
SDG 2: Zero hunger

Addressing the Needs, Gaps, and Challenges of PILMICO Foods Corp. through Science and Technology Research and Development: an ExperTISE Project

➤ *Rodel D. Guerrero, Ph.D.*

The PCIEERD Expert Intervention for Scientific Engagement (ExperTISE) Program is set to enhance collaboration between regional consortia researchers and industry partners in their respective regions. Intending to address industry needs and gaps, this program encourages researchers to immerse themselves in local industries, identify challenges, and engage with industry leaders. The MSU-Iligan Institute of Technology has partnered with PILMICO Foods Corp as part of this initiative. The collaboration aims to bridge the gap between industry expectations and the expertise of researchers, resulting in the development of research proposals that leverage science and technology innovations. Over a period of six months, the program will culminate in the submission of impactful research proposals to PCIEERD, driving regional growth and development.

Implementation Period: March 2022 to September 2022

Research Funder: DOST-PCIEERD

Collaborators: PILMICO Foods Corp.

SDG 9: Industry, Innovation, and Infrastructure



Enhancing my.eskwela for Synchronous Classes in Public Schools during the COVID-19 Pandemic and Beyond

➤ Orven E. Llantos, Ph.D.

The COVID-19 pandemic has disrupted the education sector, compelling schools to adopt online learning as a safety measure. However, the Philippines' poor internet infrastructure poses challenges, particularly for public schools that lack the resources to implement synchronous online classes. In addition, fragmented software tools further hinder seamless learning experiences, causing cognitive overload. My.eskwela, a social Learning Management System (sLMS), integrates video conferencing and classroom management features to address these issues. Teachers and parents have applauded the platform's efficiency and accessibility, simplifying the learning process. Moreover, my.eskwela enables inclusivity by providing access to information through text-only phones. By bridging the gaps in online education, my.eskwela contributes to the country's literacy advancement and empowers learners for a brighter future.

Implementation Period: January 2022 to March 2023

Research Funder: DOST-NorMinCIEERD

Collaborators: Department of Education, Iligan City

SDG 4: Quality Education

Establishment of R&D Center for Sustainable Polymers

➤ Arnold A. Lubguban, Ph.D.

In an audacious endeavor to propel research and development within higher education institutions (HEIs), the Center for Sustainable Polymers under the Science for Change NICER Program of the DOST-PCIEERD at Mindanao State University - Iligan Institute of Technology (MSU-IIT) is poised to unleash an era of unprecedented growth in Northern Mindanao. There are three (3) projects to be positioned as a pivotal catalyst for regional transformation into a thriving innovation hub, the Center embarks on a mission to overcome the hurdles presented by the copious amounts of coconut by-products and fish waste in Region 10. Leveraging strategic alliances with esteemed HEIs and industries, it forges a path towards revolutionizing sustainable polymer research and development. With its pioneering status as the epicenter of Sustainable Polymers R&D in Mindanao and the Philippines, the Center emerges as a beacon of innovation, bridging critical gaps in bio-based polymer advancements. By nurturing breakthroughs in industrial and medical biopolymer applications and addressing the dearth of laboratory facilities and polymer experts, it empowers local industries to compete on the global stage and actively contribute to inclusive economic growth. As the triumph of this groundbreaking initiative unfolds, the Philippines will rise as a dominant provider of accessible and competitive bio-based polymer products, firmly establishing its prominence within the sustainable economic landscape.

Implementation Period: November 2021 to October 2024

Research Funder: Science for Change NICER Program DOST-PCIEERD

Collaborators: MSU-Naawan, MSU-Marawi, Ateneo de Davao University, Caraga State University, Chemrez Technologies, Inc., Multiflex RNC (URATEX Philippines), Nuevochem Specialties, Inc., MERA Bio-Nutraceuticals Corp.

SDG 9: Industry, Innovation, and Infrastructure

SDG 12: Responsible Consumption and Production



Processing of Coconut Monoglycerides (CMG) into Functionalized Polyols for Industrial Polyurethane Applications

► Arnold A. Lubguban, Ph.D.

Coconut, a cornerstone of the Philippine economy and a top export commodity, holds immense untapped potential. However, the coconut industry has faced sluggish progress in recent years. In response, a groundbreaking project aims to rejuvenate the industry by enhancing coconut farm productivity and capitalizing on value-added coconut products. Comprising three comprehensive studies, the project delves into the utilization of Coconut monoglycerides (CMG) to develop functional polyols tailored for various industrially significant applications. These include wall panel sandwich insulation, offering a green alternative to viscoelastic memory foam, and a highly-absorbent flexible foam designed to mitigate oils and grease in wastewater. Encouragingly, initial lab tests have yielded promising data, fueling optimism for the project's potential impact. By harnessing the versatility of coconuts, this initiative aims to revitalize the coconut industry, creating a brighter future for farmers and positioning the Philippines as a global leader in innovative coconut-based solutions.

Implementation Period: November 2021 to October 2024

Research Funder: NICER DOST-PCIEERD

Collaborators: MSU-Naawan

MSU-Marawi

Ateneo de Davao University

Caraga State University

Chemrez Technologies, Inc.

Multiflex RNC (URATEX Philippines)

SDG 9: Industry, innovation and infrastructure

SDG 12: Responsible consumption and production



Development of Extracellular Matrix Composed of Natural Polymers from Fish Processing Wastes for Nutraceutical and Biomedical Applications

➤ Ronald P. Bual, Ph.D.

As global fish production continues to surge, so does the generation of fish processing wastes (FPW). These wastes, encompassing bones, skin, scales, heads, and viscera, hold immense nutritional value, packed with proteins, fatty acids, and minerals comparable to those found in fish fillets and other consumable products. To address the environmental challenges and maximize the value of these resources, a groundbreaking project is dedicated to the value-added conversion of FPW from tilapia, milkfish, and tuna processing plants. By utilizing a highly functional extracellular matrix (ECM) derived from these wastes, the project aims to produce cutting-edge solutions, including a wound healing patch and a potent functional food supplement. The ECM is obtained through a meticulous decellularization process, rich in bioactive compounds such as collagen, peptides, chitin, polyunsaturated fatty acids (PUFAs), enzymes, and minerals. This natural ECM provides an ideal cellular growth and functionality environment, making it a promising candidate for wound healing patches. Furthermore, the decellularized ECM sourced from fish tissues, known for its abundance of omega-3 fatty acids, phospholipids, and other vital nutrients, has the potential to enhance the healing process significantly. Additionally, the project aims to capitalize on the rich sources of essential amino acids and bioactive components within FPW, creating a functional food supplement. Fish-derived marine collagen peptides (MCP) found in these wastes have been recognized for their ability to improve cutaneous wound healing and angiogenesis when administered orally. By transforming FPW into value-added products, this innovative project not only tackles environmental concerns but also unlocks the vast potential of these underutilized resources, paving the way for a more sustainable and health-conscious future.

Implementation Period: December 2021 to November 2024

Research Funder: NICER DOST-PCIEERD

Collaborators: MSU-Naawan, MERAV Bio-Nutraceuticals Corp., Greenstone Pharmaceuticals, Inc., Bureau of Fisheries and Aquatic Resources – Region 10

SDG 3: Good health and well-being

SDG 12: Responsible consumption and production

Innovation of polyurethane-modified concrete-nanocomposite from crude glycerol for industrial flooring system applications

➤ Arnold C. Alguno, Ph.D.

In the Philippines, biofuel plants producing coco-methyl esters generate significant by-products, including copra cake, glycerol, and coconut fatty acid distillates. Unfortunately, there is an excess of crude glycerol annually, leading to its low-value sale and subsequent expensive purification processes. However, a groundbreaking research study presents a one-pot process to convert coconut oil acylglycerols into high molecular weight and high hydroxyl-functionality polyols. These polyols will serve as a key ingredient in developing a polyurethane-modified concrete (PMC) flooring system. PMC is a resilient and chemical-resistant resin floor known for its exceptional durability, making it ideal for applications in dry environments such as the food, pharmaceutical, and manufacturing industries. By utilizing crude coconut oil and crude glycerol, this research aims to create a sustainable alternative to existing PMC options, encompassing crucial characteristics such as low VOC emissions, rapid application and curing, temperature and thermal shock resistance, chemical and impact resistance, substrate moisture tolerance, and safety. This innovation addresses the challenge of managing coconut by-products and contributes to the development of eco-friendly and long-lasting flooring.

Implementation Period: November 2021 to October 2024

Research Funder: NICER DOST-PCIEERD

SDG 9: Industry, innovation and infrastructure
SDG 12: Responsible consumption and production

Mining Areas Rehabilitation in the Southern Philippines using Microrganisms

➤ Joey Genevieve T. Martinez, Ph.D.

The environmental impact of mining activities in the Philippines has led to stringent regulations for large-scale operations. However, small-scale mining continues to pose concerns, particularly due to the excessive use of mercury in gold extraction. The government emphasizes the importance of rehabilitation plans to address ecological risks and minimize degradation. However, rehabilitation success is often measured based on plant species' survival, which may overlook crucial soil indicators. Nematodes, key players in the soil food web, respond rapidly to changes in soil conditions and can serve as reliable indicators of soil health. This study aims to assess nematode diversity and composition across mining sites, develop local measures to evaluate rehabilitation strategies using nematodes, and create a mathematical model for numerical simulations of rehabilitation initiatives. By understanding nematode responses and identifying effective parameters, this research will contribute to efficient and science-based mining area rehabilitation, supporting ecosystem revival and sustainable land use.

Implementation Period: April 2021 to March 2023

Research Funder: DOST and Hinatuan Mining Company

SDG 15: Life on Land

SDG 12: Responsible Consumption and Production

Developing natural ways to rehabilitate mercury-contaminated soils and evaluating their efficiency using bio-indicators

➤ Joey Genevieve T. Martinez, Ph.D.

In the Philippines, mining operations have raised concerns due to the environmental impact of toxic metals, particularly mercury (Hg), used extensively in small-scale mining activities for gold extraction. Addressing the lack of regulation and proper waste disposal, this research project aims to assess the phytoremediation potential of native fern species in sequestering Hg from the soil. By incorporating biochar, known for immobilizing pollutants, the study seeks to enhance the efficiency of Hg sequestration while preventing leaching. Moreover, the project will evaluate the response of soil communities, including nematodes and microbes, to these remediation strategies, considering their vital role in soil processes and their potential as indicators of soil recovery. Through this holistic approach, the project aims to contribute to sustainable mining practices and rehabilitate abandoned mining areas in the Philippines.

Implementation Period: January 2020 to August 2022
Research Funder: VLIR-UOS Belgium

SDG 15: Life on land
SDG 13: Climate action
SDG 3: Good health and well-being

Trophic role of the Sardinella lemuru off the Zamboanga Peninsula

➤ *Ephrime B. Metillo, Ph.D.*

Embarking on a pioneering endeavor, this project aims to unravel the dietary preferences and predators of the prized sardine species, *Sardinella lemuru*, through stomach content analysis and C, N, and O stable isotope analysis. By constructing a comprehensive food web model, researchers will gain insights into the intricate relationships within the ecosystem. Armed with this knowledge, they will establish optimal utilization strategies for sardines, considering the rates of fisheries harvesting and the impact on both the species and its competitors and predators off the Zamboanga Peninsula. This initiative paves the way for sustainable management practices, ensuring the long-term preservation of this vital marine resource.

Implementation Period: April 2021 to March 2023

Research Funder: DOST-PCAARRD

Collaborators: University of the Philippines Visayas, Jose Rizal Memorial State University

SDG 14: Life Below Water



Key Technological Research of Philippines and China on Portable Power Generation Based on Gasification of the Municipal Solid Wastes (MSW) and Agricultural Biomass Pretreated by Co-hydrothermal Process

➤ Alexander O. Mosqueda, D.Eng.

In a groundbreaking 2-year project funded by the PCIEERD Grants-In-Aid Program and the Ministry of Science and Technology of China, Mindanao State University - Iligan Institute of Technology and East China University of Science and Technology are leading the way in portable power generation. This work aims to explore the energy yield of processed biomass and municipal solid waste through innovative hydrothermal carbonization pretreatment. By harnessing the lignin content as a natural binder, they are developing binderless fuel pellets from hydrochar, which are optimized for mechanical strength and durability. Furthermore, the generated conditions and parameters will be upscaled to develop a pilot-generating plant that utilizes biomass and municipal solid waste, providing portable energy conversion solutions and addressing waste management challenges. This project promises to transform waste into a valuable resource and revolutionize power generation.

Implementation Period: January 2020 to August 2022

Research Funder: Department of Science and Technology – Philippine Council for Industry, Energy, and Emerging Technology Research and Development (DOST-PCIEERD) and Ministry of Science and Technology (MOST) China

Collaborators: East China University of Science and Technology, Pilimco Foods Corporation

SDG 7: Affordable and Clean Energy

SDG 12: Responsible Consumption and Production

Recovery of Rare Earth and Strategic Elements from Coal Fly Ash by Hydrometallurgical Techniques

➤ *Vannie Joy T. Resabal, Ph.D.*

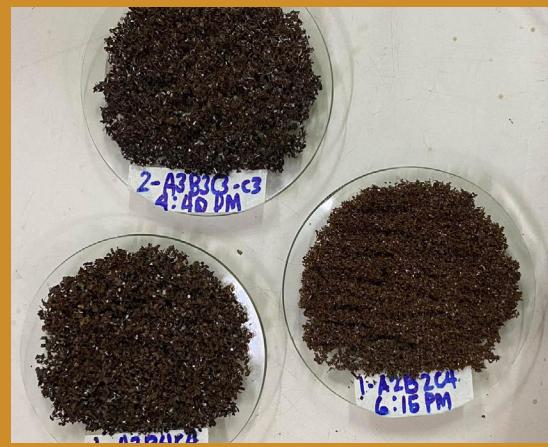
The discovery of rare earth elements (REEs) and strategically important metals within coal fly ashes presents an enticing opportunity for their recycling, offering both economic and environmental advantages over disposal. Traditional recovery processes for these critical metals are complex and energy-intensive, generating various waste products. However, coal fly ash possesses inherent advantages due to its amenable physical form, making metal recovery more efficient than primary ore processing. Additionally, the absence of radioactive elements simplifies processing and enhances environmental safety. This pioneering project aims to explore the potential of coal fly ash in the Philippines as a valuable resource for rare earth and strategic elements, examining its feasibility for metallurgical processing in pursuit of economical and environmentally sustainable practices.

Implementation Period: January 16, 2021 to February 15, 2023

Research Funder: DOST-PCIEERD

Collaborators: STEAG State Power Inc.

SDG 12: Responsible Consumption and Production



A novel technique for the recovery of valuable metals from AMD through bimetallic materials

➤ *Vannie Joy T. Resabal Ph.D.*

As the mining and mineral processing industries embrace sustainable practices, a paradigm shift is occurring, shifting focus from conventional remediation techniques to recovering valuable elements from mining waste. Acid mine drainage (AMD), typically considered an environmental concern, holds untapped potential as a resource for valuable metals, sulfuric acid, and reusable water. The geochemical properties of AMD resemble those of pregnant leach solutions used in extracting metals from low-grade ores, suggesting the presence of recoverable metals. Enhanced recovery through galvanic interaction, specifically utilizing aluminum-based magnetic bimetallic particles, shows promise for selectively precipitating metallic ions like copper, nickel, and zinc. This groundbreaking project aims to recover these valuable metals from AMD, offering a sustainable solution while facilitating their easy separation and subsequent reuse.

Implementation Period: February 28, 2022 to February 27, 2023

Research Funder: DOST-PCIEERD

Collaborators: De La Salle University (DLSU)

Carmen Copper Corporation

SDG 9: Industry, innovation and infrastructure

SDG 12: Responsible consumption and production

Collaborative Aerial-Ground Unmanned System for Exploration and Monitoring of Philippine Active Volcanoes

➤ *Carl John O. Salaan, Ph.D.*

In a groundbreaking initiative, this project revolutionizes volcano exploration in the Philippines by harnessing the power of collaborative aerial-ground unmanned systems. By integrating drones and mobile ground robots with shared autonomy, volcanologists can remotely gather crucial data on active volcanoes while minimizing exposure to hazardous conditions. The project's three-stage approach—deployment, exploration, and retrieval—enables efficient data collection and monitoring. With real-time information on volcanic activities, scientists can improve eruption predictions, reduce casualties, and enhance disaster response. This pioneering technology marks a significant step forward in the country's disaster preparedness and underscores the commitment to safer and more advanced volcano exploration.

Implementation Period: June 1, 2022 to May 31, 2024

Research Funder: DOST-PCIEERD

SDG 13: Climate action

SDG 11: Sustainable cities and economies

High-throughput MiFish metabarcoding approach for simultaneous multiple species detection from environmental DNA samples for biomonitoring, ecosystem conservation strategies, and fishery sustainability

➤ Sharon Rose Tabugo, Ph.D.

The province of Maguindanao is under the Bangsamoro Autonomous Region in Muslim Mindanao (BARM), Philippines, which holds areas and islands that offer rich Biodiversity for its inhabitants. However, the ecosystem services it offers are often undermined and neglected. Sustainability is necessary to address present problems and future services. Biomonitoring has been used and deemed essential for ecosystem conservation and the sustainability of resources. Fishing communities derived the most direct and indirect benefits from aquatic ecosystem services. Fishing management had focused much on maximizing the catch of single target species and often ignored habitat, predators, and prey of interest of the target species and other ecosystem vital components and interactions. However, worldwide fisheries management is currently shifting from a single-species approach to an ecosystem approach. The “ecosystem-based fishery management” approach is to sustain the ecosystem and fisheries it supports. Herewith, evaluating ecosystem health inevitably requires continuous monitoring of biotic and abiotic components in ecosystems which are meaningful in detecting environmental degradation and biodiversity loss when temporal changes in ecosystems occur. Monitoring of aquatic resources can be done through non-invasive methods such as utilizing environmental DNA (eDNA).

Implementation Period: January 2023 to July 2023

Research Funder: MOST-BARM

Collaborators: BARM

SDG: 14: Life below water

SDG 15: Life on land

A tale of seahorses and pipefishes: Real-time DNA Barcoding using nanopore sequencing for rapid assessment, conservation and local research capacity building

➤ *Sharon Rose Tabugo, Ph.D.*

The beautiful Island of Mindanao, in the southern part of the Philippines, remained unexplored to some extent due to existing security threats in some areas. This left many organisms unstudied and undocumented. As a result, population loss is inevitable, and some organisms die without data on their existence. In contrast, others are heavily exploited without knowledge of how to alleviate pressure on wild populations and address genetic diversity and conservation. This study employed DNA barcoding for diversity assessment, especially for problematic/complex species (e.g. *Hippocampus kuda*) and its allies, such as the pipefishes. This project provided a rapid, practical, and feasible approach for DNA barcoding for species identification and delineation, especially in underdeveloped and remote areas, to assist in conservation priorities. This is to understand and monitor populations. Moreover, community outreach and awareness through focal group discussions (FGDs) were done to educate and strengthen the local research capacity of local stakeholders on diversity and conservation. It is expected that such efforts will help populations in the area to be preserved, if not recovered, to address sustainability.

Implementation Period: 2020-2022

Research Funder: Idea Wild (International)

Collaborators: Local Government Unit of Iligan

SDG: 14: Life below water

SDG 15: Life on land

Anti-Cancer Drug Leads from Marine Sponges Collected Off the Coasts of Mindanao

➤ Mylene M. Uy, DSc

Exploring the vast biodiversity of Mindanao's coastal waters, a groundbreaking project has set its sights on the discovery of potential anticancer compounds derived from marine sponges. The project encompasses two critical aspects: isolating and identifying compounds from active priority sponge extracts obtained during Phase 1, evaluating their anticancer activities, and determining their structures in Phase 2. In Phase 1, a team of dedicated PhD Chemistry students, working alongside researchers, successfully isolated and elucidated the structures of ten known compounds and one newly discovered compound from the active sponge extracts. Among these discoveries are 7-dehydrocholesterol peroxide, phyllofolactones H and I, scalarin, Δ -sitosterol, scalandysin B, ceramides A and B, curcidiol and curcuphenol, aaptamine, and sarasinoside A1. These compounds have shown promising potential as anticancer agents, displaying activities such as apoptosis induction, antiproliferation, and antimigration. Furthermore, Phase 2 of the project involved the evaluation of 100 extracts from 50 sponges, 16 extracts from 8 seahorses, and two extracts from pipefish. These marine extracts were subjected to rigorous tests against colon carcinoma and lung carcinoma cells, leading to the identification of several candidate priority fractions and extracts with remarkable anticancer properties. This research serves as a testament to the untapped potential of marine ecosystems and their role in developing novel therapies to combat cancer. Furthermore, by harnessing the power of nature, this project offers hope for the future of anticancer drug discovery. Finally, it highlights the importance of preserving our marine resources for scientific exploration and innovation.

Implementation Period: January 2019 to June 2022

Research Funder: DOST-PCHRD

Collaborators: University of Florida,
Hiroshima University

SDG 3: Good health and well-being

SDG 14: Life below water



SUGPO: Sustainable mine water management UsinG modified hydrothermal carbon from Prawn shells for Optimum removal of contaminants

➤ *Maria Cristina P. Vegafría, Ph.D.*

Large volumes of seafood waste, such as crustacean shells, can be a potential raw material for the production of high-value products such as chitosan. Chitosan is a promising biodegradable and non-toxic material with multiple applications, including wastewater treatment. This study identified local sources of crustacean (crab, prawn, shrimp) shells and added value to these wastes by producing a chitosan-based hydrothermal carbon (HTC), an adsorbent intended for mine water treatment. The project has three key components, namely: 1) assessing the sustainability of prawn shell supply from seafood restaurants and wet markets in Iligan City, 2) synthesizing HTC through an optimized microwave irradiation technique, and 3) evaluating its efficacy in treating wastewater from a gold processing facility in Libona, Bukidnon. This project opens doors for future endeavors in producing composite materials and exploring alternative raw materials, ultimately aiming for the commercialization of HTC and other chitosan-based adsorbents in the Philippines.

Implementation Period: November 2020 to July 2022

Research Funder: DOST-PCIEERD

Collaborators: WHK Manufacturing and Trading Corporation

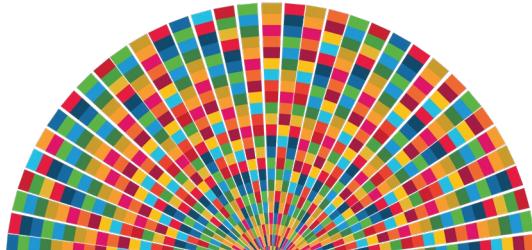
SDG 12: Responsible Consumption and Production

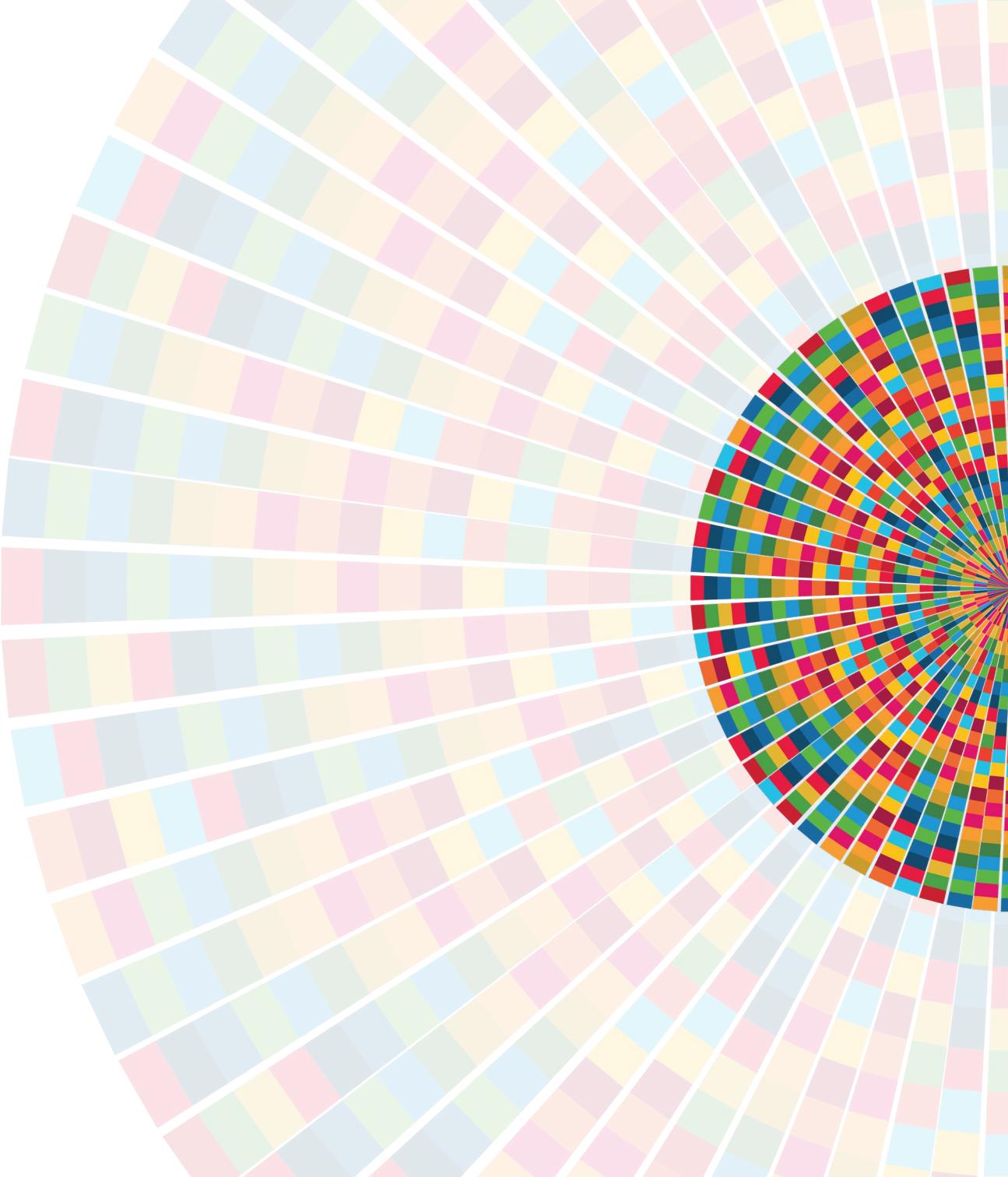
SDG 6: Clean Water and Sanitation

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RESEARCH BRIEF

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