WESTERN PHILIPPINES UNIVERSITY

RESEARCH, INNOVATION, DEVELOPMENT, AND EXTENSION

ANNUAL CONFERENCE PROCEEDINGS 2026

"Integrating Science, Education, and Governance for Sustainable Development: Advancing Knowledge, Resources, and Resilience"

15 April 2026 WPU-Main Campus Aborlan
16 April 2026 WPU-Puerto Princesa Campus

KEYNOTE SPEAKER

Dr. Hernando P. Bacosa
Professor of Environmental Science
Mindanao State University-Illigan Institute of Technology

HOSTED BY:

College of Education

RIDE Annual Conference Proceedings 2026

"Integrating Science, Education, and Governance for Sustainable Development: Advancing Knowledge, Resources, and Resilience"

15 April 2026
College of Education Audio Visual Hall
WPU-Main Campus, Aborlan, Palawan
Host: College of Education (CEd)
16 April 2026
Audio Visual Hall, WPU-Puerto Princesa Campus, Puerto Princesa City
Host: College of Education (CEd)

Participating Colleges:
College of Agriculture, Forestry and Environmental Sciences (CAFES)
College of Arts and Sciences (CAS)
College of Criminal Justice Education (CCJE)
College of Education (CEd)
College of Engineering and Technology (CET)
College of Fisheries and Natural Sciences (CFiNS)
College of Public Administration and Management (CPAM)

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About the Conference

This year marks the second Research, Innovation, Development, and Extension (RIDE) Annual Conference of the Western Philippines University (WPU). With the theme "Integrating Science, Education, and Governance for Sustainable Development: Advancing Knowledge, Resources, and Resilience," the conference brings together the faculty, staff, and students of WPU in a structured forum where research outputs are disseminated, critiqued, and refined. Building on the success of the inaugural conference, this second gathering reaffirms the University's commitment to advancing research, innovation, development, and extension as core pillars of academic excellence.

The event showcases a total of 126 original research studies presented across the two campuses. Among these, 105 are oral presentations, while 21 are poster presentations. The presentations are organized into three parallel sessions aligned with the mandates of the four research and development consortia in which WPU holds membership: the MIMAROPA Agriculture, Aquatic, and Natural Resources Research and Development Consortium (MAARRDEC), the Southern Tagalog Agriculture, Aquatic, and Resources Research Development and Extension Consortium (STAARRDEC), the Southern Tagalog Integrated Research and Development Consortium (STIRDC), and the MIMAROPA Health Research and Development Consortium (MHRDC). Session 1 covers Agriculture, Aquatic, and Natural Resources (fisheries, aquaculture, marine biology, agriculture, forestry, food security, and natural resource management); Session 2 covers Health, Environment, and Community Well-being (health sciences, public health, education, environmental studies, and community development); and Session 3 covers Integrated Research, Innovation, and Development (education, social sciences, business, governance, ICT, engineering, and interdisciplinary studies). This consortium-aligned structure also serves as an in-house review of the research conducted and reported to the RIDE office, ensuring that WPU's outputs speak directly to regional and national development priorities.

To manage the number of presenters and increase student participation, the event is scheduled on two separate dates and venues: April 15, 2026, at the College of Education Audio-Visual Hall, WPU-Main Campus, Aborlan; and April 16, 2026, at the WPU-PPC Audio-Visual Hall, Puerto Princesa City. This conference is co-hosted by the College of Education in both campuses. The University invited a distinguished plenary speaker, Dr. Hernando P. Bacosa, Professor VI of the Mindanao State University-Iligan Institute of Technology, to frame the theme of the gathering and inspire all participants. Speaking on both conference days at the WPU-Main Campus in Aborlan and the WPU-PPC Campus in Puerto Princesa City, he tackled the triple planetary crisis of pollution, climate change, and biodiversity loss, drawing the connection between WPU's research directions and the broader regional and national development agenda.

Presenters participating in the oral and poster competitions are categorized into three divisions: the Professional Category, open to all WPU faculty, research staff, and extension workers; the Graduate Student Category, open to enrolled MS and PhD students; and the HS/Undergraduate Student Category, open to high school and undergraduate students. Entries are further grouped into competing and non-competing categories. Each oral presenter is given ten minutes for presentation followed by a three-minute open forum, while poster presenters are allotted three minutes for poster pitching and one minute for questions. A panel of judges composed of subject matter experts evaluates the presentations using a standardized rubric. Cash prizes and certificates are awarded to the top three presenters in each category per session, and all presenters receive certificates of participation as a token of appreciation for their dedication to research and knowledge sharing.

This annual conference serves as the internal review and selection process of papers for presentation at regional, national, and international scientific fora. It reinforces the University's mandate of providing advanced education and professional instruction in agriculture, fisheries, forestry, engineering, environmental science, education, arts and sciences, rural development, and other relevant fields, while promoting research and extension services and strengthening WPU's leadership in these disciplines.

The RIDE Annual Conference 2026 stands as a testament to the unity and shared dedication of the WPU community in pursuing a progressive and sustainable society through research, innovation, development and extension.

JHONAMIE MABUHAY-OMAR, PhD
Director, Research and Development Office

Preface

Dear Colleagues,

It is our great pleasure to present the Proceedings of the 2026 RIDE Research Forum. We hope this first volume will serve as a valuable resource and enduring source of inspiration for researchers, educators, policymakers, practitioners, and students committed to advancing knowledge and innovation.

The 2026 RIDE Research Forum marks the second research forum organized by the Research, Innovation, Development, and Extension (RIDE) Department. Building upon WPUs long-standing tradition of hosting scholarly gatherings through its research unit, this year's forum reflects the University's continuing commitment to cultivating a vibrant culture of research, innovation, and academic excellence.

This first volume features **14 full papers** and **126 research abstracts** organized under three major themes:

1. **Integrating Science, Education, and Governance for Sustainable Development;**
2. **Health, Environment, and Community Well-being; and**
3. **Integrated Research, Innovation, and Development.**

The research presented in this forum addresses critical and emerging issues in environmental sustainability, community development, governance, information and communications technology (ICT), engineering, education, health, and other interdisciplinary fields. Beyond serving as a venue for scholarly exchange, the forum aimed to strengthen the research capabilities of students, encourage faculty and staff to pursue impactful and relevant investigations, and generate knowledge that responds to pressing local needs while contributing to broader national and global development priorities. Through these collective efforts, the forum supports the sustainable development of Palawan and the West Philippine region while advancing the University's mission of excellence in instruction, research, innovation, extension, and production.

We extend our sincere appreciation to all researchers who generously shared their work through oral and poster presentations. Your scholarly contributions enriched the discussions, stimulated new ideas, and inspired meaningful dialogue toward addressing contemporary societal challenges.

Our sincere thanks likewise go to the College of Education, under the leadership of its Dean, Dr. Mary Jane D. Gamozo, for serving as co-organizer of the forum. The dedication, professionalism, and collaborative spirit of its faculty, staff, and students were instrumental in delivering a well-organized, engaging, and academically enriching event.

We are equally grateful to the RIDE Department for its visionary leadership, unwavering commitment, and steadfast efforts in sustaining a dynamic research culture at WPU. Through its initiatives, the Department continues to create opportunities for scholarly collaboration, innovation, and knowledge generation that benefit both the University and the wider community.

As editors of these proceedings, we are confident that this collection of research will encourage further inquiry, foster interdisciplinary collaboration, and inspire future studies that contribute meaningfully to the advancement of science, education, technology, and sustainable development. We hope that the ideas and findings presented herein will serve as a catalyst for continued excellence and innovation in research.

We look forward to strengthening our partnerships, fostering vibrant intellectual exchange, and advancing many more meaningful research endeavours in the years to come.

The Editors

TABLE OF CONTENTS

Conference Program

Day 1

College of Education-Audio Visual Hall, Western Philippines University-Main Campus, San Juan, Aborlan, Palawan
April 15, 2026

7:30 – 8:00	Registration Prayer National Anthem	
8:00 – 9:00	Welcome Remarks	**Dr. Lota A. Creencia** VP for Research, Innovation, Development, and Extension
	Message	**Dr. Amabel S. Liao** University President, Western Philippines University
	Introduction of the Plenary Speaker	**Dr. Lovina A. Hamora** Associate Dean, College of Education-Main Campus
9:00 – 9:30	Plenary Talk	**Dr. Hernando P. Bacosa** Professor VI, Mindanao State University-Illigan Institute of Technology
9:30 – 9:40	Open Forum	
9:40 – 9:45	Awarding of Certificate to the Plenary Speaker	**Dr. Amabel S. Liao** University President, Western Philippines University **Dr. Lota A. Creencia** VP for Research, Innovation, Development, and Extension
9:45 – 10:00	Photo Opportunity Introduction of Participants, Mechanics of Presentation and Introduction of Judges	**Bernadette R. Javier** Master of Ceremony
10:00 – 12:00	Parallel Sessions Main Hall	**Ruel F. Olapane** Moderator
	Breakout Room 1	**Dale C. Caabas** Moderator
	Breakout Room 2	**Ofelia A. Luarez** Moderator
12:00 – 13:00	Lunch Break	
13:00 – 16:00	Continuation of Parallel Sessions	
16:00 – 17:00	Announcement of Winners Closing Ceremony	

DAY 2

Campus Audio Visual Hall, Western Philippines University-Puerto Princesa Campus, Sta. Monica, Puerto Princesa City, Palawan
April 16, 2026

7:30 – 8:00	Registration Prayer National Anthem	
8:00 – 9:00	Welcome Remarks	**Dr. Lota A. Creencia** VP for Research, Innovation, Development, and Extension
	Message	**Dr. Amabel S. Liao** University President, Western Philippines University
9:00 – 9:30	Introduction of the Plenary Speaker	**Dr. Rastanura M. Bober** Associate Dean, College of Education-PPC Campus
	Plenary Talk	**Dr. Hernando P. Bacosa** Professor VI, Mindanao State University-Illigan Institute of Technology
9:30 – 9:40	Open Forum	
9:40 – 9:45	Awarding of Certificate to the Plenary Speaker	**Dr. Amabel S. Liao** University President, Western Philippines University **Dr. Lota A. Creencia** VP for Research, Innovation, Development, and Extension
9:45 – 10:00	Photo Opportunity Introduction of Participants, Mechanics of Presentation and Introduction of Judges	**Kei Jullesse Q. Macolor** Master of Ceremony
10:00 – 12:00	Parallel Sessions Main Hall	**Kei Jullesse Q. Macolor** Moderator
	Breakout Room 1	**Manuel L. Bucad** Moderator
	Breakout Room 2	**Jerome L. Hernandez** Moderator
12:00 – 13:00	Lunch Break	
13:00 – 16:00	Continuation of Parallel Sessions	
16:00 – 17:00	Announcement of Winners Closing Ceremony	

CONFERENCE PARALLEL SESSIONS

DAY 1 - Oral Presentation

Parallel Session 1: Agriculture, Aquatic, and Natural Resources

Time	Presenter	Title
10:00-10:10	**Nicole Angela D. Blancia**	Bioactivity of Garlic (*Allium sativum* L.) Extract Against Rice Bug (*Leptocorisa oratorious* Fabricius)
10:15-10:25	**Alejacel P. Bernardo**	Restoration of Mined-out Soil Using Carbonized Rice Hull and Rice Hay Compost
10:30-10:40	**Rene E. Cayapas, Jr.**	Sensory Quality and Consumer Acceptability of Banana-Based Energy Bars with Corn Crunch
10:45-10:55	**Nancy Fabian**	Influence Of Green Amaranth (*Amaranthus viridis* L.) Density on the Growth and Yield of Tomato (*Solanum lycopersicum* L.)
11:00-11:10	**Syrell E. Largavista**	Carbon Stocks Assessment in Wetlands, Agricultural Areas, and Artificial Forests at Western Philippines University
11:15-11:25	**Kasandra Lean A. Ramos**	Identification and Ecological Status of Seagrass Areas Along The Selected Coastal Areas of East Coast Aborlan Palawan
11:30-11:40	**Kim Joshua L. Monteverde**	Abundance and Diversity Of Insects Captured by Different Colored Light Traps in Eggplant Plantations
11:45-11:55	**Marcos E. Bollido**	Evaluation of locally formulated feed on growth performance of broiler and native chicken
13:00-13:10	**Alejandro A. Bernardo, Jr.**	Green Spaces in WPU Main Campus: Refugia for Endemic and Conservation-Priority Wildlife
13:15-13:25	**Keiven Mark B. Ampode**	Dietary L-Tryptophan Supplementation Mitigates Heat Stress and Improves Production Performance and Meat Sensory Attributes in Broilers
13:30-13:40	**Snowie Jane G. Ampode**	Iron Slag–Based Silicate Fertilizer Enhances Soil Organic Carbon Sequestration and Stabilization in Rice Paddies
13:45-13:55	**Abegail P. Arpon**	Effects of Organic Fertilizers on the Vegetative Growth and Yield of Parsley (*Petroselinum crispum*) Grown in Greenhouse Conditions
14:00-14:10	**Jessabelle C. Bacalangco**	Access to Marine Resources: Implication for Small-Scale Artisanal Fishers in Narra, Palawan

Parallel Session 2: Health, Environment, and Community Well-being

Time	Presenter	Title
10:00-10:10	**Fely Jane C. Francisco**	Formulation and Acceptability of Tawa-Tawa (*Euphorbia hirta*) Gummies
10:15-10:25	**Razell G. Delos Reyes**	Maternal Autonomy: A Phenomenological Inquiry on the Participation of Tagbanua Women in Household Decision-Making
10:30-10:40	**Mary Hazel Mae L. Gabo**	Innovative Biosand Filter Communal Water Treatment at Sitio Sugod-Uno, Barangay Cabayugan, Puerto Princesa City
10:45-10:55	**Blander D. Pagliawan**	Level Of Satisfaction On Health Services Among Mothers In Isla Sombrero, Poblacion, Aborlan, Palawan
11:00-11:10	**Jeremiah C. Magallanes**	Awareness and Disposal Practices on Plastic Packaging Waste among Online Shopping Consumers at Western Philippines University, Aborlan, Palawan
11:15-11:25	**Nica Ella E. Cahilig**	Bioefficacy of different concentration of calamansi (*Citrofortunella macrocarpa*) peelings scented candle as Anopheles (*Anopheles flavirostris*, Diptera: Culicidae) repellent

11:30-11:40	**Anne Gellie P. Pablo-Limco**	Development and Stability of Freeze-Dried Indian Gooseberry (*Emblica officinalis*) Alginate Microbeads and Their Application in Yogurt Fortification
11:45-11:55	**Eva Niña B. Lopez**	STEM Education in ASEAN Countries: Practices and Way Forward
13:00-13:10	**John Carl S. Calites**	Assessing Facility Needs for Rural School Infrastructure: A Case Study of Maruso Elementary School, Rizal, Palawan
13:15-13:25	**Jhon Mark G. Monte**	Level of Compliance with the Philippine Green Building Code (PGBC) among Mainland Municipalities of Palawan
13:30-13:40	**Shaina Mae Ramos**	Implementation Of Duties And Responsibilities Of The Barangay Anti-Drug Abuse Council In Selected Barangays Of Aborlan, Palawan
13:45-13:55	**Julie E. Camacho**	Youth With A Mission Programs in Palawan, Philippines
14:00-14:10	**Bernalyn R. Butaca**	Putting Into Practice: Assessment Of School Learning Action Cell (Slac) Program Among Elementary Schools In Bataraza District I
14:15-14:25	**Elizaldy A. Aquino**	Workload and Performance of Elementary Teachers in Narra Del Norte
14:30-14:40	**Edison C. Gabileo**	Community Awareness of Cybercrime and Security Measures in Rural Palawan, Philippines: Insights for Evidence-Based Policy and Local Governance
14:45-14:55 P.M.	**Geneva O. Dumdumaya**	Fingerprint Classification Of Police Investigators: A Competency-Based Enhancement Program
15:00-15:10 P.M.	**Marlene D. Jagmis**	Community Engagement And Involvement Towards Good Governance In Aborlan, Palawan

Parallel Session 3: Integrated Research, Innovation, and Development

Time	Presenter	Title
10:00-10:10	**Carl Valencia Demafelis**	Analyzing the Efficacy of Alugbati Extracts (*Basella alba*) as Alternative Highlighter
10:15-10:25	**Mielban Jean C. Caralipio**	Development of a Foot-Operated Coconut Dehusker
10:30-10:40	**Bhea Vannesa R. Ombe**	Social System Barriers of Out-of-school Youth in Accessing the Alternative Learning System
10:45-10:55	**Mark Daniel L. Lucero**	Compressed Earth Bocks Incorporating Clam Shell (*Polymesoda erosa*) as Natural Binder Reinforced with Coconut Fiber
11:00-11:10	**Princess Nonita P. Tayab**	Evaluating Okra (*Abelmoschus esculentus*) Mucilage as a Plant-Derived Plasticizing Agent for Cementitious Materials
11:15-11:25	**John Vicent C. Openia**	Evaluating the Tensile Strength of Rattan as a Sustainable Alternative to Steel Reinforcement in Sitio Tina, Culandanum, Aborlan, Palawan
11:30-11:40	**Jenny Joyce S. Cuervo**	Fabrication of cement Board utilizing Saba Banana (*Musa paradisiaca* L.) Fiber for Reinforcement and Coal Fly Ash as Partial Replacement to Cement
11:45-11:55	**Kasandra Elizze V. Arga**	Development of Pneumatic-Driven Coconut Milk Extractor
13:00-13:10	**Rylle Zeus Salvador**	Assessing the Feasibility of a Pilot-Scale Sustainable Biofiltration System for Greywater Treatment and Reuse
13:15-13:25	**Krystle B. Betorin**	Procrastination Uncovered: Exploring Experiences, Contributing Factors, and Intervention Strategies of Education Students
13:30-13:40	**Coleman C. Tiw-an**	Development Of Abaca Fiber Extraction Machine
13:45-13:55	**Cyrus Candelaria**	Design and Fabrication of Electric Lawn Mower with Grass Collector
14:00-14:10	**Pauline Claire A. Dabalus**	Development of Bamboo Leaves Ash Eco-Bricks for Sustainable School Sanitation in Sitio Tina: A Community-Based Assessment

14:15-14:25	**Jeiane Kate O. Bacosa**	Assessment of Municipal Compliance with PD 1096 in Building Permit Implementation in Municipalities of Mainland Palawan
14:30-14:40	**Christine Acosta**	Automating the Approval Chain: An E-Faculty Workload System with Integrated Signatory Tracking
14:45-14:55	**Kathlaine May B. Esteban**	The effect of Geopolymer Cement and Recycled Plastic Aluminates on the Flexural Strength of Roofing Materials
15:00-15:10	**Mary Jane D. Gamozo**	Evaluation of Teaching Effectiveness Across Campuses, Colleges, and Academic Ranks at Western Philippines University: A Cross-Sectional Statistical Study

DAY 2 - Oral Presentation

Parallel Session 1: Agriculture, Aquatic, and Natural Resources

Time	Presenter	Title
10:00-10:10	**Ben Jan E. Hisona**	Occurrence and spatial distribution of Cyanobacteria in recreational waters of Honda Bay, Palawan: Influence of environmental factors and public health implications
10:15-10:25	**Hurriker Keen M. Malagum**	Spatial Distribution and Assemblages of Zooplankton during the Northeast Monsoon in Shark Fin Bay, Taytay, Palawan, Philippines
10:30-10:40	**Maria Cristina Canonico-Rosero**	Fertilization and Hatching Performance of Asian Native Catfish *Clarias Macrocephalus*, Palawan, Philippines
10:45-10:55	**Marvy Claire N. Mortega**	From Fish Waste to Green Packaging: Formulation and Characterization of Biodegradable Film from Milkfish (*Chanos chanos*) Scale-derived Fish Gelatin
11:00-11:10	**Noe D. Reyes**	Monsoonal Variation in Phytoplankton Assemblages and Selected Physicochemical Parameters in Shark Fin Bay, Taytay, Palawan
11:15-11:25	**Ma. Lotus E. Patiluna**	Reproductive and morphometric characteristics of Spider Conch, *Lambis lambis* (Linnaeus, 1758) in Honda Bay, Palawan
11:30-11:40	**Maria Corazon R. Collantes**	Socio-Economic Profile Of Penshell (*Atrina pecinata*) Fishers And Assessment Of Fisheries Vulnerability In Sorsogon City, Philippines
11:45-11:55	**Kenneth M. Panganiban**	Assessment of Competencies and Training Needs of Agritourism Extension Workers in Puerto Princesa City, Palawan
13:00-13:10	**Evelyn Palañigo**	Climate Change Adaptation Strategies Employed By Small-Scale Rice Farmers In Barangay Burirao, Narra, Palawan
13:15-13:25	**Niño Jess Mar F. Mecha**	Reports of Dead Marine Mammals in the Coastal Water of Culion, Northern Palawan, Philippines

Parallel Session 2: Health, Environment, and Community Well-being

Time	Presenter	Title
10:00-10:10	**Ezekiel C. Remiendo**	Gut Microbial Profile of the Common Spider Conch (*Lambis lambis*) in Cowrie Island, Honda Bay, Palawan: Implication to Public Health
10:15-10:25	**John Lloyd T. Abrea**	Stories of Resilience Among Mothers Affected By a Fire Incident
10:30-10:40	**John Andrei B. Sanchez**	Antibiotic-Resistant Bacteria and Microplastic Contamination in Blood Cockles (*Anadara* sp.) from Cowrie Island, Puerto Princesa City, Palawan
10:45-10:55	**Aiko C. Pascubillo**	Challenges Encountered By Female Officers Of Puerto Princesa City Police Office

11:00-11:10	**Edgar P. Paalan**	Little Wanderers in Recreational Waters: Seasonal Dynamics of Phytoplankton Communities and Potentially Toxic Species in Bacuit Bay, El Nido, Palawan
11:15-11:25	**Jomel G. Baobao**	The Impact of Concepcion-Sagrada-Bogtong Marine Reserve on Community Well-Being
11:30-11:40	**Hannah Palma**	Wildlife Trading in Selected Barangays of Puerto Princesa City
11:45-11:55	**Genesis A. Peñaflor**	Barangay Development Plan In El Nido Palawan
13:00-13:10	**Ronald T. Magbanua**	Barangay Parliamentary Procedures in Puerto Princesa City, Palawan
13:15-13:25	**Gloria Placido Gonzales**	Welfare And Development Programs for Inmates or Persons Deprived of Liberty at The Bureau of Jail Management and Penology (BJMP)
13:30-13:40	**Cecilia F. Malolos**	Decoding Gen Z: Structural equation modeling of attitudes, intentions, and behaviors toward environmental sustainability

Parallel Session 3: Integrated Research, Innovation, and Development

Time	Presenter	Title
10:00-10:10	**Fheter John B. Calanday**	WildALERT: Design and Nationwide Implementation of a Digital Intelligence System for Enhancing Wildlife Crime Reporting in the Philippines
10:15-10:25	**Romelyn T. Dacanay**	The Traditional Dances Of The Tagbanua: Basis For Cultural Preservation
10:30-10:40	**Shena Mae T. Garpeza**	Exploring Sound Patterns in the Batak Language: A Phonological Analysis of an Endangered Language in Palawan
10:45-10:55	**Aira Joy G. Decierto**	Students' Knowledge On The Process for Filing Cybercrime Incidents
11:00-11:10	**Marevic P. Zabanal**	Influence of Social Media on Investigation
11:15-11:25	**Anna Rose L. David**	Linguistics Flair: A Comparative Study of Morphological Construction in Popular and Cuyonon Swardspeak
11:30-11:40	**Rizel Ann Benoja Sonio**	Emergency Response Of Barangay Irawan Puerto Princesa City, Palawan
11:45-11:55	**Abba Hilary B. Abuel**	Online Shopping Experience: Basis Against Scam Victimization
13:00-13:10	**Leah Mae M. Damasco**	Barangay Justice System in Taytay, Palawan
13:15-13:25	**Rhea D. Juab**	Records Management System of the Department of Environment and Natural Resources - Palawan
13:30-13:40	**Marcus Miguel A. Bruno**	Analysis Of Internal Migration in Brooke's Point, Palawan: Implications for Policy Formulation (2025)
13:45-13:55	**Jerald J. Cena**	Capabilities of Barangay Police Security Officers (BPSO) in the Maintenance of Peace and Order in Barangay San Pedro, Puerto Princesa City
14:00-14:10	**Karen Salve M. Maute**	Statistical competency of Grade 12 senior high school learners in selected secondary schools in Palawan
14:15-14:25	**Cynthia A. Tucay**	Service Delivery of Barangay Officials in Barangay Babuyan, Puerto Princesa City
14:30-14:40	**Emmalyn T. Venturillo**	"Optimizing University Canteen Operations Using Queuing Theory: A Multi-Counter Service Analysis"

Poster Presentations

Session 1 - Agriculture, Aquatic, and Natural Resources	
Shiela Mae M. Lindog	Production and Quality Assessment of Lemongrass Powder from Stalk and Leaf Using Different Drying Methods
Allysa B. Casibo	Physicochemical Drivers and Temporal Dynamics of Red Tide Events in Batan Bay Estuary, Aklan, Philippines

Session 2 - Health, Environment, and Community Well-being	
Anne Gellie P. Pablo-Limco,	A Functional Sip: Development of Calamansi-Flavored Black Rice Infusion Beverage
Ivy A. Magbanua	Pagtatangkal: A Narrative Inquiry into Youth Livelihood, Cultural Identity, and Experiences in Traditional Fishing
Avien Ynna M. Hasan	Spatiotemporal Variation in Coliform Load and Presence of Putative Pathogenic Bacteria in Recreational Waters of Palawan
Emalyn J. Sahawi	Composition and Spatial Distribution of Potentially Toxic Phytoplankton and Dynamics of Water Quality in Recreational Waters in Palawan, Philippines

Session 3 – Integrated Research, Innovation, and Development	
Marlon D. Flores	Perceptive Approach on Mathematical Creativity Strategies to Enhance Problem Solving and Comprehension Skills
Carlah Faye N. Badilla	From Banana By-Products to Market Opportunities: Technology Transfer of Banana Energy Bar and Banana Peel Liquor for Cooperative Enterprise Development in Palawan
Sittie Hashima R. Umpar	Effects of taro root crops (*Alocasia macrorrhizos*) with rice husk ash (RHA), and silica sand on soil erosion control

Message from the University President

Let me deviate from the usual formal publication messages by starting with these lyrics from Dua Lipa's song, "Levitating:"

"If you wanna run away with me, I know a galaxy and I can take you for a ride."

As the lyrics said, the RIDE Conference can help us run away a bit from our regular life, and take a "RIDE" farther and deeper into the big and small corners of the galaxies that WPU has uncovered this year.

The next lyrics go: "I had a premonition that we fell into a rhythm

Where the music don't stop for life

Shining just the way I like

Glitter in the sky, glitter in my eyes", In the realm of research, innovation, development, and extension, WPU has been building a steady rhythm, steadily shining and glittering in MIMAROPA and all of the Philippines.

In 2024, WPU was hailed as the SOLE winner of the Global Health Focus's "Top Performing MIMAROPA Universities in Research Production in 2024" for being the ONLY MIMAROPA University with Scopus indexed Publications that year. This title was also still defended by WPU in 2025 after producing 224 Scopus-indexed research outputs in the last 5 years. Because of this research productivity, WPU was recently awarded the prestigious Research Productivity Award at the 3rd National Research Congress of the Philippines.

Our very own research journal, the Palawan Scientist, is one of only 27 Scopus indexed journals in the Philippines. It is also ranked 7th among 16 Philippine journals in the 2024 Clarivate Journal Citation Reports.

On Innovation, WPU is home to the ONLY Metals Engineering and Innovation Center and ONLY Additive Manufacturing Center in MIMAROPA.

Needless to say, we are the leading University for research in MIMAROPA. Research is our way of collecting galaxy's glitter, and WPU is shining full of glitter! WPU deserves to see that glitter right before our eyes. This Conference has done just that: Glitter in the sky, glitter in my eyes. Shining just the way I like. And with this Conference, the rhythm music of research excellence doesn't stop for life.

Which leads me to the last line: "If you're feeling like you need a little bit of company, you met me at the perfect time"

This Conference did not just bring the glitter of research closer to our eyes, it also brought us...each other. The 45 undergraduate, 7 graduate, and 22 Professional presenters in the MAIN CAMPUS ALONE added up to 73 researches, 73 pieces of the galaxy's glittering pieces.

These studies are all here now in this journal, put together as puzzle pieces to get a clearer view of the galaxies, and hopefully to inspire each other in what other puzzle pieces we can uncover individually, or together.

I hope that upon finishing this journal, you get inspired by all the glitter that our researchers presented, and be ready to work on new research ideas and collaboration.

Congratulations to everyone who made the RIDE Conference 2026 possible!

To God be all the Glory.

Amabel S. Liao, PhD
WPU President

Message from the VP RIDE

It is my pleasure to welcome everyone to this year's WPU RIDE Annual Conference.

This year's conference, anchored on the theme "**Integrating Science, Education, and Governance for Sustainable Development: Advancing Knowledge, Resources, and Resilience**," underscores the importance of interdisciplinary collaboration in addressing the complex challenges of sustainable development. It reflects Western Philippines University's continuing commitment to generating knowledge, fostering innovation, and strengthening partnerships that contribute to the well-being of our communities and the nation.

This annual conference has become an important platform for showcasing the scholarly and creative endeavours of our faculty, researchers, staff, and students. It also highlights the University's vibrant research culture by providing opportunities to disseminate research findings, exchange ideas, and cultivate meaningful academic collaborations. This year's conference brings together participants from all seven colleges of the University through both oral and poster presentations, reflecting the breadth and diversity of research being undertaken across disciplines.

For our student researchers, this conference offers a valuable opportunity to strengthen research competencies, build confidence in scholarly communication, and engage with experts and fellow researchers. Beyond the recognition accorded to outstanding presentations, participation in this conference provides an important foundation for representing the University in regional, national, and even international research engagements.

The University likewise remains steadfast in expanding opportunities for research, innovation, and extension. Building on the momentum of this conference, succeeding initiatives will continue to provide venues for learning, collaboration, and the translation of research into meaningful innovations and community impact. Together, these efforts reinforce Western Philippines University's vision of becoming a leading institution in knowledge generation and sustainable development.

As this first WPU Conference Proceedings document the scholarly contributions presented during the conference, may they serve as a lasting testament to the dedication, creativity, and excellence of our researchers. May the studies contained in this volume inspire further inquiry, strengthen interdisciplinary collaboration, and encourage evidence-based solutions to the pressing issues confronting our society.

My sincere appreciation goes to the members of the Research, Innovation, Development, and Extension (RIDE) Department and the College of Education, this year's host; the conference committees; mentors; presenters; reviewers; and all participants whose collective efforts have made this event possible. Your commitment to advancing research and academic excellence continues to strengthen the University's mission of serving society through knowledge, innovation, and public service.

May this conference and its proceedings inspire all of us to pursue research with excellence, integrity, and purpose for the benefit of our communities, our nation, and future generations.

Thank you, and I wish everyone a meaningful and productive conference.

Lota A. Creencia, PhD
Vice President for Research, Innovation, Development, and Extension

Message from Dean of College of Education

On behalf of the College of Education, it is my honor and privilege to extend warm greetings to all presenters, researchers, faculty members, students, and guests of the RIDE Annual Conference 2026 of Western Philippines University.

As co-host of this meaningful academic gathering, the College of Education proudly joins the Department of Research, Innovation, Development and Extension (RIDE) in celebrating this year's conference theme: "Integrating Science, Education, and Governance for Sustainable Development: Advancing Knowledge, Resources, and Resilience." This timely and relevant theme highlights the importance of interdisciplinary collaboration in addressing today's complex challenges and building a more sustainable and resilient future for our communities.

The paper and poster presentations featured in this conference demonstrate the dedication, creativity, and scholarly excellence of our researchers and innovators. These contributions not only expand knowledge but also promote practical solutions, informed policies, and transformative educational practices. Through these presentations, we see the power of research in driving innovation, empowerment, and sustainable development.

May this conference inspire meaningful discussions, productive collaborations, and continued engagement in research and extension initiatives that create lasting impact. Congratulations to the organizers, presenters, and everyone whose hard work has contributed to the success of this event.

Together, may we continue building knowledge-driven, resource-responsive, and resilient communities.

Mary Jane D. Gamozo, PhD
Dean, College of Education

About the Keynote Speaker

Dr. Hernando P. Bacosa is a Professor of Environmental Science at Mindanao State University–Iligan Institute of Technology (MSU-IIT) and the founding Campus Director of the MSU Extension Campus in Bataraza, Palawan. He earned his Bachelor of Science in Biology from Mindanao State University–Marawi, where he graduated *Magna Cum Laude,* as Class Valedictorian, and a University Student Leadership Awardee. He subsequently obtained his Master of Science and Doctor of Philosophy in Environmental Studies, specializing in Environmental Chemistry and Microbiology, from Tohoku University, Japan.

Born and raised in Brooke's Point, Palawan, Dr. Bacosa completed his secondary education at the Palawan National Agricultural College-Agricultural Science High School (PNAC-ASHS) now Western Philippines University, where he graduated as class valedictorian. His academic and professional career reflects an interdisciplinary foundation in environmental science and pollution research.

Dr. Bacosa's research focuses on the chemistry and microbiology of marine oil spills, bioremediation, sustainable polymers, wastewater treatment, solid waste management, and macroplastic and microplastic pollution. He also completed an internship at the Secretariat of the United Nations Convention to Combat Desertification (UNCCD) in Bonn, Germany.

He served for more than seven years as a postdoctoral research scientist at the University of Texas at Austin and Texas A&M University in the United States, where he conducted interdisciplinary studies on the 2010 *Deepwater Horizon* oil spill and the 2014 Texas City "Y" oil spill. Prior to joining MSU-IIT, he was a recipient of the Department of Science and Technology (DOST) Balik Scientist Program, with Mindanao State University–Naawan and Western Philippines University serving as his host institutions.

Dr. Bacosa has authored more than 140 peer-reviewed scientific publications on oil-spill chemistry and microbiology, as well as on macroplastic and microplastic pollution. He was recognized as the top publishing faculty member of MSU-IIT, producing 23 Scopus-indexed publications in 2024 and 30 publications in 2025.

Dr. Bacosa has played a pivotal role in national environmental emergency response efforts. As the DOST Lead Expert for the 2023 Oriental Mindoro Oil Spill and the 2024 Manila Bay Oil Spill, he provided scientific and technical guidance to local government units, national government agencies, emergency response teams, and international organizations.

His contributions to science have earned him numerous prestigious recognitions, including the **Gawad Chancellor sa Natatanging Guro ng Pamantasan sa Larangan ng Pananaliksik sa Agham at Teknolohiya** of MSU-IIT and the **Japan Society for the Promotion of Science (JSPS) Outstanding Filipino Fellow Award** in 2023. In 2024, he received the **National Academy of Science and Technology (NAST) Environmental Science Award** for his pioneering research on atmospheric microplastics in the Philippines.

Widely recognized as one of the country's foremost experts on oil spills and environmental pollution, Dr. Bacosa is a sought-after media resource person on environmental issues. In 2025, he was named to the prestigious **Asian Scientist 100**, which recognizes Asia's most outstanding and influential researchers for their significant contributions to science and innovation.

Gist of the Message of Dr. Hernando P. Bacosa

Opening Remarks

Dr. Hernando P. Bacosa opened his message by extending his warm congratulations to the Research, Innovation, Development, and Extension (RIDE) team for successfully conducting its second research conference. He commended the remarkable efforts of Western Philippines University (WPU) in fostering a vibrant research culture and encouraged the institution to further strengthen its research initiatives while maintaining a balanced commitment to its three core mandates—instruction, research, and extension. Drawing from the experience of the Mindanao State University–Iligan Institute of Technology (MSU-IIT), he shared the value of dedicating an entire Research Week to scholarly activities and expressed the hope that WPU would adopt a similar practice.

About MSU-IIT

Dr. Bacosa introduced MSU-IIT as a relatively young institution, established about 6 decades ago, yet distinguished by its significant academic achievements. Despite occupying only 11 hectares, the university serves more than 30,000 students and has approximately 600 faculty members. He highlighted that MSU-IIT is the only university outside Luzon recognized in the physics and environmental sciences category of the recent *Times Higher Education World University Rankings*, emphasizing that research productivity—including funded projects, publications, conference presentations, and citations—accounts for a substantial portion of the ranking criteria.

Academic and Professional Journey

Reflecting on his academic journey, Dr. Bacosa shared that he grew up in Palawan and studied at Palawan National Agricultural College- Agricultural Science High School (PNAC-ASHS, now WPU) before completing his undergraduate education at MSU Marawi. His pursuit of advanced studies led him to Japan, where he completed his master's degree, doctoral studies, and postdoctoral research, followed by specialized training in Germany and research appointments at the University of Texas and Texas A&M University. These international experiences reinforced his conviction that complex environmental problems cannot be addressed by a single discipline alone but require the collective expertise of biologists, chemists, geologists, medical scientists, engineers, and social scientists through interdisciplinary collaboration.

Addressing the Triple Environmental Crisis

Dr. Bacosa emphasized that the world is currently confronting a "triple crisis" consisting of climate change, biodiversity loss, and pollution. He explained that climate change is primarily driven by rising carbon dioxide emissions from transportation, industrial activities, and deforestation, resulting in warming oceans, coral degradation, declining fish populations, melting polar ice, and rising sea levels. He further noted that the Philippines remains most vulnerable to climate change due to its geographic location and extensive coastal communities, while recognizing that developing nations often have fewer resources for adaptation than wealthier countries.

Focusing on plastic pollution, Dr. Bacosa described it as one of the most pressing environmental challenges today. Citing global statistics, he noted that China generates approximately 8.8 million metric tons of plastic waste annually, followed by Indonesia with 3.2 million metric tons and the Philippines with 1.9 million metric tons. Rather than viewing these figures solely as alarming, he challenged researchers to recognize them as opportunities for meaningful scientific investigation and innovation.

Plastic Pollution Research: From Discovery to Action

Dr. Bacosa highlighted the extensive work of his research group in investigating plastic pollution across diverse ecosystems, including the atmosphere, forests, mountains, rivers, lagoons, beaches, coral reefs, seagrass beds, marine waters, and even the human body. Research conducted in Puerto Princesa revealed that 76% of surveyed beaches were heavily contaminated with plastic debris, while studies in Metro Manila detected airborne plastic particles. He underscored that these scientific findings prompted local government interventions, demonstrating how research can generate evidence to inform policy and support effective environmental management.

Oil Spill Investigation and Fisheries Protection

As an illustration of science informing public policy, Dr. Bacosa recounted his role as a scientific adviser to the Philippine government during the MT *Princess of the Orient* oil spill incident in Mindoro. Using oil fingerprinting techniques, his research team successfully traced oil contamination in Palawan waters, approximately 400 km from the spill site, and confirmed its origin through chemical analysis.

More importantly, the scientific evidence demonstrated that widespread fishing restrictions were unnecessary because contaminant levels in fish and seawater remained below toxic thresholds. Based on these findings, Dr. Bacosa recommended limiting fishing bans only to affected areas rather than imposing blanket restrictions. This evidence-based approach protected both marine resources and the livelihoods of fishing communities, illustrating the transformative role of scientific research in addressing environmental and socioeconomic concerns.

Pathways Toward Sustainable Solutions

Looking ahead, Dr. Bacosa presented several promising strategies for addressing plastic pollution. These included developing biodegradable plastics from seaweed, an abundant resource in Palawan, expanding the traditional 3R framework (Reduce, Reuse, Recycle) into a 6R approach by incorporating Remake, Repair, and Refuse, promoting nature-based wastewater treatment systems such as constructed wetlands, and embracing circular economy principles that maximize the value and lifespan of plastic materials.

Building Expertise Through Collaboration

Dr. Bacosa emphasized that genuine scientific expertise requires years of sustained learning, research, mentorship, and practical experience. He noted that developing deep specialization typically takes 5 to 10 years, comparable to the extensive training required in professional fields such as medicine. Drawing from collaborations across more than seventy countries and partnerships with researchers from Japan, Taiwan, Hong Kong, the United States, and Europe, he stressed that environmental challenges transcend national boundaries and therefore demand international cooperation. He likewise underscored the importance of mentoring future researchers who will continue advancing scientific knowledge globally.

A Vision for the Future

In concluding his address, Dr. Bacosa acknowledged that while science has contributed to environmental challenges such as plastic pollution, it also provides the knowledge and innovation necessary to overcome them. He called for research that is transparent, accessible, and responsive to the needs of policymakers and communities, while encouraging the responsible use of technology to pursue the Sustainable Development Goals. Finally, he challenged students, faculty members, and researchers to embrace science, strengthen interdisciplinary collaboration, and work collectively across generations and national boundaries to build a more sustainable future.

List of Full Papers

Abstract Presentations

Green Spaces in WPU Main Campus: Refugia for Endemic and Conservation-Priority Birds and Mammals

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ABSTRACT

This study explores the ecological role of the green spaces within the Western Philippines University (WPU) Main Campus as refugia for endemic and conservation-priority birds and mammals amid increasing anthropogenic pressures on the surrounding landscape. Specifically, it evaluates the bird and mammal assemblages utilizing these green spaces, with emphasis on species diversity and the presence of endemic and conservation-priority species. Wildlife surveys employed transect counts, mist netting, cage trapping, visual encounter surveys, and opportunistic observations. Data collection was conducted from August 2022 to September 2025. Ecological analyses included species richness, relative abundance, Shannon-Wiener diversity index, Pielou's evenness index, frequency, and averages. The survey recorded 119 bird and mammal species, including 21 endemic species, 10 endemic subspecies, and 30 conservation-priority species. These findings demonstrate that the green spaces within the WPU Main Campus support high wildlife diversity, including endemic, migratory, and conservation-priority species, emphasizing their role in both local and broader biodiversity conservation. The campus green spaces also supported 27 species of migratory birds, highlighting its role as a staging and overwintering habitat along the East Asian–Australasian Flyway. Consequently, conserving these areas is essential for sustaining wildlife populations in human-dominated landscapes. It is recommended that WPU strengthen policies for the expansion and enhancement of green spaces through sustainable landscaping practices, such as the use of native flora, reduced pesticide application, and the installation of wildlife-friendly structures. Other institutions are likewise encouraged to establish and maintain green spaces to support biodiversity conservation.

Keywords: biodiversity, ecosystem function, habitat loss, landscape ecology

INTRODUCTION

Habitat loss, driven largely by human activities, is one of the most critical threats to global wildlife diversity. It occurs when natural environments are cleared, degraded, or fragmented due to urbanization, agriculture, industrial development, and infrastructure expansion. This process drastically reduces suitable wildlife habitats and disrupts the ecological balance and connectivity of ecosystems (Hefty and Koprowski 2021; Lwankomezi and Kaganga 2024). In areas severely affected by habitat loss, the remaining fragments of vegetation play a crucial role in supporting extant wildlife populations. These landscape patches function as refugia, providing food, shelter, and breeding sites that help sustain biodiversity within human-dominated landscapes (Galo et al. 2017). Such vegetated fragments, particularly those found in developed and urban environments, are commonly referred to as green spaces. Apart from their role in supporting wildlife, green spaces perform other essential ecosystem functions and provide a wide range of goods and services to local communities. Their vegetation helps cool surrounding environments, improve air quality, and enhance water quality (Ramaiah and Avtar 2019; U.S. Environmental Protection Agency 2021), while also offering aesthetic and recreational benefits that contribute to improved quality of life and human well-being (Jabbar et al. 2021).

Academic institutions located in urban and settlement areas usually have vast natural spaces sprawling among the patches of their building facilities. Unlike other urban spaces that experience significant degradation due to human activity and development, green spaces within educational campuses are typically safeguarded from intensive anthropogenic pressures. In some academic institutions, green spaces host ecologically diverse habitats that serve as critical refugia for native flora and fauna, many of which are endemic and conservation priority species (Sanilorente et al. 2023).

Academic institutions often integrate green spaces into their campus design to promote environmental sustainability. These efforts help conserve ecologically important areas and mitigate the impacts of urbanization on local biodiversity. In academic settings, these spaces typically experience less degradation than other urban landscapes due to institutional policies aimed at preserving them. Additionally, they often receive active management and preservation efforts, which help maintain their ecological integrity and minimize human disturbance.

Research has shown that green spaces in universities tend to provide more stable environments for wildlife compared to other community parks or areas that experience higher levels of human activity, construction, and pollution (Ong et al. 1999; Obana and Buot 2025). The relatively low levels of degradation and disturbance in these spaces make them more effective at supporting endemic and conservation priority species that are particularly sensitive to habitat loss.

In this regard, the green spaces on the Western Philippines University (WPU) Main Campus, which feature diverse ecological characteristics and habitat types, have strong potential to function as refugia for endangered and conservation-priority species that are becoming increasingly rare in surrounding areas due to ongoing anthropogenic pressures. However, studies on the extent to which these green spaces support wildlife diversity, particularly endemic and conservation-priority species, remain limited. Hence, this study was conducted to explore how the green spaces within the WPU Main Campus contribute to biodiversity conservation, focusing specifically on their role as habitats for wildlife species. Specifically, it aims to determine the wildlife assemblages utilizing these green spaces by assessing species richness, abundance, Shannon–Wiener diversity index, and Pielou's evenness. Additionally, the study evaluates the presence of endemic and conservation-priority species among birds, mammals, amphibians, and reptiles.

METHODS

Time and Place of the Study

The study was conducted at the Western Philippines University (WPU) Main Campus in Aborlan, Palawan, over a three-year period from August 2022 to September 2025.

Research Design

This study employed a descriptive-longitudinal survey design to assess the wildlife biodiversity in the green spaces of WPU across wet and dry seasons over a three-year period. The design integrates a combination of both quantitative and qualitative approaches through standardized and opportunistic field sampling methods to provide a comprehensive assessment of species composition and distribution.

Field data were collected using multiple complementary techniques, including standard transect walks, visual encounter surveys (VES), mist netting, cage trapping, and opportunistic data observation such as spotlighting and audio surveys were also employed to confirm the presence of secretive, skulking and cryptic species. Incidental records of captured, road killed, and photo documented wildlife in the vicinity were also noted.

Sampling was conducted during both the wet and dry seasons over a period of three years to capture temporal variations in species occurrence, abundance, and activity patterns. This repeated seasonal sampling allowed for the analysis of biodiversity trends and potential seasonal influences on wildlife distribution.

Data Collection

The study used two1-kilometer transect lines, strategically laid across the WPU main campus, passing through different green spaces identified for this study. The transect lines served as references for observing birds and mammals. The purpose of this method was to observe and document species occurrence, distribution, and abundance across the campus.

The wildlife survey was conducted along the established transect routes. During the transect walk survey, all birds and mammals detected using visual and auditory cues were identified, photo-documented, and recorded. Audio recordings of ambient noise in selected habitats along the transects were also made to verify the presence of vocal wildlife species (Schaub et al. 2011).

The transect walk survey during the day was conducted in the morning between 0600H and 1000H, and in the afternoon between 1500H and 1800H. Another transect count was conducted at night to observe nocturnal species. This was carried out in the evening between 1800H and 2100H (Barton et al. 2010).

Active searching for wildlife and signs of their presence, such as feathers, nests, roosting areas, droppings, quills, burrows, and tracks, was also conducted in different habitat types along the transect routes (Veith et al. 2004). This method was employed because it is effective in detecting shy, skulking, and cryptic or well-camouflaged species that may not be easily observed through conventional transect walk surveys.

Opportunistic observations were also made throughout the study. These observations were recorded whenever the researcher encountered bird and mammal species outside the survey period or just outside the designated survey area. This informal method provided valuable data on the presence of species that were not the primary focus of the formal surveys (Tulloch et al. 2013).

Data Analysis

The data were analyzed using descriptive biological statistics, including species richness, relative abundance, Shannon-Wiener diversity index (Shannon 1948), and Pielou's evenness index, frequency, and averages. The level of endemism of birds and mammals were based on existing literatures, while their conservation status was determined using the Red List of Threatened Species by the International Union for the Conservation of Nature (IUCN), and PCSD Resolution No. 15-521 by the Palawan Council for Sustainable Development (PCSD).

RESULTS

Bird and Mammal Assemblage

The wildlife surveys conducted in the green spaces of the WPU Main Campus during both wet and dry seasons from 2022 to 2025 recorded 1,308 individuals belonging to 119 species from 62 families (Table 1). Avifauna exhibited higher species richness and abundance, comprising 929 individuals from 103 species distributed across 40 families. In contrast, mammals were represented by 379 individuals comprising 16 species distributed across 12 families (Table 2).

The green spaces of the WPU Main Campus in Aborlan, Palawan supported a high level of bird and mammal diversity from 2022 to 2025, as reflected in both seasonal and overall survey results. A total of 119 species were recorded across the entire study period, with species richness notably higher during the wet season (113 species) compared to the dry season (72 species). Similarly, abundance also followed the same pattern, among the total of 1,308 individual wildlife encounters, the wet season had greater proportion (779 individuals) than the dry season (529 individuals).

Seasonal diversity analysis further highlights the ecological importance of the campus green spaces. The Shannon–Wiener Diversity Index (H') was higher in the wet season (H' = 4.73) compared to the dry season (H' = 4.27), indicating greater species diversity during periods of higher moisture availability. The overall diversity index (H' = 4.78) still reflects a highly diverse community, suggesting that the campus consistently supports a

Table 1. Families, common names, scientific names, endemism and conservation status of birds and mammals recorded in the green spaces of WPU Main Campus, Aborlan, Palawan from 2022 to 2025 (**Legend:** *R – Resident Species, R* – Resident with Palawan Endemic Subspecies, PHES – Philippine Endemic Species, PHES* – Palawan Endemic Species, M – Migratory, NoE – Not Evaluated, LC – Least Concern, NT – Near Threatened, V – Vulnerable, E – Endangered, CE – Critically Endangered*.

Family	Common Name	Scientific Name	Endemism	IUCN	PCSD 15-521
Avifauna					
Accipitridae	Crested Serpent-Eagle	*Spilornis cheela palawanensis*	R*	LC	E
Accipitridae	Crested Goshawk	*Accipiter trivirgatus palawanus*	R*	LC	E
Accipitridae	White-Bellied Sea Eagle	*Haliaeetus leucogaster*	R	LC	E
Aegithinidae	Common Iora	*Aegithina tiphia*	R	LC	LC
Alcedinidae	Oriental Dwarf Kingfisher	*Ceryx erithaca*	R	LC	LC
Alcidinidae	Blue-Eared Kingfisher	*Alcedo meninting*	R	LC	LC
Alcedinidae	Common Kingfisher	*Alcedo atthis*	M	LC	LC
Alcidinidae	Stork-Billed Kingfisher	*Pelargopsis capensis*	R	LC	LC
Anatidae	Wandering Whistling Duck	*Dendrocygna arcuata*	R	LC	LC
Ardeidae	Intermediate Egret	*Egretta intermedia*	M	LC	LC
Ardeidae	Eastern Cattle Egret	*Bubulcus coromandus*	M	LC	LC
Ardeidae	Little Egret	*Egretta garzetta*	M	LC	LC
Ardeidae	Great Egret	*Ardea alba*	M	LC	LC
Ardeidae	Striated Heron	*Butorides striata*	R	LC	LC
Ardeidae	Cinnamon Bittern	*Ixobrychus cinnamomeus*	R	LC	LC
Ardeidae	Black Crowned Night Heron	*Nycticorax nycticorax*	R	LC	LC
Ardeidae	Rufous Night Heron	*Nycticorax caledonicus*	R	LC	LC
Ardeidae	Grey Heron	*Ardea cinerea*	M	LC	LC
Ardeidae	Purple Heron	*Ardea purpurea manilensis*	R	LC	LC
Artamidae	White-Breasted Woodswallow	*Artamus leucorynchus leucorynchus*	R	LC	LC
Caprimulgidae	Large-Tailed Nightjar	*Caprimulgus macrurus*	R	LC	LC
Campephagidae	Pied Thriller	*Lalage nigra nigra*	R	LC	LC

Campephagidae	Ashy Minivet	*Pericrocotus divaricatus*	M	LC	LC
Charadriidae	Pacific Golden Plover	*Pluvialis fulva*	M	LC	LC
Charadriidae	Little Ringed Plover	*Charadrius dubius*	M	LC	LC
Charadriidae	Greater Sand Plover	*Anarhynchus leschenaultii*	M	LC	LC
Charadriidae	Kentish Plover	*Charadrius alexandrinus*	M	NT	LC
Cisticolidae	Rufous-Tailed Tailorbird	*Orthotomus sericeus*	R	LC	LC
Cisticolidae	Zitting Cisticola	*Cisticola juncidis nigrostriatus*	R	LC	LC
Columbidae	Spotted Neck Dove	*Spilopelia chinensis*	R	LC	LC
Columbidae	Zebra Dove	*Geopelia striata*	R	LC	LC
Columbidae	Pink-Necked Green Pigeon	*Treron vernans*	R	LC	LC
Columbidae	Black-Chinned Fruit Dove	*Ptilinopus leclancheri*	R*	LC	V
Columbidae	Common Emerald-Dove	*Chalcophaps indica*	R	LC	LC
Columbidae	Reddish Cuckoo-Dove	*Macropygia tenuirostris*	R	LC	LC
Corvidae	Palawan Crow	*Corvus pusillus*	PHES*	LC	LC
Cuculidae	Chestnut-Breasted Malkoha	*Phaenicophaeus curvirostris*	R	LC	LC
Cuculidae	Square-Tailed Drongo-Cuckoo	*Surniculus lugubris brachyurus*	R	LC	LC
Cuculidae	Plaintive Cuckoo	*Cacomantis merulinus*	R	LC	LC
Cuculidae	Sunda Brush Cuckoo	*Cacomantis sepulcralis*	R	LC	LC
Cuculidae	Asian Koel	*Eudynamys scolopaceus*	R	LC	LC
Cuculidae	Greater Coucal	*Centropus sinensis*	R	LC	LC
Cuculidae	Lesser Coucal	*Centropus bengalensis javanensis*	R	LC	LC
Dicaeidae	Pygmy Flowerpecker	*Dicaeum pygmaeum palawanorum*	R*	LC	LC
Dicaeidae	Palawan Flowerpecker	*Prionochilus plateni*	PHES*	LC	V
Dicruridae	Hair-Crested Drongo	*Dicrurus hottentottus palawanensis*	R*	LC	LC
Dicruridae	Ashy Drongo	*Dicrurus leucophaeus leocophaeus*	R	LC	LC
Estrildidae	Chestnut Munia	*Lonchura atricapilla*	R	LC	LC
Estrildidae	Scaly-Breasted Munia	*Lonchura punctulata cabanisi*	R	LC	LC
Estrildidae	White-Bellied Munia	*Lonchura leucogastra palawana*	R	LC	LC
Hirundinidae	Barn Swallow	*Hirundo rustica*	M	LC	LC
Laniidae	Brown Shrike	*Lanius cristatus*	M	LC	LC
Laridae	Whiskered Tern	*Chlidonias hybrida*	M	LC	LC
Locustellidae	Striated Grassbird	*Megalurus palustris forbesi*	R	LC	LC
Monarchidae	Blue-Paradise Flycatcher	*Terpsiphone cyanescens*	PHES*	NT	V
Monarchidae	Black-Naped Monarch	*Hypothymis azurea azurea*	R	LC	LC
Motacillidae	Paddy Field Pipit	*Anthus rufulus lugubris*	R	LC	LC
Motacillidae	Grey Wagtail	*Motacilla cinerea*	M	LC	LC
Motacillidae	Yellow Wagtail	*Motacilla flava*	M	LC	LC
Motacillidae	Forest Wagtail	*Dendronanthus indicus*	M	LC	LC
Muscicapidae	White-Vented Shama	*Copsychus niger*	PHES*	LC	V
Muscicapidae	Palawan Blue Flycatcher	*Cyornis lemprieri*	PHES*	NT	V
Muscicapidae	Mangrove Blue Flycatcher	*Cyornis rufigastra*	R	LC	LC
Muscicapidae	Grey-Streaked Flycatcher	*Muscicapa griseisticta*	M	LC	LC
Nectariniidae	Pale Spiderhunter	*Arachnothera dilutior*	PHES*	LC	V
Nectariniidae	Palawan Sunbird	*Cinnyris aurora*	PHES*	LC	LC
Nectariniidae	Brown-Throated Sunbird	*Anthreptes malacensis paraguae*	R*	LC	LC
Nectariniidae	Purple-Throated Sunbird	*Leptocoma sperata*	R	LC	LC
Passeridae	Eurasian Tree Sparrow	*Passer montanus*	R	LC	LC
Pellorneidae	Ashy-Headed Babbler	*Malacocincla cinereiceps*	PHES*	LC	V

Picidae	Spot-Throated Flameback	*Dinopium everetti*	PHES*	NT	V
Picidae	White-Bellied Woodpecker	*Dryocopus javensis*	R*	LC	V
Picidae	Red-Headed Flameback	*Chrysocolaptes erythrocephalus*	PHES*	E	E
Picidae	Great Slaty Woodpecker	*Mulleripicus pulverulentus*	R	V	V
Pittidae	Hooded Pitta	*Pitta sordida*	R	LC	LC
Podargidae	Palawan Frogmouth	*Batrachostomus chaseni*	PHES*	NA	V
Psittaculidae	Blue-Naped Parrot	*Tanygnathus lucionensis salvadorii*	R	NT	CE
Psittaculidae	Blue-Headed Raquet Tail	*Prioniturus platenae*	PHES*	V	E
Psittaculidae	Red Vented Cockatoo	*Cacatua haematuropygia*	PHES	CE	CE
Pycnonotidae	Palawan Bulbul	*Alophoixus frater*	PHES*	LC	V
Pycnonotidae	Ashy-Fronted Bulbul	*Pycnonotus cinereifrons*	PHES*	LC	LC
Pycnonotidae	Black-Headed Bulbul	*Pycnonotus atriceps*	R	LC	LC
Rallidae	White-Browed Crake	*Amaurornis cinerea*	R	LC	LC
Rallidae	Red-Legged Crake	*Rallina fasciata*	R	LC	LC
Rallidae	Buff-Banded Rail	*Hypotaenidia philippensis*	R	LC	LC
Rallidae	Common Moorhen	*Callinula chloropus*	R	LC	LC
Rallidae	Watercock	*Gallicrex cinerea*	R	LC	LC
Rallidae	White-Breasted Waterhen	*Amaurornis phoenicurus*	R	LC	LC
Recurvirostridae	Black-Winged Stilt	*Himantopus himantopus*	M	LC	LC
Rhipiduridae	Philippine Pied Fantail	*Rhipidura nigritorquis*	PHES	LC	LC
Rostratulidae	Greater Painted-Snipe	*Rostratula benghalensis*	R	LC	LC
Scolopacidae	Temminck's Stint	*Calidris temminckii*	M	LC	LC
Scolopacidae	Red-necked Stint	*Calidris ruficollis*	M	LC	LC
Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	M	LC	LC
Scolopacidae	Wood Sandpiper	*Tringa glareola*	M	LC	LC
Scolopacidae	Pectoral Sandpiper	*Calidris melanotos*	M	LC	LC
Scolopacidae	Marsh Sandpiper	*Tringa stagnatilis*	M	LC	LC
Scolopacidae	Common Greenshank	*Tringa nebularia*	M	LC	LC
Scolopacidae	Common Redshank	*Tringa totanus*	M	NT	LC
Strigidae	Spotted Wood Owl	*Strix seloputo wiepkeni*	R*	LC	E
Sturnidae	Asian Glossy Starling	*Aplonis panayensis*	R	LC	LC
Timaliidae	Pin-Striped Tit-Babbler	*Mixornis gularis woodi*	R*	LC	LC
Turnicidae	Barred Buttonquail	*Turnix suscitator haynaldi*	R*	LC	LC
Mammal					
Pteropodidae	Common Short-Nosed Fruit Bat	*Cynopterus brachyotis*	R	LC	LC
Pteropodidae	Dagger-Toothed Flower Bat	*Macroglossus minimus*	R	LC	LC
Pteropodidae	Giant Flying Fox	*Pteropus vampyrus*	R	NT	E
Megadermatidae	Common Asian Ghost Bat	*Megaderma spasma*	R	LC	LC
Hipposideridae	Diadem Roundleaf Bat	*Hipposideros diadema*	R	LC	LC
Muridae	Malaysian Field Rat	*Rattus tiomanicus*	R	LC	LC
Muridae	Polynesian Rat	*Rattus exulans*	R	LC	LC
Muridae	Asian House Rat	*Rattus tanezumi*	R	LC	LC
Tupaiidae	Palawan Tree Shrew	*Tupaia palawanensis*	PHES*	LC	E
Sciuridae	Northern Tree Squirrel	*Sundasciurus juvencus*	PHES*	LC	V
Cercopithecidae	Long-Tailed Macaque	*Macaca fascicularis philippensis*	R	E	E
Mustilidae	Oriental small-Clawed Otter	*Aonyx cinereus*	PHES*	V	E
Viverridae	Common Palm Civet	*Paradoxurus hermaphroditus*	R	LC	LC
Hystricidae	Palawan Porcupine	*Hystrix pumila*	PHES*	V	E
Felidae	Leopard Cat	*Prionailurus bengalensis heaneyi*	R	LC	E
Mephitidae	Palawan Stink Badger	*Mydaus marchei*	PHES*	LC	V

Table 2. Total number of families, species and individuals of different birds and mammals recorded in the green spaces of WPU Main Campus, Aborlan, Palawan from 2022 to 2025.

Taxonomic Level	Bird	Mammal	Total
Family	40	12	62
Species	103	16	119
Individuals	929	379	1308

Wide variety of species throughout the year. Finally, Pielou's Evenness Index (J') values were relatively high and comparable between seasons, with 0.88 in the wet season and 0.85 in the dry season, resulting in an overall evenness of 0.85 (Table 3).

Table 3. Seasonal trend in species richness, abundance, Shannon-Wiener Diversity Index, and Pielou's Evenness Index of birds and mammals recorded in the green spaces of WPU Main Campus, Aborlan, Palawan from 2022 to 2025.

Diversity Indicator	Wet Season	Dry Season	Over-all
Species Richness	113	72	119
Abundance	779	529	1308
Shannon-Wiener Diversity Index (H')	4.73	4.27	4.78
Pielou's Evenness Index (J')	0.88	0.85	0.84

From 2022 to 2025, wildlife diversity in the green spaces of the WPU Main Campus showed a slight declining trend in bird and mammal species richness, decreasing from 97 species in 2022–2023 to 92 species in 2024–2025. Abundance fluctuated moderately, with 444 individuals recorded in 2022–2023, decreasing to 429 in 2023–2024, and slightly increasing to 435 in 2024–2025 (Table 4).

Table 4. Temporal Trends in Species Richness, Abundance, Shannon–Wiener Diversity Index, and Pielou's Evenness Index of birds and mammals in the green spaces of WPU Main Campus, Aborlan, Palawan from 2022 to 2025.

Diversity Indicator	2022-2023	2023-2024	2024-2025
Species Richness	97	96	92
Abundance	444	429	435
Shannon-Wiener Diversity Index (H')	4.57	4.56	4.52
Pielou's Evenness Index (J')	0.87	0.87	0.87

Despite these changes, diversity remained relatively stable, as indicated by the Shannon–Wiener Index, which showed only a minimal decrease from 4.57 to 4.51 across the study period. Similarly, Pielou's Evenness Index remained consistently high (0.87), suggesting a fairly even distribution of individuals among species throughout the years.

Level of Endemism

A total of 119 bird and mammal species were recorded in the green spaces of WPU Main Campus from 2022 to 2025. Of these, 21 were endemic, including two Philippine endemic species, 19 Palawan endemic species, and 10 Palawan endemic subspecies (Table 5). Birds had the largest proportion of endemic taxa, with 26 of the 103 recorded species considered endemic at the species and subspecies levels. On the other hand, only five Palawan endemic species were recorded out of the total of 16 species.

Finally, it is worth noting that 27 species of birds are migratory and are present only during their overwintering season. The findings highlight the role of green spaces of WPU Main Campus as important habitats for both resident and overwintering migratory bird species. The results also emphasize the importance of this area as a staging and stopover site for migratory birds along the East Asian–Australasian Flyway.

Table 5. Number of endemic bird and mammal species recorded in the green spaces of WPU Main Campus, Aborlan, Palawan from 2022 to 2025.

Endemism	Number of Species		
	Bird	Mammal	Total
Philippine Endemic Species	2	0	2
Palawan Endemic Species	14	5	19
Palawan Endemic Subspecies	10	0	10
Resident Species	50	11	61
Migratory Species	27	0	27
Total	103	16	119

Conservation Status

In the context of this study, the conservation status presented was based on the highest priority status given by either IUCN or PCSD. Most bird and mammal species recorded in the WPU Main Campus green spaces

were classified as Least Concern (89 species), while 30 species were identified as conservation priorities, including 2 Critically Endangered, 12 Endangered, 14 Vulnerable, and two Near-Threatened species (Table 6). Birds accounted for the majority of conservation priority species, with 22 recorded species, while mammals were represented by eight conservation priority species.

Table 6. Number of conservation priority species of birds and mammals recorded in the green spaces of WPU Main Campus, Aborlan, Palawan from 2022 to 2025.

Conservation Status	Number of Species		
	Bird	Mammal	Total
Critically Endangered (CE)	2	0	2
Endangered (EN)	6	6	12
Vulnerable (VU)	12	2	14
Near-Threatened (NT)	2	0	2
Least Concern (LC)	81	8	89

DISCUSSION

Wildlife Assemblage

The results indicate that the green spaces of WPU Main Campus support a highly diverse wildlife assemblage, with 119 species recorded across multiple taxa. The dominance of birds in both richness and abundance reflects their ecological adaptability to diverse heterogeneous green spaces present in the campus landscape. The dominance of avifauna supports earlier observations that many bird species function as "exploiters" and "adapters," allowing them to thrive in human-modified environments (Conole, 2014). Although habitat disturbance at the landscape level negatively affects mammal assemblages (Casula et al. 2017), the relatively high abundance of mammals suggests that the habitat in the green spaces in the campus provides variety of resources and other vital life support processes to these species.

Seasonal patterns revealed higher species richness, abundance, and diversity during the wet season, while evenness remained consistently high, indicating a relatively balanced community structure across periods. This trend suggests that wetter conditions provide more favorable habitat resources such as increased food availability, vegetation cover, and shelter which support a wider range of species. Dry season affects the availability of resources that may cause decline in the population of many species by reducing population growth rate and viability (Brawn et al. 2017). The observed increase in wildlife records during the wet season is likely associated with ecological processes such as breeding cycles, heightened ecosystem productivity, and the arrival of migratory bird species overwintering in the wetlands of the WPU Main Campus. Notably, many migratory birds were recorded during the wet season surveys, substantially contributing to the higher observed diversity and species richness.

The Philippines is part of the East Asian–Australasian Flyway, a critical corridor for millions of waterbirds and terrestrial migratory species, providing stopover sites, feeding grounds, and wintering habitats along the route (Oracion et al. 2021). The occurrence of many migratory species in the WPU Main Campus during the wet season highlights its role as a seasonal stopover and overwintering site. Collectively, these findings underscore the importance of the wet season in sustaining both resident and migratory birds and mammals within the WPU Main Campus green spaces.

The higher species richness, abundance, and diversity during the wet season also highlights the influence of increased resource availability and favorable environmental conditions on wildlife activity. The consistently high evenness values across seasons indicate a relatively balanced community structure.

Temporal trends revealed a slight decline in species richness from 2022 to 2025, although diversity and evenness remained stable. This suggests that while some species may be affected by ongoing disturbances, overall community structure has been maintained. These findings underscore the importance of campus green spaces as refugia for birds and mammals, while also emphasizing the need for continued conservation efforts to sustain biodiversity over time.

Level of Endemism

A total of 119 bird and mammal species were recorded in the green spaces of the WPU Main Campus from 2022 to 2025, of which 31 (26%) are endemic to the Philippines and Palawan. The high level of endemism particularly the Palawan endemic species (19) and endemic subspecies (10) underscore the biogeographic significance of the WPU campus within the Palawan faunal region. Many of these endemic species are found only in limited biogeographic range, and nowhere else on the planet. Conserving these species is of utmost importance. Birds comprised the majority of endemic taxa, with 26 endemic species and subspecies recorded, while mammals also contributed notable endemic representation with five endemic taxa documented.

The concentration of endemic species recorded in the survey highlights the critical importance of conserving the campus green spaces, as these taxa are restricted in distribution and more vulnerable to habitat loss. In line with this, Gracia et al. (2021) emphasizes that identifying areas with high endemism is essential to focus and prioritize conservation efforts. Therefore, protecting these green spaces is crucial to ensure the sustainable existence of locally unique biodiversity and to support broader regional conservation initiatives.

The presence of 27 migratory bird species further emphasizes the role of the campus as a seasonal habitat for overwintering species, indicating its value beyond resident biodiversity. Sun et al. (2020) mentioned that conserving and protecting important nature reserves has positive effects on overwintering bird habitats.

Collectively, the coexistence of resident, endemic, and migratory species underscores the function of WPU green spaces as important refugia in a human-modified landscape, supporting both conservation-priority taxa and transient species.

Conservation Status

The assessment of conservation status indicates that most bird and mammal species recorded in the WPU Main Campus green spaces are classified as Least Concern, suggesting that the area continues to support relatively stable populations of non-threatened species. Although these Least Concern species are not currently at risk of extinction, Rey et al. (2024) mentioned that they remain equally important as threatened species, as they play vital roles in maintaining ecosystem functions and services such as pollination (Raju et al. 2005; Muchhala et al. 2009), seed dispersal (Mayta et al. 2025), and trophic regulation. Thus, their continued presence contributes significantly to ecosystem stability and resilience, reinforcing the importance of conserving green spaces not only for endangered taxa but for the broader ecological community.

Moreover, the presence of 30 conservation-priority species, including Critically Endangered, Endangered, Vulnerable, and Near-Threatened taxa, highlights the ecological significance of these habitats. Birds comprised most threatened species, reflecting their sensitivity to habitat changes and their reliance on diverse vegetation and habitat structures, while mammals also contributed notably to the threatened categories. Understanding local biodiversity, particularly the presence of endemic and threatened species in campus green spaces, is essential for developing effective institutional conservation strategies. Conservation actions undertaken today will determine the future sustainability of biodiversity (Kioumarsi et al. 2026). Taken together, these findings highlight the critical role of campus green spaces as refugia for both common and at-risk species, contributing significantly to local biodiversity conservation.

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Monsoonal Variation in Phytoplankton Assemblages and Selected Water Physicochemical Parameters in Shark Fin Bay, Taytay, Palawan

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ABSTRACT

Phytoplankton serve as important indicators of water quality and ecosystem condition. This study examined the seasonal variation of phytoplankton communities in Shark Fin Bay, Taytay, Palawan, Philippines, in relation to monsoonal changes. Monthly sampling was conducted from July to December 2025 at six sites within the Shark Fin Bay Marine Protected Area. Phytoplankton composition, abundance, diversity, and harmful genera were assessed together with selected physicochemical parameters, including temperature, salinity, dissolved oxygen, pH, total suspended solids, water transparency, depth, and nutrients. Results showed clear differences between the Southwest and Northeast Monsoons. The Northeast Monsoon recorded higher phytoplankton abundance but lower diversity, indicating dominance by fewer taxa. In contrast, the Southwest Monsoon supported a more diverse community, although overall abundance was lower. Harmful genera, including *Alexandrium* and *Prorocentrum*, were also observed. These findings provide baseline information for phytoplankton monitoring and harmful algal bloom management in Shark Fin Bay, with relevance to fisheries sustainability and coastal conservation.

Keywords: abundance, environmental drivers, harmful algal blooms, marine protected areas, seasonal dynamics

INTRODUCTION

Phytoplankton are fundamental components of marine ecosystems because they serve as primary producers, support aquatic food webs, and respond rapidly to changes in environmental conditions. As major contributors to global primary productivity, phytoplankton influence nutrient cycling, dissolved oxygen dynamics, and the overall ecological functioning of coastal and marine waters (Behrenfeld Randerson 1998; Behrenfeld et al. 2008). Their short generation times and high sensitivity to physical, chemical, and biological changes make them valuable biological indicators of water quality and ecosystem health (Roelke et al. 2003; Yusuf 2020). Variations in temperature, salinity, light availability, dissolved oxygen, nutrient concentrations, rainfall, and hydrodynamic conditions can strongly affect phytoplankton composition, abundance, diversity, and distribution (Wiggert et al. 2005; Behrenfeld & Boss 2014; Deng et al. 2014).

In tropical coastal ecosystems, phytoplankton communities are strongly influenced by seasonal environmental variability, particularly in areas affected by monsoon systems. Monsoonal shifts alter rainfall patterns, wind direction, water circulation, sediment resuspension, freshwater inflow, and nutrient inputs, all of which may contribute to changes in phytoplankton assemblages (Parab et al. 2006; Gatdula et al. 2017; Anutaliya 2023). During periods of increased nutrient availability or water-column stability, certain phytoplankton groups may proliferate rapidly, sometimes resulting in harmful algal blooms (HABs). These blooms can disrupt marine food webs, reduce water quality, affect fisheries productivity, and pose risks to public health through toxin accumulation in seafood (Azanza and Taylor 2001; Wells et al. 2020; Azanza et al. 2024). Therefore, understanding the relationship between monsoonal variability, physicochemical conditions, and phytoplankton community structure is essential for improving coastal monitoring and management strategies.

The Philippines is particularly vulnerable to harmful algal blooms because of its extensive coastline, productive bays, and strong dependence on fisheries and coastal resources. HAB events have been documented in numerous coastal areas of the country, with several bays repeatedly affected by shellfish toxicity and bloom-forming phytoplankton species (BFAR 2021; Azanza et al. 2024). In Palawan, HAB-related concerns have been reported since the first documented occurrence in Malampaya Sound in 1998, indicating the ecological and socioeconomic importance of monitoring phytoplankton dynamics in the province (Furio & Gonzalez 2002; Yñiguez et al. 2020). Because many coastal communities in Palawan depend on fisheries, mariculture, and marine tourism, changes in phytoplankton communities and the possible occurrence of harmful taxa may have direct implications for food security, livelihood stability, and coastal ecosystem health.

Shark Fin Bay in Taytay, Palawan is an ecologically significant coastal area that forms part of a Marine Protected Area network. The area contains productive coastal habitats such as coral reefs, seagrass beds, and mangrove-associated waters, which support fisheries and local biodiversity. It is also influenced by seasonal monsoon patterns and increasing anthropogenic pressures, including coastal runoff, fishing activities, and land-based inputs near protected and non-protected zones (Brun et al. 2024). Previous observations in the area have indicated the presence of potentially harmful phytoplankton, including dinoflagellates associated with bloom development and shellfish toxicity risk (Paalan et al. 2026). These conditions highlight the need for site-specific baseline information on phytoplankton assemblages and their relationship with environmental drivers.

Despite the ecological importance of Shark Fin Bay, baseline information on its phytoplankton community remains limited. Existing conservation initiatives in the area focus largely on habitat protection, fisheries management, and marine biodiversity monitoring, but systematic information on phytoplankton composition, abundance, diversity, harmful genera, and physicochemical drivers is still insufficient. This gap limits the ability of local stakeholders, resource managers, and government agencies to develop early-warning systems and science-based management responses to possible HAB events. Furthermore, while Marine Protected Areas are often expected to contribute to improved ecological conditions, the extent to which phytoplankton assemblages differ between MPA and non-MPA stations in Shark Fin Bay remains unclear.

To address these gaps, this study examined the monsoonal variation in phytoplankton assemblages and selected water physicochemical parameters in Shark Fin Bay, Taytay, Palawan. Specifically, it aimed to: (1) assess the composition, abundance, and diversity of phytoplankton assemblages; (2) assess the seasonal variation in selected water physicochemical parameters between the Southwest and Northeast Monsoon periods; and; and (3) determine the relationship between phytoplankton community structure and environmental gradients across monsoon seasons using redundancy analysis. The findings of this study provide important baseline information for harmful algal bloom monitoring, coastal resource management, and the development of long-term ecological monitoring programs in Shark Fin Bay and other monsoon-influenced tropical coastal systems.

METHODS

Study Area and Sampling Design

Phytoplankton sampling was conducted under the Sea Academy Plus Project in Shark Fin Bay, Taytay, Northern Palawan, Philippines, an area characterized by shallow coastal waters, seagrass beds, coral reefs, mangroves, and a network of Marine Protected Areas (MPAs) (Brun et al. 2024). Six sampling stations were established based on the project's monitoring sites, including four stations within the MPA network and two outside its boundaries (Table 1; Figure 1). In December 2023, the toxic dinoflagellate *Pyrodinium bahamense* was recorded across all stations under pre-bloom conditions (Paalan et al. 2026). To better assess temporal variability and potential harmful algal bloom development, sampling frequency was increased from bimonthly to monthly.

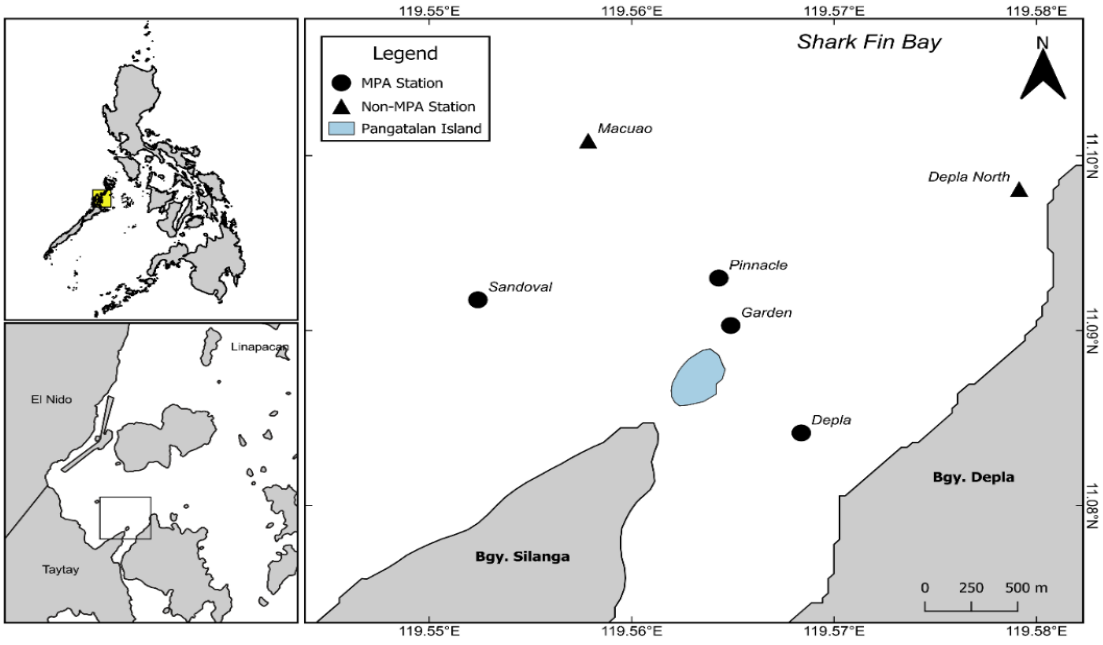

Figure 1. Map of the study area and sampling stations in Shark Fin Bay, Taytay, Palawan, Philippines.

Table 1. Coordinates of sampling stations in Shark Fin Bay, Taytay, Palawan, Philippines.

Station	Longitude (E)	Latitude (N)
Depla	119°34.130'	11°5.049'
Depla North	119°34.747'	11°5.890'
Garden	119°33.894'	11°5.416'
Macuao	119°33.470'	11°6.057'
Pinnacle	119°33.859'	11°5.579'
Sandoval	119°33.143'	11°5.506'

Data Collection

Sampling was conducted monthly from July to December 2025 during the last week of each month, covering both the Southwest Monsoon (Habagat) and Northeast Monsoon (Amihan). Fieldwork was performed between 08:00 and 12:00 to maintain consistency and account for peak phytoplankton surface activity (Kudela, 2010).

Surface water temperature (°C), salinity (ppt), and dissolved oxygen (mg L^{-1}) were measured in situ at 0.5 m depth using a YSI Pro2030 multiparameter meter, while pH was measured using an HT-1202 digital pH meter. All measurements were taken in triplicate. Water transparency was determined using a 20-cm Secchi disk.

Surface water samples were collected for nitrate (NO_3^-), phosphate (PO_4^{3-}), and total suspended solids (TSS) analyses. Nutrient concentrations were measured using Hanna Instruments portable photometers (HI97728 and HI97713) following manufacturer protocols. Due to equipment unavailability, nutrient data for July and August were not obtained. TSS analysis was conducted using vacuum filtration with pre-weighed glass microfiber filters, followed by oven drying at 60°C for 24 h. TSS concentration was expressed in mg L^{-1}.

Phytoplankton Sampling and Analysis

Phytoplankton samples were collected using a 20 µm mesh plankton net (30-cm mouth diameter) vertically towed from 1 m depth to the surface. Sampled water volume was estimated using the cylinder volume equation:

$$V = \pi r^2 L$$

where V is the sampled water volume (m^3), r is the net radius, and L is the tow distance.

Samples were concentrated into 50 mL cod-end containers, preserved with 5% buffered formaldehyde, and analyzed using light microscopy. Phytoplankton were identified to genus level following standard taxonomic references (Thomas 1997; Omura et al. 2012), while harmful taxa were verified using the IOC-UNESCO Harmful Microalgae Reference List. Enumeration was performed using a Sedgewick–Rafter chamber from 1 mL subsamples counted in triplicate under a BA210 microscope (Motic, Germany). Phytoplankton density was calculated following Relox (2002):

$$Density\ (cells\ L^{-1}) = \frac{N \times V_1}{V_s}$$

where N is the number of counted cells, V_1 is the total sample volume, and V_s is the filtered seawater volume. Relative abundance and community indices (Shannon diversity, dominance, richness, and evenness) were also computed.

Data Analysis

Normality and homogeneity of variance were tested using Shapiro–Wilk and Levene's tests, respectively. Spatial and temporal differences in environmental parameters and phytoplankton density were analyzed using one-way ANOVA or Kruskal–Wallis tests, depending on data distribution. Relationships between phytoplankton abundance and environmental variables were assessed using Redundancy Analysis (RDA). Diversity indices were calculated in PAST version 4.17, and all statistical analyses were performed in R software at $\alpha = 0.05$.

RESULTS

Phytoplankton Composition across sampling areas and Monsoon seasons

The data showed that phytoplankton observed across the six sampling areas of Shark Fin Bay is summarized in Table 2. A total of 66 genera belonging to four major functional groups were identified. Among these, diatoms comprised the most diverse group with 46 genera, followed by dinoflagellates with 18 genera. Cyanobacteria and silicoflagellates were represented by one genus each. Variations in genus composition were observed among sampling stations. Garden, Pinnacle, and Sandoval recorded the highest phytoplankton

composition, with 51 genera each, followed by Depla with 48 genera. Macuao had 44 genera, while Depla North showed the lowest composition with 40 genera. Phytoplankton composition also varied between monsoon seasons. A total of 53 genera were shared between the Southwest Monsoon (SWM) and Northeast Monsoon (NEM) periods. Genera present in both monsoons included the diatoms *Bacteriastrum, Chaetoceros, Coscinodiscus, Diploneis, Ditylum, Guinardia, Hemialus, Licmophora, Odontella, Pleurosigma, Rhizosolenia,* and *Thalassionema*. Dinoflagellate genera included *Akashiwo, Alexandrium, Dinophysis, Gonyaulax, Prorocentrum, Protoperidinium,* and *Tripos*. The cyanobacterial genus *Oscillatoria* and the silicoflagellate genus *Dictyocha* were likewise recorded in both monsoon periods. A total of 11 genera were found exclusively during the Southwest Monsoon, namely *Amphidinium, Amphora, Biddulphia, Craticula, Entomoneis, Gomphonema, Goniodoma, Podolampas, Rhodomonas, Thalassiosira,* and *Ulnaria*. In contrast, only two genera were unique to the Northeast Monsoon: *Detonula* and *Skeletonema* (Figure 2).

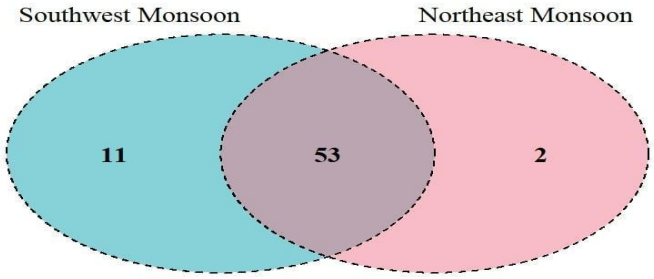

Figure 2. Venn diagram showing the number of phytoplankton genera unique to each monsoon season and shared between the southwest and northeast monsoons in Shark Fin Bay, Taytay, Palawan, Philippines.

Table 2. Phytoplankton composition across sampling sites and months. **"+"** denotes the presence of genera, while **"–"** indicates their absence at the respective sampling sites and months.

Genus	Station					
	Depla	Depla North	Garden	Macuao	Pinnacle	Sandoval
Diatom						
Amphisolenia	+	+	-	+	+	+
Amphora	-	-	+	-	-	-
Asterionellopsis	-	-	-	+	+	+
Asteromphalus	-	-	-	-	-	+
Bacillaria	+	+	+	+	+	+
Bacteriastrum	+	+	+	+	+	+
Biddulphia	-	-	+	-	-	-
Campylodiscus	+	-	+	+	+	+
Cerataulina	+	+	+	+	+	+
Chaetoceros	+	+	+	+	+	+
Corethron	+	+	+	+	+	+
Coscinodiscus	+	+	+	+	+	+
Craticula	-	-	+	-	+	+
Cylindrotheca	+	-	+	-	+	+
Dactyliosolen	+	-	+	+	-	+
Detonula	+	-	-	-	+	-
Diploneis	+	+	+	+	+	+
Ditylum	+	+	+	+	+	+
Entomoneis	-	-	-	-	+	-
Eucampia	+	+	+	-	-	-
Fragilaria	-	+	-	-	+	+
Gomphonema	-	-	-	-	+	-
Guinardia	+	+	+	+	+	+
Hemialus	+	+	+	+	+	+
Lauderia	+	+	+	+	+	+
Leptocylindricus	+	-	-	+	+	+
Licmophora	+	+	+	+	-	+
Lyrella	-	+	+	+	+	+
Melosira	+	-	+	+	+	+
Navicula	+	+	+	-	+	+

Genus	Station					
	Depla	Depla North	Garden	Macuao	Pinnacle	Sandoval
Nitszchia	+	+	-	-	+	+
Odontella	+	+	+	+	+	+
Pinnularia	+	+	+	+	+	+
Pleurosigma	+	+	+	+	+	+
Proboscia	+	+	+	+	+	+
Pseudo-nitszchia	+	+	+	+	+	+
Rhizosolenia	+	+	+	+	+	+
Rhodomonas	-	-	+	-	-	-
Skeletonema	-	-	-	+	-	-
Synedra	+	-	+	+	+	-
Thalassionema	+	+	+	+	+	+
Thalassiosira	-	-	-	-	-	-
Thalassiothrix	+	-	+	+	+	-
Triceratium	+	+	+	+	+	+
Tropidoneis	+	+	+	+	+	+
Ulnaria	-	-	-	-	-	+
Dinoflagellates						
Akashiwo	+	-	+	-	-	+
Alexandrium	+	+	+	+	+	+
Amphidinium	-	-	+	-	-	+
Dinophysis	+	+	+	+	+	+
Diplopsalis	-	-	+	-	+	+
Goniodoma	-	-	+	-	-	-
Gonyaulax	+	+	+	+	+	+
Gymnodinium	+	+	+	+	+	+
Gyrodinium	+	-	+	+	+	+
Noctiluca	+	+	+	-	+	+
Ornithocercus	-	+	-	-	-	-
Peridinium	+	+	+	+	+	+
Phyrophacus	+	+	+	+	+	+
Podolampas	-	-	-	+	-	-
Prorocentrum	+	+	+	+	+	+
Protoperidinium	+	+	+	+	+	+
Pyrocystis	+	+	+	-	+	-
Tripos	+	+	+	+	+	+
Cyanobacteria						
Oscillatoria	+	+	+	+	+	+
Silicoflagellate						
Dictyocha	+	-	+	+	+	+
Total	**48**	**40**	**51**	**44**	**51**	**51**

Phytoplankton Composition across stations and sampling months

The phytoplankton assemblage in Shark Fin Bay was dominated by *Thalassionema*, with a mean density of ($\bar{x}$ = 27,685 cells/L), and *Chaetoceros*, with ($\bar{x}$ = 19,801 cells/L). These two genera consistently represented the largest proportion of the community across both sampling months and stations, with a total mean density of ($\bar{x}$ = 47,486 cells/L) (Figure 3 and Figure 4). Other notable genera contributing to the community composition included *Bacteriastrum* ($\bar{x}$ = 9,016 cells/L), *Tripos* ($\bar{x}$ = 1,153 cells/L), *Protoperidinium* ($\bar{x}$ = 746 cells/L), *Prorocentrum* ($\bar{x}$ = 639 cells/L), *Lauderia* ($\bar{x}$ = 3,073 cells/L), and *Cerataulina* ($\bar{x}$ = 880 cells/L).

Across the six sampling stations, *Thalassionema* was the most dominant genus at most sites, followed by *Chaetoceros*. While the proportional contributions of minor taxa varied among stations, the overall community structure remained relatively consistent throughout the study area (Figure 3). At stations such as Depla, Garden, and Pinnacle, *Thalassionema* and *Chaetoceros* consistently constituted the majority of the phytoplankton assemblage, while other genera, such as *Bacteriastrum* and *Protoperidinium*, were present in smaller proportions. However, there was noticeable variation in the relative abundance of these minor taxa across stations, suggesting site-specific environmental factors influencing community composition.

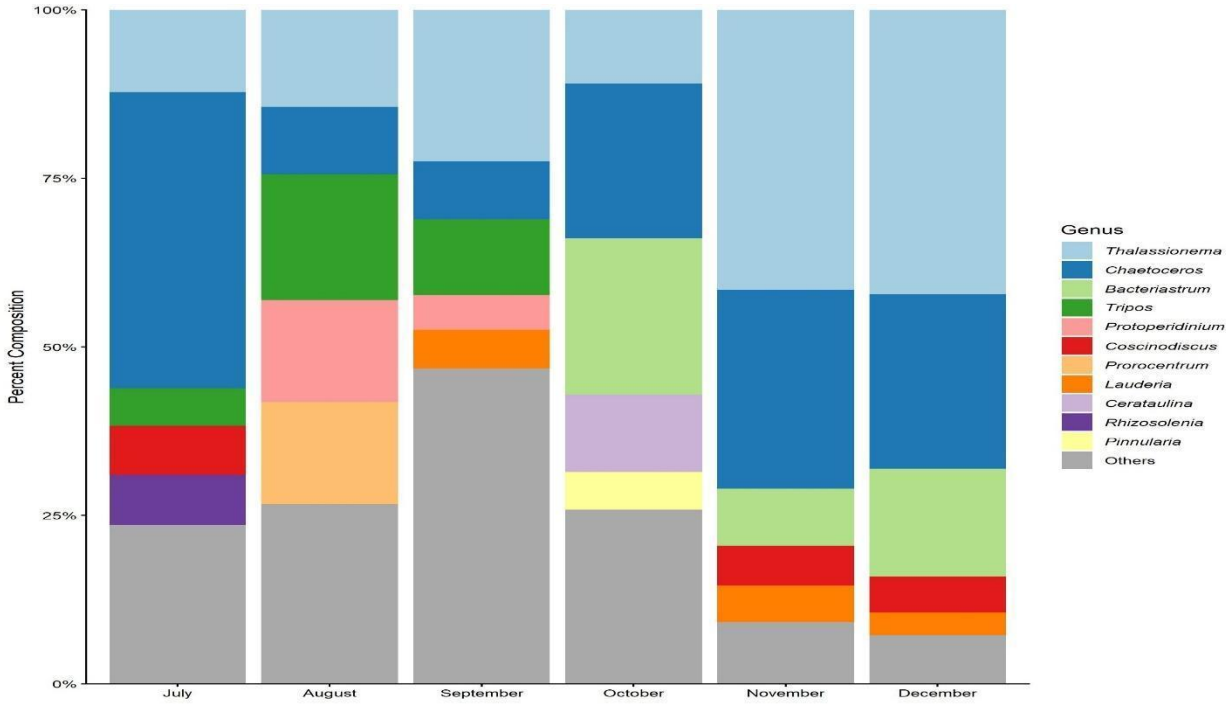

Figure 3. The percentage contribution of the dominant phytoplankton genera to the total abundance. Among sampling stations in Shark Fin Bay, Taytay, Palawan, Philippines.

Additionally, the monthly percent composition showed distinct trends, particularly during the Southwest Monsoon from July to September. In July, the assemblage was primarily dominated by *Chaetoceros* ($\bar{x}$ = 731 cells/L). August exhibited a more balanced distribution across several genera, with *Tripos* ($\bar{x}$ = 625 cells/L) and *Protoperidinium* ($\bar{x}$ = 506 cells/L) contributing significantly. In September, the community displayed greater taxonomic diversity, indicating an increase in community complexity. Conversely, November and December were marked by a notable increase in *Thalassionema* ($\bar{x}$ = 26,064 cells/L) abundance, suggesting a seasonal shift towards a more uneven assemblage characteristic of the Northeast Monsoon period (Figure 4).

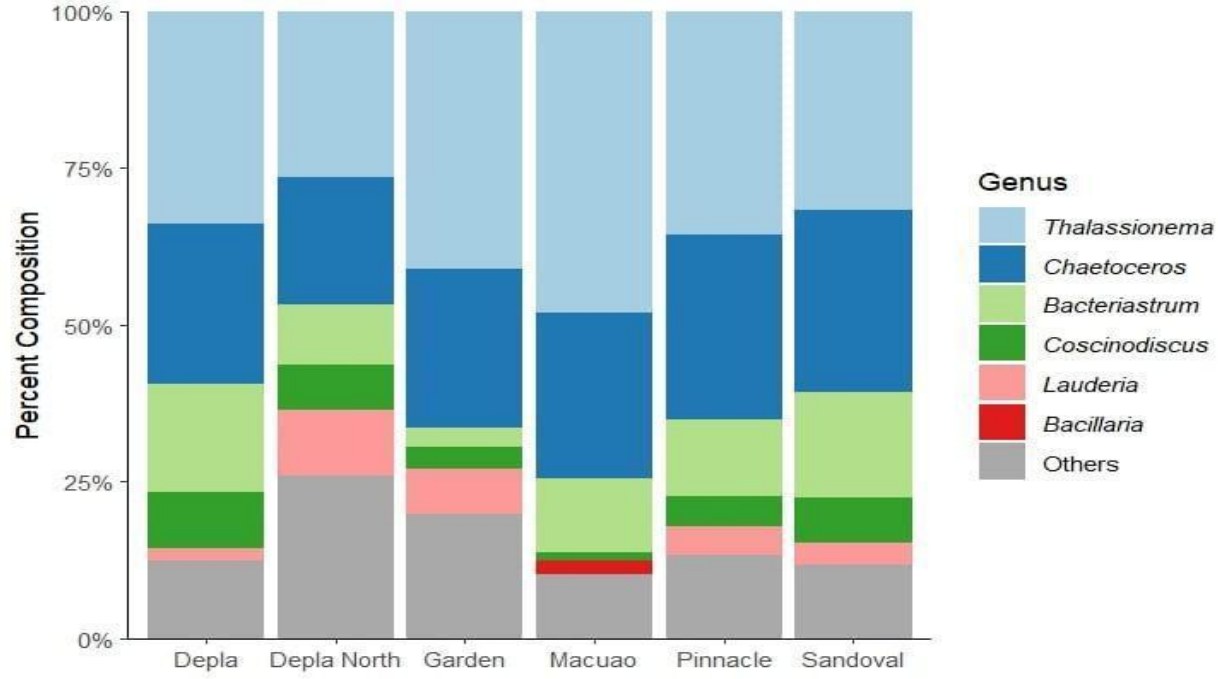

Figure 4. The percentage contribution of the dominant phytoplankton genera to the total abundance. Among sampling months in Shark Fin Bay, Taytay, Palawan, Philippines.

Seasonal Variation in Phytoplankton Abundance and Diversity Indices

Seasonal comparison showed that phytoplankton community attributes differed significantly between the Southwest and Northeast Monsoon periods (Figure 5). Phytoplankton abundance was significantly greater during the Northeast Monsoon, as shown by the higher median and broader distribution of values relative to the Southwest Monsoon (Figure 5). In contrast, the Shannon–Wiener diversity index was significantly higher during the Southwest Monsoon, indicating that this period supported a more diverse phytoplankton assemblage. Additionally, richness and evenness were both significantly higher during the Southwest Monsoon, suggesting greater taxonomic representation and a more equitable distribution of individuals among genera. The Northeast Monsoon, although characterized by higher abundance, exhibited reduced diversity, richness, and evenness, reflecting the increasing dominance of a limited number of taxa. These findings demonstrate that monsoonal variation strongly influenced phytoplankton community structure, with the Southwest Monsoon favoring a more diverse and balanced assemblage, and the Northeast Monsoon promoting higher biomass but lower community complexity.

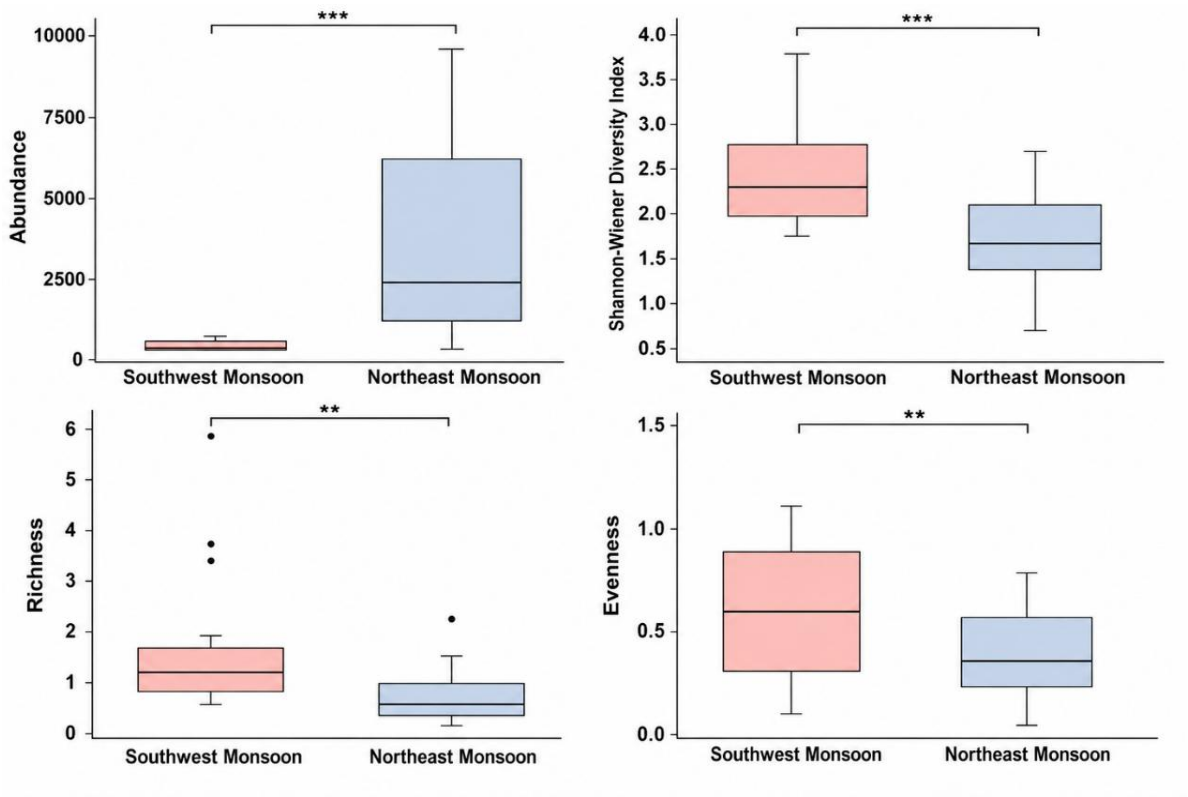

Figure 5. Phytoplankton abundance, diversity, richness, and evenness in Shark Fin Bay during Monsoon season.

Monsoonal Variation in Selected Water Physicochemical Parameters

The analysis of selected water physicochemical parameters revealed notable differences between the Southwest and Northeast Monsoons. As shown in Figure 6, temperature and dissolved oxygen concentrations were significantly higher during the Southwest Monsoon. In contrast, pH and total suspended solids were significantly elevated during the Northeast Monsoon. It is important to note that phosphate and nitrate data were unavailable for July and August (SWM); consequently, these parameters appeared higher due to the lack of data for two months during the Southwest Monsoon. However, salinity, water transparency, and water depth did not show significant variations between the two monsoon periods. These findings suggest that distinct environmental conditions characterize each monsoon. The Southwest Monsoon is associated with warmer, more oxygenated waters, whereas the Northeast Monsoon is characterized by higher suspended solids and pH levels, with minimal nutrient concentrations. These seasonal fluctuations in water physicochemical parameters likely influenced the observed changes in phytoplankton community composition between the two monsoonal periods.

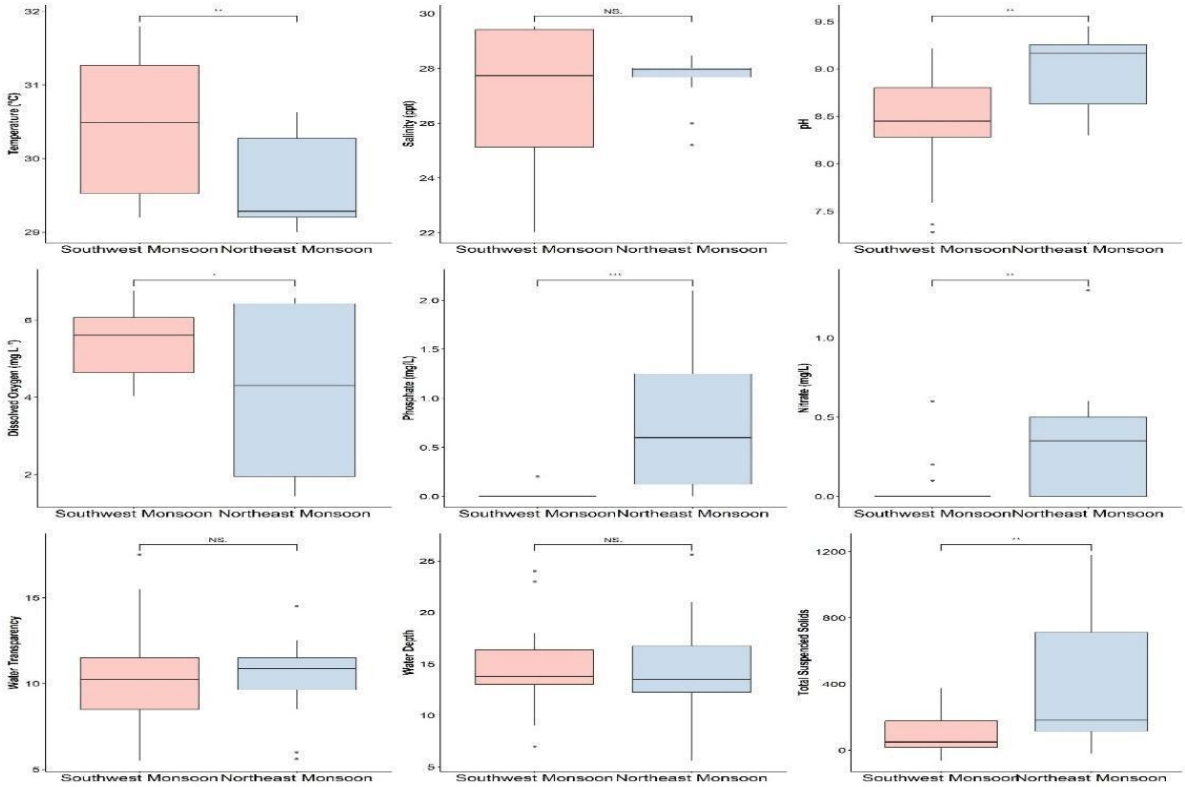

Figure 6. Comparison of water physicochemical parameters between Monsoon periods.

Phytoplankton Distribution and Environmental Gradients Across Monsoon Periods

The redundancy analysis (RDA) revealed distinct relationships between phytoplankton genera and environmental variables across monsoon periods. The first two canonical axes explained 78.79% of the phytoplankton–environment variation, with RDA1 accounting for 64.92% and RDA2 for 13.87% (Figure 7). Temperature and dissolved oxygen (DO) emerged as the dominant gradients on the positive side of RDA1, indicating their strong influence under warmer and more oxygenated conditions associated with the Southwest Monsoon. In contrast, the negative side of RDA1 was associated with higher nitrite, phosphate, salinity, pH, and total suspended solids (TSS), which were more characteristic of the Northeast Monsoon. Water transparency and depth showed moderate influence, as indicated by their vectors positioned closer to the center of the ordination plot.

The RDA ordination also demonstrated a clear separation between monsoon periods. Southwest Monsoon samples were mostly distributed along the positive side of RDA1, reflecting higher temperature and DO levels that favored phytoplankton taxa adapted to warmer and oxygen-rich waters. Conversely, Northeast Monsoon samples were positioned along the negative side of RDA1, suggesting stronger associations with nutrient-enriched, saline, alkaline, and more turbid conditions. This separation indicates that seasonal hydrographic shifts, particularly changes in temperature, oxygen availability, nutrient concentration, and suspended solids, were important drivers of phytoplankton community structure in the study area.

Specific genera showed distinct environmental associations. *Tripos*, *Protoperidinium*, *Prorocentrum*, and *Dinophysis* were associated with the positive side of RDA1, suggesting affinity for Southwest Monsoon conditions. In contrast, *Chaetoceros* and *Bacteriastrum* were linked to the negative side, indicating stronger association with nutrient-rich and higher-salinity conditions during the Northeast Monsoon. *Lauderia*, *Ditylum*, and *Thalassionema* were closely related to nutrient and TSS gradients, suggesting tolerance or preference for more turbid and nutrient-enriched waters. Meanwhile, *Ceratulina* and *Thalassiothrix* were positioned near the center of the ordination, indicating broader ecological tolerance and weaker dependence on specific environmental gradients.

These results showed that the spatial distribution of stations reflected environmental heterogeneity across the study area. Stations on the positive side of RDA1 were characterized by warmer and more oxygenated waters, whereas those on the negative side were influenced by higher nutrients, salinity, and suspended solids. These findings emphasize the role of monsoon-driven environmental variability and local station conditions in shaping phytoplankton distribution and community composition.

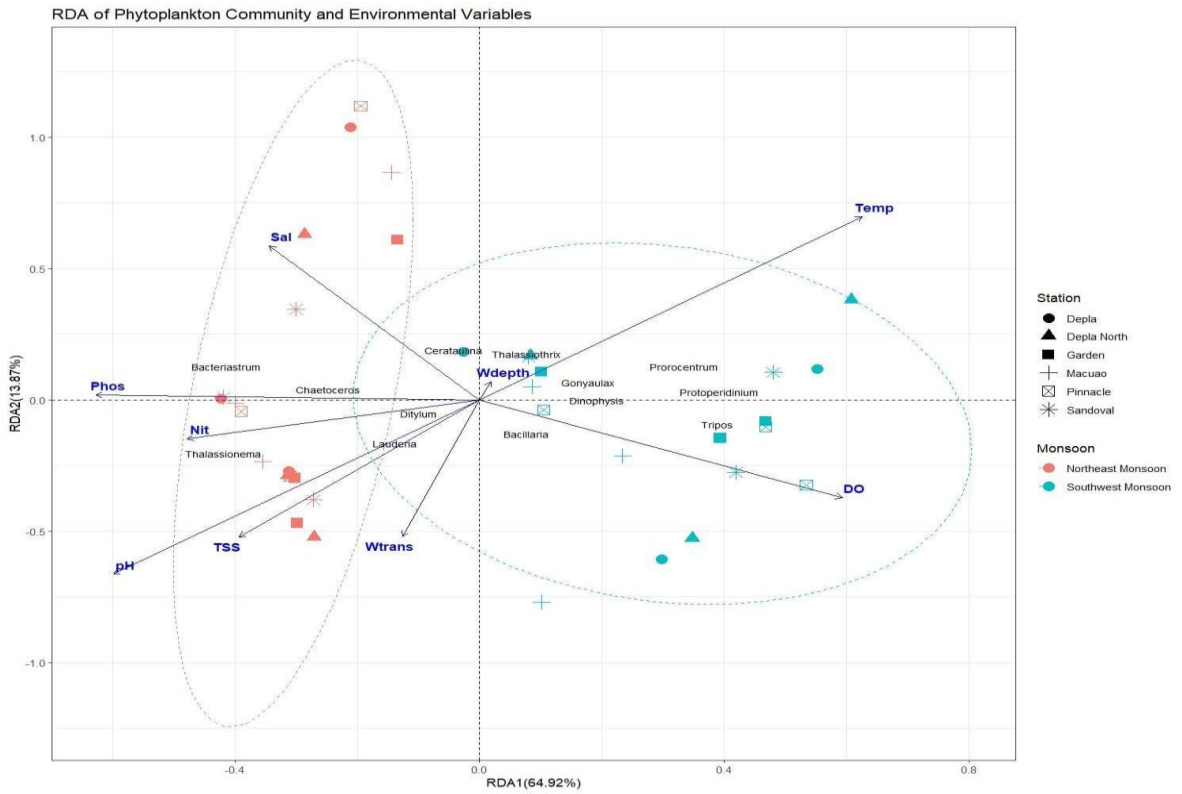

Figure 7. Redundancy analysis (RDA) of phytoplankton community and environmental variables in Shark Fin Bay, Taytay, Palawan, Philippines,

DISCUSSION

Phytoplankton Composition, Abundance, and Diversity

In this study we observed diatoms are the most diverse phytoplankton group, comprising 46 genera, followed by dinoflagellates with 18 genera. Cyanobacteria and silicoflagellates were the least represented, with only one genus each. This result supports previous studies emphasizing the dominance of diatoms in tropical marine ecosystems (Malviya et al. 2016; Fu et al. 2022). In Philippine coastal waters, diatoms are often abundant because of their adaptability to changes in temperature, salinity, and nutrient availability (Ravelo et al. 2022). Similarly, Liu et al. (2022) reported that phytoplankton richness in relatively homogenous coastal environments is influenced more by temporal fluctuations than by spatial differences.

Although less diverse, dinoflagellates were also well represented and widely distributed across the study area. Genera such as Alexandrium, Gonyaulax, Prorocentrum, and Protoperidinium occurred in all sampling stations, suggesting broad ecological tolerance. Their coexistence with diatoms indicates a dynamic coastal system where nutrient enrichment and water column stratification may occur intermittently (Gao et al. 2025). Such patterns are common in tropical coastal areas affected by seasonal monsoon cycles, where changes in water stability and nutrient conditions favor different phytoplankton groups (Parab et al. 2006).

The presence of dinoflagellates is also notable because some genera have been associated with harmful algal bloom events in Malampaya Sound, including those recorded in 1998 and 2000 (Borja et al. 2000; Furio & Gonzalez 2002). In this study, potentially toxic genera were observed, particularly Alexandrium, with a mean density of 80.7 cells/L. This genus is associated with paralytic shellfish poisoning, which results from toxins accumulating in filter-feeding shellfish and moving through the food web to humans and other animals (Etheridge, 2010; Barua et al. 2024). Dinophysis was also recorded at a mean density of 180.3 cells/L and has been linked to diarrhetic shellfish poisoning, although it rarely forms dense blooms (Reguera et al. 2014; Borja et al. 2000).

Seasonal Differences Between the Southwest and Northeast Monsoons

The comparison of phytoplankton communities between the Southwest Monsoon (SWM) and Northeast Monsoon (NEM) revealed significant differences in abundance, diversity, richness, and evenness. Phytoplankton abundance was significantly higher during the NEM (~6,800 cells L^{-1}). In contrast, the SWM exhibited significantly higher Shannon–Wiener diversity values (~2–3), along with greater richness and evenness, indicating a more diverse and evenly distributed community during this period. The present study revealed the comparison effects of the Northeast Monsoon (NEM) and Southwest Monsoon (SWM) on phytoplankton communities, highlighting the significant role of seasonal shifts in environmental conditions. During the Northeast Monsoon,

increased phytoplankton biomass was observed, but this was accompanied by a notable reduction in diversity and evenness. Furthermore, the community became dominated by a fast-growing or opportunistic taxa such as *Thallasionema and Chaetoceros* (Canini et al. 2013; Gatdula et al. 2017). In contrast, although the SWM was associated with lower overall phytoplankton abundance, it supported a more diverse and well-balanced community (Canini et al. 2013. These results support our hypothesis that changes in environmental factors such as water temperature, salinity, and nutrient availability are key drivers of phytoplankton community structure (Parab et al. 2006; Gatdula et al. 2017).

Selected Water Parameter Profile in Shark Fin Bay

The comparison between the Southwest Monsoon (SWM) and Northeast Monsoon (NEM) showed significant differences in selected physicochemical parameters. Temperature and dissolved oxygen (DO) were higher during the SWM, with temperature ranging from 29.2°C to 31.8°C and DO from 1.4 to 6.7 mg L^{-1}. These values are consistent with monsoonal patterns reported in tropical coastal waters (Jacinto et al. 2011; Villanoy et al. 2011; Nisha & Achyuthan 2014). However, the low DO value of 1.4 mg L^{-1} also indicates possible oxygen stress, similar to previous observations in Manila Bay where hypoxic conditions were reported during the SWM (Jacinto et al. 2011; Gatdula et al. 2017).

In contrast, the NEM recorded higher pH and total suspended solids. The increase in suspended solids may be linked to stronger winds, rainfall, runoff, and water-column mixing during this season (Wiggert et al. 2020; Unnithan et al. 2025). The higher pH values observed during NEM, ranging from 8.40 to 9.45, may also be associated with daytime phytoplankton photosynthesis, which reduces dissolved CO_2 in the water, together with enhanced vertical mixing (Wiggert et al. 2020).

A major limitation of the study was the absence of phosphate and nitrate data for July and August during the SWM. This gap may have affected the comparison by making nutrient concentrations appear higher during the NEM, as shown in Figure 15. Despite this limitation, the available data suggest that nutrient enrichment, particularly nitrate and phosphate, was more evident during the NEM and may have contributed to algal growth and changes in the aquatic food web (Jacinto et al. 2011; Avenido 2023).

Water transparency and depth did not differ significantly between the two monsoon periods. This suggests that these parameters were less affected by seasonal changes compared with temperature, DO, pH, nutrients, and suspended solids. The relatively stable transparency also indicates that other processes, including suspended particles and phytoplankton abundance, may have varied without strongly altering overall light penetration (Wu et al. 2016; PEMSEA 2023).

Relationship Between Water Parameters and Phytoplankton Assemblage

The Redundancy Analysis (RDA) showed that temperature and salinity were significantly related to phytoplankton assemblages during both the Southwest and Northeast Monsoons, with both variables recording a significance value of 0.001. This indicates that these two factors are important drivers of phytoplankton distribution in the study area. During the Southwest Monsoon, temperature and dissolved oxygen explained 64.92% of the variation, suggesting that changes in water-column conditions, such as stratification, mixing, and water-mass movement, influenced the observed community patterns (Jacinto et al. 2011; Araujo et al. 2016).

Seasonal differences were also reflected in the dominant phytoplankton groups. Warmer conditions during the Southwest Monsoon were associated with armored dinoflagellates, including *Prorocentrum*, *Protoperidinium*, *Gonyaulax*, *Dinophysis*, and *Tripos*. This agrees with previous studies showing that higher temperatures can favor dinoflagellates, especially in more stratified waters where their motility gives them an advantage over diatoms (Xiao et al. 2018; Wei et al. 2024). In contrast, during the Northeast Monsoon, higher salinity and nutrient availability supported the abundance of diatoms such as *Bacteriastrum*, *Chaetoceros*, and *Thalassionema*, which are known to thrive under nutrient-enriched and well-mixed conditions (Ravelo et al. 2022; Bharathi et al. 2026).

In general, the results showed that seasonal changes in temperature, salinity, and nutrients strongly shape phytoplankton community composition. The increasing trend in sea surface temperature may further favor dinoflagellates over diatoms, which could have ecological consequences, including a higher risk of harmful algal blooms in coastal waters (Gobler et al. 2017; Develi et al. 2022; Mutshinda et al. 2025). These findings highlight the importance of continued monitoring of phytoplankton communities and environmental conditions, particularly in areas affected by monsoon variability, warming, and local pollution.

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GENERATIVE AI STATEMENT

OpenAI's ChatGPT was used only as a writing support tool to improve grammar, clarity, and reference formatting. All content generated with the assistance of AI was carefully reviewed, revised, and verified by the authors to ensure accuracy, originality, and alignment with academic standards.

ETHICAL CONSIDERATIONS

No animals were harmed, and no human subjects were involved during this study.

DECLARATION OF COMPETING INTEREST

The authors declare that theres no competing interests to any authors.

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Occurrence and Spatial Distribution of Cyanobacteria in Recreational Waters of Honda Bay, Palawan: Environmental Conditions and Public Health Implications

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ABSTRACT

The increasing occurrence of cyanobacteria in coastal waters poses ecological and human safety concerns. However, baseline information for recreational areas in Honda Bay, Palawan remains limited. This study assessed cyanobacteria occurrence and spatial distribution, determined associated environmental conditions, and evaluated public health risks. Water samples were collected at five stations (Wharf, Cowrie Island, Pandan Island, Starfish Island, and Luli Island) using the vertical tow method. Cyanobacteria were identified microscopically and expressed as cells/L; potentially toxin–producing genera were identified for public health risk assessment. Physicochemical parameters measured on–site included temperature, pH, salinity, dissolved oxygen, conductivity, oxidation–reduction potential, total dissolved solids, total suspended solids, water transparency, and depth. Cyanobacteria were present at all stations, ranging from 168 to 3,032 cells/L with marked spatial variation. Dominant and potentially harmful genera included *Planktothrix* sp., *Nodularia* sp., *Trichodesmium* sp., *Synechococcus* sp., and *Merismopedia* sp., which are associated with skin irritation, allergic reactions, and poisoning posing risks to tourism and recreation. Analysis showed that water transparency influenced cyanobacterial density; clearer waters with increased light penetration enhanced photosynthetic efficiency, supporting cyanobacterial growth. These findings provide baseline data for Honda Bay and highlight the need for regular monitoring to support local coastal water management and risk reduction strategies.

Keywords: coastal waters, dissolved oxygen, light availability, cyanobacterial density, spatial variation.

INTRODUCTION

Cyanobacteria, also known as blue–green algae, are photosynthetic prokaryotes widely distributed in illuminated aquatic environments (Whitton 2012). They are among the most abundant organisms on planet Earth. Most surface waters contain cyanobacteria, which are common microorganisms. One of the main causes of their excessive development is high nutrient concentration (Merel et al. 2013). While some cyanobacteria are beneficial, many are capable of producing harmful algal blooms (HABs) when environmental conditions are favorable, such as warm temperatures, stagnant water, and elevated nutrient levels (Paerl and Otten 2013). These blooms can threaten aquatic ecosystems, livelihoods, and human health.

HABs are a growing global challenge, increasing in frequency due to climate change and nutrient loading, with conditions declining in many regions including Palawan, Philippines (Paerl and Otten 2013). Current management and regulations of HABs in Palawan include issuing HAB alerts to local government units (LGUs) when cell density reaches 200 cells/L or above, implementing mandatory bans on shellfish harvesting, and expert recommendations for LGUs to address sewage and domestic waste in coastal areas to reduce nutrient loading.

There is growing public awareness that toxic cyanobacteria pose significant health risks, particularly in recreational waterways (World Health Organization 2020). Potential health implications of cyanobacterial toxins include gastrointestinal illness, respiratory issues, and allergic reactions, concerns of growing importance for tourists and communities that depend on coastal bays for recreation and livelihood. Many countries have enacted regulations to protect human health from these toxins. The World Health Organization (WHO) has established provisional guideline values for cyanotoxins in drinking water and released guidelines for protecting human health in recreational waterways (Chorus et al. 2021).

Recreational waters such as lakes, rivers, and beaches present particular concern because people often have direct and prolonged contact with the water. When these waters become contaminated with cyanobacterial blooms, people engaging in leisure activities such as swimming, wading, or water sports may contact harmful cyanobacterial toxins (World Health Organization 2020). Exposure can lead to skin rashes, eye and ear irritation, and respiratory problems. If contaminated water is accidentally ingested, it may cause serious health complications.

Honda Bay, located on the eastern coast of Puerto Princesa City, Palawan, Philippines, is one of the most visited islands in the province due to its rich biodiversity, vibrant tourism sector, and active fisheries, making it an ecologically and economically significant body of water. However, increasing anthropogenic activities such as tourism, coastal development, and agricultural runoff may alter water quality by increasing nutrient levels, which can lead to cyanobacteria proliferation and toxin production that pose serious health risks to both communities and tourists. Despite the importance of Honda Bay, baseline data for cyanobacteria occurrence are limited in the area, and little is known about how environmental factors may influence cyanobacteria distribution.

This study aimed to assess the occurrence and spatial distribution of cyanobacteria in Honda Bay by identifying taxa to the lowest possible taxonomic level, determining their cellular density expressed as cells/L, and characterizing their distribution patterns across five selected sampling stations. The study also determined environmental factors by measuring key physicochemical parameters, including temperature, salinity, pH, dissolved oxygen, conductivity, total dissolved solids, water transparency, and depth, in relation to observed cyanobacterial densities across sampling stations. Furthermore, the study evaluated the public health risks associated with cyanobacterial occurrence in Honda Bay by identifying potentially toxigenic genera capable of producing toxins.

METHODS

Study site

This study was conducted in Honda Bay, a premier tourist destination located on the eastern coast of Puerto Princesa City, Palawan, approximately 10–12 kilometers northeast of the city proper. Five recreational water areas within Honda Bay were investigated: Wharf, Cowrie Island, Pandan Island, Starfish Island, and Luli Island as shown in Figure 1.

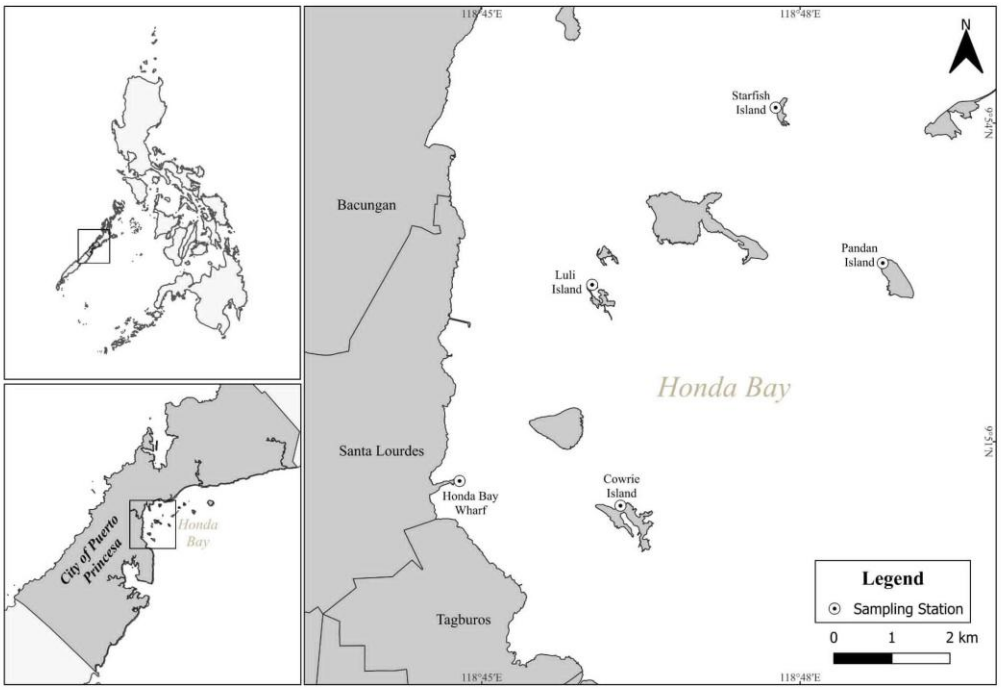

Figure 1. Map showing the sampling sites in Honda Bay, Puerto Princesa City, Palawan.

Sampling procedure

This study was conducted on May 31, 2025 during daytime at 8 o`clock in the morning. Measurements of water parameter and collection of water samples was collected in five different sites in Honda Bay. Water samples were placed into labeled bottles and added immediately with five percent formalin solution to preserved and eliminate zooplankton that might consume the target samples which are the phytoplankton including cyanobacteria, the samples were viewed and analyzed in the laboratory using compound microscope.

Water parameters

The water parameter was measured to front, middle and back of the boat one meter below the water surface to compute the average mean of the pH, ORP(mv), Dissolved Oxygen(mg/L), conductivity(uS/cm), Total Dissolved Solids (mg/L), salinity (ppt), and Temperature(°C) were measured using multi parameter. Secchi disk

was used to measure the water transparency (m) by averaging the water depth at which the device disappears and reappear, while the Water depth (m) was be measured by submerging the Secchi disk until it reached the seafloor. And the Total Suspended Solids (TSS) were determined by using gravimetric filtration method.

Cyanobacteria in the water column

Cyanobacteria samples were collected in the water column using vertical tow method, at which the plankton net was vertically towed two meters deep below the water surface and rested for at least 30 seconds before pulling it up. A plankton net that has one meter in length, a mouth that has 30cm in diameter, and a mesh size of 20 µm was used to filter the seawater, by squeezing the net down to the mesh the seawater condensed in the codend at which where the water samples was collected. The seawater samples were transferred to a pre–labeled bottles and then preserve immediately by adding 5% formaldehyde solution. A portion of one ml from concentrated water samples in triplicates were analyzed using Sedgewick rafter counting cells (20grids by 50grids) and viewed under compound microscope with 100x magnifications.

Environmental condition analysis

Water quality parameters including temperature, pH, dissolved oxygen, salinity, conductivity, total suspended solids, total dissolved solids, and water transparency were analyzed using descriptive statistics such as mean and standard deviation. Cyanobacteria density was compared across sampling sites to examine potential associations with environmental variables.

Public health risks assessment

Potential public health implications were assessed based on the presence and abundance of potentially toxin–producing cyanobacteria. Identified taxa were compared with documented toxin–producing genera reported in previous literature and World Health Organization (WHO) recreational water guidelines.

Data analysis

Data for cyanobacteria composition, mean density, relative abundance, and frequency of occurrence will be recorded in an excel sheet and presented in a table. Standard Deviation (SD) will be calculated for density data. Toxic Cyanobacteria/Cyanocenter Taxonomic reference list of toxic cyanobacteria was used for identification of potential harmful cyanobacteria species. For the water samples, cyanobacteria density was calculated by using the equation below.

$$\text{Density (Expressed in cells/L)} = \frac{(N \, x \, V_1)}{V_s}$$

Where N = number of cells in one ml aliquot; V_1 =total of cyanobacteria sample; V_s = volume of seawater filtered by plankton net within hauling depth.

RESULTS

Species composition of Cyanobacteria

Several Cyanobacteria taxa were identified across five sampling stations in Honda Bay including filamentous, unicellular, and colonial forms Figure 2. Filamentous taxa such as *Planktothrix* sp*., Schizothrix* sp*., Pseudoanabaena* sp., and *Trichodesmium* sp. were distinguish primarily by their cylindrical filaments, but were further differentiate based on specific morphological characteristics. *Planktothrix* sp. exhibits unbranched filaments, *Trichodesmium* sp. forms clustered filaments, and *Pseudoanabaena* sp. is characterized by fine, thin filaments. In contrast, *Oscillatoria* sp. and *Schizothrix* sp. possess relative thicker filaments. *Nodularia* sp. was identified by its filamentous structure regularly spaced heterocytes and a discoid appearance. Among the unicellular and colonial taxa, *Prochlorococcus* sp. was identified by its extremely small, individual coccoid cells. *Aphanocapsa* sp. exhibits spherical coccoid cells, while *Synechoccus* sp. is characterized its organized cellular arrangement forming ovoid colonies.

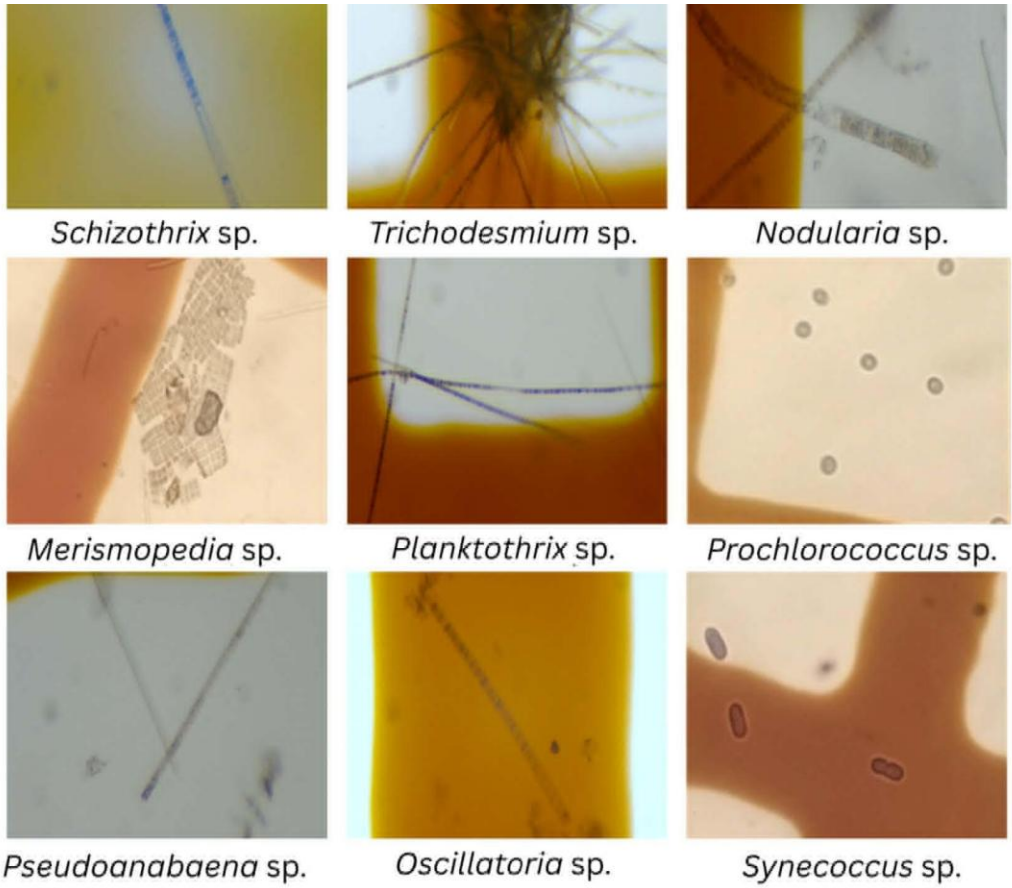

Figure 2. Cyanobacteria taxa identified across five sampling sites.

Cyanobacterial densities

Across the five sampling stations, Pandan Island exhibited the highest total cyanobacterial density (3,032 cells/L), followed by Starfish Island (2,314 cells/L) and Cowrie Island (2,267 cells/L), while Wharf showed the lowest density (168 cells/L) Figure 3. *Planktothrix* sp. dominated the assemblage at Pandan Island and Starfish Island, reaching the highest recorded densities. *Merismopedia* sp. was abundant at Cowrie Island and Pandan Island but was absent at Starfish and Luli Islands. Several taxa, including *Synechococcus* sp. and *Pseudoanabaena* sp., were recorded only at Starfish Island, whereas *Prochlorococcus* sp. was absent at Wharf.

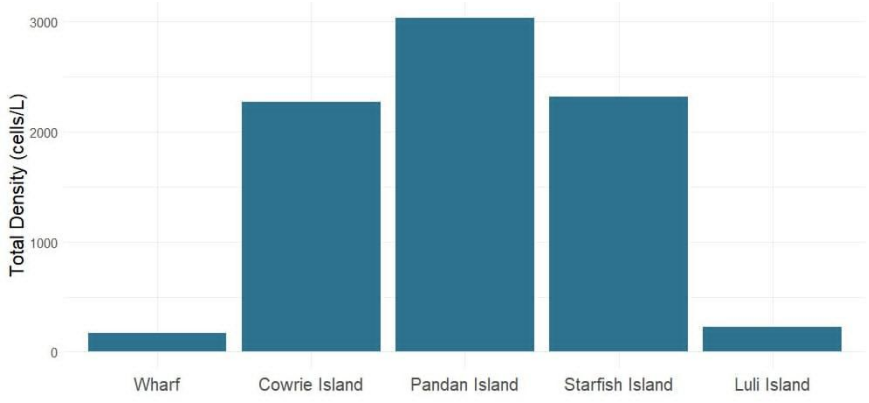

Figure 3. Cyanobacteria density Cells/L across five sampling station.

Environmental condition of the study sites

The physicochemical conditions of five sampling stations showed relatively uniform values for temperature, salinity, pH, and dissolved oxygen, while conductivity, oxidation–reduction potential (ORP), water transparency and depth, and total suspended solids exhibited more variation Figure 4. Surface water temperature remained stable across the study area, ranging from a minimum of 29.96°C at Luli to a maximum of 30.54°C at Cowrie. Conductivity values were consistent (approximately 47–48 µS/cm) at most stations, with the exception

of Cowrie, which recorded a notably lower value of 34.89 µS/cm. Salinity levels showed minimal fluctuation, with values between 30.54 psu (Luli) and 31.26 psu (Wharf and Cowrie). In contrast, the Oxidation–Reduction Potential (ORP) showed an increasing trend across the stations, starting at 35.63 mV at the Wharf and reaching a peak of 47.29 mV at Luli. The pH levels were consistently alkaline, ranging narrowly from 8.32 to 8.39, indicating a stable chemical environment. Similarly, Dissolved Oxygen (DO) levels showed very little variance, maintaining a range between 2.25 mg/L and 2.30 mg/L across all five stations. The physical characteristics of the water column showed significant spatial differences: Water Depth and Transparency: Depth increased progressively from the Wharf (0.65 m) to Luli (11.35 m). At the first four stations, transparency was equal to the total depth, suggesting that the euphotic zone extended to the benthos. However, at Luli, transparency was limited to 3.95 m despite a depth of 11.35m. Total Suspended Solids (TSS): TSS concentrations fluctuated between stations, with the highest concentration recorded at the Wharf (37.95 mg/L) and the lowest at Pandan (21.85 mg/L).

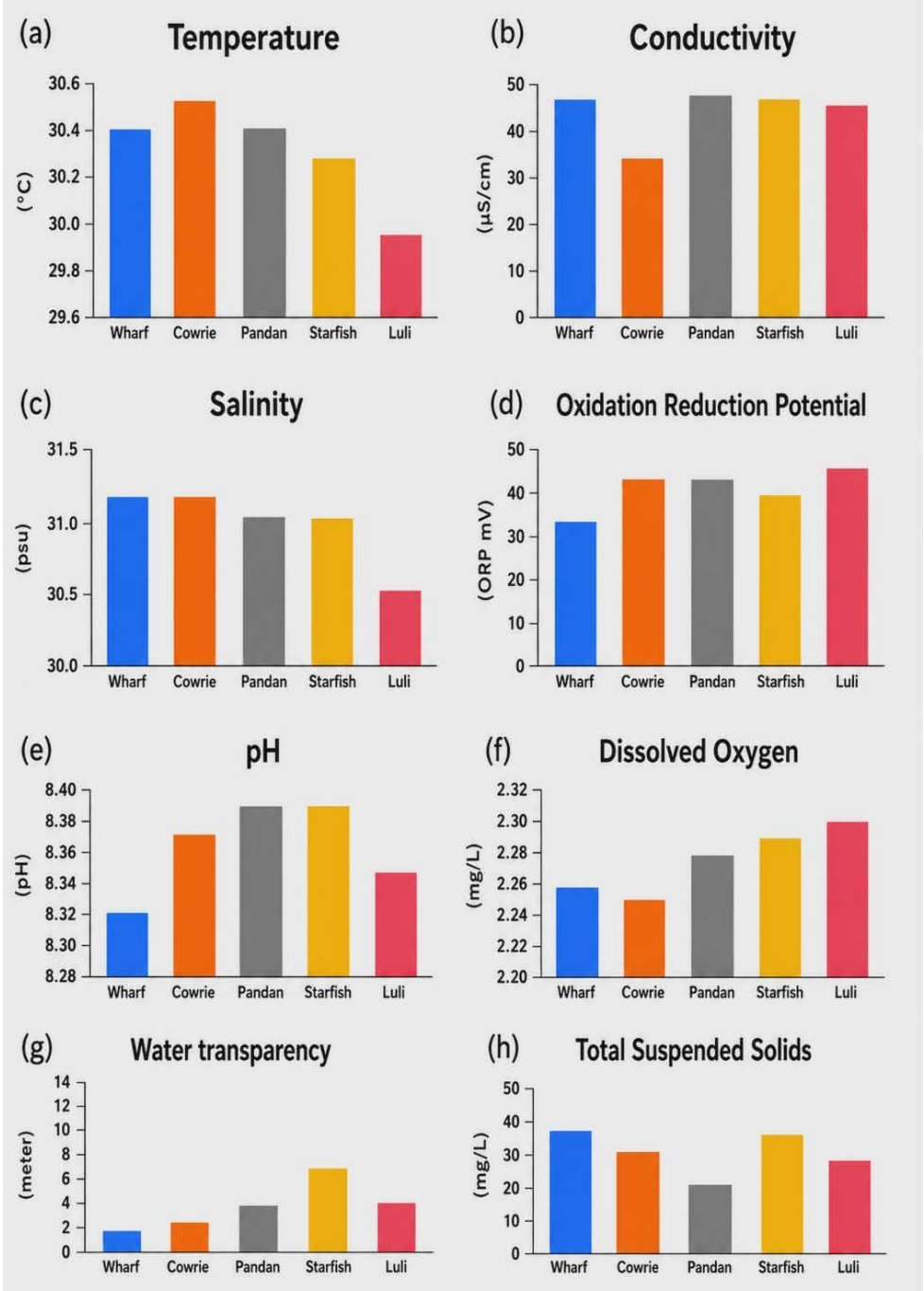

Figure 4. Physicochemical parameters across Honda Bay. (a) showing temperature; (b) showing conductivity; (c) showing salinity; and (d) showing ORP; (e) showing pH value; (f) showing Dissolved Oxygen; (g) showing water transparency and depth; and (h) showing Total suspended solids.

Occurrence of Potentially Harmful Cyanobacteria taxa

Composition and distribution of cyanobacteria taxa, cyanobacteria in Honda Bay as shown in Figure 5 revealed the presence of several potentially toxic taxa across all sampled sites. The community composition was characterized by a mix of filamentous and colonial genera, with varying relative abundances depending on the location. In contrast, *Merismopedia* sp. showed a highly site–specific distribution. It was the dominant taxon at the Cowrie site, comprising 56% of the recorded taxa, and maintained a significant presence at Pandan (24%) and the Wharf (12%). Notably, this genus was entirely absent from the Starfish and Luli stations. Minor taxa and non–toxic composition other potentially toxic genera were recorded in lower frequencies: *Oscillatoria* sp. was consistently present across all sites, peaking at Pandan (11%) and remaining below 10% at the other four locations. *Trichodesmium* sp. was most abundant at Cowrie (11%) and Pandan (9%), but was not detected at the Luli station. *Nodularia* sp. maintained a relatively low but stable presence, ranging from 1% to 6% across the five sites. *Synechococcus* sp. was the least frequent taxon, appearing only at the Starfish site with a minimal relative abundance of 1%. The non–toxic cyanobacteria taxa represented a significant portion of the community at the Wharf, accounting for 48% of the total. At the remaining sites, the proportion of non–toxic taxa was considerably lower, ranging from 8% at Cowrie to 22% at Luli.

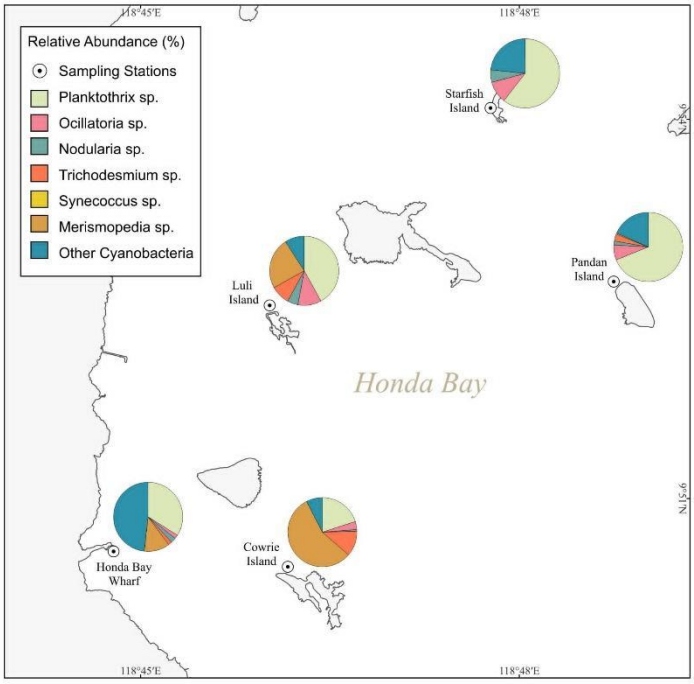

Figure 5. Potentially toxic cyanobacteria distribution across five sampling sites in Honda Bay.

The potentially toxic cyanobacteria identified in the Honda Bay, along with their associated toxins and known health risks Table 1. Several taxa were linked to hepatotoxins, including *Planktothrix* sp., *Nodularia* sp., *Synechococcus* sp., and *Merismopedia* sp., which are known producers of microcystins or nodularin associated with liver damage. Neurotoxins such as anatoxin, saxitoxin, palytoxin, and 42–hydroxy–palytoxin were associated with *Planktothrix* sp. and *Trichodesmium* sp., posing risks of paralytic shellfish poisoning and other severe seafood–related intoxications. Some taxa were also linked to cytotoxic effects and bioaccumulation in seafood.

Table 1. Possible public health risks associated with cyanobacteria.

Potentially toxin–producing taxa	**Toxin**	**Known health risks If Level 2 of WHO ALF is reached (100,000cells/mL)**	**Routes**
Plantothrix sp.	Microcystins Neurotoxic Anatoxin Planktocylin Aplysiatoxin	Liver damage Paralytic Shellfish Poisoning (PSP)	Accidental ingestion of contaminated water, and consumption of contaminated seafood.
Nodilaria sp.	Hepatotoxic Nodularin	Liver damage	Accidental ingestion and inhalation of airborne aerosols.

Teichodesmium sp.	Palytoxin and 42–Hydroxy palytoxin	Clupeotoxisma severe form of seafood poisoning from eating plankton–feeding fish	Accidental ingestion and inhalation of airborne aerosols.
Oscillatoria sp.	Neurotoxin and Saxitoxin	Paralytic Shellfish Poisoning (PSP)	Consumption of contaminated seafood.
Synechoccus sp.	Microcystins and Cytotoxin	Bioaccumulation in seafood, LPS irritation	Skin contact, and accidental ingestion of contaminated water.
Merismopedia sp.	Microcystins	Liver damage	Accidental ingestion of contaminated water.

DISCUSSION

Spatial Distribution of Cyanobacteria in Honda Bay

Cyanobacterial density varied markedly among stations, with the lowest density recorded at Wharf and the highest density observed at Pandan Island, followed by Starfish Island. Intermediate densities were recorded at Cowrie and Luli Islands. This spatial pattern suggests that cyanobacteria in Honda Bay are not uniformly distributed and are influenced by localized environmental conditions. The low cyanobacterial density at Wharf may be attributed to shallow depth, low water transparency, and frequent anthropogenic disturbances such as boat traffic and docking activities, which can increase turbidity and disrupt phytoplankton growth. According to Harris et al. (2024), environmental conditions can limit the occurrence of cyanobacteria through abiotic mechanisms such as physical transport, hydraulic flushing, and water column mixing, which disrupt the stratification and may cause buoyant cyanobacteria to sink. In contrast, island stations such as Pandan and Starfish Islands exhibited clearer waters and greater depths, allowing enhanced light penetration that supports photosynthetic activity and cyanobacterial proliferation. Light availability and water column stability are important environmental conditions for cyanobacterial growth, as clearer water enhance photosynthesis. According to Journey et al. (2013), cyanobacterial abundance is strongly influenced by environmental factors including light availability, hydrology, and water column stratification, Changes in light penetration caused by water turbidity or clearer water conditions can alter phytoplankton community and influenced cyanobacterial production, while stable water conditions can further support cyanobacterial proliferation.

Water Parameters

Water temperature across all stations ranged from 29.96°C to 30.54°C, which falls within the optimal range for cyanobacterial growth in tropical marine environments, where warmer waters are often observed to favor population growth. Although temperature was consistently high, its limited variability among stations suggests that water temperature acted as a supporting factor rather than a primary driver of spatial differences in cyanobacterial density.

Water transparency and depth showed relatively clear spatial variation and were closely associated with cyanobacterial density patterns. Stations with higher transparency and deeper waters, such as Pandan and Starfish Islands, supported higher cyanobacterial densities. Increased light availability enhances photosynthetic efficiency, favoring cyanobacterial growth (Ho et al. 2017). Conversely, Wharf exhibited the lowest transparency and depth, which likely restricted light penetration and reduced cyanobacterial abundance.

The relationship observed between Cyanobacteria density and Total Suspended Solids (TSS) suggest a notable inverse correlation across the majority of the sampling stations. At Starfish Island, the study recorded the highest Cyanobacteria density (3,032 cells/L) corresponding with the lowest TSS concentration of 21.85 mg/L. Conversely, the Wharf station exhibited the highest TSS level (37.95 mg/L) alongside the lowest Cyanobacteria density of 168 cells/L. This inverse relationship can be attributed to several ecological factors such as light limitation, and physical interference. These findings emphasize the importance of optical conditions in regulating cyanobacterial occurrence in coastal marine waters.

Increasing water pH significantly impacts Cyanobacterial growth and productivity, even for halo–alkaliphilic species adapted to high pH environments. As pH increased the biomass yield decreased (Yi et al. 2024). The pH values across stations were slightly alkaline and exhibited minimal variation. Such conditions are generally favorable for cyanobacteria; however, the narrow pH range suggests that pH did not significantly contribute to differences in cyanobacterial density among stations.

Dissolved oxygen concentrations were relatively low at all stations. Low DO levels may reflect high microbial respiration or biological oxygen demand associated with planktonic activity. While cyanobacteria contribute oxygen through photosynthesis, bloom decay and microbial decomposition can reduce oxygen levels, potentially affecting overall water quality.

Salinity values were stable and characteristic of marine environments, supporting the presence of marine cyanobacterial taxa. The limited variation in salinity and conductivity among stations indicates that these parameters had minimal influence on spatial differences in cyanobacterial density.

Public Health Implications

Honda Bay is a major recreational and tourism area where activities such as swimming, snorkeling, and island–hopping increase human exposure to coastal waters leading to significant dermal exposure that may cause acute skin irritation, rashes, and blisters (Rzymski and Poniedzialek 2012), and high risk of accidental water ingestion particularly in children (O`Keefe 2024). Inland exposure near contaminated waters also increases the risk of inhaling toxic Cyanobacteria as toxins from Cyanobacteria, can become airborne aerosols which can be transported (Lim et al. 2023).

Overall, the occurrence of cyanobacteria, including potentially toxic taxa, raises public health concerns due to possible exposure through skin contact, accidental ingestion, and inhalation of aerosols. Although cyanobacterial densities observed in this study do not necessarily indicate active bloom conditions. The lack of baseline data in Palawan makes it difficult to assess long–term risks. This study provides essential baseline information that can support future public health monitoring and early warning systems for recreational waters.

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GENERATIVE AI STATEMENT

The OpenAI's ChatGPT was used only to improve grammar, clarity, and formatting references. The authors reviewed and verified all AI–generated content to ensure accuracy and compliance with academic standards.

ETHICAL CONSIDERATIONS

No animals were harmed, and no human subjects were involved during this study.

DECLARATION OF COMPETING INTEREST

The authors declare that there are no competing interests to any authors.

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Restoration of Mined–out Soil Using Carbonized Rice Hull and Rice Hay Compost

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ABSTRACT

Mining activities contribute significantly to land degradation, resulting in nutrient–deficient and unproductive soils that require effective rehabilitation strategies. This study evaluated the effectiveness of Rice Hay Compost (RHC) and Carbonized Rice Hull (CRH) as organic amendments to restore the productivity of mined–out soil collected from the mining area of Berong Nickel Corporation at Quezon, Palawan. A Completely Randomized Design (CRD) was used consisting of nine treatments with varying proportions of RHC and CRH amendments applied to mined–out soil, each replicated eight times. Growth and yield parameters, including leaf length, leaf width, number of leaves, fresh weight, and biomass, were measured over a 59–day growing period. Data were analyzed using Analysis of Variance (ANOVA), and Duncan's Multiple Range Test (DMRT) Post Hoc analysis at 1% level of significance. Results showed highly significant differences ($P < 0.01$) among treatments for all measured parameters. Treatment 9 (60% mined–out soil + 20% RHC + 20% CRH) consistently produced the highest growth and yield values, while the control (100% mined–out soil) and treatments with low amendment levels (T2–T5) exhibited the poorest performance. The combined application of RHC and CRH at higher proportions significantly enhanced plant growth and biomass production. The study concludes that the combination of 20% RHC and 20% CRH is the most effective treatment for enhancing the growth and yield of Pechay in mined–out soils. These findings highlight a sustainable and cost–effective approach for rehabilitating degraded mining areas using agricultural waste materials.

Keywords: soil rehabilitation, organic soil amendment, degraded soil restoration, agricultural waste utilization, sustainable agriculture

INTRODUCTION

Mining is essential for modern life, supplying raw materials for infrastructure and technology. In the Philippines, there are 59 operating metallic mines and some of them are in Palawan (Mines and Geosciences Bureau 2024), contributing significantly to the economy and local livelihoods. However, mining also causes serious environmental impacts, particularly soil degradation. Mining activities such as stripping, excavation, and dumping disrupt the soil's physical, chemical, and biological properties, reducing its capacity to support ecosystem functions (Feng et al. 2019; Leila et al. 2021). Studies have also shown that mining reduces soil nutrients, disturbs microbial communities, and negatively affects plant growth (Ma et al. 2019).

Soil degradation is a major global issue, characterized by the loss of soil fertility, structure, and biodiversity. Mining contributes to this problem by releasing toxic substances and heavy metals such as copper, zinc, lead, manganese, and iron into the soil, which accumulate and disrupt soil processes (Zheng et al. 2021). Areas near mining sites are particularly vulnerable, posing risks to soil quality, food safety, and human health (Bafghi et al. 2024). These concerns have led to stricter regulations, with the Department of Environment and Natural Resources (DENR) requiring mining companies to implement progressive rehabilitation throughout the mining life cycle (Department of Environment and Natural Resources 2022).

Despite these efforts, natural recovery through succession is often slow and insufficient, especially in severely degraded mined–out areas. Harsh soil conditions such as compaction, nutrient deficiency, and toxicity hinder plant establishment and microbial activity, limiting ecosystem recovery (Feng et al. 2019). Without intervention, erosion persists, biodiversity remains low, and environmental risks continue. Therefore, active restoration strategies are necessary.

Ecological engineering offers a sustainable approach to rehabilitation by utilizing natural processes to restore degraded lands (Mariola et al. 2019). Successful restoration depends on soil quality, appropriate plant selection, and proximity to natural forests that serve as seed sources (Konnig et al. 2023). Since mined–out soils are typically low in organic matter, the addition of organic amendments such as compost can improve soil structure and fertility (Nunez 2013; Liu et al. 2014).

Agricultural wastes, particularly from rice production, present a viable solution. Rice hull and rice straw are often improperly disposed of through dumping or burning, causing environmental issues (Nidoy 2016).

However, these materials can be converted into useful soil amendments such as Carbonized Rice Hull (CRH) and Rice Hay Compost (RHC), which supply essential nutrients and improve soil properties (Dinh et al. 2024). The Department of Agriculture (2005) promotes recycling these residues to enhance soil productivity while reducing waste.

Despite their potential, limited studies have examined the effectiveness of CRH and RHC in rehabilitating mined–out soils. Thus, this study aims to evaluate their effectiveness in improving soil fertility and physicochemical properties using Pechay (*Brassica rapa* L.) as a test plant. Specifically, it seeks to assess the effects of different combinations of Rice Hay Compost (RHC) and Carbonized Rice Hull (CRH) on the vegetative growth of Pechay, using leaf length, leaf width, and number of leaves as growth parameters; determine their effects on yield performance as measured by fresh weight and total biomass; and identify the most effective combination of these amendments that produces optimal growth and yield in mined–out soil. Pechay is a suitable indicator species due to its sensitivity to soil conditions, with its growth and biomass reflecting variations in soil quality (Schloter et al. 2003; Zhang et al. 2023; Zunaidi et al. 2024).

METHODS

Research Design

The study employed a completely randomized design (CRD) to test the effects of different levels and combinations of Rice Hay Compost (RHC) and Carbonized Rice Hull (CRH) on the growth and yield of Pechay (*Brassica rapa L.*). The treatments consisted of pure mined–out soil as a control, along with various levels and combinations of Rice Hay Compost (RHC) and Carbonized Rice Hull (CRH). These treatment combinations allowed for the evaluation of individual effects of RHC and CRH as well as their interaction effects on growth and yield of Pechay. The experimental treatments and replicates were randomly assigned to experimental units (pots) to minimize bias and ensure valid comparisons.

This experimental design was appropriate for determining the combined and individual effects of CRH and RHC on the growth performance of Pechay cultivated in rehabilitated mined–out soil under controlled conditions.

Locale of the Study

The study was conducted within the Western Philippines University Main Campus, located in San Juan, Aborlan, Palawan.

Data Gathering Procedures

Materials used in the Study. The volume of soil and soil amendments used in this study were measured using graduated beakers to ensure accuracy in formulating the different treatments. The mixtures of mined–out soil and amendments were placed in standard–sized plastic pots capable of holding four liters of planting material. A metal spatula was used to transfer Pechay seedlings into the treatment pots. Plant growth parameters, particularly, leaf length and width were measured using a caliper. At the end of the experiment, a calibrated digital weighing scale was used to determine the fresh biomass and dried biomass of the Pechay samples. In addition, Pechay samples were thoroughly dried in a hot air oven at 105^{O}C for 14 hours to obtain the dried biomass.

Collection of Soil Samples and Soil Amendments. The mined–out soil was collected from the Berong Nickel Corporation (BNC) mining sites. The collected soil was air–dried and sieved to remove large particles prior to use. The Rice Hay Compost (RHC) was sourced from a local farm, while the Carbonized Rice Hull (CRH) was bought from a local supplier. All materials were stored in clean, labeled containers before treatment preparation.

Sowing of Seeds and Growing of Pechay Seedlings. Pechay (*Brassica rapa* L.) seeds were sown in seedling trays containing a uniform germination mix composed of garden soil, compost, and sand. The trays were placed under partial shade and watered regularly to maintain adequate moisture. Healthy and uniform seedlings were selected 11 days after sowing, once they reached the two– to three–leaf stage.

Planting of Pechay Seedlings in Pots. The selected Pechay seedlings were transplanted individually into the prepared treatment pots, one seedling per pot. Transplanting was done in the late afternoon to minimize transplant shock. Each seedling was placed in a central hole, lightly pressed into the soil mixture, and watered immediately after transplanting to promote establishment in a new planting material.

Growing, Maintenance, Harvesting, and Weighing. During the growing period, the plants were exposed to natural sunlight and watered regularly to maintain adequate soil moisture. No chemical fertilizers were used to isolate the effects of the organic amendments. Pesticide application was minimized and only applied when pests were present to prevent damage that could affect the data. Plant growth particularly, leaf length and width, number of leaves, and leaf coloration were monitored and recorded weekly.

After 59 days, or upon reaching maturity, the Pechay plants were harvested and fresh weight was recorded immediately to prevent weight loss due to air drying. These measurements were used to evaluate the influence of CRH and RHC on the growth and yield of Pechay in rehabilitated mined–out soil.

The experiment was arranged in a Completely Randomized Design (CRD) with nine treatments consisting of pure Carbonized Rice Hull (CRH), pure Rice Hay Compost (RHC), and their combinations at different proportions (0%, 10%, and 20% by volume). These treatment combinations were as follows:

Table 1. Treatment combinations and proportions.

Treatment	Mined–Soil	Rice hay compost	Carbonized rice hull
1	100%	–	–
2	90%	10%	–
3	90%	–	10%
4	80%	20%	–
5	80%	–	20%
6	80%	10%	10%
7	70%	10%	20%
8	70%	20%	10%
9	60%	20%	20%

Each treatment with eight replications was thoroughly mixed to achieve uniform composition, with a total planting volume of four liters per pot.

Data Analysis

The data on fresh weight and biomass were subjected to natural logarithmic (LN) transformation to achieve homogeneity of variance and normal distribution, meeting the assumptions required for valid statistical. The transformed data were then analyzed using the Analysis of Variance (ANOVA). Since the mean fresh weight and biomass showed highly significant differences among treatments at the 1% level of significance, the means were further separated using Duncan's Multiple Range Test (DMRT) as a post hoc analysis. The data on average number of leaves, average leaf length and average leaf width were also analyzed using ANOVA, followed by DMRT for mean comparison.

RESULTS

The growth and yield performance of Pechay (*Brassica rapa* L.) grown in mined–out soil amended with different levels and combinations of Carbonized Rice Hull (CRH) and Rice Hay Compost (RHC) showed significant variation among treatments.

Vegetative Growth

Leaf Number. Analysis of variance (ANOVA) revealed a highly significant effect of treatments on leaf number ($F_{8,63} = 7.97$, $P < 0.001$) (Table 1). Treatment 9 recorded the highest mean leaf number (11.63), which was significantly greater than all other treatments. Treatments 6, 7, and 8 produced moderately high leaf numbers, while Treatments 1 to 5 had the lowest values and were statistically comparable to the control.

Table 2. Average Leaf number of Pechay (*Brassica rapa* L.) grown in mined–out soil amended with different levels and combinations of Carbonized Rice Hull (CRH) and Rice Hay Compost (RHC), (Note: Means with the same letter are not significant from each other.

Treatment	Leaf Number
1	6.75^{cd}
2	6.25^{d}
3	7.00^{cd}
4	6.13^{d}
5	5.75^{d}
6	8.13^{bc}
7	8.13^{bc}
8	8.50^{b}
9	11.63^{a}
Grand Total	546
Grand Mean	7.59
ANOVA	($F_{8, 63} = 7.97$, $P < 0.001$)

ANOVA

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	p–value
Treatment	8	208.42	26.05	7.97**	0.000
Error	63	206.00	3.27		
Total	71	412.42			

**highly significant

Leaf Length. Leaf length was also significantly affected by the treatments ($F_{8,63} = 15.91$, $P < 0.001$) (Table 2). Treatment 9 produced the longest leaves (56.99 mm), significantly outperforming all other treatments. Treatments 6, 7, and 8 showed intermediate values, whereas Treatments 1 to 5 exhibited shorter leaf lengths.

Table 3. Average leaf and length of Pechay (*Brassica rapa* L.) grown in mined–out soil amended with different levels and combinations of Carbonized Rice Hull (CRH) and Rice Hay Compost (RHC). (Note: Means with the same letter are not significant from each other).

Treatment	Leaf Length (mm)
1	38.81^{cd}
2	33.98^{d}
3	39.77^{cd}
4	39.29^{cd}
5	35.15^{d}
6	45.75^{bc}
7	49.48^{b}
8	46.17^{bc}
9	56.99^{a}
Grand Total	3468.44
Grand Mean	42.82
ANOVA	($F_{8, 63} = 15.91$, $P < 0.001$)

ANOVA

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	p–value
Treatment	8	5628.12	703.52	15.91**	0.000
Error	63	2785.12	71		
Total	71	8413.24			

** highly significant

Leaf Width. A highly significant effect of treatments on leaf width was observed ($F_{8,63} = 16.50$, $P < 0.001$). Treatment 9 had the widest leaves (46.96 mm), followed by Treatments 7, 8, and 6. Treatments 1 to 5 produced significantly narrower leaves (Table 3).

Table 4. Average leaf width of Pechay (*Brassica rapa* L.) grown in mined–out soil amended with different levels and combinations of Carbonized Rice Hull (CRH) and Rice Hay Compost (RHC), (Note: Means with the same letter are not significant from each other).

Treatment	Leaf Width (mm)
1	32.14^{d}
2	28.60^{e}
3	32.79^{d}
4	32.51^{d}
5	29.62^{e}
6	35.00^{c}
7	38.07^{b}
8	36.77^{bc}
9	46.96^{a}
Grand Total	2499.62
Grand Mean	34.72
ANOVA	($F_{8, 63} = 16.50$, $P < 0.001$)

ANOVA

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	p–value
Treatment	8	5421.47	677.68	16.50**	0.000
Error	63	2588.15	41.08		
Total	71	8009.62			

** highly significant

Yield Performance

Fresh Weight. The ANOVA indicated a highly significant effect of treatments on fresh weight ($F_{8,63} = 13.566$, $P < 0.001$) (Table 4). Treatment 9 recorded the highest mean fresh weight (51.46 g), which was significantly higher than all other treatments. Treatments 6, 7, and 8 produced intermediate fresh weights, while Treatments 1 to 5 showed significantly lower values ranging from 6.79 to 9.70 g (Treatment 4).

Table 5. Mean Fresh weight of Pechay (*Brassica rapa* L.) grown in mined–out soil amended with different levels and combinations of Carbonized Rice Hull (CRH) and Rice Hay Compost (RHC), (Note: Means with the same letter are not significant from each other).

Treatment	Fresh Weight (g)
1	8.53^{c}
2	6.79^{c}
3	9.19^{c}
4	9.70^{c}
5	6.97^{c}
6	18.11^{b}
7	23.31^{b}
8	25.50^{b}
9	51.46^{a}
Grand Total	1276.39
Grand Mean	17.73
ANOVA	$F_{8,63} = 13.566$, $P < 0.001$

ANOVA

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	p–value
Treatment	8	31.534	3.942	13.566**	0.000
Error	63	18.306	0.291		
Total	71	49.839			

Natural log (LN) was used ** highly significant

Biomass. Biomass data, after natural logarithm transformation, also showed a highly significant treatment effect ($F_{8,63} = 9.661$, $P < 0.001$). In general, treatments receiving higher levels of organic amendments produced greater biomass compared to treatments with lower amendment rates.

Treatment 9 yielded the highest biomass (4.15 g), significantly exceeding all other treatments. Treatments 7 and 8 formed the second group, followed by Treatment 6, while Treatments 1 to 5 recorded the lowest biomass values. These results exhibited a pattern like that observed for fresh weight.

Table 6. Mean biomass of Pechay (*Brassica rapa* L.) grown in mined–out soil amended with different levels and combinations of Carbonized Rice Hull (CRH) and Rice Hay Compost (RHC), (Note: Means with the same letter are not significant from each other).

Treatment	Biomass (g)
1	0.99^{d}
2	0.72^{d}
3	1.03^{cd}
4	1.01^{cd}
5	0.71^{d}
6	1.57^{bc}
7	1.95^{b}
8	2.11^{b}
9	4.15^{a}
Grand Total	113.84

Grand Mean	1.58
ANOVA	$F_{8,63} = 9.661$, $P < 0.001$

ANOVA

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	p–value
Treatment	8	21.881	2.735	9.661**	0.000
Error	63	17.835	0.283		
Total	71	39.716			

Natural log (LN) was used ** highly significant

DISCUSSION

Growth Parameters

The results clearly demonstrate that the application of Carbonized Rice Hull (CRH) and Rice Hay Compost (RHC) significantly improved the vegetative growth of Pechay (*Brassica rapa* L.) grown in mined–out soil, as reflected in leaf number, leaf length, and leaf width.

Treatment 9 consistently produced the highest values across all growth parameters. This treatment, composed of 60% mined–out soil, 20% RHC, and 20% CRH, provided the most favorable growing conditions. The superior vegetative performance can be attributed to improved soil fertility, enhanced nutrient availability, better moisture retention, improved soil structure, and increased microbial activity (Abdaljabar et al. 2025; Yu et al. 2024). These findings indicate that balanced and higher levels of organic amendments are most effective in enhancing plant growth.

The increase in leaf number, length, and width suggests enhanced vegetative development. Leaves are the primary sites of photosynthesis; thus, increased leaf area likely contributed to improved photosynthetic efficiency. This observation supports the findings of Goyit et al. (2023), who emphasized that leaf growth parameters are reliable indicators of plant productivity.

Treatments 6, 7, and 8 also showed improved growth compared to lower treatments, indicating that moderate to high levels of CRH and RHC positively influence vegetative development. A clear increasing trend was observed as the proportion of organic amendments increased and the percentage of mined–out soil decreased, highlighting the importance of both amendment level and balanced combination.

In contrast, Treatments 1 to 5 exhibited poor vegetative performance. These treatments contained little to no organic amendments and a higher proportion of mined–out soil, which is typically characterized by low organic matter, poor nutrient availability, and unfavorable physical properties. Such conditions limit plant growth and development (Mante et al. 2019), confirming that mined–out soils alone are insufficient for optimal crop production.

These findings demonstrate that mined–out soils can be effectively rehabilitated through the incorporation of appropriate organic amendments. The combined use of RHC and CRH provides a sustainable and cost–effective approach for improving soil fertility and promoting plant establishment in degraded mining areas.

Yield Parameters

The application of CRH and RHC also had a significant effect on the yield performance of Pechay, as reflected in fresh weight and biomass production.

Treatment 9 produced the highest fresh weight and biomass among all treatments, demonstrating a strong positive response to higher combined levels of organic amendments. The marked increase in yield suggests a synergistic effect when both CRH and RHC are applied at 20% each. This combination likely improved soil aeration, water–holding capacity, nutrient retention, and overall soil structure, thereby creating optimal conditions for root development and nutrient uptake.

Treatments 6, 7, and 8 also exhibited significantly higher yield compared to Treatments 1 to 5, indicating that moderate to high levels of organic amendments enhance plant productivity. A consistent increasing trend in fresh weight and biomass was observed as the level of organic amendments increased and the proportion of mined–out soil decreased. This trend highlights the importance of both the amount and balanced combination of CRH and RHC in maximizing crop yield.

In contrast, Treatments 1 to 5 recorded the lowest fresh weight and biomass values. These treatments had minimal or no organic amendments, resulting in poor soil conditions that restricted plant growth. Mined–out soils

are generally characterized by low nutrient content, poor structure, and limited biological activity, which negatively affect plant productivity (Mante et al. 2019).

The findings are consistent with previous studies. Herencia and Maqueda (2016) reported that organic amendments improve soil nutrient content, including nitrogen, phosphorus, and magnesium, which are essential for plant growth. Similarly, Zanao et al. (2022) demonstrated that CRH enhances soil physicochemical properties, while Danapriatna et al. (2023) reported that RHC improves soil organic carbon and nutrient levels. These improvements collectively contribute to increased biomass accumulation and overall plant productivity.

Overall, the results confirm that the combined application of RHC and CRH is effective in enhancing the yield performance of Pechay in mined–out soils. Given the poor condition of mined–out soils, characterized by low fertility, poor structure, and limited biological activity (Singh et al. 2024), the use of these organic amendments offers a practical, sustainable and low–cost approach for soil rehabilitation.

From an application standpoint, mining companies and land rehabilitation practitioners may adopt the combination of 60% mined–out soil, 20% RHC, and 20% CRH as an effective soil enhancement strategy for restoring degraded mined–out lands. Government agencies such as the Department of Environment and Natural Resources (DENR), Department of Agriculture (DA), and Local Government Units (LGUs) may also incorporate these organic amendments into land restoration and reforestation programs to improve soil quality and support vegetation establishment.

Furthermore, farmers and local communities in mining–affected areas are encouraged to utilize agricultural wastes such as rice hay and rice hulls as organic soil amendments. Their combined application provides a low–cost and sustainable method for improving soil productivity in nutrient–depleted environments.

Finally, further research is recommended to evaluate the long–term effects of CRH and RHC on soil properties, microbial activity, and plant performance under field conditions. Future studies should also explore their application to other crops and native tree species to support broader land rehabilitation and ecosystem restoration efforts.

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GENERATIVE AI STATEMENT

The author used Chat GPT 4o for this research as a tool to check for grammar mistakes.

ETHICAL CONSIDERATIONS

This study was conducted with careful attention to environmental safety, ethical research standards, and responsible resource management. The mined–out soil used in the experiment was collected only from designated areas with prior permission from local authorities, ensuring that no additional environmental degradation occurs. The soil amendments, including CRH and RHC, were derived from locally available agricultural wastes, promoting sustainable and eco–friendly waste recycling practices.

All plant materials, particularly Pechay (*Brassica rapa* L.), were handled following accepted horticultural practices to ensure that no harm was caused to biodiversity or surrounding ecosystems. The study also adhered to the ethical use of pesticides, applying them in a safe, responsible, and justifiable manner to minimize potential harm to humans, non–target organisms, and the environment while still achieving their intended purpose.

Furthermore, organic wastes generated during the experiment were properly disposed of in a composting facility to support environmentally sound waste management.

DECLARATION OF COMPETING INTEREST

The authors declare that there are no competing interests to any authors.

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Spatial Distribution and Assemblages of Zooplankton during the Northeast Monsoon in Shark Fin Bay, Taytay, Palawan, Philippines

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ABSTRACT

Marine Protected Areas (MPAs) are vital for biodiversity conservation, yet monitoring often focuses on larger species, neglecting microscopic organisms that form the marine food web's foundation. This research determined the spatial distribution and community assemblages of zooplankton within Shark Fin Bay. Field sampling was conducted at six stations: four within MPAs (Depla, Garden, Pinnacle, and Sandoval) and two in non–MPAs (Depla North and Macuao). Zooplankton were collected via five–minute horizontal surface tows using a 200–micron mesh plankton net. Laboratory analysis involved the displacement method to determine biomass and identification using a Bogorov counting chamber. The highest–abundance station recorded a wet weight of 49.5 ml/m³, density of 1,249.79 ind/m³, and diversity index of 1.808, while Depla North showed the lowest abundance. The Wilcoxon signed–rank test revealed no significant differences between MPA and non–MPA stations ($p > 0.05$). Taxonomic composition was dominated by Calanoid copepods and Cyclopoida, indicating a stable but localized community structure. Garden station was notably dominated by Appendicularia, which constitutes a significant portion of many nekton species' diet. The findings demonstrate that Shark Fin Bay supports a robust zooplankton community. This research provides critical baseline data for MPA management, suggesting that conservation efforts must account for these "invisible" foundational species to ensure long–term sustainability of the bay's fisheries and marine productivity. Further temporal studies are recommended to assess zooplankton variability in the bay.

Keywords: appendicularia, diversirty, marine protected area, plankton

INTRODUCTION

Marine Protected Areas (MPAs) are specific regions where human activities are limited to protect essential ecosystems and conserve marine biodiversity. By safeguarding diverse habitats, MPAs contribute to the restoration of ocean productivity, the mitigation of environmental degradation, and the preservation of ecosystem services. As the pressures from overfishing, pollution, and climate change intensify, MPAs are increasingly vital in maintaining ocean health and ensuring the long–term protection of marine biodiversity (Gennari 2024).

Recently, the Marine Conservation Institute and the Sulubaai–Environmental Foundation have announced that the Shark Fin Bay MPA Network is now a Blue Spark marine protected area collaboration. This network protects tropical reefs, seagrass meadows, and mangrove forests, which support a high diversity of species. The area provides habitat for an array of threatened and endangered species, including black–tip reef sharks, hawk bills, green turtles, and several endangered tropical fish, including napoleon wrasse. The local communities of Shark Fin Bay are committed to revitalizing the coastal and marine ecosystems upon which they rely on food and their livelihoods (Daily Tribune 2025).

Zooplankton, a subset of the broader planktonic community, are heterotrophic organisms that inhabit both freshwater and marine environments. The term “plankton” encompasses a diverse array of organisms that float or drift within aquatic realms. Among these, zooplankton are distinguished by their heterotrophic nature, signifying their reliance on external organic matter for sustenance, as opposed to autotrophic organisms that can synthesize their own food (BNO Team 2024). Changes in zooplankton communities over time may indicate subtle environmental changes to their habitats. Zooplankton play a crucial role in not only the material transport and energy flow through the food web but also in the control of the community structure and population size in different aquatic biomes via upward and downward effects (Sun X., et al. 2021). Therefore, indices of zooplankton abundance and species diversity can be used to determine the health of an ecosystem. Many local councils and water managers collect phytoplankton and zooplankton samples as indicators of water quality, often in response to the increasing incidence of algal blooms in rivers and estuaries (Queensland Government 2018). Profiling helps

understand the structure of the zooplankton community and how it relates to environmental factors and other organisms in the ecosystem (Duarte et al. 2014).

The aim of this study was to determine the zooplankton diversity of Shark Fin Bay, Palawan. Specifically, the study aimed to (1) determine the composition, abundance, and diversity of the zooplankton community, (2) map the distribution of dominant taxa, and (3) compare the assemblages between stations within and outside the MPAs.

METHODS

Study Site

This study was conducted in Shark Fin Bay situated at the northern east coast of mainland Palawan, Philippines. The sampling stations were based on the established monitoring sites for fish eDNA project of the Sea Academy (**Table 1**). The sampling stations were composed of four (4) stations within Marine Protected Area (MPA) and two stations outside MPA area (**Figure 1**). In recent years, the bay has been impacted by illegal and destructive fishing practices, which have disrupted the marine ecosystem and biodiversity.

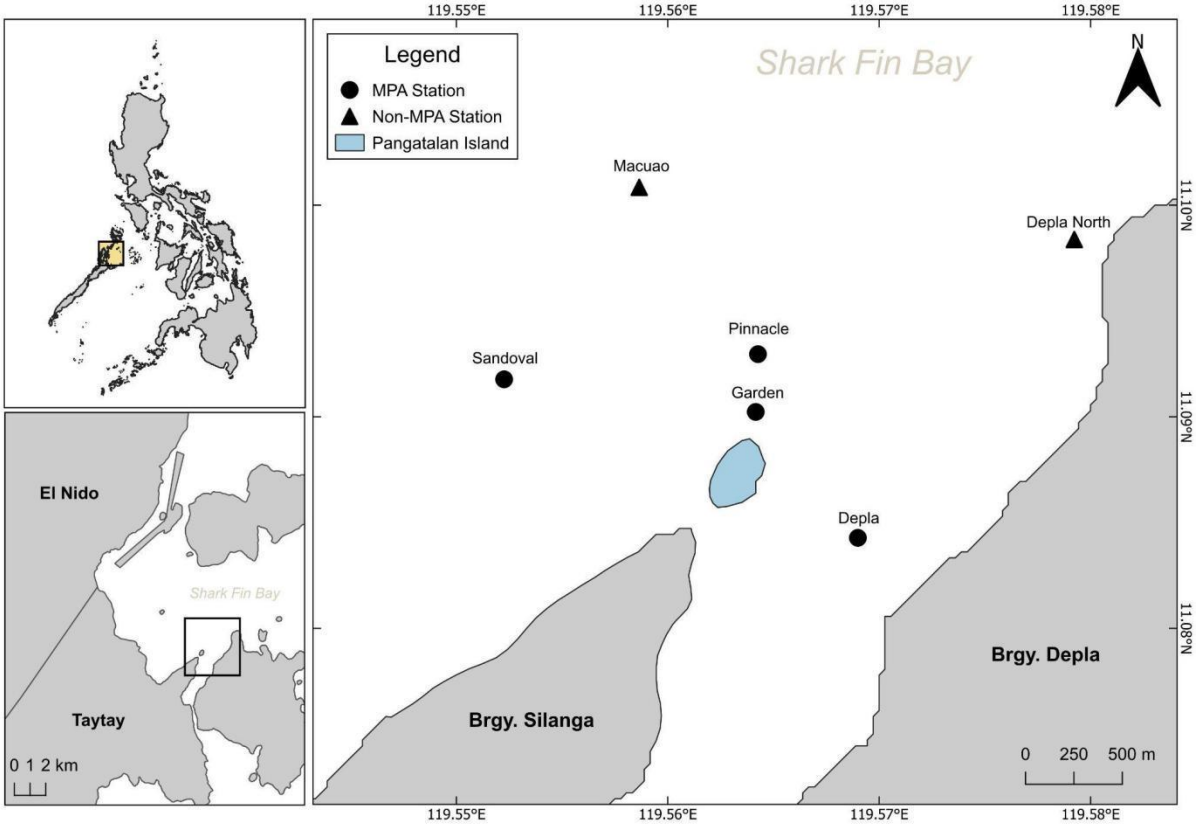

Figure 1. Map of the study area and location of sampling stations in Shark Fin Bay, Taytay, Palawan.

Table 1. Coordinates of the designated sampling stations including longitude and latitude measurements.

Station	Longitude	Latitude
Depla N	119.57923	11.09838
Macuao	119.55866	11.10084
Depla	119.56898	11.084263
Garden	119.564172	11.09021
Pinnacle	119.564273	11.092943
Sandoval	119.552252	11.091739

Sampling procedure

Zooplankton samples were collected using a plankton net with a mesh size of 200 microns and a mouth diameter of 50 cm. The collection process involved horizontal towing, with the net affixed to the side of a boat moving at a constant speed of one knot. Upon retrieval, the plankton net was sprayed to concentrate the samples at the cod end. The concentrated samples were then sieved to remove large debris and transferred to pre–labeled bottles. Preservation of the samples was achieved by using 10% formalin, and the bottles were sealed with parafilm to prevent leakage. The samples were placed in an ice box and promptly transported to the Microbiology

Laboratory at the Aquatic, Biodiversity, Biotechnology and Aquaculture R&D building, Western Philippines University, Puerto Princesa Campus.

Sample preparations

The zooplankton were extracted from the container and placed in a 200–micron sieve to eliminate any phytoplankton present. Large debris were manually removed using forceps. Following this cleaning process, the sieve was employed to concentrate the zooplankton using a wash bottle. Once concentrated, a spatula was utilized to transfer the samples into a tube for the measurement of their wet weight. Subsequently, the volume (ml) of water containing the zooplankton was measured. The mixture was then transferred to another tube using a sieve to separate the zooplankton from the water, and the volume was measured again. The volume of water was subtracted from the zooplankton mixture with water to determine the total wet weight of the sample. This type of procedure is called displacement method because this method (submersion, or dunking method) can be used to accurately measure the volume of the human body and other oddly shaped objects by measuring the volume of fluid displaced when the object is submerged (Choi, J. H. et al. 2024). Measuring the zooplankton biomass is also done by having the formula of $A= pi(r^2)D$ and Biomass= Wet weight/Total filtered seawater (m^3).

Microscopic examination of samples

Following the determination of the sample's biomass, the zooplankton were placed in a Bogorov counting chamber. This type of chamber is utilized in limnology and oceanography for the quantification of plankton, particularly zooplankton, under a stereomicroscope. These chambers accommodate a small volume of the sample for examination under a dissecting microscope. The design and configuration of the shallow etched grooves facilitate the identification of specific areas within the chamber. The straight sides maintain a consistent focus, while the rounded edges prevent the specimens from becoming ensnared.

Statistical Analysis

Diversity and richness indices were computed using Shannon–Weiner diversity and Margalef's richness, respectively. Wilcoxon statistics was used to determine significant differences between MPA and non–MPA stations, since test for normality of data was not satisfied.

RESULTS

Phytoplankton Composition, Abundance, and Diversity

A total of 14 zooplankton taxa were recorded across the six sampling stations: Depla North, Macuao, Depla, Garden, Pinnacle, and Sandoval . The total zooplankton density varied considerably among stations, ranging from 194.40 ind/m^3 at Depla North to 1249.79 ind/m^3 at Sandoval. Relatively low densities were also observed in Macuao (202.63 ind/m^3) and Depla (218.12 ind/m^3), whereas much higher densities were recorded at Garden (729.92 ind/m^3) and Pinnacle (1091.52 ind/m^3) as shown in **Figure 2**.

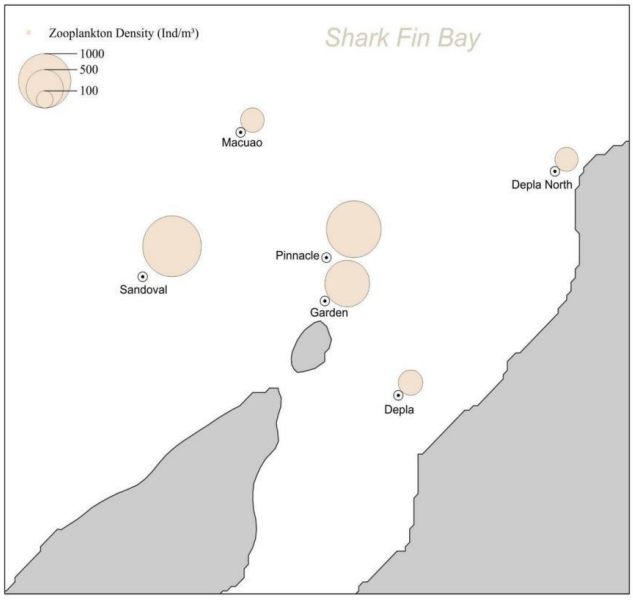

Figure 2. Spatial map of zooplankton total abundance (density: Ind/m^3) in Shark Fin Bay, Palawan.

Copepods constituted the dominant zooplankton group across all stations (Figure 3). Among them, Calanoida showed the highest densities in most stations, particularly at Sandoval (407.57 ind/m³) and Pinnacle (377.71 ind/m³), followed by Garden (131.98 ind/m³), Depla North (129.47 ind/m³), Macuao (105.36 ind/m³), and Depla (105.29 ind/m³). Cyclopoida was the second most abundant copepod group, with densities increasing toward the latter stations, reaching 354.33 ind/m³ in Sandoval and 268.59 ind/m³ in Pinnacle. Harpacticoida occurred in lower densities but were present in all stations, with the highest value observed at Sandoval (64.34 ind/m³). Among non–copepod taxa, Appendicularia exhibited notable abundance, particularly at Pinnacle (368.07 ind/m³) and Garden (355.91 ind/m³), indicating a strong contribution to the overall zooplankton density at these stations. Other groups such as Ostracoda, Chaetognatha, fish eggs, and nauplii were also recorded across most stations but generally occurred in moderate to low densities. Nauplii were particularly abundant at Sandoval (80.85 ind/m³).

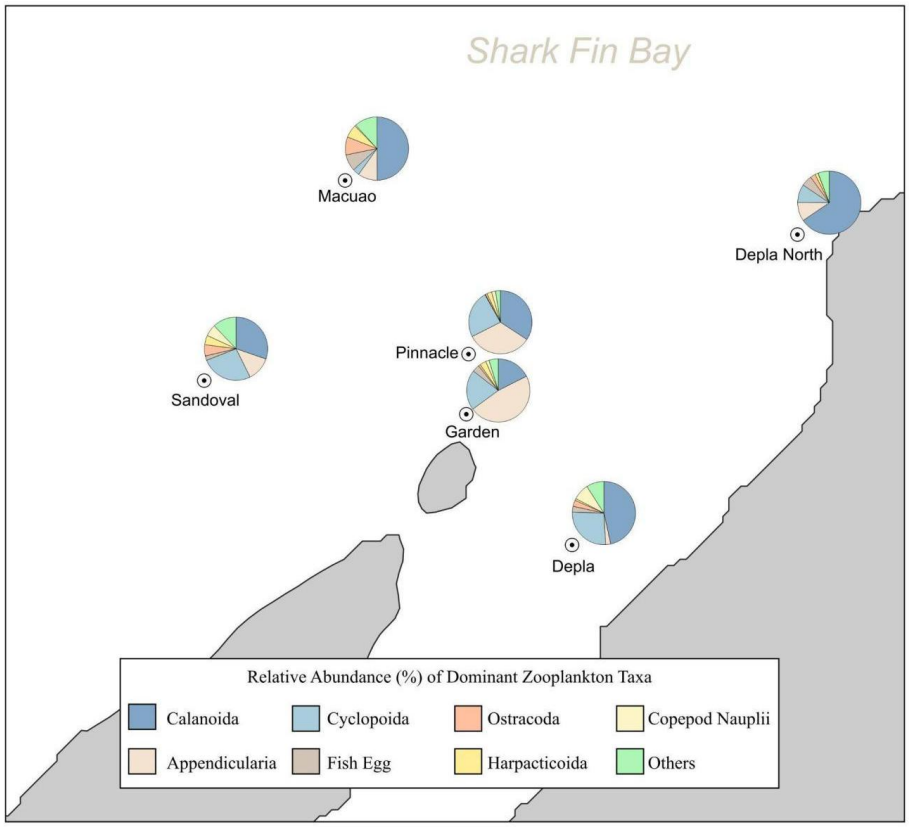

Figure 3. Spatial distribution map and relative abundance (%) of dominant zooplankton taxa.

Larval forms including crab zoea, euphausiids, mysids, and polychaete larvae were present in relatively low densities across stations. Rare taxa such as gastropod larvae and foraminiferans were only observed in Macuao, with very low densities. Moreover, the results indicate a higher zooplankton density in the stations within MPAs (Garden, Pinnacle, Depla and Sandoval) compared to the non–MPAs (Depla North, Macuao), with copepods, particularly Calanoida and Cyclopoida, dominating the zooplankton community structure.

Figure 4 shows the spatial distribution of zooplankton biomass (ml/100 m³) across the six sampling stations in Shark Fin Bay. Biomass was highest at Sandoval with 49.54 ml/100 m³, this was followed by Pinnacle with 36.33 ml/100 m³, Garden with 19.82 ml/100 m³, and Depla with 16.51 ml/100 m³. In contrast, Macuao and Depla North recorded the lowest zooplankton biomass with 3.63 ml/100 m³ and 2.97 ml/100 m³, respectively. Consistently, the distribution pattern suggests that stations within MPAs (Sandoval, Pinnacle, Garden, and Depla) supported higher zooplankton biomass compared with the stations outside MPAs (Macuao and Depla North).

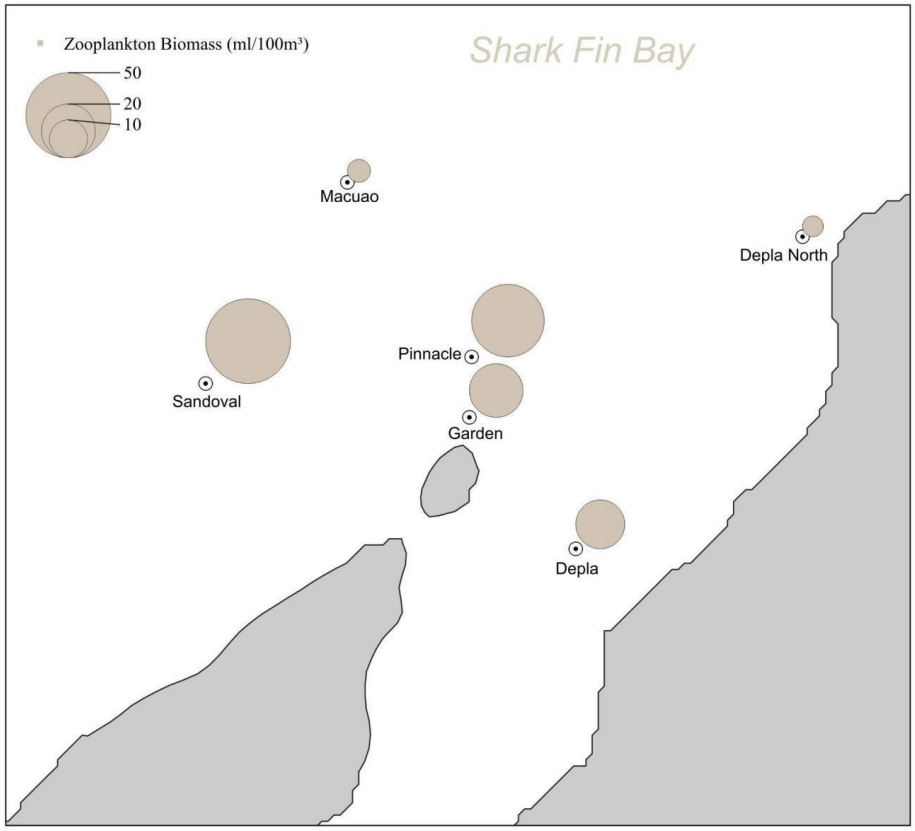

Figure 4. Spatial map of zooplankton total biomass (wet weight: ml/100m^3) in Shark Fin Bay, Palawan.

The Shannon diversity index (H') ranged from 1.232 to 1.808 across stations as show in Table 2. The highest diversity was recorded at Sandoval (H' = 1.808), indicating a relatively more diverse zooplankton assemblage at this station. This was followed by Macuao (H' = 1.642) and Depla (H' = 1.526). Moderate diversity values were observed at Garden (H' = 1.45) and Pinnacle (H' = 1.385), while the lowest diversity occurred at Depla North (H' = 1.232).

The evenness index ranged from 0.2858 to 0.5081, suggesting moderate variation in the distribution of individuals among taxa. Sandoval exhibited the highest evenness (0.5081), indicating a more balanced distribution of zooplankton individuals among species. In contrast, Depla North recorded the lowest evenness (0.2858), suggesting that a few taxa dominated the zooplankton community at this station. The remaining stations such as Depla (0.3833), Macuao (0.3689), Garden (0.3554), and Pinnacle (0.333) showed moderate levels of species distribution.

The Margalef richness index values ranged from 1.044 to 1.491, reflecting relatively similar species richness among stations. Macuao had the highest richness (1.491), followed by Depla North (1.267) and Depla (1.251). Lower richness values were observed at Garden (1.1), Pinnacle (1.057), and Sandoval (1.044). The results indicate that Sandoval exhibited the highest zooplankton diversity and evenness, while Macuao showed the greatest species richness. In contrast, Depla North had the lowest diversity and evenness, suggesting a more uneven distribution of zooplankton taxa at that station.

Table 2. Diversity Indices of zooplankton communities among sampling stations.

Diversity Index	Depla North	Macuao	Sandoval	Pinnacle	Depla	Garden
Shannon–Weiner (H')	1.232	1.642	1.808	1.385	1.526	1.45
Eveness_ (e^H/S)	0.2858	0.3689	0.5081	0.333	0.3833	0.3554
Margalef's Richness	1.267	1.491	1.044	1.057	1.251	1.1

Comparison between MPA and Non–MPA stations

The comparison between Marine Protected Areas (MPA) and Non–Marine Protected Areas (NMPA) showed no statistically significant differences across all measured metrics based on the Wilcoxon test ($p > 0.05$) at $\alpha = 0.05$ (Figure 5). Similarly, the Shannon–Wiener diversity index showed slightly higher values in MPA

(1.55) than in NMPA (1.45), but this difference was also not significant ($p > 0.05$). Margalef's richness index followed a different trend, with NMPA (1.35) slightly higher than MPA (1.10), yet again with no significant difference ($p > 0.05$).

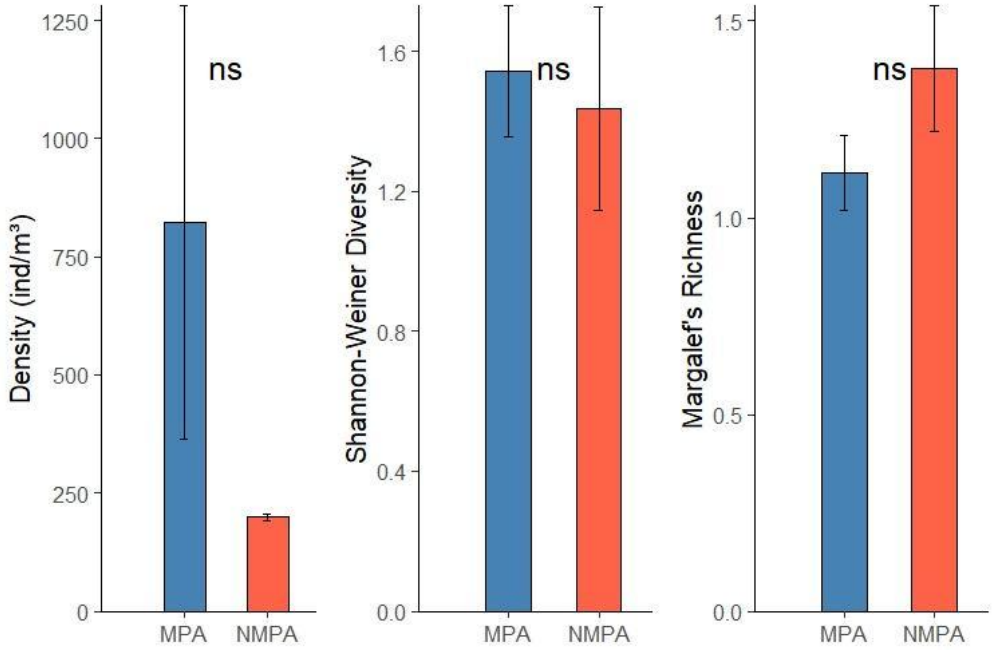

Figure 5. Comparison between Marine Protected Area and Non–Marine Protected Area in terms of density, diversity, and richness.

DISCUSSION

Phytoplankton Composition, Abundance, and Diversity

The present study revealed spatial variation in the composition, abundance, and diversity of zooplankton across the six sampling stations in Shark Fin Bay. A total of 14 zooplankton taxa were recorded, indicating a moderately diverse zooplankton community within the study area. The differences observed among stations suggest that environmental conditions may influence zooplankton distribution and abundance. Zooplankton community structure is influenced by environmental variables such as temperature, salinity, and nutrient availability, which can vary within Marine Protected Areas (MPAs) due to localized protection and management strategies (Gao et al. 2025). For example, in the Coiba National Park MPA, zooplankton abundance was linked to favorable oceanographic conditions (Olivera EB et al. 2023). Similarly, in the Iroise Sea MPA, seasonal and inter–annual variations in zooplankton abundance were observed, driven by phytoplankton composition and abiotic factors (Benedetti et al. 2019).

Zooplankton density varied considerably among stations, ranging from 194.40 ind/m³ at Depla North to 1,249.79 ind/m³ at Sandoval. These spatial variations suggest that environmental heterogeneity within Shark Fin Bay influences zooplankton distribution. Notably, four of the six sampling stations, Sandoval, Pinnacle, Garden, and Depla, were located within MPAs and recorded higher densities compared to the two non–MPA stations, Depla North and Macuao. However, statistical analysis revealed no significant differences in density between MPA and non–MPA stations, suggesting that the observed variation in abundance cannot be definitively attributed to protection status alone. This finding indicates that other environmental factors, such as hydrodynamics, nutrient availability, and habitat structure, may be equally or more important drivers of zooplankton abundance in the bay than MPA designation.

The dominance of copepods, particularly Calanoida and Cyclopoida, across all stations is consistent with typical zooplankton community structures in tropical marine ecosystems. Copepods are widely recognized as the most abundant and ecologically important zooplankton group because they play a critical role in transferring energy from primary producers to higher trophic levels such as fish larvae and small pelagic fishes. The high abundance of Calanoida observed in Sandoval and Pinnacle may indicate favorable feeding conditions since many calanoid copepods are efficient grazers of phytoplankton. Calanoida copepods are often used as indicators of good water quality and are associated with reduced anthropogenic impact (Belmonte 2021; Choi et al. 2024). Similarly, the variable density of Cyclopoida across stations may reflect differences in food availability or environmental conditions. Cyclopoida are highly adaptable to a wide range of environmental conditions, including eutrophic and hypoxic environments. Their ability to tolerate adverse conditions, such as high salinity or low oxygen, enhances

their dominance in diverse habitats (Ladhar et al. 2015; Xu et al. 2015; Min et al. 2021; Choi et al. 2023; Rocha–Diaz et al. 2024).

Among non–copepod taxa, Appendicularia showed notably high densities at Pinnacle and Garden, contributing significantly to the overall zooplankton density at these stations. Appendicularians are known to thrive in nutrient–rich environments because of their ability to efficiently filter small particles, including picoplankton and detritus. Their high abundance may indicate areas of elevated productivity or localized nutrient enrichment within the bay. Appendicularians act as a critical link in marine food webs, bridging primary producers and higher trophic levels through their eggs, trunks, and filtering houses, which serve as food for copepods, chaetognaths, ctenophores, and fish larvae (Costalago et al. 2012; Capitanio et al. 2018; Alves et al. 2025). The presence of Ostracoda, Chaetognatha, fish eggs, and nauplii underscores the dynamic and multi–trophic nature of planktonic ecosystems, which are vital for sustaining marine food webs (López et al. 2007; Costa et al. 2020; Peter et al. 2020; Dinç et al. 2026).

The occurrence of larval forms, including crab zoea, euphausiids, mysids, and polychaete larvae, although in relatively low densities, highlights the role of Shark Fin Bay as a potential nursery or spawning ground for various marine organisms. Larval dispersal connects different habitats, such as estuaries, coastal zones, and open oceans, ensuring genetic exchange and population connectivity (Able et al. 2011; Simith et al. 2014; Dvoretsky and Dvoretsky 2022). The presence of fish eggs across several stations further supports the ecological importance of the area for fish reproduction and early development. Fish eggs are foundational to the recruitment and sustainability of fish populations, and their abundance and spatial distribution directly impact larval survival and early recruitment success, which are critical for maintaining fishery stocks (Rajeesh et al. 2022; Utami et al. 2025; Wu et al. 2025). In contrast, rare taxa such as gastropod larvae and foraminiferans, which were only recorded at Macuao, may reflect localized environmental conditions or sporadic plankton dispersal patterns influenced by water currents. Foraminiferans contribute to nutrient cycling and carbon sequestration, while gastropods act as decomposers and nutrient providers in coastal ecosystems (Supusepa et al. 2023; Isfaeni et al. 2024; Islam et al. 2025).

Spatial Distribution of Zooplankton

The spatial distribution of zooplankton biomass exhibited considerable variation across stations. Sandoval recorded the highest biomass (49.54 ml/100 m^3), followed by Pinnacle (36.33 ml/100 m^3), Garden (19.82 ml/100 m^3), and Depla (16.51 ml/100 m^3). In contrast, Macuao (3.63 ml/100 m^3) and Depla North (2.97 ml/100 m^3) recorded the lowest biomass values. The high biomass observed in certain stations may be linked to the combined presence of abundant copepods and appendicularians, both of which significantly contribute to total plankton biomass.

The Shannon diversity index indicated moderate diversity overall, ranging from 1.232 to 1.808 across stations. Sandoval exhibited the highest diversity (1.808) with the most balanced distribution of taxa (evenness = 0.5081), suggesting a more stable and diverse zooplankton community. In contrast, Depla North recorded the lowest diversity (1.232) and evenness (0.2858), indicating that the zooplankton community at this station was dominated by a few taxa. The Margalef richness index revealed that Macuao had the highest species richness (1.491), despite its relatively low density and biomass, suggesting a greater variety of taxa but fewer individuals. Sandoval and Pinnacle, in contrast, exhibited lower species richness but substantially higher abundance, indicating that a few dominant taxa (particularly copepods and appendicularians) contributed substantially to total zooplankton density, a pattern commonly observed in productive marine plankton communities.

Comparison between MPA and Non–MPA stations

Statistical analysis revealed no significant differences between MPA and non–MPA stations in any of the measured metrics: density ($p > 0.05$), biomass ($p > 0.05$), Shannon diversity index ($p > 0.05$), evenness ($p > 0.05$), or species richness/Margalef index ($p > 0.05$). The absence of significant differences suggests that MPA designation may not be the primary driver of zooplankton community structure in Shark Fin Bay. Instead, multiple factors likely exert greater influence on zooplankton dynamics, including abiotic variables (temperature, salinity, nutrient availability, oxygen concentration), water mass connectivity and hydrodynamic exchanges that homogenize communities between protected and unprotected areas, predation by fish species that move freely across boundaries (Toruan 2021), and temporal variability in zooplankton composition driven by seasonal environmental changes (Du et al. 2019; Serafim–Júnior et al. 2019; Prasertphon et al. 2023). Additionally, the scale of this study, six stations sampled at a single time point, may be insufficient to capture the temporal and spatial dynamics necessary to detect MPA effectiveness. The comparable community metrics between MPA and non–MPA stations indicate that both environments support functionally similar zooplankton communities, suggesting that assembly and maintenance processes operate similarly across protection categories. These findings highlight that evaluating MPA effectiveness requires longer–term, multi–seasonal monitoring coupled with comprehensive assessment of physical and biogeochemical variables.

This study revealed clear spatial variation in zooplankton composition, abundance, biomass, and diversity across the six sampling stations in Shark Fin Bay. Copepods, particularly Calanoida and Cyclopoida, dominated the community structure across all stations, highlighting their ecological importance in the area. Zooplankton density, biomass, diversity, richness, and evenness varied among individual stations, but statistical analysis indicated no significant differences between MPA and non–MPA stations. This finding suggests that factors other than MPA status, such as localized hydrodynamics, nutrient availability, habitat heterogeneity, predation, and temporal variability, are primary drivers of zooplankton community structure in Shark Fin Bay. These results underscore the complexity of evaluating MPA effectiveness and highlight the need for longer–term, multi–seasonal monitoring coupled with comprehensive assessment of physical and biogeochemical variables to elucidate the mechanisms governing zooplankton ecology in the bay.

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GENERATIVE AI STATEMENT

There were no AI tools incorporated in the making of this manuscript.

ETHICAL CONSIDERATIONS

The study did not involve human and animal subjects as it is focused on the Spatial Distribution and Assemblages of Zooplankton during the Northeast Monsoon in Shark Fin Bay, Taytay, Palawan, Philippines.

DECLARATION OF COMPETING INTEREST

The authors declare that there is no competing interests to any authors.

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Assessing Facility Needs for Rural School Infrastructure: A Case Study of Maruso Elementary School, Rizal, Palawan

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ABSTRACT

Rural infrastructure development in the Philippines is frequently constrained by high costs and transport dependence, resulting in inadequate facilities at public schools. This study assesses the facility deficits of Maruso Elementary School in Rizal, Palawan, and establishes engineering priorities that civil engineering can address. The study also aims to identify the most urgent facility needs, assess the local availability of specific bamboo varieties, and measure the level of community acceptance and awareness regarding bamboo–based construction. A descriptive feasibility study was conducted using surveys distributed to 72 respondents within the school and local community, mainly focusing on quantifying infrastructure dissatisfaction. The study identified the Comfort Room as the highest priority facility (89.04%), followed by the Waiting Shed (10.96%). A majority of respondents (56%) reported inadequacy in existing comfort rooms and shelters, indicating a need for additional infrastructure. Resource assessment showed that bamboo is widely available, with 94.44% of participants noting its presence in the area. Taken together, these results indicate that context–appropriate, low–cost engineering interventions using locally sourced bamboo can feasibly address the school's most pressing facility needs while building local capacity and reducing reliance on distant suppliers. However, there is a growing concern around 48% regarding the maintenance of bamboo and 33% for its degradability. Suggesting that treated bamboo is essential to improve resistance to biological decay while maintaining structural integrity. Furthermore, strategically reconfiguring the bamboo–concrete interface through mechanical interlocking maximizes the structural efficiency and economic viability of these bio–composite materials. In addition, we suggest exploring the integration of sustainable building materials in these expansions: constructions of school classrooms and waiting sheds, as it is needed and suggested by the respondents, as well as evaluating the feasibility of using bamboo as reinforcement in low–load structures.

Keywords: Bamboo construction, facility needs assessment, rural school infrastructure, community acceptance, geographically isolated and disadvantaged areas (GIDA)

INTRODUCTION

The Philippine educational system faces a persistent infrastructure crisis. National projections estimate a shortage of 58,000 to 81,000 classrooms by 2040, with many regions already recording student–to–classroom ratios well above the national standard (Abrigo et al. 2025). In some urban areas, more than 90% of elementary students are taught in classes of 50 or more, a situation that reflects both the scale and urgency of the problem. These national trends are magnified in Geographically Isolated and Disadvantaged Areas (GIDAs) such as Rizal, Palawan, where remote geography and elevated transport costs make conventional construction largely impractical, leaving schools like Maruso Elementary unable to maintain even basic sanitary and shelter facilities.

Several interrelated problems compound the infrastructure shortfall. First, the national target for annual classroom construction has fallen sharply, from 91,000 units in 2016 to 12,445 in 2024, widening the gap between need and delivery (Marcelo, 2024). Second, budgetary and implementation failures persist: classroom construction completion rates have consistently remained below 85% since 2016, largely due to funding shortfalls (Manatlao, 2024). Third, logistical and economic barriers disproportionately affect remote island communities, where inflation and the high cost of transporting conventional materials, steel and concrete, make standard construction approaches increasingly unsustainable (Ticke, 2025).

Despite these well–documented challenges, localized assessments that explore alternative, cost–effective construction methods for remote schools remain scarce. There is an underexplored opportunity to leverage locally available, sustainable materials, particularly bamboo as viable alternatives for low–load school infrastructure in GIDAs. The specific gap this study addresses is the absence of a comprehensive facility needs assessment for Maruso Elementary School that simultaneously documents infrastructure priorities and evaluates the technical and social feasibility of using local bamboo for targeted construction interventions.

The general objective of this study is to assess the facility needs of Maruso Elementary School in Rizal, Palawan, and to translate those needs into practical, locally feasible solutions. Specifically, the study aims to: (1) identify and prioritize the most urgent infrastructure requirements of the school and the surrounding community; (2) assess the local availability and species diversity of bamboo; and (3) evaluate community acceptance of bamboo as a construction material, with attention to perceived cost–effectiveness, usability, and maintenance concerns.

METHODS

Descriptive Analysis

This study employed a descriptive research design to assess the facility needs of Maruso Elementary School and the feasibility of using locally sourced bamboo as a construction material. Descriptive research was deemed appropriate as the study aimed to systematically document existing conditions, quantify respondent perceptions, and characterize available local resources without experimental manipulation (Creswell, 2014).

Slovin's Formula

In this study, Slovin's formula was utilized to determine the appropriate sample size from the total population of 72 respondents in Sitio Maruso. By applying Slovin's formula, the study ensured that the chosen sample size would balance accuracy with efficiency, minimizing sampling error while still reflecting the views of the community. With a margin of error set at 5%, the computation is as follows:

Where:

n=Sample Size

N=Population Size

e=Margin of error

$$n = \frac{N}{1 + Ne^2}$$

$$n = \frac{72}{1 + 72(0.05)^2}$$

$n = 61.017 \approx 62 < 72$, thus 72 is considered

Given the small and clearly bounded population of 72 individuals, a total enumeration (census) approach was adopted. All accessible and eligible members of the population were invited to participate, ensuring complete coverage of available data sources within the community.

Data Analysis

Quantitative data were analyzed using descriptive statistics, including frequency counts and percentages. Responses related to facility adequacy, bamboo availability, and community acceptance were tabulated and presented through figures and tables. All data were processed using Microsoft Excel.

RESULTS

Demographic Profile

Figure 1 shows the age distribution of respondents, where the majority fall within the 25–34 years (45.83%) and 35–44 years (41.67%) age groups. Only a small portion belongs to the 18–24 years (5.56%) and 45–54 years (5.56%) categories, while 1.39% are aged 55–64, and none are 65 or older. This indicates that most respondents are in their prime working and parenting years, which is significant because these age groups are directly engaged in supporting their children's education and are most likely to be concerned about school infrastructure needs.

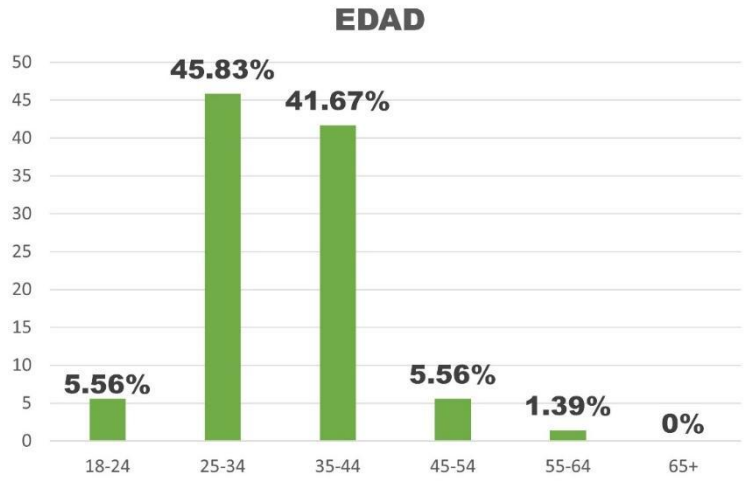

Figure 1. Age of respondents.

Figure 2 presents the gender distribution, showing that 61% of respondents were female, while 39% were male.

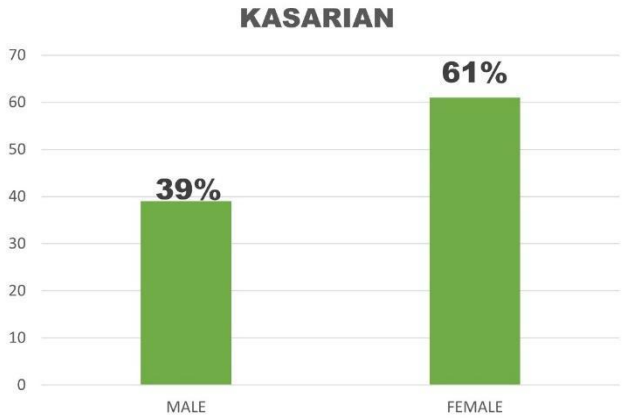

Figure 2. Gender of the respondents.

Figure 3 illustrates the monthly income levels of respondents, revealing that 75% earn between ₱0–5,000, which highlights the community's economic vulnerability. Meanwhile, 16.67% earn between ₱5,001–10,000, and only 1.39% each fall into the ₱10,001–15,000 and above ₱15,000 categories. Additionally, 4% did not disclose their income. This data underscores the financial limitations of the community, suggesting that residents may struggle to contribute to infrastructure projects without external support. It also emphasizes the importance of cost–effective and sustainable building solutions for schools in the area.

Figure 3. Monthly income of the respondents.

Types of Structures

Table 1 shows the types of structures present in Sitio Maruso, with four light structures made of wood, bamboo, and other local materials, two mixed structures combining local materials with concrete, and three concrete structures reinforced with steel. The prevalence of light structures indicates reliance on inexpensive, locally available resources, while the presence of mixed and concrete structures demonstrates attempts to achieve durability despite limited resources. This finding supports the study's recommendation to integrate bamboo with concrete, as such hybrid construction could balance affordability, sustainability, and structural strength for school facilities.

Table 1. Numbers and Types of Structures

Types of Structures	No.
Light	4
Mixed	2
Concrete	3

Facility needs

Figure 4 reveals a notable insufficiency in the availability of school facilities, particularly comfort rooms and waiting sheds. More than half of the respondents (56%) expressed that the current number of these facilities is inadequate to meet the needs of both students and teachers. In contrast, only a small proportion (15%) believed that the existing facilities are sufficient, while nearly a third (29%) remained uncertain.

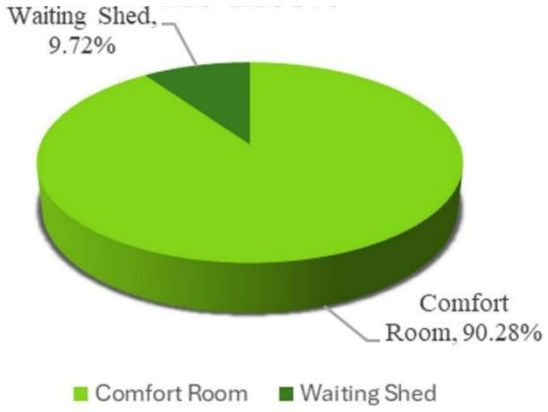

Figure 4. Facility needs.

Bamboo Availability

According to Figure 5, bamboo is not only abundant but also diverse in species within the study area. With 94.44% of respondents confirming its accessibility, bamboo emerges as a highly sustainable and locally sourced material that can be readily integrated into construction projects. The distribution of bamboo species further enriches its potential applications. Patong, identified by 40.23% of respondents, is the most common type, followed by Kawayan tinik (24.71%), Tiring (18.97%), Buho (13.79%), and Bayog (2.30%).

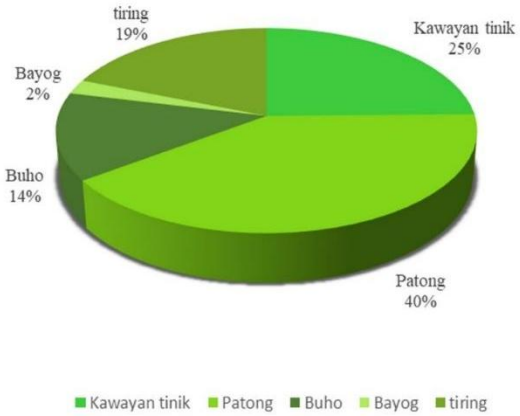

Figure 5. Bamboo Availability.

Community Acceptance

Based on Figure 6, community acceptance of bamboo use in school construction was overwhelmingly positive, with 100% of respondents supporting its application for comfort rooms and waiting sheds. Additionally, 86.11% of the community acknowledged bamboo's potential as a primary building material, and 80.56% had prior experience with bamboo structures.

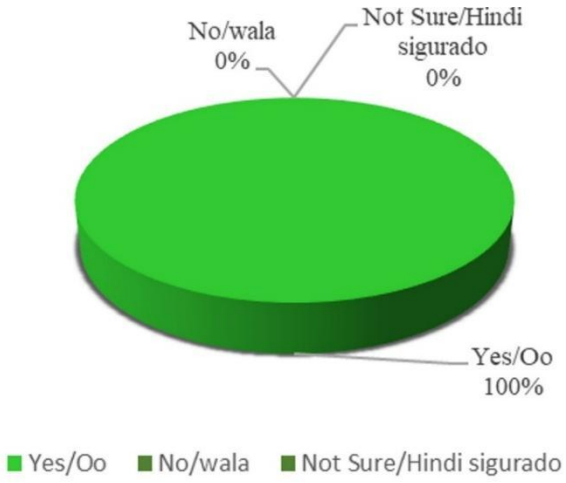

Figure 6. Community Acceptance.

DISCUSSIONS

Socioeconomic Context and Its Implications

The demographic data establish a clear socioeconomic backdrop for this study. The majority of respondents are working–age adults (25–44 years) with monthly household incomes below ₱5,000, a profile consistent with rural GIDAs in Palawan. This economic reality directly shapes the feasibility calculus for any proposed intervention: construction solutions must be affordable, locally executable, and low in maintenance cost. The National Center for Education Statistics (2023) notes that in comparable rural settings, parental engagement in school infrastructure advocacy is strongest among working–age households, whose children's educational welfare is most immediately at stake. The low–income profile of Sitio Maruso corroborates findings from Bundi et al. (2024), who found that communities with limited financial resources in the Philippines demonstrate a strong preference for locally available materials over conventional construction inputs.

Facility Needs

The finding that 56% of respondents perceive existing comfort rooms and waiting sheds as inadequate is not merely a local observation, it reflects a well–documented national and global deficit in school WASH infrastructure. Sharma et al. (2024) established a direct link between inadequate sanitation facilities and elevated student absenteeism, particularly among female students. Freeman et al. (2012) similarly found that improvements in school sanitation were associated with reduced gastrointestinal illness and better attendance in developing–country contexts. The present study's results reinforce these findings and add to a growing body of evidence calling for targeted WASH infrastructure investment in GIDAs.

The identification of the Comfort Room as the top–priority facility by 89.04% of respondents carries practical significance: it indicates that community members prioritize dignity and hygiene above other infrastructure amenities. The 29% who were uncertain about facility adequacy may reflect a normalization of substandard conditions, rather than genuine satisfaction, a finding that merits further qualitative investigation in future research.

Bamboo as a Construction Resource

The near–universal availability of bamboo (94.44%) and the identification of five distinct species represent a significant material resource. Each species has distinct mechanical properties relevant to construction suitability. Nugroho et al. (2023) documented that bamboo exhibits a favorable strength–to–weight ratio, with variation across species, age, and growing conditions. This reinforces the need for species–specific structural testing before committing to a construction standard, a recommendation that this study identifies as a priority for subsequent research. The proximity of bamboo supply to the construction site eliminates the transportation cost barrier that undermines conventional material use in remote communities (Adebowale and Agumba 2025; Escamilla and Habert 2024).

Community Acceptance and Its Role in Implementation Success

The full community support for bamboo use in school construction strengthens the practical groundwork for its implementation. Bundi et al. (2024) demonstrated through life cycle assessment that cement bamboo frame technology garnered strong social acceptance in Philippine social housing programs precisely in contexts where communities had prior exposure to the material, a pattern consistent with the 80.56% of respondents in this study who reported prior experience with bamboo structures. Silvana et al. (2016) similarly found that cultural familiarity with bamboo, rooted in vernacular Philippine architecture, contributes to baseline confidence in its constructive applications.

However, the study also surfaces important cautions. Nearly half of respondents (48%) expressed concern about bamboo maintenance, and a third (33%) cited degradability. These concerns are technically grounded: untreated bamboo is susceptible to fungal decay, insect infestation, and moisture–induced deterioration (Nugroho et al. 2023). Effective implementation therefore, requires not only the construction of bamboo facilities but also a complementary community education component on proper treatment methods, including heat treatment, borax–boric acid treatment, or other established preservation techniques.

FUNDING

There were no funding agencies in the public, commercial, or not–for–profit sectors in conducting this study.

GENERATIVE AI STATEMENT

Claude ai (Sonnet 4.6) by anthropic was used to generate image for visualization of the bamboo + concrete beam, bamboo + concrete column and bamboo + concrete footing at figure 7.

ETHICAL CONSIDERATION

This study adhered to the ethical principles of voluntary participation, informed consent, and confidentiality. Before data collection, all participants were briefed on the study's purpose, scope, and the nature of their involvement. Participation was entirely voluntary, and respondents were granted the right to withdraw at any stage without consequence.

To ensure participant privacy, all collected data were anonymized during analysis and reporting; no personally identifiable information (PII) is associated with the responses. The raw data are kept secure and accessible only to the research team. Furthermore, the researchers conducted the study with due respect for the cultural norms and practices of the Maruso community, ensuring that data gathering did not disrupt school operations or community activities. Finally, the researchers declare complete academic objectivity, with no conflicts of interest or external funding influencing the study's design, execution, or findings.

DECLARATION OF COMPETING INTEREST

The authors declare that there is no competing interests to any authors.

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Cybercrime Awareness and Digital Security in Rural Palawan, Philippines: Insights for Evidence–Based Local Governance

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ABSTRACT

While digital technology offers vital opportunities, such as remote work and e–commerce, to isolated regions like southern Palawan, it also exposes residents to rising cybercrime, creating an urgent need for this study to inform and guide the local government's protective safety measures. This study assessed community awareness of cybercrime and helped the community secure itself from cyber threats. Using the descriptive method, convenience sampling via the Sloven formula was used to determine the participants in Aborlan, Palawan. The mean and T–test were used for data analysis. A validated questionnaire was administered. The findings show that respondents (176) have a mean age of 43.2 years, and that their income comes from small businesses they established in the barangay. Their demographic profile influences their perceptions of the community's safety needs and awareness of digital activities. The respondents believe that reporting cybercrime helps prevent future incidents, and sex significantly influences the measured variable, with females showing higher responses than males at the 0.05 level of significance. Based on respondents' suggestions, schools teach students digital citizenship and cybersecurity, emphasizing the importance of understanding digital footprints and applicable rules. The seminar aims to raise community awareness of cyber threats, such as hacking, phishing, and scams, to help detect suspicious online activity and, in case of an emergency, report to the proper authority, such as the Anti–Cybercrime Unit or the Philippine National Police. This study concluded that strengthening awareness of cybercrime in rural areas is important to address the increasing threats to the digital environment. This requires a comprehensive plan to raise community awareness and ensure that the LGU's municipal and provincial–wide initiatives develop policies and guidelines for awareness–raising and reporting when crimes occur. Those initiatives lessen the threats of cybercrime. This study recommends initiating a cybercrime awareness plan that includes studies of crime incidence, cyber best practices, cyber reporting, and implementation–related issues. The plan includes the adoption and formulation of policies from the local government units, the province, and the municipal government.

Keywords: Safe digital practices, information security, municipal policymaking, data–driven local governance, communication technology

INTRODUCTION

Digital technology has empowered individuals and enterprises to engage in previously unattainable activities, such as remote work, online learning, and e–commerce, providing vital access to information and income opportunities (United Nations Office on Drugs and Crime 2023). This increased reliance on digital activities has opened new horizons for communication, commerce, and employment. People in remote areas, particularly in southern Palawan communities like Aborlan, are now being introduced to multimedia technologies previously accessible only in larger towns. As internet access expands in these southern regions, more residents are rapidly adopting social media, internet banking, and digital communication systems to connect more easily (Department of Information and Communication Technology 2023).

However, this rapid digital expansion exposes communities to severe risks, as Palawan remains highly vulnerable to cyber threats despite its geographic distance from more urbanized cities. Reports from the DICT (2023) and the Philippine National Police Anti–Cybercrime Group (PNP–ACG) (2022), emphasize a cumulative increase in cybercrime cases across the Philippines. This reliance on cyber activities has escalated threats like hacking and scamming, resulting in financial loss and severe psycho–emotional anguish for victims, especially women and young people (PNP–ACG 2022). Cybercrime further undermines public safety because structural resources or local prevention programs are often hard to find or unavailable in sufficient quantities.

To combat these threats, national frameworks such as the Cybercrime Prevention Act (RA 10175) and the Data Privacy Act (RA 10173) serve as vital legal instruments designed to protect, educate, and keep the public safe. Yet, for several reasons, regulatory protection and enforcement remain unequal across different parts of the country. Public safety is compromised when citizens lack awareness of these existing laws or the new mechanisms enacted to address digital offenses.

Recognizing these gaps, the province of Palawan and its Local Government Units (LGUs)—particularly at the barangay level—are actively implementing localized safety measures and enhancing digital security to protect residents in the province's southern region (Reynoso 2023). To address increasingly sophisticated global threats, contemporary cybersecurity frameworks emphasize international cooperation, risk assessment, and policy development (Laidlö and Jungbauer 2024; Lysenko et al. 2024), providing the standard protocols that local initiatives must align with to enhance cyber resilience (Craig et al. 2022).

This paper aims to assess the cybercrime awareness and digital security among selected barangays in the Municipality of Aborlan, Palawan, Philippines. As a descriptive baseline, the resulting empirical data and qualitative insights will directly serve as a foundational roadmap for local governance. By identifying critical vulnerabilities and institutional gaps at the grassroots level, this study will provide actionable recommendations to help barangay councils and the municipal government design localized cybersecurity policies, establish targeted digital literacy training programs, and deploy more effective community–level safety measures.

METHODS

Research Design

This study utilized a descriptive research design. The researcher used convenience sampling, with the sample size determined by the Slovin formula; respondents were selected based on their accessibility and willingness to participate in the survey on cybercrime awareness.

Research Respondents

This study has 176 respondents, determined by the Sloven formula. These are the residents of the barangay Isaub, San Juan, and Jose Rizal, Aborlan, Palawan. These barangays were selected as they were the most network–accessible parts of the municipality, where they can access online technologies.

Research Instruments

This study utilized a survey questionnaire to collect data in the three rural barangays. The questionnaire was validated by IT practitioners and public administration professors through content validation.

Data Treatment

The scale was used to interpret the relationship between the respondents' scores and their corresponding levels of knowledge and agreement. Mean scores ranging from 4.21 to 5.00 were interpreted as Very High, indicating that respondents strongly agreed and demonstrated a strong level of awareness or practice. Scores ranging from 3.41 to 4.20 were interpreted as High, indicating that the majority of respondents agreed and were aware of the subject under study. Scores ranging from 2.61 to 3.40 were interpreted as Moderate, reflecting a neutral or moderately aware response. Scores ranging from 1.81 to 2.60 were interpreted as Low, indicating that respondents disagreed with or had limited knowledge of the topic. Finally, scores ranging from 1.00 to 1.80 were interpreted as Very Low, indicating that respondents strongly disagreed and exhibited minimal awareness or understanding. A t–test was used to determine the significant relationship between the identified common threats in digital security and the demographic profiles of respondents.

RESULTS

Sociodemographic Profile of the Respondents

This study gathered demographic data to establish respondents' identities, allowing researchers to verify participants' perspectives on cybercrime awareness and Digital Security in Rural Palawan, Philippines. Thus, Table 1 shows that most respondents are female (128 or 73%), while males account for 27%. The largest age group is 41–50 years old (57 or 32.39%); this is followed by 31–40 years old (51 or 29%), 51 years and above (45 or 25%), and 30 years old and below (23 or 13.1%). Most respondents (169 or 96.02%) are self–employed or run their own businesses. A small portion (3.41%) works in government agencies, and only one respondent (0.57%) is employed in a private agency. At the time of the survey, the majority were self–employed in small businesses within their barangays.

Table 1. Sociodemographic Profile of the Respondents. Note: *n*=Sample population number of respondents.

PROFILE OF THE RESPONDENTS	FREQUENCY	PERCENTAGES
	n=176	*(%)*
Sex		
Male	48	27.00

Female	128	73.00
Age		
30 and below	23	13.10
31–40	51	29.00
41–50	57	32.39
Mean – 43.2 years old		
51 and above	45	25.57
Income sources		
Business–self–employed	169	96.02
Private agency employee	1	0.57
Government agency	6	3.41

Awareness of Recognizing the Common Threats

Based on the survey data collected (Table 2) from 176 respondents (n = 176), the evaluation of the community's Recognition of Common Threats yields an overall mean score of 3.65, corresponding to a descriptive rating of Agree. The most pronounced finding in this category is the deep collective concern about community safety, as evidenced by the statement "They believe cybercrime is a serious issue in our community," which captures the highest level of consensus, with a mean of 4.47 (Strongly Agree). This acute awareness of local vulnerability is paired with a solid understanding of specific, severe offenses, as shown by the high agreement levels for the dangers of Online Sexual Exploitation of Children (OSEC) at 4.00 (Agree) and familiarity with the severe impacts of identity theft at 3.77 (Agree).

Table 2. Recognition of common threats in and their responses in Aborlan, Palawan from 176 respondents (n=176).

Recognition of Common Threats	(n=176)	
	Mean	DR
They are aware of common cyber threats, including scams, phishing, and fake job offers	3.00	Moderate Agree
They identified suspicious links or websites that may lead to hacking or malware.	3.00	Moderate Agree
They understand the dangers of online sexual exploitation of children (OSEC).	4.00	Agree
They are familiar with cases of identity theft and their impact on victims.	3.77	Agree
They believe cybercrime is a serious issue in our community.	4.47	Strongly Agree
Overall Mean	**3.65**	**Agree**

Significant Findings on the Recognition of Common Threats in Terms of Sex

A comparative statistical analysis between male and female groups across specific metrics yielded a statistically significant result (Table 3). The female group had a higher mean score (4.04) than the male group (3.52), indicating a descriptive difference in their performance or responses. To determine if this difference was statistically meaningful, a hypothesis test was conducted. The analysis revealed a remarkably strong positive correlation coefficient ($R = 0.9485$), suggesting a highly tight alignment in the data structure between the groups. With a calculated p–value of 0.0068, which falls well below the standard alpha significance level (0.05), the findings are highly significant. Because the test statistic surpassed the critical threshold (t–critical = 2.13), the null hypothesis is formally rejected. This confirms that the observed variation between the male and female variables is not due to random chance but represents a statistically significant difference.

Table 3. Significant findings on the recognition of common threats in terms of sex of the respondents *(*T–TEST *Level of Significance = 0.05).*

Variables	**Mean**	**R**	**p–value**	**t–critical**	**Interpretation**
Male	3.52	0.9485	0.0068	2.13	Reject the null hypothesis.
Female	4.04				

Safe Digital Practices

The Safe Digital Practices of the 176 respondents (n = 176), as shown in Table 4, yield a positive overall mean score of 3.80, indicating a descriptive rating of Agree. This indicates that the community generally

implements proactive measures to secure its digital footprint. Among the assessed behaviors, the respondents demonstrated the highest commitment to personal data privacy, strongly agreeing with the practice of avoiding oversharing personal information online, with a mean score of 4.28 (Strongly Agree). This strong protective instinct toward personal information is supported by strong compliance with credential management and privacy controls, as evidenced by high agreement with using strong, unique passwords (4.03, Agree) and with reviewing and adjusting social media privacy settings (3.74, Agree).

Table 4. Safe digital practices related to cybercrime and security measures among respondents of Aborlan, Palawan (n=176).

Safe Digital Practices	**n=176**	
	Mean	**DR**
Regularly update my devices and software to protect against cyberattacks.	3.29	Moderate Agree
Use strong and unique passwords for my online accounts.	4.03	Agree
Review and adjust my social media privacy settings.	3.74	Agree
Avoid oversharing personal information online	4.28	Strongly Agree
Only download applications and files from trusted sources.	3.68	Agree
OVERALL MEAN	**3.80**	**Agree**

Reporting and Support Mechanisms among Respondents

Table 5 presents survey data on reporting and support mechanisms among the 176 respondents (n = 176), indicating a highly favorable outlook, with all indicators reflecting consensus or strong agreement. The most notable finding is the community's profound belief in civic duty and collective security, as evidenced by the statement "They believe reporting cybercrime helps prevent future incidents," which secured an overwhelming mean score of 4.81 (Strongly Agree). This reflects an exceptional level of proactive intent and awareness regarding the value of crime documentation. This high ideological support translates well into general practical knowledge, as respondents agreed they know where to report if they or someone they know becomes a victim of cybercrime (mean of 3.89), which is backed by a solid foundation of institutional confidence, seen in their trust that law enforcement agencies will act against reported cases (3.69) and their personal confidence in reporting cybercrime cases to authorities (3.63).

Table 5. Reporting and support mechanisms of respondents in terms of cybercrime and security measures in Aborlan, Palawan (n=176).

REPORTING AND SUPPORT MECHANISMS	n=176	
	Mean	DR
They know where to report if I or someone I know becomes a victim of cybercrime.	3.89	Agree
They feel confident in reporting cybercrime cases to authorities.	3.63	Agree
They trust that law enforcement agencies will act against reported cybercrime cases	3.69	Agree
They are aware of hotlines or online platforms for reporting cybercrime.	3.48	Agree
They believe reporting cybercrime helps prevent future incidents.	4.81	Strongly Agree

Gaps and Challenges in Cybercrime

The survey data in Table 6, collected from a sample of 176 respondents (n = 176), indicate that evaluating institutional gaps and community challenges highlights critical areas of concern, with all listed items receiving agreement or strong agreement, as observed in Table 4. The most severe challenge identified by the respondents is the Insufficient Local Cybercrime Prevention Programs, which garnered the highest mean score of 4.65 (Strongly Agree). This is closely followed by Weak Institutional and Policy Frameworks at the LGU Level, with a mean score of 4.50 (Strongly Agree), emphasizing a significant demand for stronger local governance and localized cybersecurity initiatives.

Table 6. Gaps and challenges on cybercrime and security measures in Aborlan, Palawan (n=176).

GAPS AND CHALLENGES	n=176	
	Mean	DR
Lack of Community Awareness and Digital Literacy	4.00	Agree
Insufficient Local Cybercrime Prevention Programs	4.65	Strongly Agree
Limited Knowledge of Legal Rights and Reporting Channels	4.00	Agree

Weak Institutional and Policy Frameworks at the LGU Level	4.50	Strongly Agree
Rapid Technological Changes and Emerging Threats	3.79	Agree

DISCUSSION

Sociodemographic Profile of the Respondents

In rural Philippine municipalities like Aborlan, traditional primary industries such as farming and fishing often draw men away from the household during the day, leaving women to anchor local community life through household management, community associations, and neighborhood microenterprises. Consequently, cybercrime awareness campaigns, such as community extension seminars and information literacy drives, must be intentionally tailored to engage this highly active female population. Because mothers and female community leaders serve as the primary managers of household information in these rural setups, educating them creates a powerful, localized trickle–down effect that effectively safeguards children and the elderly from online threats (Taufik et al. 2022).

This age profile signals a noteworthy digital literacy gap. Individuals aged 31 and older are generally "digital immigrants" who did not grow up with smartphones or the internet. Digital immigrants, particularly older adults, have adopted smartphones and other digital technologies later in life, often driven by necessity in professional environments (Thangavel and Chandra 2024). They are statistically more vulnerable to social engineering tactics, such as phishing, smishing (SMS scams mimicking banks or government lotteries), and online misinformation. Because their baseline familiarity with evolving cybersecurity threats is lower than that of the younger generation, digital security training in Aborlan must avoid overly technical jargon and focus on practical, step–by–step protective behaviors.

Most respondents are self–employed or run small businesses in their barangays, while a small fraction work in government or private agencies. In a rural economy like Aborlan's, formal corporate infrastructure is limited. Local livelihoods depend heavily on independent micro–, small–, and medium–sized enterprises (MSMEs), agricultural trade, and informal neighborhood commerce (Daulay 2025).

Awareness of Recognizing the Common Threats

The respondents have a generally strong collective baseline awareness of digital safety risks in the locality. The community possesses a strong emotional and conceptual firewall, but a weak technical defense. Residents deeply fear the consequences of cybercrime but are only moderately equipped to recognize the entry points (e.g., clicking a compromised link) that enable it, as cited by Cross et al. (2021). The study reports that a majority of community members view cybercrime as a serious problem in Australia, a finding also observed in the Philippines. The Federal Trade Commission (2023) explains that suspicious links and fake websites are commonly used to deliver malware or steal personal information, resulting in low awareness among residents.

Significant Findings on the Recognition of Common Threats in Terms of Sex

Female respondents registered a significantly higher mean score than male respondents. This indicates that women in this sample are more aligned with safe digital practices, have higher legal literacy, and exhibit a more acute recognition of cyber threats than their male counterparts. The exceptionally high Pearson correlation coefficient indicates that, although the absolute scores differ (women consistently score higher), the patterns of their responses are almost perfectly synchronized. If males scored an item low (e.g., technical software updates), females also scored it relatively lower; if females scored an item exceptionally high (e.g., community concern over OSEC or data privacy), males did too. They share the same perceptual priorities, but women maintain a consistently higher baseline of agreement or vigilance. The correlation shows that men and women share the same structural strengths and vulnerabilities. Therefore, educators and internal auditors designing community extension programs do not need to build separate educational materials for each gender. The content of the cybersecurity modules (focusing heavily on technical threat detection and reporting platforms) can remain the same; only the delivery and outreach strategies need to be customized to ensure that both genders are reached effectively. Increasing gender diversity in cybersecurity not only addresses representation but also enhances team effectiveness and innovation, as diverse perspectives contribute to more comprehensive solutions (Pacheco 2024).

Safe Digital Practices

A respondent can have an incredibly strong password and share nothing on social media, yet remain highly vulnerable if they are running an outdated operating system. Cybercriminals frequently exploit unpatched system vulnerabilities to execute malware or spyware behind the scenes. This means a user's device could still be compromised without them ever revealing their password or oversharing data. Because the majority of respondents are self–employed or run small businesses in their barangays (Table 1), their smartphones serve as both business tools and digital wallets (e.g., GCash, Maya). Running outdated operating systems exposes these

critical financial lifelines to device–level exploits, turning a simple software neglect into a severe financial risk that could compromise their working capital. Auxier et al. (2019) state that most Americans are concerned about how their personal information is used online and take steps to limit what they share. The result aligns with the Philippines' awareness. At the same time, the CISA (2023) explains that regularly updating software and devices is one of the most effective ways to protect against cyberattacks and known vulnerabilities, which contrasts with the results of this study.

Reporting and Support Mechanisms Awareness among Respondents

The highest score in this dataset is for the belief that reporting cybercrime helps prevent future incidents. This indicates that the community does not view reporting as merely a reactive or punitive measure to recover lost funds; rather, they see it as a proactive, preventative tool for community safety. In close–knit rural barangays, security and peace of mind are collective responsibilities. This exceptional score suggests that respondents possess a strong sense of solidarity—they are highly motivated to report a crime if it means protecting their neighbors, relatives, and fellow business owners from falling into the same trap. While the willingness to report is exceptionally high, the lowest relative score in this framework is for actual awareness of specific digital hotlines and online platforms. This creates a subtle operational bottleneck. The community is mentally and emotionally prepared to cooperate with the law, but they lack immediate, friction–free access to the exact technical tools needed to initiate that contact. Conversely, while technology can enhance community–police relations, it may also introduce new challenges, such as surveillance concerns and the potential for exacerbating existing mistrust, particularly in marginalized communities (Törn 2023).

Gaps and Challenges in Cybercrime

The primary reason for these high scores is that while cybersecurity is managed at a macro level by national agencies (such as the PNP–ACG or the National Privacy Commission), these frameworks rarely trickle down effectively to rural, municipality–level governance. Local Government Units (LGUs) in developing areas often lack the technical expertise, budget, and localized ordinances required to enforce digital safety. Because the majority of the respondents in this demographic are self–employed or run small businesses within their barangays, they rely heavily on digital platforms and mobile wallets (e.g., GCash) to survive. When they encounter digital threats, they realize there are no local municipal desks, emergency hotlines, or localized counseling programs to support them. This lack of a nearby safety net drives the intense consensus that local programs are insufficient. To address these critical governance gaps, the Aborlan Local Government Unit (LGU) must swiftly enact localized municipal ordinances that mandate cybersecurity budgets, formalize operational data privacy protocols, and establish a dedicated digital complaints desk. To overcome the resource constraints of building an independent IT security framework, the LGU should strategically collaborate with local academic institutions. By leveraging university community extension services to deliver targeted information literacy initiatives, the municipality can efficiently transform the academic sector into the proactive grassroots prevention program the community urgently demands. Latifiyah (2025) mentioned that targeted drives can address specific literacy gaps, such as digital and financial literacy, which are crucial for community empowerment and informed decision–making.

Respondents' Suggestions for improvement

Based on the responses to the open–ended questions, the respondents recommended that individuals take responsibility for their own computer safety, with parents providing guidance to children on internet privacy, safety, and online etiquette. They further suggested that schools teach students digital citizenship and cybersecurity, emphasizing the importance of understanding digital footprints and adhering to applicable rules. In addition, the respondents recommended that community seminars be conducted to raise awareness of common cyber threats, such as identity theft and scams. These suggestions align with Internet Safety Basic Rules and Recommendation (ISBRR) (2025), which notes that digital security involves parental guidance on internet privacy and safety, complemented by school instruction on digital citizenship and cybersecurity, underscoring the importance of understanding digital footprints and practicing responsible online behavior.

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GENERATIVE AI STATEMENT

The concepts, results, and discussion within this paper are the authors' original work and represent their independent contribution. AI tools, specifically Grammarly (version 1.2.210.1786) and Gemini 2.5 Pro, were used solely for manuscript editing, grammar refinement, and readability improvement. These tools were not involved in data generation, analysis, interpretation of results, or the formulation of primary arguments.

DECLARATION OF COMPETING INTEREST

The authors declare no competing interests.

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Formulation and Consumer Acceptability of Tawa–Tawa (*Euphorbia hirta*) Gummies

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ABSTRACT

Tawa–tawa (*Euphorbia hirta*) is a medicinal plant widely used in the Philippines, particularly as a traditional decoction during dengue episodes. Despite its common use, its bitter taste and strong herbal aroma limit its acceptability, especially among children and individuals who do not prefer herbal drinks. This study aimed to develop tawa–tawa gummies and determine their sensory qualities and general acceptability as affected by varying levels of tawa–tawa decoction and citric acid. A 3 × 3 factorial experimental design was used, consisting of three levels of tawa–tawa decoction (10%, 20%, and 30% w/v) and three levels of citric acid (2%, 2.5%, and 3% w/v). Nine treatment combinations were evaluated by 48 panelists using a 9–point Hedonic Scale for color, appearance, aroma, mouthfeel, sourness, sweetness, bitterness, and general acceptability. Descriptive data were analyzed using frequency and mean, while inferential analysis involved analysis of variance and contour plot analysis. Results showed that all formulations were generally acceptable. No significant differences were observed in color, appearance, and aroma, while significant differences were found in mouthfeel, sourness, sweetness, bitterness, and general acceptability. Among the treatments, the formulation containing 30% w/v tawa–tawa decoction and 2.5% w/v citric acid obtained the highest overall acceptability. The findings indicate that tawa–tawa can be successfully developed into a gummy product with acceptable sensory properties. Tawa–tawa gummies may serve as a more convenient and palatable alternative to the usual herbal decoction and may offer potential as a functional food product.

Keywords: herbal gummy, sensory evaluation, market acceptability, formulation, medicinal plant

INTRODUCTION

Tawa–tawa (*Euphorbia hirta*), also called as *gatas–gatas, magatas* or *botonis*, is a widely available herbal plant found in open grasslands and waste places throughout the Philippines. For many years, it has been used in traditional medicine, particularly as a supportive remedy for dengue fever (Cayona & Creencia 2022). Numerous testimonies from local communities report that drinking tawa–tawa decoction may help increase the blood platelets of dengue patients. According to Atienza et al. (2015), tawa–tawa contains biochemical compounds such as terpenoids, tannins, phorbic acid, fatty acids, sterols and flavonoids, including quercitrol and quercetin and their derivatives, which may contribute to its potential therapeutic effects, including increasing platelet count. Because of these perceived benefits, tawa–tawa has become one of the most commonly used herbal remedies in many Filipino households during dengue outbreaks.

Despite its popularity, the traditional method of consuming tawa–tawa through boiling and drinking its decoction is often unappealing, especially to children, because of its herbal taste and aroma (Perera et al. 2018). Hence, this creates a need for product innovations that make the consumption of herbal preparations more pleasant, convenient and acceptable to younger and more sensitive consumers.

Gummies are a type of confectionery widely known for their chewy texture and playful shapes such as bears, worms and other colorful forms. They are typically made from gelatin, pectin or other gelling agents that create a soft and elastic structure. Because of their enjoyable texture and flavor, gummies have become a popular medium for delivering vitamins, minerals and herbal extracts. The functional food industry continues to expand globally, and gummies are now commonly used as carriers for nutritional supplements because they are easy to consume, especially for children and elderly individuals who have difficulty swallowing tablets or capsules (Mutlu et al. 2018).

Given the potential health benefits of tawa–tawa and the growing trend toward functional gummies, developing tawa–tawa gummies presents an innovative strategy to make this traditional herbal remedy more palatable and accessible. Transforming tawa–tawa decoction into a gummy form may encourage intake among children and adults who dislike drinking herbal teas. Additionally, since no commercially available tawa–tawa gummy product currently exists in the market, this study addresses a gap in product innovation and contributes to the development of locally inspired nutraceuticals. This study generally aimed to develop "tawa–tawa" gummies. Specifically, it aimed to develop the formulation of the product, determine the description and acceptability of the gummies as affected by the levels of "tawa–tawa" decoction and acidification and their market acceptability.

METHODS

Procurement of Raw Materials

The Tawa–tawa plant (*Euphorbia hirta*) was freshly collected within the vicinity of Aborlan, Palawan, while other raw materials, such as glucose syrup and citric acid, were purchased locally. All materials used for product preparation were food–grade to ensure safety and quality. The collected tawa–tawa plants were manually sorted by removing the roots, wilted leaves and damaged or discolored parts. Only fresh, green leaves and tender stems were selected for use in the study. The plant was characterized by its small, hairy stems and green, oval–shaped leaves with serrated edges, as shown in Figure 1.

Figure 1. Tawa–tawa Plant (*Euphorbia hirta*) used in the study.

It typically grows in open grasslands and roadsides and contains bioactive compounds such as flavonoids, tannins, and phenolic compounds known for their antioxidant and antimicrobial properties. These characteristics made the tawa–tawa plant suitable for use as a natural ingredient, contributing to the product's preservative and health–promoting qualities.

Plant Decoction Preparation

The Tawa–tawa leaves and stalks were collected, sorted and cleaned using tap water. Roots were removed from the plant. The cleaned plant materials were weighed and decocted by boiling them in water for 15 minutes. The resulting tea was then strained using a cheesecloth and stored in a clean container. The level of plant material used was based on the experimental plan provided in Table 1.

Table 1. Factorial arrangement of tawa–tawa decoction and citric acid levels.

Citric Acid %w/v	Tawa–tawa Decoction % w/v		
	10	**20**	**30**
2	T1	T2	T3
2.5	T4	T5	T6
3	T7	T8	T9

Gummy Preparation

Tawa–tawa gummies were prepared following the method of Yan et al. (2021) with modification in measurements, the gelatin was first rehydrated in tawa–tawa tea prepared through decoction. The sugar was then mixed with a portion of the tawa–tawa tea and melted over medium heat until it turned into candy syrup. Once the sugar melted, glucose syrup was added to the mixture. When the glucose syrup was fully dissolved into the sugar syrup, the bloomed unflavored gelatin was incorporated and mixed until a smooth consistency was achieved. The prepared tawa–tawa gummy syrup was then poured into molds and refrigerated for at least 30 minutes in 40 ± 2°C (35.6°F to 46.4°F) to allow the gummies to set properly.

Experimental Design

This study employed a two–factor, 3×3 factorial design. The factors were the levels of tawa–tawa decoction (% w/v) and citric acid (% w/v). The prepared decoction was used as the base ingredient in making Tawa–tawa gummies. Table 1 presents the factorial arrangement of the different levels of tawa–tawa decoction and citric acid used in the study, which the nine treatment combinations.

Sensory Evaluation

Forty–eight (48) panelists evaluated the sensory characteristics and acceptability of the samples, following an incomplete block design (IBD) based on the Cochran and Cox experimental design. Each panelist

tasted six (6) samples out of nine (9) treatments. A sensory evaluation sheet was developed based on the initial sensory evaluation of the gummies. The sensory evaluation was conducted in two (2) replications.

Data Analysis

The data gathered from the sensory evaluation were tabulated and organized using the Design Expert 13 software and statistically analyzed through Analysis of Variance (ANOVA) to determine significant differences among treatments. Descriptive statistics such as mean and frequency were also computed to summarize the panelists' evaluation scores on color, appearance, aroma, mouthfeel, sourness, sweetness, bitterness and general acceptability of the tawa–tawa gummies.

In addition, contour plot analysis was performed to visually illustrate the interaction effects between tawa–tawa decoction levels and citric acid concentrations on the sensory attributes of the gummies. The contour plots provided a graphical representation of the response surface which allow for the identification of optimal combinations of factors that yielded the most desirable product characteristics. Lastly, the desirability factor was used to optimized the formulation based on the results of RSM analysis.

RESULTS

Gummies made with different formulation of tawa–tawa decoction and citric acid produce producs with different color and textural properties. Results in Table 2 is in accordance with the color description in Figure 2. Even with variation in color properties, the mean acceptability scores ranged from 7.09 to 7.30, indicating that all treatments were rated within the "Like Moderately" category on the 9–point Hedonic scale which means that all gummy formulations were generally acceptable to the panelists.

T1 T2 T3 T4 T5 T6 T7 T8 T9

Figure 2. Color of developed tawa–tawa gummies.

Table 2. Color description and mean acceptability scores of tawa–tawa gummies, (*Note:* ns – not significant (P–value > 0.05).

Treatment	Description	*f* (%)	Description	Mean Acceptability^{ns}
1	Reddish Brown	30.30	Like Moderately	7.18±1.50
2	Brown	28.79	Like Moderately	7.19±1.56
3	Golden Brown	30.30	Like Moderately	7.30±1.30
4	Reddish Brown	45.20	Like Moderately	7.12±1.33
5	Brown	45.31	Like Moderately	7.09±1.87
6	Golden Brown	48.44	Like Moderately	7.23±1.42
7	Reddish Brown	33.00	Like Moderately	7.14±1.21
8	Reddish Brown	37.10	Like Moderately	7.14±1.71
9	Golden Brown	41.00	Like Moderately	7.30±1.54

The appearance description and mean acceptability of tawa–tawa gummies were shown in Table 3. The mean acceptability scores of appearance ranged from 6.79 to 7.16, indicating that all treatments were rated within the "Like Moderately" range on the 9–point Hedonic Scale. The descriptive ratings show that most of the treatments were characterized as having a moderate turbidity, as described by 50% of panelists, while some were described as very weak turbid. This implies that differences in formulation influenced the clarity of the samples.

Table 3. Appearance description and mean acceptability scores of tawa–tawa gummies (*Note:* ns – not significant (P–value > 0.05).

Treatment	Description	*f* (%)	Description	Mean Acceptability^{ns}
1	Moderate Turbidity	42.42	Like Moderately	6.87±1.50
2	Moderate Turbidity	41.00	Like Moderately	7.12±1.13
3	Moderate Turbidity	45.20	Like Moderately	6.96±1.29
4	Moderate Turbidity	45.31	Like Moderately	7.00±1.07
5	Moderate Turbidity	45.31	Like Moderately	7.09±1.37
6	Very Weak Turbidity	56.30	Like Moderately	6.92±1.29
7	Moderate Turbidity	56.50	Like Moderately	6.79±1.31
8	Moderate Turbidity	45.31	Like Moderately	7.14±1.57
9	Very Weak Turbidity	34.00	Like Moderately	7.16±1.52

The aroma description and mean acceptability mean of tawa–tawa gummies as evaluated by the panelists (Table 4). All treatments were described as having a perceptible tawa–tawa aroma, implying that the characteristic aroma of tawa–tawa was noticeable across all samples with no significant difference at varying levels of tawa–tawa and citric acid.

Table 4. Aroma description and mean acceptability scores of tawa–tawa gummie, (*Note:* ns – not significant (P–value > 0.05).

Treatment	Description	*f* (%)	Description	Acceptability Mean^{ns}
1	Perceptible Tawa–tawa Aroma	27.27	Like Moderately	6.81±1.89
2	Perceptible Tawa–tawa Aroma	27.27	Like Moderately	6.89±1.30
3	Perceptible Tawa–tawa Aroma	29.03	Like Moderately	7.01±1.43
4	Perceptible Tawa–tawa Aroma	25.00	Like Moderately	6.85±1.46
5	Perceptible Tawa–tawa Aroma	26.60	Like Moderately	6.96±1.34
6	Perceptible Tawa–tawa Aroma	29.70	Like Moderately	7.00±1.28
7	Perceptible Tawa–tawa Aroma	26.00	Like Moderately	6.74±1.39
8	Perceptible Tawa–tawa Aroma	28.12	Like Slightly	6.45±1.89
9	Perceptible Tawa–tawa Aroma	26.00	Like Moderately	6.98±1.68

The mouthfeel description of the developed tawa–tawa gummies are all described with very weak astringency (Table 5). ANOVA results suggest that tawa–tawa decoction have a significant effect on the mouthfeel of the product. Figure 3 reveals that higher levels of tawa–tawa increases mouthfeel acceptability.

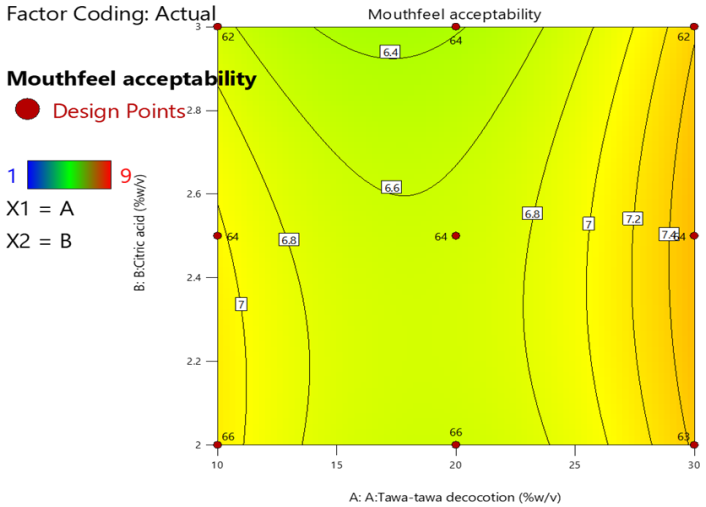

Figure 3. Contour plot showing the interaction effects of tawa–tawa decoction and citric acid levels on mouthfeel acceptability.

Table 5. Mouthfeel description and mean acceptability scores of tawa–tawa gummies, *Note:* ***–** significant difference (P–value < 0.05).

Treatment	Description	*f* (%)	Description	Acceptability Mean*
1	Very Weak Astringency	32.00	Like Moderately	7.15±1.64
2	Very Weak Astringency	28.78	Like Moderately	6.57±2.04
3	Very Weak Astringency	42.00	Like Moderately	7.48±1.45
4	Very Weak Astringency	45.31	Like Moderately	6.85±1.32
5	Very Weak Astringency	45.31	Like Moderately	6.98±1.71
6	Very Weak Astringency	39.10	Like Moderately	7.40±1.28
7	Very Weak Astringency	31.00	Like Moderately	6.80±1.47
8	Very Weak Astringency	25.00	Like Slightly	6.12±2.07
9	Very Weak Astringency	27.14	Like Moderately	7.50±1.77

The descriptive results of sourness show that most samples were perceived as sour, while others were described by the panelists as slightly sour due to the direct influence of citric acid concentration on taste intensity (Table 6). ANOVA results indicate that sourness is significantly affected by citric acid levels. As shown in the contour plot (Figure 4), sourness acceptability reached slightly higher values at moderate concentrations of both tawa–tawa decoction and citric acid. This region represents the point where panelists perceived the higher acceptability flavor.

Table 6. Sourness description and mean acceptability of tawa–tawa gummies (*Note:* ***–** significant difference (P–value < 0.05).

Treatment	Description	*f* (%)	Acceptability Description	Acceptability Mean*
1	Sour	36.36	Like Moderately	6.92±1.69
2	Slightly Sour	44.00	Like Slightly	6.31±1.84
3	Slightly Sour	35.48	Like Moderately	7.46±1.24
4	Sour	37.50	Like Moderately	6.57±1.82
5	Sour	36.00	Like Moderately	6.90±1.59
6	Sour	31.30	Like Moderately	7.21±1.56
7	Sour	31.00	Like Slightly	6.48±1.57
8	Sour	29.70	Like Slightly	6.17±2.06
9	Sour	29.03	Like Moderately	7.38±1.52

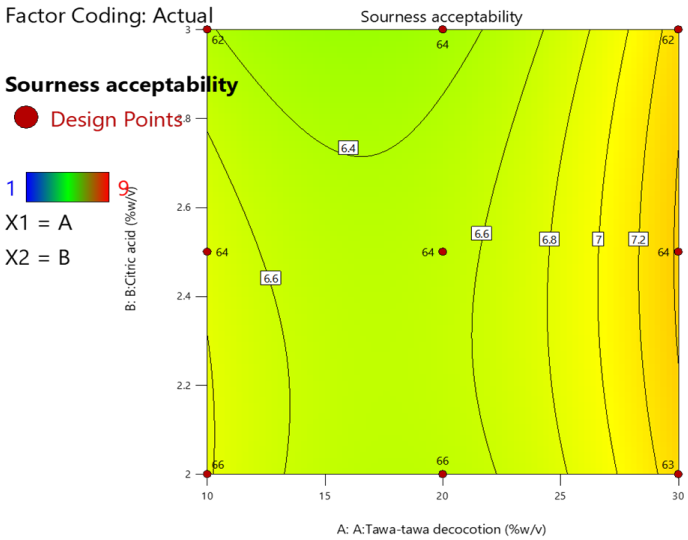

Figure 4. Contour plot showing the interaction effects of tawa–tawa decoction and citric acid levels on sourness acceptability.

Table 7 shows the sweetness description and mean acceptability of the developed tawa–tawa gummies. The mean scores ranged from 6.18 to 7.58, which correspond to the "Like Slightly" to "Like Moderately" range on the 9–point Hedonic Scale. This indicates that all treatments were generally acceptable in terms of sweetness, showing that the taste balance between sugar, glucose syrup and citric acid was pleasing to most of the panelists.

Table 7. Sweetness description and mean acceptability scores of tawa–tawa gummies, (*Note:* ***–** significant difference (P–value < 0.05).

Treatment	Description	*f* (%)	Acceptability Description	Acceptability Mean*
1	Sweet	30.30	Like Moderately	7.12±1.64
2	Sweet	32.00	Like Moderately	6.62±1.97
3	Sweet	32.25	Like Moderately	7.38±1.57
4	Slightly sweet	42.18	Like Moderately	6.82±1.34
5	Sweet	37.50	Like Moderately	6.76±2.16
6	Sweet	31.30	Like Moderately	7.35±1.48
7	Sweet	29.03	Like Moderately	6.67±1.70
8	Slightly sweet	39.10	Like Slightly	6.18±1.98
9	Sweet	27.14	Like Moderately	7.58±1.50

The sweetness description revealed that the majority of treatments were perceived as sweet, while a few were rated as slightly sweet showing that citric acid concentration affected the perception of sweetness. The contour plot for sweetness acceptability revealed a curved response surface, indicating a quadratic relationship between tawa–tawa decoction (% w/v) and citric acid (% w/v) (Figure 5). As shown in the contour plot, sweetness acceptability was highest (7.4) with the highest concentration of tawa–tawa decoction combined with a moderate level of citric acid, as indicated by the yellow orange–colored region on the right side of the plot. In contrast, the green gradient, which represents lower acceptability scores, was observed at lower tawa–tawa concentrations (between 13% to 24%) across the range of citric acid levels.

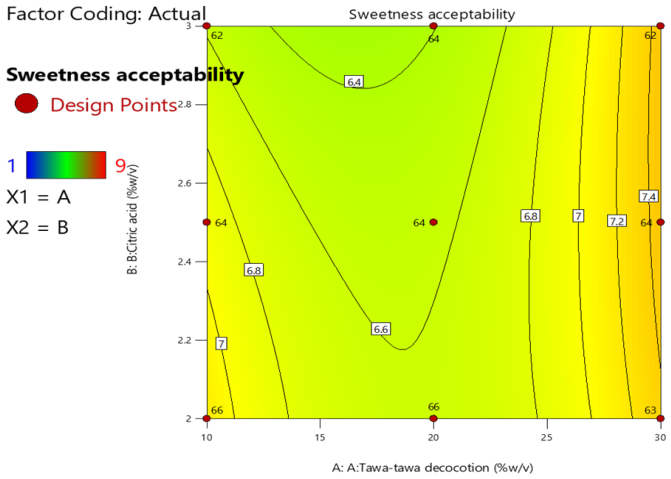

Figure 5. Contour plot showing the interaction effects of tawa–tawa decoction and citric acid levels on sweetness acceptability

The bitterness results show that some treatments were described as slightly bitter, while others were described as bitter, suggesting that the level of bitterness differs depending on the formulation (Table 8). ANOVA results revealed that bitterness acceptability is significantly affected by levels of tawa–tawa decoction. The contour plot shows that bitterness acceptability was primarily influenced by tawa–tawa concentration, with higher decoction levels (around 29%) resulting in greater liking when paired with low citric acid content (around 2.3%) (Figure 6).

Table 8. Bitterness description and mean acceptability scores of tawa–tawa gummies *Note:* ***–** significant difference (P–value < 0.05).

Treatment	**Description**	***f* (%)**	**Acceptability Description**	**Acceptability Mean***
1	Slightly bitter	41.00	Like Moderately	7.12±1.41
2	Bitter	33.33	Like Slightly	6.36±1.65
3	Slightly bitter	50.00	Like Moderately	7.22±1.46
4	Bitter	36.00	Like Slightly	6.14±1.39
5	Bitter	28.12	Like Moderately	6.76±1.69
6	Slightly bitter	41.00	Like Moderately	7.25±1.26
7	Bitter	27.42	Like Moderately	6.82±1.36
8	Bitter	25.00	Like Slightly	5.60±1.76
9	Slightly bitter	50.00	Like Moderately	7.35±1.49

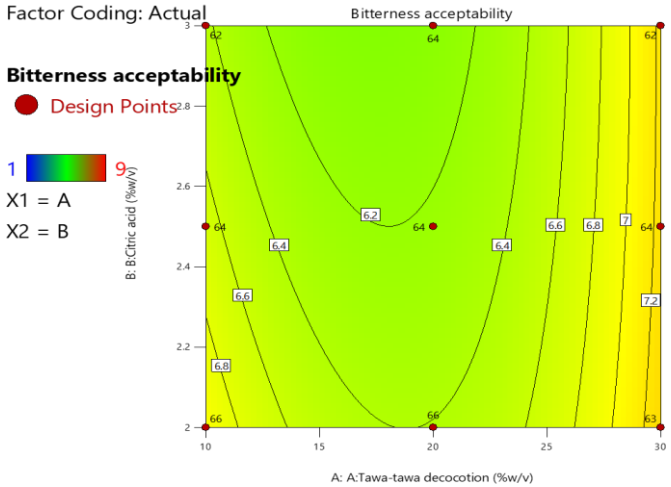

Figure 6. Contour plot showing the interaction effects of tawa–tawa decoction and citric acid levels on bitterness acceptability.

Table 9 shows the description and mean acceptability ratings of the tawa–tawa gummies in terms of general acceptability. This sensory quality represents the overall evaluation of the product by the panelists, integrating all sensory characteristics such as color, appearance, aroma, taste, sourness, sweetness, bitterness and

mouthfeel. The purpose of this evaluation was to determine which formulation achieved the highest consumer preference among the different treatment combinations.

As shown in table 9, the descriptive ratings ranged from "like moderately" to "like very much," indicating that all formulations were generally accepted by the sensory panel. The mean acceptability scores ranged from 6.56 to 7.61, signifying that the panelists found the gummies palatable and satisfactory. Treatments 1, 2, 3, 4, 5, 7, and 8 were rated as "like moderately," while Treatments 6 and 9 were rated as "like very much." The results further revealed a significant difference (P–value < 0.05) among treatments, indicating that the variation in citric acid concentration had a significant effect on the overall acceptability of the gummies. Citric acid has an important role in enhancing flavor balance by complementing sweetness, masking bitterness and providing a refreshing tartness that improves the overall sensory experience. Overall, all formulations were found acceptable, but among all treatments the best formulation was Treatment 6 which achieved the highest overall mean acceptability score (7.61) and was described as "like very much." This implies that the higher amount of decoction (30%w/v) and optimal level (2.5%w/v) of citric acid in treatment effectively enhanced the sensory balance of the gummies which make it the most desirable formulation among the tested samples.

Table 9. General description and mean acceptability scores of tawa–tawa gummies (*Note:* ***–** significant difference (P–value < 0.05).

Treatment	Description	*f* (%)	Mean Acceptability*
1	Like moderately	31.81	7.15±1.41
2	Like moderately	31.81	6.86±1.65
3	Like moderately	28.79	7.48±1.46
4	Like moderately	21.21	6.61±1.39
5	Like moderately	22.72	6.91±1.69
6	Like very much	30.30	7.61±1.26
7	Like moderately	24.24	6.98±.36
8	Like moderately	30.30	6.56±1.76
9	Like very much	31.82	7.58±1.33

DISCUSSION

Variations in color description and mean scores did not indicate a significant difference in color acceptability among treatments. The color of the candies noticeably changed and appeared darker with formulation differences (Cebin et al. 2024). However, based on the analysis of variance, the differences among the color mean acceptability scores were found to be not significant (P–value > 0.05). This means that the different levels of tawa–tawa decoction and citric acid used in the formulations did not significantly influence the color acceptability of the gummies even though color is visibly different throughout the treatments (Figure 3).

Color and appearance are closely related, they often influence how a product is perceived. Appearance is a broader visual category that includes color and other visual features such as shape, size, translucency/opacity, surface texture, gloss and uniformity, all of which contribute to the initial quality impression of the food (Carneiro et al. 2022). Thus, while color is one component, appearance is about the full set of visual cues that a consumer uses to judge a product's freshness, quality or appeal. Appearance result revealed that the differences among the treatments were found to be not significant (P–value > 0.05). This means that the variation in appearance scores was statistically insignificant, implying that the differences observed among treatments were minimal and not influenced by the formulation, which supports their potential for consumer preference and market acceptance.

Aroma of the gummies was not strongly influenced by the proportion of tawa–tawa decoction or citric acid. The perceptible aroma of tawa–tawa was likely masked by the gelatin and citric acid used in the formulation. According to Lawless (1991), aroma is a critical factor in food quality and sensory evaluation because it strongly influences flavor perception and consumer acceptance. Thus, the consistent aroma acceptability across treatments indicates that the developed tawa–tawa gummies show a favorable aromatic quality suitable for potential market preference.

Mouthfeel plays an important role in consumer acceptance of foods and beverages. Mouthfeel and texture are closely related but distinct sensory attributes of food, where texture refers to the structural, mechanical and surface properties of a product such as hardness, viscosity and smoothness perceived through the senses of sight, sound, touch and movement (kinesthetics) (Marciniak–Lukasiak et al. 2024), while mouthfeel describes the subjective physical sensations experienced specifically within the oral cavity during consumption. Mouthfeel arises from the interaction of these textural properties with chemosensory and somatosensory receptors and is primarily transmitted by the trigeminal nerve (van Eck et al. 2019). Thus, texture provides the physical foundation of a food, whereas mouthfeel represents the integrated sensory and physiological perception of that texture during eating. The findings imply that the mouthfeel of the tawa–tawa gummies was generally acceptable across all

treatments, with treatment 9 achieving the highest level of acceptability based on panelist ratings because the formulation used in this treatment resulted in gummies with the most pleasing balance of softness and mild astringency that gives a smooth and enjoyable mouthfeel. According to Ditschun et al. (2025), mouthfeel has an essential role in shaping overall sensory perception, as it integrates tactile sensations such as smoothness, cohesiveness and astringency, which strongly affect product acceptability and consumer preference.

The results on sourness revealed a significant difference (P–value < 0.05) among treatments which indicate that the different concentrations of citric acid significantly affected the perceived sourness of the gummies. This confirms that the amount of citric acid has an essential role in defining the flavor profile and sensory appeal of the product. Overall, the findings imply that the sourness of tawa–tawa gummies was influenced by the amount of citric acid added.

At higher concentrations of tawa–tawa decoction, the contour lines flattened, indicating a gradual decline in acceptability which may be attributed to the herbal bitterness of tawa–tawa that could mask the pleasant sour taste of the gummies. The unpleasant taste of tawa–tawa has been previously reported in the article of Uy (2015), describing the tawa–tawa as undesirable flavor or bitter taste comparable to "drinking soil" which discourages for consumption. Although citric acid is the main resource for the sourness of the product, its effect may have been reduced at higher decoction levels because of increased bitterness. According to Lambros et al. (2020), citric acid is positively correlated with acidity, sour taste, citrus aroma and flavor and negatively correlated with bitterness as it is commonly used to mask the bitter taste and improve palatability. Conversely, at lower concentrations, the sour taste from citric acid may not be strong enough, which is why it resulted in a slightly lower acceptability. Overall, the contour plot implies that sourness acceptability was influenced by both formulation factors, with tawa–tawa concentration having a greater influence. The relatively smooth gradient and low curvature of the plot indicate that differences among treatments were minor. However, the quadratic nature of the response implies that the best sourness acceptability was achieved at higher levels of tawa–tawa decoction and moderate levels (2.5%w/v) of citric acid, where the gummies had a balanced and pleasant sourness.

For sweetness, the differences among the treatments were found to be significant (P–value < 0.05). This implies that the amount of citric acid had a significant impact on the sweetness perception of the gummies. Citric acid, while contributing to sourness, also influences how sweetness is perceived by balancing or masking sugary flavors depending on its concentration. Overall, the findings imply that treatment 9 which achieved the highest mean score offered the most preferred sweetness among all formulations which also implies that a 3%w/v citric acid concentration provided an ideal balance between sweet and sour tastes, enhancing flavor complexity without overpowering the sweetness.

Bitterness was included to assess if the product's bitterness threshold is acceptable to consumers. There is a significant difference (P–value < 0.05) among treatments, indicating that the different levels of citric acid significantly influenced the perceived bitterness of the tawa–tawa gummies. Citric acid known for its acidity may help balance or mask the inherent bitterness of tawa–tawa extract. Treatments containing higher levels of citric acid, particularly treatment 9 (3%w/v citric acid) likely achieved better flavor harmony by reducing the perception of bitterness through acid–sweet interaction. Conversely, lower citric acid levels may have been insufficient to counteract the natural bitter compounds from the tawa–tawa plant. Overall, the results imply that the bitterness of tawa–tawa gummies decreased as the citric acid concentration increased, enhancing the product's bitterness acceptability. Treatment 9 which obtained the highest mean score was produced the most favorable flavor balance because a 3%w/v citric acid level effectively minimized bitterness and improved overall palatability.

The highest general acceptability (7.4) occurred at higher tawa–tawa decoction levels (approximately 28%) combined with a mid–range citric acid concentration (around 2.3%), as indicated by the yellow–orange region, while yellow–green areas represented lower liking scores. This implies that panelists preferred formulations with sufficient tawa–tawa to provide a recognizable herbal character without negatively affecting overall sensory perception. This result is supported by the mouthfeel, sourness, sweetness and bitterness contour plots, which consistently showed that a balanced combination of higher tawa–tawa decoction levels and moderate citric acid concentrations produced higher acceptability scores. Accordingly, general acceptability declined slightly beyond the optimal region and was also lower at very low decoction levels due to a weaker sensory profile. Overall, general acceptability was mainly influenced by tawa–tawa concentration with optimal results achieved at higher extract levels and moderate acidity which clearly identifying a balanced formulation zone.

Determining market acceptability is an important part of product development, especially for newly developed food products, because it shows whether consumers are willing to try, buy, use, and continue using the product in the market over time (Dike et al. 2025). In this study, the market acceptability test was conducted with 100 untrained participants. Acceptability was measured using a Hedonic scale, where participants rated how much they liked or disliked the product based on sensory qualities such as appearance, flavor, taste, texture, and overall acceptability. This method is commonly used because it gives a direct picture of consumer preference and the product's potential for market success.

In this study, the consumer acceptability test revealed that the majority of respondents gave positive evaluations for the developed tawa–tawa gummies. Specifically, 57% of the panelists reported that they liked the taste of the gummies, 58% indicated that they liked the flavor and 58% expressed positive general acceptability. These results were based on a 4–point Hedonic scale used in the study, where the smiling face emoji corresponds to the verbal interpretation "Like." This implies that the formulation successfully achieved appealing sensory characteristics, particularly in taste and flavor, while also satisfying overall consumer expectations.

Furthermore, 80% of respondents expressed their willingness to purchase the developed tawa–tawa gummies. This result shows that the product has good potential in the market. Willingness to purchase is an important indicator of consumer confidence and perceived value, as it goes beyond simple liking and reflects actual buying intention (Ali and Ali 2020).

Overall, the results showed that the developed tawa–tawa gummies attained good consumer acceptability and show strong potential for market.

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This study received in–kind support from the Western Philippines University.

GENERATIVE AI STATEMENT

I hereby declare that no generative artificial intelligence (AI) tools or AI–assisted writing platforms were used in the conceptualization, data gathering, analysis, interpretation, and writing of this study.

ETHICAL CONSIDERATIONS

- Informed consents were obtained prior the sensory evaluation of this study. Studies involving human subjects must have followed the institutional and national guidelines set by the ethics board.
- Studies involving minors or children below 18 years old must have a secured consent statement form.
- Studies involving the use of animals must have also followed all institutional and national ethical guidelines for the care and use of test/experimental animals.

DECLARATION OF COMPETING INTEREST

The authors declare that there are no competing interests or personal relationships that could have appeared to influence the work reported in this paper.

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Microbial Abundance and Coliform Contamination in the Gut of *Lambis lambis* from Recreational Water of Cowrie Island, Honda Bay, Palawan

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ABSTRACT

The gut microbiota of marine mollusks reflects both their dietary inputs and exposure to environmental contaminants, making them valuable indicators of microbial ecology in coastal ecosystems. This study investigated the microbial abundance and coliform contamination in the gut of *Lambis lambis* collected from Cowrie Island, Honda Bay, with the objectives of quantifying the abundance of microbial bacteria and fungi and determining coliform levels using the Most Probable Number (MPN) method. A total of ten (10) adult specimens were collected and analyzed using culture–based microbiological techniques. Microbial abundance was determined through serial dilution and plate count methods. Coliform levels were assessed using the conventional three–tube MPN method. Results showed that bacterial populations were consistently higher than fungal populations, with bacterial counts ranging from 19.5×10^4 to 57.1×10^4 CFU/g, while fungal counts ranged from 1.67×10^4 to 7.7×10^4 CFU/g. Coliform analysis revealed MPN values ranging from 150 to 460 MPN/100 mL, all exceeding the recommended standard limit of 100 MPN/100 mL. The elevated coliform counts indicate exposure of *L. lambis* to contaminated marine environments, possibly influenced by anthropogenic activities such as tourism and coastal pollution. The findings suggest that bacteria dominate the gut microbiota of *L. lambis* and that the species may serve as a potential bioindicator of microbial pollution in coastal ecosystems. This study provides baseline information on the microbial ecology and environmental conditions of recreational marine waters in Honda Bay, Palawan.

Keywords: microbial abundance, coliform contamination, Most Probable Number, gut microbiota, coastal pollution.

INTRODUCTION

The Common Spider Conch, *Lambis lambis* (Linnaeus, 1758), locally known as "Saang" or "Ranga–ranga" in the Philippines, is a marine gastropod belonging to the family *Strombidae*. This species is widely distributed throughout the Indo–West Pacific region and commonly inhabits shallow coastal ecosystems such as coral reefs, seagrass beds, reef flats, and mangrove–associated habitats (Abbott 1960; Poutiers 1998). In the Philippines, particularly in Palawan, *L. lambis* is considered an ecologically and economically important marine resource that contributes to artisanal fisheries and local food security (Bellchambers et al. 2011; Rabia et al. 2023).

Gut–associated microorganisms are essential components of marine invertebrate physiology because they contribute to digestion, nutrient cycling, metabolism, and host health (Nayak 2010; Wei et al. 2018). The gut microbiota of marine gastropods is generally composed of diverse bacterial and fungal communities influenced by environmental conditions, diet, and habitat quality. However, despite the ecological importance of *L. lambis*, limited information is available regarding its gut microbial abundance and associated microbial contamination in coastal marine ecosystems, specifically in recreational waters.

Recreational marine waters are vulnerable to microbial pollution resulting from anthropogenic activities such as tourism, sewage discharge, coastal development, and improper waste disposal (Akita et al. 2021). Coliform bacteria are widely used as indicators of fecal contamination and environmental sanitation (Rompré et al. 2002). Elevated coliform levels in marine organisms may indicate exposure to polluted waters and possible public health risks associated with seafood consumption. In tourist destinations such as Cowrie Island in Honda Bay, increasing human activities may contribute to microbial contamination in coastal habitats (Cayabo et al. 2021).

Given the dual importance of *L. lambis* as both a food resource and a sentinel organism in coastal ecosystems, this study aimed to (1) characterize the bacterial and fungal abundance in the gut microbiota of *L. lambis*, and (2) assess coliform contamination levels of this species collected from Cowrie Island, Honda Bay, Palawan. The results will provide baseline microbiological data to evaluate the sanitary quality of recreational waters and the potential use of *L. lambis* as a bioindicator of coastal microbial pollution in the region.

METHODS

Study Site and Sample Collection

The sample collection was conducted on December 10, 2025 at the recreational marine waters of Cowrie Island (9°50'23"N 118°46'05"E) located in Honda Bay (Figure 1).

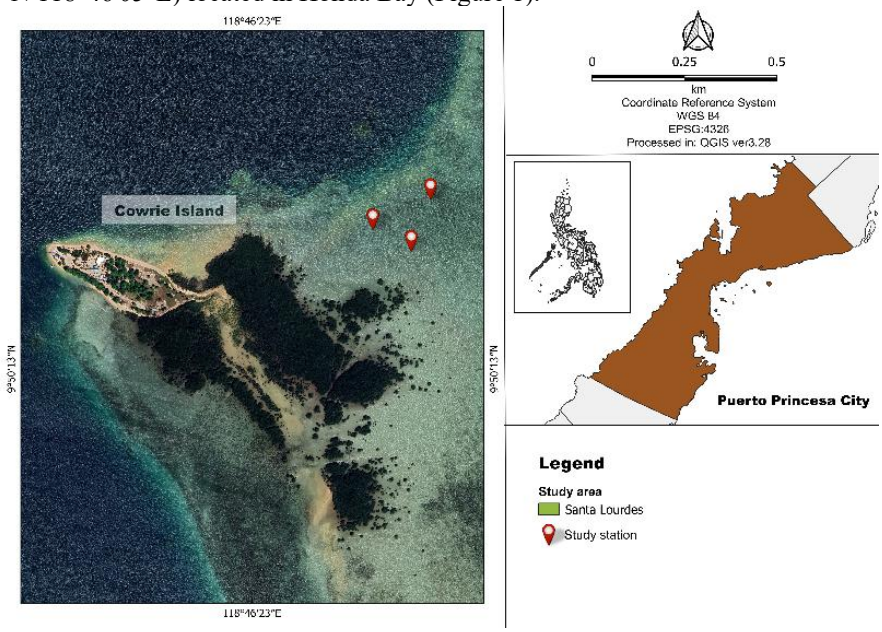

Figure 1. Map showing the locale of the study at Cowrie Island, Honda Bay, Puerto Princesa City, Palawan.

A total of ten (10) adult specimens of *Lambis lambis* were collected through handpicking and shallow diving. Collected specimens were individually placed in sterile plastic containers containing ambient seawater and transported to the laboratory using an ice cooler. Species identification was based on shell morphological characteristics following the taxonomic guide of Poutiers (1998) (Figure 2). Prior to dissection, the shell surfaces were cleaned and sterilized using 70% ethanol followed by sterile distilled water rinsing to minimize external contamination.

Figure 2. Picture of Genus *Lambis* cited in the book of "The living marine resources of the Western Central Pacific Volume 1" (Poutiers, 1998).

Dissection and Sample

Using aseptic techniques, the digestive tract of each specimen was carefully isolated. Gut contents were aseptically removed and homogenized using a sterile mortar and pestle. The homogenized samples were combined into three composite samples for microbial analyses. Approximately 10 g of homogenized gut sample was mixed with 90 mL of sterile distilled water to prepare the stock suspension for serial dilution and microbiological examination.

Quantification of Bacterial and Fungal Abundance

The microbial abundance was quantified using the serial dilution and plate count method following Mabuhay et al. (2004). Serial dilutions up to 10^{-4} were prepared from the homogenized gut suspension. For total bacterial count, Nutrient Agar (NA) was used. This medium was suitable for enumerating heterotrophic bacteria from marine samples. Bacterial plates were incubated at 35 °C for 24 hours (Mabuhay et al. 2004). For fungal enumeration, Potato Dextrose Agar (PDA) was used and incubated at 35°C for seven (7) days. After incubation, visible colonies were counted and expressed as colony–forming units per gram (CFU/g) using the formula:

CFU/g = (average number of colonies × reciprocal of dilution factor) / volume plated (mL)

Most Probable Number (MPN) of Coliform

Coliform levels were determined using the conventional three–tube Most Probable Number (MPN) method following Rompré (2002). Homogenized gut samples were inoculated into lactose broth tubes containing Durham tubes. Double–strength lactose broth tubes received 10 mL inoculum, while single–strength lactose broth tubes received 1 mL and 0.1 mL inocula, respectively. All inoculated tubes were incubated at 35°C for 24–48 hours. Tubes exhibiting gas production and turbidity were considered positive for coliform bacteria. The number of positive tubes was compared with the standard MPN reference table to estimate coliform density expressed as MPN/100 mL (**Table 1**).

Data Analysis

Descriptive statistics such as mean and standard deviation were used to summarize bacterial and fungal abundance expressed as CFU/g and coliform levels expressed as MPN/100 mL. Coliform results were interpreted based on the standard MPN reference table following Rompré (2002) (Table 1).

Table 1. Most Probable Number (MPN) of Coliform Reference Table.

MPN Determination for multiple tube tests numbers of tubes giving positive reaction out of			**MPN** index per 100 mL	**94%** confidence limit	
3 of 10mL each	3 of 1mL each	3 of 0.1mL each		Lower	Upper
0	**0**	**1**	**3**	**<0.5**	**9**
0	**1**	**0**	**3**	**<0.5**	**13**
1	**0**	**0**	**4**	**<0.5**	**20**
1	**0**	**1**	**7**	**1**	**21**
1	**1**	**0**	**7**	**1**	**23**
1	**1**	**1**	**11**	**3**	**36**
1	**2**	**0**	**11**	**3**	**36**
2	**0**	**0**	**9**	**1**	**36**
2	**0**	**1**	**14**	**3**	**37**
2	**1**	**0**	**15**	**3**	**44**
2	**1**	**1**	**20**	**7**	**89**
2	**2**	**0**	**21**	**4**	**47**
2	**2**	**1**	**28**	**10**	**150**
3	**0**	**0**	**23**	**4**	**120**
3	**0**	**1**	**39**	**7**	**130**
3	**0**	**2**	**64**	**15**	**380**
3	**1**	**0**	**43**	**7**	**210**
3	**1**	**1**	**75**	**14**	**230**
3	**1**	**2**	**120**	**30**	**380**
3	**2**	**0**	**93**	**15**	**380**
3	**2**	**1**	**150**	**30**	**440**
3	**2**	**2**	**210**	**35**	**470**
3	**3**	**0**	**240**	**36**	**1,300**
3	**3**	**1**	**460**	**71**	**2,400**
3	**3**	**2**	**1,100**	**150**	**4,800**
3	**3**	**3**	**>1,400**		
From: Standard Method for Examination of water and wastewater, twelfth edition. (New York: The American Public Health association, Inc., p. 608)					

RESULTS

Microbial Abundance (Bacteria and Fungi)

The bacterial populations in the gut of *L. lambis* ranged from 19.5 × 10^4 CFU/g to 57.1 × 10^4 CFU/g, while fungal populations ranged from 1.67 × 10^4 CFU/g to 7.7 × 10^4 CFU/g (Table 2). Bacterial populations consistently outnumbered fungal populations across all samples, indicating the predominance of bacteria in the gut microbiota.

Table 2. Microbial Colony Counts (CFU/g) from the Gut of *Lambis lambis* on Nutrient and Potato Dextrose Agar Medium.

Homogenized Gut Samples	Replicate Per Samples	Count Colonies	Average Per Colonies	Mean CFU/g
Nutrient Agar				
Sample 1	R1	499	195	19.5x10^4
	R2	34		
	R3	52		
Sample 2	R1	148	459	45.9 x10^4
	R2	1,058		
	R3	171		
Sample 3	R1	940	571	57.1x10^4
	R2	448		
	R3	324		
Potato Dextrose Agar				
Sample 1	R1	1	2	2 x10^4
	R2	4		
	R3	1		
Sample 2	R1	2	77	7.7x10^4
	R2	227		
	R3	1		
Sample 3	R1	1	1.67	1.67 x10^4

Most Probable Number (MPN) of Coliform

The data showed that all *Lambis lambis* gut samples collected at Cowrie Island at Honda Bay, Puerto Princesa City, Palawan were positive for coliform bacteria, with MPN index ranging from 150 to 460 MPN per 100 mL (**Table 3**). All samples tested showed coliform counts which exceeded the recommend fecal coliform bacteria limit, which is 100 MPN per 100 mL with 'Fair" to "Poor" classification of samples (Table 3).

Table 3. Most Probable Number (MPN) of Coliform and Bacteriological Classification of the Gut Samples of *Lambis lambis*.

Guts of *L. lambis* Sample (Triplicate)	MPN Index per 100 mL	Category (Grade)	Interpretation
Sample 1	**150**	**II (fair)**	Indicates moderate presence of coliform bacteria, suggesting exposure to contaminated environments.
Sample 2	**240**	**III (fair)**	Indicates increased bacterial contamination likely influenced by human activities.
Sample 3	**460**	**IV (poor)**	Indicates heavy contamination and potential risk to human health.

DISCUSSION

Microbial Abundance

The results reveal that *Lambis lambis* from Cowrie Island harbors a gut microbiota dominated by bacteria, with counts consistently exceeding fungal populations by approximately 10–fold. This bacterial dominance likely reflects the established metabolic roles of bacteria in digestion, nutrient assimilation, and energy metabolism in marine gastropods, consistent with previous findings in other mollusks (Nakagawa et al. 2017).

The bacterial abundance may also indicate adaptation to the local environmental conditions and food composition in Honda Bay. In contrast, the presence of fungi in substantially lower and more variable amounts (ranging from 1.67×10^4 to 7.7×10^4 CFU/g) suggests they function as transient residents rather than permanent members of the core microbiota (Polinski et al. 2019). The variability in fungal counts across specimens could reflect differences in environmental exposure, dietary inputs, or individual host factors influencing colonization dynamics. These findings align with the general pattern observed in marine invertebrate microbiota, where bacteria comprise the dominant microbial community while fungi play secondary ecological roles.

Coliform Contamination

The detection of coliform bacteria exceeding the recommended standard limit of 100 MPN/100 mL in all ten specimens is a significant finding that warrants careful interpretation. The MPN values ranging from 150 to 460 MPN/100 mL indicate systemic exposure of *L. lambis* to fecal contamination, likely influenced by multiple anthropogenic stressors in Cowrie Island, including tourism activities, inadequate sewage treatment, coastal development, and improper waste disposal (Cayabo et al. 2021; Rabia et al. 2023). These elevated coliform levels indicate not only environmental pollution but also potential public health risks for consumers of *L. lambis* harvested from these waters, as coliforms are established indicators of fecal contamination and the potential presence of pathogenic microorganisms. This finding underscores the need for regular microbiological monitoring of seafood resources in recreational waters.

Bioindicator Potential and Ecological Implications

This study provides empirical evidence supporting the use of *L. lambis* as a bioindicator species for assessing microbial pollution in coastal marine ecosystems. The gut microbiota of marine invertebrates serves as a biological archive of their environmental exposure, reflecting the microbiological quality of their habitat through both the presence of environmental bacteria and the accumulation of fecal contaminants (Wilkins et al. 2019). As a sedentary or slow–moving benthic organism with a filter–feeding or detritivorous feeding strategy, *L. lambis* integrates microbial signals over time, making it particularly valuable for assessing chronic or spatial patterns of microbial pollution that point–source water sampling may miss. The consistent detection of coliform contamination across all specimens suggests that the Cowrie Island maybe exposed to fecal pollution, indicating that environmental remediation efforts and improved sanitation infrastructure are needed to protect both the ecosystem health and the food security of local fishing communities. Given the coliform levels detected in *L. lambis* specimens, consumers of this species should adopt rigorous food safety practices, including thorough cooking at temperatures sufficient to eliminate fecal indicator bacteria and potential pathogens, as well as proper handling and storage protocols. These preventive measures are essential to mitigate foodborne disease risks associated with the consumption of shellfish from potentially contaminated marine environments. Further investigation of the microbial composition of *L. lambis* and correlation with water quality parameters (e.g., dissolved oxygen, nutrient levels, bacterial community structure in water samples) would strengthen the bioindicator framework and enable more targeted management interventions in Honda Bay.

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GENERATIVE AI STATEMENT

AI (Artificial Intelligence) was used solely for language editing, grammar correction, sentence refinement, and formatting of the manuscript in accordance with the required publication template. All data collection, analyses, interpretations, and scientific conclusions were conducted and verified solely by the author.

ETHICAL CONSIDERATIONS

Collection and handling of *Lambis lambis* specimens were conducted following institutional and standard ethical guidelines for marine organism research. Specimens were handled using appropriate laboratory safety and aseptic procedures to minimize contamination and unnecessary harm during sample processing.

DECLARATION OF COMPETING INTEREST

The authors declare that there is no competing interest associated with this study.

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ROLE OF ATUHORS: *ECR conceptualized the study, conducted field sampling and laboratory analyses, interpreted the data, and prepared the initial manuscript. AYMH supervised the laboratory procedures and revised the manuscript. JAMO provided overall conceptualization, reviewed and revised the manuscript.*

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Microplastic Contamination Analysis in Blood Cockles (*Anadara* sp.) from Cowrie Island, Puerto Princesa City, Palawan

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ABSTRACT

Microplastics pose escalating threats to marine ecosystems and public health worldwide. Cowrie Island, despite its rich marine biodiversity, faces chronic anthropogenic pressures that degrade coastal ecology. Blood cockles (*Anadara* sp.), among the most frequently harvested shellfish in the area, are particularly vulnerable to microplastic contamination. This study aimed to detect and characterize microplastics in *Anadara* sp. from Cowrie Island. Thirty samples were collected and microplastics were characterized by particle type, shape, and color using standard methods. A total of 45 microplastic particles were found, with fibers comprising 40% of the total. Particle concentration ranged from 0.14/g to 0.24/g. Black microplastics were predominantly observed, with most particles exhibiting elongated shapes. These findings raise significant public health concerns regarding consumption of *Anadara* sp. from Cowrie Island and emphasize the need for regular water quality monitoring and expanded research employing advanced detection methods.

Keywords: bioaccumulations, bivalves, coastal contamination, plastic pollution

INTRODUCTION

Microplastics (or MPs; <5 mm) pollution remains largely unstudied in the Philippines. Understanding the characteristics, abundance, and environmental fate of plastic debris across size classes, including MPs that are difficult to detect, is important for environmental sustainability (Espiritu et al. 2019). Microplastics contaminate water, land, air, and groundwater, with ecological impacts on plants, animals, and humans. Microplastics act as vectors of toxins, absorbing pollutants and promoting bioaccumulation in marine ecosystems, organisms, and food webs (Amelia et al. 2021). Human exposure to microplastics necessitates evaluation of exposure pathways and toxicological effects on human health. Microplastics may contain and transfer harmful chemicals to plants and animals, potentially increasing bioaccumulation in food chains (Sana et al. 2020).

Recreational waters are marine environments, particularly coastal areas, that support diverse aquatic organisms and accommodate recreational activities such as tourism and fishing (Cayabo et al. 2021; World Health Organization 2021). However, increasing recreational activities in these waters raise public health concerns due to potential environmental contamination. Microplastic pollution on recreational beaches has been documented, with intermediate contamination levels observed compared to previous studies (Wu et al. 2020). Resort beaches showed elevated microplastic concentrations, indicating a positive correlation between microplastic pollution and tourism intensity. Microplastics are consumed by marine organisms, creating potential health risks through food chain bioaccumulation (Miller et al. 2020). The Philippines relies heavily on marine resources for food security, making microplastic contamination a public health concern.

Blood cockles (*Anadara* sp.) are bivalve mollusks enclosed between two shells joined by an elastic hinge ligament. They typically inhabit tidal mudflat areas with low oxygen content and possess hemoglobin that enables high oxygen retention. As filter–feeding organisms, blood cockles are economically and ecologically important and can serve as indicators of ecosystem water quality. Consequently, they are exposed to and at high risk of contamination by microorganisms and inorganic materials, including bacteria, viruses, toxin–producing dinoflagellates, and phytoplankton (Jantan et al. 2018). Moreover, microplastics are also shown to be consumed by blood cockles (Ta et al. 2022) in Thailand. The presence of microplastics in *Anadara* sp. poses potential health hazards to the community.

Cowrie Island (9°50'21.51" N 118°46'10.22" E), a popular recreational area in Honda Bay, supports active fisheries and tourism industries due to its rich marine ecosystem (Gonzales 2004). However, increasing anthropogenic pressures from recreational activities threaten water quality, marine ecosystem integrity, and public health. This study addresses these concerns by quantifying microplastic contamination in *Anadara* sp., providing relevant data for community, fisheries, medical, and academic stakeholders. This study aimed to (1) detect microplastic contamination in *Anadara* sp. from Cowrie Island and (2) characterize microplastic types.

Microplastic contamination data in these economically and ecologically important bivalves provide baseline information on potential public health risks and environmental contamination in marine resources from Cowrie Island, Puerto Princesa City, Palawan.

METHODS

Locale of the Study

The samples of *Anadara* sp. were collected from Cowrie Island, Puerto Princesa City, Palawan (**Figure 1**). Located at Honda Bay with the coordinates 9°50'21.51" N 118°46'10.22" E, the pristine beach of the island boosts the city's tourism as it draws volumes of tourists, foreign and locals, and the rich mangrove area of the island is home to various marine organisms.

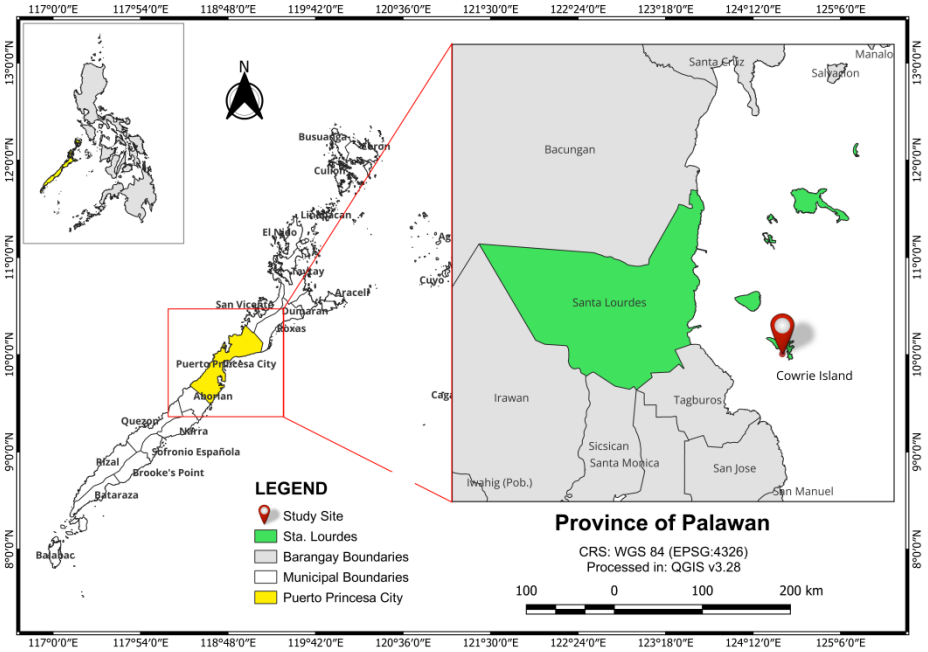

Figure 1. Map of the study site in Cowrie Island, Puerto Princesa City, Palawan.

Sample Collection and Preparation of Materials

Sampling for microplastic analysis was conducted on January 7, 2026. Thirty blood cockle samples were collected from different locations in the mangrove area of Cowrie Island and transported in glass containers within a cooler box to the Microbiological Laboratory of Western Philippines University–Puerto Princesa Campus. Glassware and equipment were cleaned thoroughly with detergent, rinsed with running water followed by filtered distilled water, and then air–dried before use. All materials used were subsequently rinsed with filtered distilled water to prevent microplastic contamination.

Preparation of Samples for Microplastic Contamination

Shells were rinsed with filtered distilled water to remove excess debris. Meat was aseptically removed using a knife and scalpel, divided into three groups by weight (Sample 1, Sample 2, Sample 3), and each group was prepared in triplicate by weight. Meat samples were cut into pieces using scissors to facilitate digestion. Samples were placed into pre–labeled Erlenmeyer flasks and covered with aluminum foil. Plastic materials such as gloves were avoided throughout the procedure.

Digestion of Organic Matter

The meat samples were soaked in 10% KOH solution where required volume was calculated using a 1:4 ratio (sample by weight solution). Samples were oven–dried for 24–48 hours at 60°C. Following digestion, samples were examined for residual organic matter. The supernatant (10% KOH and organic residue) was removed, and 100 mL of filtered distilled water was added. The replicates were rinsed with filtered distilled water by vigorous shaking to ensure complete contact with flask walls; the rinse water was retained. The 10% KOH solution was prepared by dissolving 11.8 g of 85% KOH in 100 mL of filtered distilled water (Thiele et al. 2019).

Flotation Method

Following organic matter digestion, each replicate was subjected to density separation using a concentrated saltwater solution. The volume of saltwater solution added was calculated using a 1:4 ratio (sample

by volume solution). The concentrated saltwater solution was prepared by dissolving 358.9 g of laboratory–grade NaCl in 1000 mL of filtered distilled water. Laboratory–grade NaCl was added gradually to filtered distilled water while stirring. Each replicate was mixed with the concentrated saltwater solution and allowed to settle for 12–24 hours, during which organic matter residue sank and microplastics floated to the surface (Sajorne et al. 2022).

Filtration of Microplastic Samples

Filtration was performed using a filtration set, vacuum pump, clean forceps, and Whatman filter papers. Before filtration, a blank control (filtered distilled water only) was processed to assess laboratory microplastic contamination. Each replicate was carefully decanted and filtered to prevent organic residue from entering the flask opening. Filtration continued until approximately 50 mL remained in each replicate and no organic residue entered the flask opening. Each replicate required two filter papers. After filtration, filter papers were rinsed with filtered distilled water to remove salt crystallization and transferred to pre–labeled petri dishes. Samples were oven–dried for 24 hours at 37°C (Sajorne et al. 2022).

Detection and Confirmation of Microplastics

Each filter paper was examined under a stereo microscope for the presence of microplastics. Suspected microplastics were confirmed using the Hot Needle test, where a heated needle rod (heated with an alcohol lamp) contacts the particle; polymeric microplastics melt, crumple, or bend upon contact, confirming their identity.

Characterization of Microplastics

Confirmed microplastics from each replicate were pooled with their respective sample group. All microplastics were counted and characterized by shape, color, and particle type. Particle types were classified according to Frias et al. (2018) and Gündoğdu and Çevik (2017) (**Figure 2**, **Figure 3**). Microplastics were photographed using a microscope–mounted digital camera.

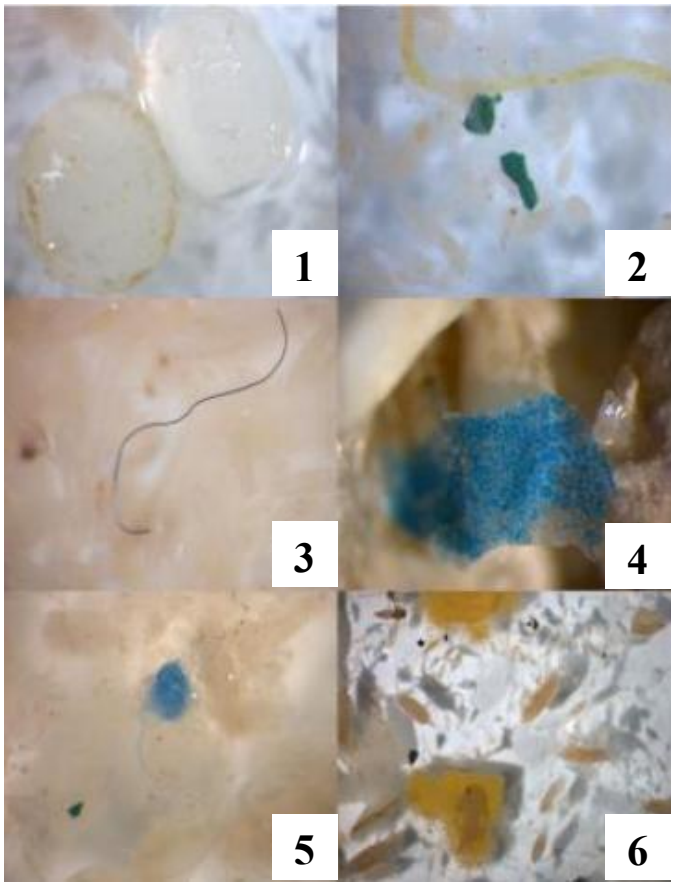

Figure 2. Examples of Microplastic Types with corresponding numbers to categories – 1) spherules/pellets, 2) fragments, 3) fibre, 4) film, 5) rope and filament, 6) sponge/foam.

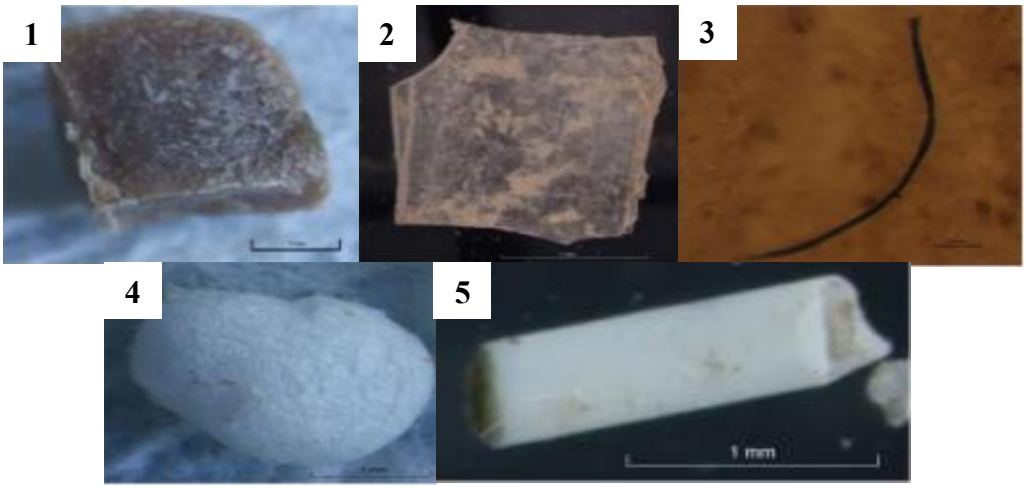

Figure 3. Shapes of Microplastics with corresponding numbers to categories – 1) irregular, 2) flat, 3) elongated, 4) spherical, and 5) cylindrical.

Data Analysis

Microplastic data were organized by sample group and replicates. Particle count, type, color, and shape were recorded for each replicate. Microplastic abundance was calculated as particles per gram of sample material (particles/g) by dividing total particle count by sample dry weight. Particle type distribution was expressed as percentage of total microplastics recovered. Color and shape frequencies were tabulated and presented as counts and percentages. Descriptive statistics including ranges and means were calculated for microplastic abundance across samples.

RESULTS

Microplastic contamination was detected in blood cockles (*Anadara* sp.) samples. Five particle types were identified: fibers, films, fragments, rope/filaments, and sponge/foam (**Figure 4**, **Table 1**). The blank control tested positive for microplastic contamination, indicating background laboratory contamination. The number was deducted from the observed MPs in samples. A total of 45 microplastics were recovered from the three samples. Fibers were the dominant particle type, comprising 40% of total microplastics, followed by fragments (33%) and films (20%). Rope/filaments and sponge/foam accounted for the remaining 7% (**Figure 5**).

Microplastic abundance per sample ranged from 0.14 to 0.24 particles/g (**Table 2**). Color distribution exhibited considerable variation: black was most prevalent at 23.1%, followed by red (19.2%), transparent (15.4%), and orange (15.4%). Brown, green, blue, and purple comprised the remaining 11% (**Figure 5**).

Four microplastic shapes were identified. Elongated particles were most abundant (n = 7), followed by irregular (n = 6), flat (n = 5), and cylindrical (n = 1) shapes (**Table 3**, **Figure 6**).

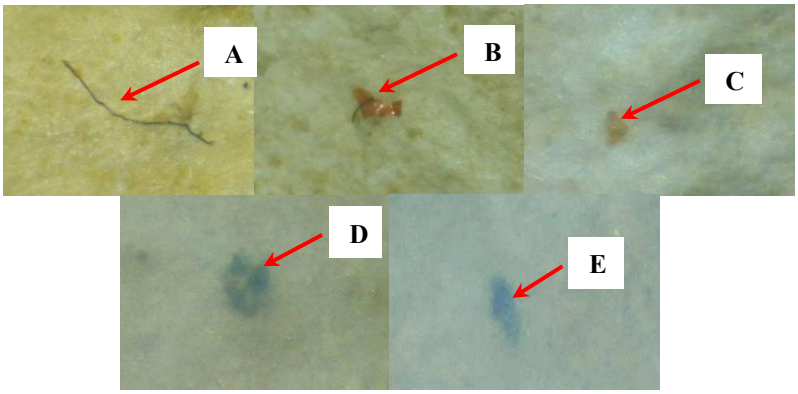

Figure 4. Examples of the microplastic particle types determined from the samples – A) fibre, B) film, C) fragments, D) rope and filament, and E) sponge/foam.

Table 1. Microplastic type, number of particles per type, and total number of microplastic particles per replicate.

Total Microplastic Particles	Microplastic Type and Total Quantity of Microplastics				
	Fibre	Fragments	Film	Rope and Filament	Sponge/Foam
Replicate 1					
S1R1	**3**	**2**			
S1R2	**2**	**1**	**1**		
S123			**1**		
Total Particles	**5**	**3**	**2**		
Replicate 2					
S2R1	**1**	**3**	**5**		
S2R2	**1**	**1**	**1**		
S2R3	**6**				
Total Particles	**8**	**4**	**6**		
Replicate 3					
S3R1	**1**	**2**			
S3R2		**4**		**1**	**2**
S3R3	**4**	**2**	**1**		
Total Particles	**5**	**8**	**1**	**1**	**2**

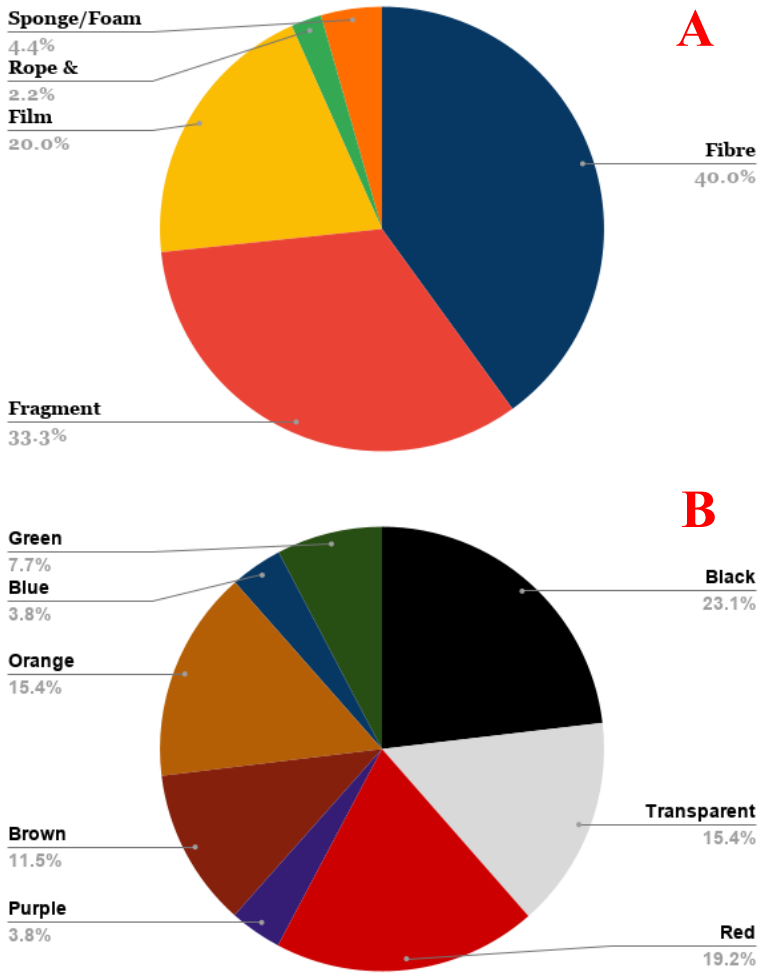

Figure 5. Characterization of Microplastics in terms of Particle Type and Color – A and B.

Table 2. Wet Weight in Grams per Sample, Quantity of Microplastic Particles and their Particles per Gram

Samples	Wet Weight in Grams	Quantity of Microplastic Particles	Particles Per Gram	Percentage of Number of Particles
Sample 1	74.325	10	0.14	22%
Sample 2	74.716	18	0.24	40%

Sample 3	71.909	17	0.24	38%
Total	220.95	45	0.62	100%

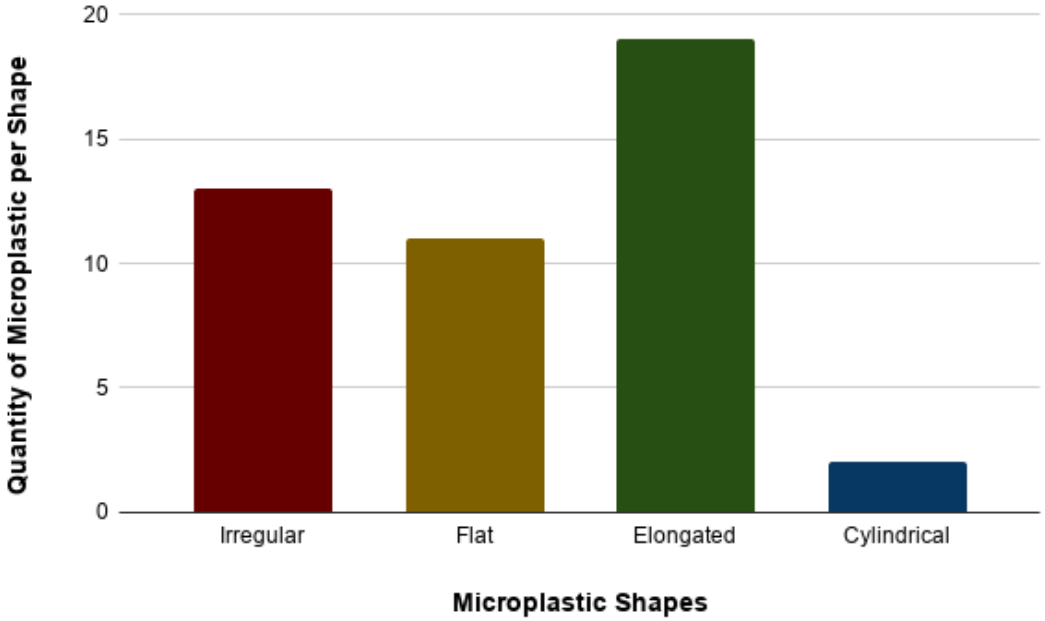

Figure 6. Quantity of Microplastic Shapes – Irregular, Flat, Elongated, and Cylindrical

Table 3. Shapes of Microplastic Particles Determined per Replicate (Indicated by ✓)

Replicates	Shapes of Microplastic Particles			
	Irregular	Flat	Elongated	Cylindrical
Sample 1				
S1R1		✓	✓	
S1R2	✓	✓	✓	
S1R3	✓			
Sample 2				
S2R1	✓	✓	✓	✓
S2R2	✓		✓	
S2R3			✓	
Sample 3				
S3R1	✓	✓	✓	
S3R2	✓	✓		
S3R3		✓	✓	

DISCUSSION

Microplastic contamination was confirmed in blood cockles collected from Cowrie Island, Puerto Princesa City, Palawan. Five distinct particle types were identified: fibers, films, fragments, rope/filaments, and sponge/foam. Overall microplastic burden and particle type composition indicated a total of 45 microplastic particles recovered across the three samples. Fibers were the dominant particle type, comprising 40% of total microplastics, a finding consistent with other bivalve microplastic studies. Multiple investigations have identified transparent fibers as the primary microplastic composition in fresh or frozen bivalve mollusks, with lesser quantities of fragments and granules (Capuozzo et al. 2025).

Fiber dominance in coastal bivalves is attributed to multiple anthropogenic sources. Fiber sources likely include fishing nets, ropes, and synthetic textile fragments released during laundering and coastal activities, which undergo fragmentation through mechanical weathering and ultraviolet degradation (Andrady 2011). This fiber

dominance aligns with findings from similar coastal environments where recreational and fishing activities are prevalent (Ruairuen and Ruangpanupan 2022). The predominance of secondary microplastics (fibers and fragments) in *Anadara* sp. suggests environmental breakdown of larger plastic debris in the surrounding marine ecosystem of Cowrie Island.

Microplastic abundance per sample ranged from 0.14 to 0.24 particles/g, demonstrating variable contamination across samples. This range is lower than commercially important bivalve species but indicates consistent microplastic exposure in these filter–feeding organisms. For context, average microplastic loads of 0.36–0.47 particles per gram have been detected in commercially important bivalve species such as mussels (*Mytilus edulis*) and oysters (*Crassostrea gigas*) (Van Cauwenberghe et al. 2015). The variation in abundance across samples may reflect differences in sample composition, individual feeding rates, or temporal exposure variation.

Color distribution exhibited considerable variation, with black being most prevalent (23.1%), followed by red (19.2%), transparent (15.4%), and orange (15.4%). Brown, green, blue, and purple comprised the remaining 11%. The diversity in microplastic colors reflects the heterogeneous nature of plastic waste in the marine environment, originating from diverse consumer products and industrial sources. Black coloration may indicate aged or degraded plastics, while vibrant colors (red, orange) may represent more recently fragmented materials. This color diversity in blood cockles mirrors findings in environmental water and sediment samples, suggesting that bivalves accumulate particles reflective of their surrounding marine ecosystem (Zhu and Wang 2020).

Four microplastic shapes were identified: elongated (n = 7), irregular (n = 6), flat (n = 5), and cylindrical (n = 1). Elongated particles were most abundant, consistent with fiber morphology dominance noted in particle type composition. Irregular shaped microplastics typically originate from mechanical fragmentation of larger debris, while elongated and cylindrical shapes are characteristic of fibers derived from textile and fishing sources (Andrady 2011). The predominance of elongated particles aligns with the fiber–dominant composition of the assemblage and supports the inference that coastal fishing and textile release are primary contamination vectors at this site.

Public health implications of microplastic contamination in *Anadara* sp. are significant given the role of bivalves in local food security and consumption patterns. Bivalves are at high risk of microplastic contamination due to their filter–feeding mechanism and pose a risk to consumers as they are ingested whole (Capuozzo et al. 2025). Microplastic contamination in seafood has emerged as a significant concern for public health and food safety, as bivalve molluscs are especially vulnerable due to their filter–feeding behavior, leading to accumulation of contaminants including microplastics (Capuozzo et al. 2025). Consumption of contaminated bivalves is a main pathway of exposure to microplastics by humans, which raises potential human health concerns (Van Cauwenberghe et al. 2015).

Annual dietary exposure for shellfish consumers can amount to thousands of microplastics per year, depending on consumption patterns and contamination levels (Van Cauwenberghe et al. 2015). Beyond the physical presence of microplastics, these particles serve as vectors for persistent organic pollutants and heavy metals that accumulate on their surface (Andrady 2011). Microplastic contamination in bivalves may pose health risks to humans via seafood consumption, based on polymer hazard index assessments indicating risk levels II–III (Zhu and Wang 2020).

This study provides important baseline microplastic contamination data for *Anadara* sp. from Cowrie Island, Puerto Princesa City, emphasizing the importance of monitoring microplastic levels in locally harvested shellfish and considering food safety implications for communities dependent on marine resources. Future research should employ additional detection methods (e.g., Raman spectroscopy, FTIR) to characterize polymer types and assess associated chemical contaminants. Comparative studies across multiple harvest sites and seasons would provide greater insight into spatial and temporal microplastic contamination patterns in Palawan's coastal ecosystems.

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GENERATIVE AI STATEMENT

There were no AI tools used in the making of this manuscript.

ETHICAL CONSIDERATIONS

A Gratuitous Permit was granted by the Palawan Council for Sustainable Development for the usage of blood cockles (*Anadara* sp.) for this study.

DECLARATION OF COMPETING INTEREST

The authors would like to express that there are no competing interests to any authors.

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Stories of Resilience: Mothers in the Aftermath of the Bagong Silang Fire

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ABSTRACT

The study is a qualitative–exploratory in nature which investigated the experiences particularly on the roles, challenges, and coping strategies of mothers affected by a devastating fire in Barangay Bagong Silang, Puerto Princesa City. Utilizing narrative inquiry through semi–structured interview guide and face–to–face interviews with ten mothers from large families, the research explored maternal resilience in the aftermath of displacement. Findings revealed that mothers performed multifaceted roles as primary caregivers, resource managers, and community helpers while facing emotional trauma, financial hardships, and inadequate shelter conditions. Despite these challenges, they utilized problem–focused and emotion–focused coping mechanisms, including budgeting, community solidarity, and prayer. The study highlights the critical role of mothers in family recovery and recommends that government agencies like the City Disaster Risk Reduction and Management Office (CDRRMO) and City Social Welfare and Development Office (CSWD) of Puerto Princesa provide holistic, gender–sensitive support and improved infrastructure at relocation sites.

Keywords: maternal resilience, fire incident, gender–sensitive support

INTRODUCTION

Disasters are a complex global problem and an inevitable truth of life, disrupting the mental health and well–being of communities and often exceeding their ability to cope using their own resources. These events are classified as either natural or human–generated calamitous events that produce great loss of human life or destruction of the natural environment and public infrastructure (Kreimer 2001). Fire disasters, characterized by uncontrolled ignitions from both natural causes like lightning and human activities, significantly threaten life and property (Madondo et al. 2023).

In the Philippines, fire incidents are a severe threat; between 2011 and 2019, over 1,300 incidents occurred, resulting in thousands of deaths and billions of pesos in property damage (Villa and Ceballos 2021). Disasters disproportionately impact vulnerable populations, particularly women and children (Shaukat S. et. al. 2025). Maternal stress following such environmental disasters can influence children's long–term health and development, while the trauma of the fire can hinder a mother's ability to engage in nurturing roles, complicating the transition back to normalcy (Mockrin et al. 2022).

Barangay Bagong Silang, a close–knit coastal community in Puerto Princesa City, experienced a catastrophic fire on February 7, 2024, which gutted 450 households and affected over 900 families (Ticke 2024). Following the incident, mothers relocated to temporary shelters reported challenges such as poor ventilation and increased educational costs due to the distance from schools. Existing studies often focus on the economic impacts or causes of fires, leaving a significant gap in the exploration of the psychological and social aspects of recovery for mothers as primary caregivers.

This study aims to fill this gap by providing a narrative analysis of the experiences of mothers affected by the fire in Barangay Bagong Silang. Specifically, the objectives are to explore the stories of resilience in terms of the roles performed by mothers, the challenges they encountered, and to identify the coping strategies they employed after the fire incident.

METHODS

Research Design

The study employed a qualitative–exploratory research design to investigate the complex social, emotional, and behavioral patterns of mothers affected by the fire. Narrative inquiry was utilized to capture personal stories and the specific meanings participants assigned to their experiences, providing a nuanced understanding of their resilience (Fraenkel, Wallen, and Hyun 2012).

Participants and Locale Selection Criteria

The researchers used purposive sampling to select ten mothers from Barangay Bagong Silang who had families with six or more members. These participants were directly affected by the fire and were listed in the official barangay records. The research was conducted between September 2024 and May 2025 in Barangay Bagong Silang and the temporary relocation sites in Barangay San Pedro.

Data Collection and Analysis Instrument and Procedure.

In–depth interviews were conducted using a semi–structured questionnaire with open–ended inquiries. To ensure cultural sensitivity and build rapport, the researchers utilized the Filipino approaches of "pakapa–kapa" (feeling out) and "pakikipagkwentuhan" (storytelling), which facilitated harmonious communication. Data were analyzed using thematic analysis following Braun and Clarke's six–phase process: familiarization, coding, searching for themes, reviewing themes, defining themes, and producing the report.

RESULTS

Roles Performed by Mothers after the Fire Incident

Following the fire incident, mothers immediately assumed the role of **primary caregivers**, placing the safety and emotional welfare of their children above material concerns. Nanay Dora exemplified this by stating, *"Bilang isang ina unang una syempre ay inasikaso ko ang mga anak ko, kasi pagtapos ng sunog anak ko talaga ang inu–una ko, diko na inisip ang mga gamit ko kasi nga makikita ko parin yun pero ang mga anak ko hindi na"*. Mothers also maintained household stability through domestic labor; Nanay Emma shared, *"Tapos pala yun naglalaba ng mga damit namin, naglilinis dito sa bahay at nagluluto basta lahat ng gawaing bahay"*.

Beyond domesticity, they acted as **resource managers**. Nanay Ace worked to provide for educational needs despite displacement: *"ang ginawa kong tungkulin ay ang mag trabaho para kumita ng pera para mabigay ko ang mga need ng anak ko sa school, lalo na nagkaroon ng adjustment o pagbabago dahil medyo malayo na sila sa school"*. Nanay Emma added*, "hahanap ka parin ng paraan paano ma provide yung pambili ng mga gamit na kailangan maka pasok sila sa school sikap ka parin". For some, this meant taking on dual–parenting roles, as Nanay Vida recounted, "Ako ang naging nanay at tatay lahat ng kailangan ng anak ko ako lang ang nag–aasikaso lalo na yung time na ng sunog"*.

Additionally, mothers served as **active participants in community relief**, with Nanay Vida, a Barangay Health Worker, noting, *"habang nag–e–evacuate kami doon nag–aassist din kami sa mga kapwa namin kabarangay na may mga sakit. Nagmomonitor din kami, nagche–check ng BP, nag–dispensed ng mga gamot"*.

Challenges Encountered by Mothers Affected by Fire Incident

Mothers faced intense **health and well–being challenges**, including lasting psychological distress. Nanay Kath shared, *"Nag–iwan po ito sa akin ng pobya o trauma dahil nga grabi yung pangyayari until now pag naiisip ko yun natatakot pa rin ako"*. Concerns for children's physical health were also prominent; Nanay Dora feared, *"na baka magkasakit mga anak ko atsaka apo ko ng leptospirosis at dengue kasi maraming lamok"*, while Nanay Emma noted persistent respiratory issues: *"ang ubo at sipon parin talaga kasi hindi maiwasan kasi nga ma–alikabok tapos mainit"*.

Financial hardships were exacerbated by displacement. Nanay Dora explained, *"pabaon ko sa mga anak at apo ko ay hindi sapat...ayaw ko na laging nag–aabsent"*. Nanay Marisol added, *"minsan nga di sila nakakapasok kasi walang budget, walang pamasahe"*. Distance from work was a major hurdle, with Nanay Dora noting, **"***Mahirap parin kasi nga nasanay kami doon malapit lang kami sa mga pinagkikitaan namin... hirap pang makahanap ng sideline"*.

Structural challenges in the shelters also caused significant stress. Nanay Bea described the impact of rain: *"isa pa yung baha... iniisip ko na baka biglang mag baha at mabasa ang mga gamit, tsaka sakripisyo rin talaga sa paglilinis"*. Nanay Ace highlighted the lack of privacy and comfort*: "hihiga kami sa semento yung higaan naman namin is banig... dagdag pa yung sa palikuran syempre sa dami ng gumagamit di naman gaya ng sarili mong Cr"*.

Coping Strategies Employed by Mothers after the Fire Incident

To manage **financial stress**, mothers utilized **budgeting and alternative livelihoods**. Nanay Lyn emphasized, *"Pinag–iipunan namin ang mga pamasahe at baon nila papuntang school para makapasok sila"*. Nanay Ace adapted by finding new ways to trade: *"Nag–aangkat ng isda kapag halimbawa na hindi maka–laot, nangungumpra para lang may malako, ganon ikot–ikot lang"*. When resources were depleted, Nanay Vida turned to family: *"Minsan naghihiram ako sa mga kapatid ng asawa ko, para lang matustusan ang mga pangangailangan ng mga anak ko"*.

Emotional coping included distraction and social support. Nanay Lyn shared, *"Inaaliw ko nalang ang sarili ko para hindi ko maisip yung mga problema... hindi ko nalang pinapakita sa mga anak ko na namomro–blema ako"*. Nanay Bea found relief through community: *"Yong ginawa ko para maibsan ang stress is*

nakikipagkwentuhan ako sa mga kapitbahay namin". **Faith** was also central; Nanay Marisol prayed, *"Sinasamahan namin ng dasal kay Lord na tulungan kaming palakasin ang loob na labanan ang hirap at sakit"*.

For **physical coping**, Nanay Dora used simple tools*: "Nagpapausok kami gamit ang egg tray... nagsisindi rin kami ng katol sa gabi naman gumagamit kami ng kulambo".* Nanay Kla managed the heat by building a small extension: *"nakagawa kami ng sala na maliit dito sa labas kahit papaano meron kaming nata tambayan kapag masyado ng mainit sa loob"*.

DISCUSSION

Roles Performed by Mothers after the Fire Incident

The prioritization of children's safety over material possessions aligns with established views of mothers as "emotional anchors" who provide stability during traumatic events (Luthar and Cicchetti 2000; Walsh 2007). This protective behavior is consistent with research characterizing maternal disaster response as caring and diligent (Ayeb–Karlsson 2020). The efforts to maintain routines like cooking and cleaning are essential for fostering child resilience and recovery in post–disaster settings (Peek 2008 with Hobfoll et al. 2007). Furthermore, the multifaceted roles identified, ranging from financial provision to community healthcare, reflect the gendered burden of caregiving and financial management prevalent in low–income households (Chant 2014; Arriagada 2002). Nanay Vida's community assistance specifically embodies the Filipino value of *bayanihan*, highlighting how maternal skills are leveraged for collective communal healing and psychological support (Martinez et. al. 2020).

Challenges Encountered by Mothers Affected by Fire Incident

The emotional distress and phobias reported confirm that fire incidents lead to long–term anxiety and emotional regulation difficulties (Levine et al. 2008). Physical health issues, such as respiratory infections and fear of vector–borne diseases, are directly linked to poor housing and waste management facilities in temporary shelters, which can significantly worsen health outcomes (Ifyalem and Jakada 2023). The financial strain on the other hand, highlights the disproportionate impact of disasters on caregivers, who often sacrifice personal needs to ensure their children's education continues (Enarson 2012; Peek and Fothergill 2008). Structural inadequacies such as low metal roofs causing extreme heat and shared latrines, not only cause physical discomfort but also erode personal dignity and increase the psychological burden on mothers. These findings emphasize the need for disaster response strategies that prioritize adequate shelter and sanitation specifically for families.

Coping Strategies Employed by Mothers after the Fire Incident

Mothers utilize a blend of emotional resilience, social networks, and problem–focused coping to maintain family stability. Adaptive budgeting and the pursuit of alternative livelihoods are crucial for household survival when primary income sources are disrupted. Socializing and faith–based practices serve as vital emotional buffers, helping mothers manage trauma and find the "inner strength" needed to support their children (Enarson 2012; Peek and Fothergill 2008). Finally, the physical adaptations, such as using mosquito nets and creating outdoor shaded areas, are practical grassroots interventions. Research suggests that improving ventilation and creating shaded spaces are effective ways to mitigate heat exposure in disaster settings, especially when formal support is limited (Galang et al. 2024, Kenny et al. 2019). These collective strategies demonstrate the great maternal strength and resourcefulness required for post–disaster recovery.

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GENERATIVE AI STATEMENT

The authors of this study did not use any AI–tools in the generation of the manuscript.

ETHICAL CONSIDERATIONS

The study prioritized ethical considerations, ensuring voluntary participation, informed consent, confidentiality, and anonymity. Participants received detailed information about the study and their rights, including the freedom to withdraw without repercussions. To protect sensitive data, confidentiality was strictly maintained, and pseudonyms were used to guarantee anonymity. The researchers also acknowledged the potential for emotional distress and designed the study to provide a supportive environment, mitigating harm while fostering trust and security. Through safeguarding participants' welfare, the study aimed to collect authentic insights while respecting their rights and dignity.

DECLARATION OF COMPETING INTEREST

The authors declare that there is no competing interests to any authors.

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Beyond Grades: Statistical Competence and its Determinants among Grade 12 Learners in Palawan, Philippines

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ABSTRACT

Statistics is a critical component of 21st–century learning, yet gaps remain between students' academic performance and their actual statistical understanding. This study examined the statistical competence of Grade 12 senior high school learners in selected secondary schools in Palawan and identified factors influencing their competence. A descriptive–correlational design was employed using a researcher–developed questionnaire administered to 154 learners from both academic and technical–vocational tracks. Descriptive statistics and Pearson's correlation were used to analyze the data. Findings revealed that although learners demonstrated outstanding academic performance in Statistics and Probability (M = 91.34), their overall statistical competence was only at a "competent" level (WM = 3.62), indicating a gap between procedural achievement and conceptual understanding. Learners showed stronger competence in computational domains, such as measures of central tendency, but lower competence in higher–order skills, including inferential statistics and bivariate analysis. Among the examined factors, student–related variables showed a significant relationship with statistical competence ($r = 0.398$, $p < .01$), while teacher– and parent–related factors were not significantly associated. Additionally, statistical competence was significantly related to academic performance and strand but not to sex. The findings highlight the central role of learner engagement and self–regulation in developing statistical competence. The study underscores the need for learner–centered, inquiry–based instructional approaches that promote higher–order thinking and conceptual understanding, particularly in geographically diverse and resource–constrained contexts such as Palawan.

Keywords: literacy, senior high school, statistical competency, academic track, TVL track

INTRODUCTION

Statistics plays a vital role in developing learners' ability to interpret data, make informed decisions, and engage in research–based inquiry. As part of the K to 12 curriculum, Statistics and Probability is designed to equip learners with essential competencies aligned with 21st–century skills, including critical thinking, problem–solving, and data literacy (Van Laar et al. 2020). These competencies are increasingly important in a data–driven society where individuals are expected to analyze and interpret information effectively (Yuniawatika 2018).

Competency–based education emphasizes mastery of skills and application of knowledge in real–world contexts (Curry and Docherty 2017). Within this framework, statistical competence extends beyond procedural knowledge to include interpretation, reasoning, and application. However, previous studies have shown that learners often demonstrate strong performance in computational tasks but struggle with higher–order statistical thinking, particularly in inferential reasoning and application (Bush et al. 2014; Jansen and Möller 2022).

In the Philippine context, research has highlighted challenges in students' understanding of statistical concepts despite satisfactory academic performance (Calma et al. 2022; Dumale and Gurat 2023; Gabio and Cajandig 2025). These findings suggest that performance–based assessments may not fully capture learners' conceptual understanding. Moreover, most studies have focused on general or urban contexts, with limited attention to geographically isolated areas such as Palawan.

Emerging evidence indicates that learners in Palawan face distinct educational challenges related to access, instructional resources, and learning environments (Perez et al. 2021; Villaruz et al. 2022; Saavedra 2025). These contextual factors may influence the development of higher–order competencies, including statistical reasoning. Additionally, while previous studies have identified student, teacher, and parent–related factors as influencing academic outcomes (Ashaari et al. 2011; Ismail et al. 2023; Naungayan et al. 2024), there remains limited localized evidence examining how these factors relate specifically to statistical competence.

Thus, this study investigates the statistical competence of Grade 12 learners in selected secondary schools in Palawan and examines the factors influencing their competence. Specifically, it aims to determine: (1) learners' demographic profile, (2) their level of statistical competence, and (3) the relationship between statistical competence and selected student, teacher, and parent–related factors.

METHODS

Research Design

This study employed a descriptive–correlational research design to examine statistical competence and its associated factors.

Locale and Participants

The study was conducted in three public secondary schools in Palawan. From a total population of 1,493 Grade 12 learners, 154 respondents were selected through random sampling.

Instrumentation

A researcher–developed questionnaire was used to collect data on statistical competence and influencing factors. The instrument demonstrated acceptable reliability with a Cronbach's alpha of 0.72 (Sweller et al. 2011).

Data Collection and Ethics

Permission was secured from school authorities, and informed consent was obtained from participants. Confidentiality and voluntary participation were ensured throughout the study.

Data Analysis

Descriptive statistics (mean and percentage) and Pearson's r correlation were used to analyze the data using SPSS.

RESULTS

Demographic Profile

As presented in Table 1, the majority of the respondents were female (53.25%), while 46.75% were male. Among the strands, ABM had the highest representation (24.68%), followed by HE (20.78%) and IA (16.88%). In terms of academic performance in Statistics and Probability, most respondents obtained an Outstanding rating (68.83%), with a mean grade of 91.34.

Table 1. Demographic profile of respondents (n = 154**).**

Category		Frequency (n)	Percentage (%)
Sex	Male	72	46.75
	Female	82	53.25
Strand	ABM	38	24.68
	STEM	19	12.34
	HUMSS	21	13.64
	GAS	7	4.55
	AFA	5	3.25
	HE	32	20.78
	IA	26	16.88
	ICT	6	3.90
Academic Performance	Outstanding (90–100)	106	68.83
	Very Satisfactory (85–89)	37	24.03
	Satisfactory (80–84)	11	7.14
	Mean Grade	91.34	Outstanding

Level of Statistical Competence

Table 2 presents the level of statistical competence of the respondents. The overall weighted mean was 3.62, described as Competent. The highest mean score was obtained in Measures of Central Tendency (WM = 4.00), followed by Probability and Non–Probability Sampling (WM = 3.94) and Frequency Distribution (WM = 3.86). The lowest mean scores were recorded in Bivariate Data Analysis (WM = 3.31), Strength of Relationship/Effect (WM = 3.31), and More than Two Population Means (WM = 3.32).

Table 2. Level of statistical competence of respondents. Legend: 4.21–5.00 = Highly Competent; 3.41–4.20 = Competent; 2.61–3.40 = Moderately Competent; 1.81–2.60 = Slightly Competent; 1.00–1.80 = Not Competent.

Indicator	WM	
Research variables and probability distributions	3.76	Competent
Random variables in real–life problems	3.79	Competent
Probability and non–probability sampling	3.94	Competent
Parameter and statistic	3.68	Competent
Frequency distribution	3.86	Competent
Measures of central tendency	4.00	Competent
Measures of dispersion	3.69	Competent
Hypothesis testing concepts	3.58	Competent
Solving hypothesis testing problems	3.53	Competent
Bivariate data analysis	3.31	Moderately Competent
Relationship between variables	3.62	Competent
Difference (one group)	3.46	Competent
Difference (two groups)	3.44	Competent
More than two population means	3.32	Moderately Competent
Strength of relationship/effect	3.31	Moderately Competent
Overall Weighted Mean	3.62	Competent

Factors Affecting Statistical Competence

Student–related factors were rated positively (WM = 4.08), particularly in engagement and information–seeking. Teacher–related factors received the highest ratings (WM = 4.43), while parent–related factors were also positively perceived (WM = 4.08) (Table 3).

Table 3. Factors Affecting Statistical Competence. Legend: 4.21–5.00 = Strongly Agree; 3.41–4.20 = Agree; 2.61–3.40 = Moderately Agree; 1.81–2.60 = Disagree; 1.00–1.80 = Strongly Disagree.

Factors	Weighted Mean	Interpretation
Student–Related Factors	4.08	Agree
Teacher–Related Factors	4.43	Strongly Agree
Parent–Related Factors	4.08	Agree

Relationship Between Statistical Competence and Profile Variables

Table 4 shows the relationship between statistical competence and selected profile variables. Statistical competence was significantly related to strand ($r = –0.296$, $p = .000$) and academic performance ($r = 0.351$, $p = .000$). No significant relationship was found between statistical competence and sex ($r = 0.141$, $p = .082$).

Table 4. Relationship Between Statistical Competence and Profile Variables. Significant at $p < .01$ (two–tailed). Note: **$p < .01$.

Variables	r–value	p–value	Interpretation	Decision
Sex	0.141	.082	Not Significant	Accept H_0
Strand	–0.296**	.000	Significant	Reject H_0
Academic Performance	0.351**	.000	Significant	Reject H_0

Relationship Between Statistical Competence and Identified Factors

As reflected in Table 5, student–related factors were significantly associated with statistical competence ($r = 0.398$, $p = .000$). Teacher–related factors ($r = 0.143$, $p = .077$) and parent–related factors ($r = 0.045$, $p = .584$) did not show significant relationships with statistical competence.

Table 5. Relationship Between Statistical Competence and Identified Factors. Significant at $p < .01$ (two–tailed). Note: **$p < .01$.

Variables	r–value	p–value	Interpretation	Decision
Student–Related Factors	0.398**	.000	Significant	Reject H_0
Teacher–Related Factors	0.143	.077	Not Significant	Accept H_0
Parent–Related Factors	0.045	.584	Not Significant	Accept H_0

DISCUSSION

The findings indicate a mismatch between learners' academic performance and their level of statistical competence. Although the respondents obtained outstanding grades in Statistics and Probability, their competence was generally limited to fundamental and computational aspects of statistics. Lower ratings were observed in areas that require analysis, interpretation, and application of statistical concepts. Similar observations have been

reported by Garfield and Ben–Zvi (2007) and Kandeel et al. (2025), who noted that students often perform well in routine calculations but encounter difficulties when asked to explain results, interpret relationships among variables, or apply statistical concepts to real–life situations. This suggests that high grades do not always reflect a strong understanding of statistical reasoning.

The results may be explained by the nature of classroom learning experiences. According to Piaget (1970) and Vygotsky (1978), learning becomes more meaningful when students actively construct knowledge through engagement, inquiry, and interaction with authentic tasks. When instruction focuses primarily on procedures and correct answers, learners may become proficient in computation but may not fully develop the ability to analyze, interpret, and use statistical information critically. As a result, students may perform well in examinations yet experience difficulties when conducting research, interpreting data, or making evidence–based decisions. This is particularly important because statistical literacy has become an essential skill in higher education, employment, and everyday life.

The significant relationship between student–related factors and statistical competence highlights the important role of learners themselves in the development of statistical understanding. Students who are motivated, actively engaged in learning activities, and willing to seek information appear more likely to develop stronger statistical competence. This finding supports earlier studies emphasizing the influence of learner attitudes, engagement, and self–directed learning on academic achievement (Ashaari et al. 2011; Moussa, 2023). The result suggests that improving statistical competence may require more than providing instructional resources; it also requires creating learning environments that encourage participation, curiosity, and responsibility for learning. Activities that involve investigation, collaboration, and problem–solving may help learners become more engaged with statistical concepts and improve their ability to apply what they have learned.

In contrast, teacher–related and parent–related factors did not show significant relationships with statistical competence. Although teachers and parents provide important academic support, learners ultimately determine how such support is translated into learning outcomes through their motivation, engagement, and self–regulatory behaviors. Previous studies have shown that student attitudes, self–efficacy, and active participation play a crucial role in academic achievement and skill development (Ashaari et al. 2011; Moussa 2023). Likewise, parental involvement contributes to learning opportunities, but its effects may vary depending on learners' responsiveness and engagement with academic tasks (Naungayan et al. 2024). These findings suggest that interventions aimed at improving statistical competence should complement support systems with strategies that strengthen learner engagement and independent learning.

The significant relationship between strand and statistical competence further suggests that variations in curricular exposure may contribute to differences in learners' statistical skills. Learners in strands that emphasize research, quantitative analysis, and problem–solving are likely to encounter more opportunities to apply statistical concepts in authentic contexts, thereby strengthening their understanding and confidence in using statistical tools. Previous studies have shown that meaningful learning experiences and opportunities for practical application contribute to the development of higher–order thinking and statistical competence (Piaget 1970; Vygotsky 1978; Kadusale et al. 2024). Similarly, educational experiences and learning environments have been found to shape learners' academic development and preparedness for analytical tasks (Perez et al. 2021). Consequently, providing equitable opportunities for data–driven learning across all strands may help promote stronger statistical competence among senior high school learners.

Overall, the findings show that strong academic performance alone does not guarantee a corresponding level of statistical competence. While learners generally perform well in Statistics and Probability, difficulties remain in competencies that require deeper understanding and application. Strengthening statistical competence therefore requires learning experiences that go beyond memorization and routine procedures. Greater emphasis on inquiry–based activities, real–world data analysis, and research–oriented tasks may help learners develop the analytical skills needed to interpret information, solve problems, and make informed decisions in an increasingly data–driven world.

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GENERATIVE AI STATEMENT

ChatGPT and other generative AI tools were not used to generate research data, conduct analyses, interpret findings, or draw conclusions. Such tools may have been used only for language editing and improving the clarity of the manuscript. The authors take full responsibility for the content of this paper.

ETHICAL CONSIDERATIONS

In this study, the researchers further explained to the respondents the purpose of the study, the confidentiality procedures and requested their signatures of consent. Responses were anonymized and assigned identification codes. Data were securely stored in a password–protected device accessible only to the researchers. The researchers ensured that no deception was involved in the conduct of the study.

DECLARATION OF COMPETING INTEREST

The author declares no competing interests.

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Property Inventory and Disposal Management of Western Philippines University Aborlan, Palawan

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ABSTRACT

This study examined the property inventory and disposal management of Western Philippines University. Specifically, the study aimed to determine the respondent demographic profile and identify the level of awareness of the respondents in terms of inventory and disposal management. Determine the problems encountered by the respondents. Identify which of the demographic profile of respondent have significant relationship with inventory awareness and also identify which of the demographic profile of the respondent have significant relationship with disposal awareness. A descriptive–correlational research design was employed, involving 180 respondents selected through simple random sampling. Data were collected using a structured questionnaire and analyzed using frequency, percentage, mean, and correlational analysis. Findings revealed that respondents were mostly mid–career, highly educated, and permanent employees of WPU. The respondents demonstrated high awareness of inventory and disposal management practices. However, several operational problems were identified, including untrained personnel handling equipment, improper maintenance, and inadequate storage practices. Correlation analysis indicated that technical training, job position, and sex had significant relationships with inventory awareness, while technical training alone showed a significant relationship with disposal awareness. Strengthening technical training programs, implementing integrated inventory management systems, adopting demand forecasting techniques, and enhancing monitoring and auditing mechanisms are recommended to further improve inventory and disposal management.

Keywords: accountability, asset tagging, inventory custodian slip, property acknowledgment receipt

INTRODUCTION

Supply and property management is an essential component of organizational efficiency, ensuring the proper acquisition, utilization, maintenance, and disposal of resources (Department of Environment and Natural Resources 2018). Effective management of supplies and assets contributes to operational efficiency, cost reduction, and sustainability. Many institutions have adopted digital inventory systems, automated tracking, and integrated management platforms to enhance transparency and accountability (Internal Organization for Standardization 2015). Studies have shown that well–managed inventory systems contribute to operational efficiency, transparency, and accountability through improved monitoring and control or organizational assets (Jonsson and Mattsson 2008; Rajeev 2008).

Moreover, global trends in supply and property management emphasize sustainable procurement, lifecycle asset management, and digital inventory systems to ensure the efficient and responsible utilization of resources throughout their useful life. Educational institutions are increasingly recognizing the need for robust inventory systems to manage resources, optimize operational costs, and ensure that facilities and learning materials are available, maintained, and properly accounted for (Gonçalves 2020; Ballestero–Alvarez 2019). Proper supply and property management directly supports Sustainable Development Goal 4 (SDG 4) of the United Nations ensuring "inclusive and equitable quality education" by helping institutions allocate and maximize resources efficiently (UNESCO, 2017). Schools and universities worldwide use inventory systems not only for asset management but also to uphold transparency, accountability, and sustainability, crucial principles in public sector governance. Organizations are increasingly adopting integrated management systems that promote transparency, accountability and sustainability in resource management (Büyüközkan and Göçer 2018; Hardgrave et al. 2011). Studies have further shown that ineffective inventory and asset management practices result in excess carrying costs, stock shortages, resource wastage, financial losses, and operational disruptions, underscoring the importance of robust and standardized management systems (Jonsson and Mattsson 2008: Rajeev 2008).

In the Philippines, supply and property management in government institutions is guided by Republic Act No. 9184 and Presidential Decree No. 1445 to ensure accountability and transparency in the use of public resources. The importance of supply and property management is further emphasized by national goals for development and governance. The government's vision, outlined in AmBisyon Natin 2040, highlights the aspiration for a "matatag, maginhawa, at panatag na buhay" (stable, comfortable, and secure life) for all Filipinos (National Economic and Development Authority, 2016). Efficient management of institutional resources, such as through sound inventory practices, supports this vision by ensuring that public services including education

are effectively delivered. Furthermore, the Philippine Development Plan 2023– 2028 calls for modernization and digital transformation in public sector operations, specifically encouraging government agencies, including educational institutions, to adopt digital systems that promote efficiency, transparency, and accountability (NEDA, 2023). According to the study of Gumilao (2024) which explored the shift from manual to automated inventory systems for the Department of Education Regional Office IX. The study found that computerized systems enabled accurate, real– time data processing, streamlined asset tracking, and improved decision–making efficiency, directly enhancing resource allocation and operational efficiency and also According to Odasco & Saong (2023) investigated the University of Baguio's Requisition, Procurement, and Inventory System (UBRPIS). Their findings suggest that an effective inventory setup enables better understanding of shortages or surpluses, thus promoting more responsive resource utilization and supporting stakeholder needs. Efficient inventory–taking remains critical in ensuring the integrity of property custodianship and accurate accounting and reporting (Republic of the Philippines 1978). In the public sector, property management serve as important mechanisms for ensuring accountability, transparency, and efficient utilization of government resources. Effective inventory practices support accurate reporting, asset safeguarding, and compliance with national regulations governing public property management (Parilla et al. 2022).

Locally, institutions like Sorsogon State University (SorSU) are tasked with optimizing their supply and property management system to support these national strategies and institutional goals. Educational institutions that fail to manage their assets efficiently face risk such as wastage, loss of public funds and service delivery bottlernecks. Digital supply and property management systems are critical tools not only for internal management but also for enhancing institutional credibility and performance. Moreover, the ease of doing business and efficient Government Service Delivery Act of 2018 (Republic Act 11032) mandates streamlined processes and efficient public service delivery. Under this law, educational institutions are encouraged to automate operations including supply and property management to ensure faster transactions, fewer delays, and improved service satisfaction. Implementing a wellorganized supply and property management system aligns with the Acts objectives by reducing administrative burdens, preventing inefficiencies and promoting data–driven decision making.

At Western Philippines University (WPU), the Supply and Property Management Office (SPMO) is responsible for the procurement, storage, distribution, and safeguarding of supplies, materials, and equipment across campuses and offices. The office also supports institutional accountability through inventory–taking procedures conducted with representatives from the Accounting Office and Internal Audit Office (Republic of the Philippines 1978). Additionally, similar offices in educational and public institutions are responsible for ensuring effective stewardship of government assets through proper procurement, storage, distribution, and inventory monitoring. Effective property management systems contribute to improved accountability and institutional performance (Roque and De Guzman 2020).

The university has adopted quality management standards through ISO 9001:2015 certification and implemented a Supply and Asset Management System to improve record–keeping, monitoring, and operational efficiency. Despite these initiatives, there remains a need to assess the effectiveness of current supply and property management practices and identify areas for improvement (Internal Organization for Standardization 2015). Previous studies have demonstrated that the adoption of quality management systems and digital inventory technologies enhances inventory accuracy, monitoring efficiency, and decision–making processes (Legaspi 2022: Hardgrave et al. 2011).

Despite advancements in inventory systems and quality management initiatives, studies continue to report challenges related to inventory accuracy, asset tracking, record reconcillation, and disposal management in public institutions (Jonsson and Mattsson 2008: Almanzor 2025). Regular assessment of supply and property management practices is therefore necessary to identify operational gaps and develop strategies that enhance accountability, efficiency, and sustainability in resource utilization.

Specifically, the study aimed to determine the respondent demographic profile and identify the level of awareness of the respondents in terms of inventory and disposal management. Determine the problems encountered by the respondents. Identify which of the demographic profile of respondent have significant relationship with inventory awareness and also Identify which of the demographic profile of the respondent have significant relationship with disposal awareness.

METHODS

Research Design

This study employed a descriptive–correlational research design, which was appropriate as it involves a fact–finding process that identifies research questions best answered through a survey. It is descriptive because its primary concern is to determine the level of inventory and disposal awareness among WPU personnel. At the

same time, it is correlational since it seeks to establish whether two or more variables are related, and if so, in what manner. Specifically, the study aims to examine the relationship between inventory level and disposal awareness, and whether these variables are associated when grouped according to age, educational attainment, years of service, relevant training attended, and monthly salary.

Respondents of the Study

The respondents of this study were regular employees of Western Philippines University (WPU) who were holders of Property Acknowledgment Receipts (PAR) and Inventory Custodian Slips (ICS). Out of approximately 380 employees, 180 respondents participated in the study through simple random sampling.

To determine the minimum sample size, Slovin's Formula was applied, as recommended in *Elementary Statistics: A Modern Approach* by Altares et al. (2003), published by Rex Book Store in Manila, Philippines. This text is widely used in Philippine academic research as a reference for basic statistical methods, including Slovin's formula for sample size determination. Based on the formula, the target number of respondents was 194. However, only 180 WPU regular employees were able to respond, which still represents a sufficient proportion of the population for meaningful statistical analysis.

Locale of the Study

The study was conducted at the Western Philippines University in Aborlan, Palawan (Figure 2) covering the WPU Compound. Western Philippines University is a state higher education institution. The university began as the Aborlan Farm settlement for the Tagbanuas (an indigenous cultural community of Palawan.) in 1910.

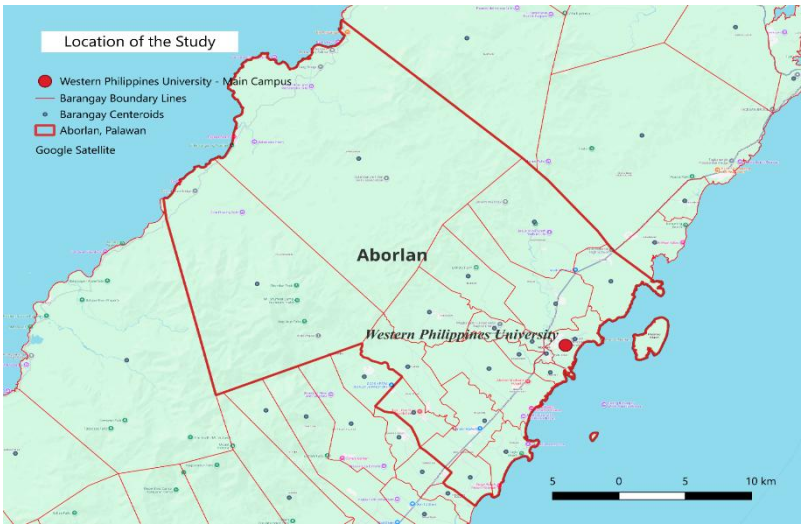

Figure 2. A map of Aborlan, Palawan, showing the study locale.

Research Instrument

A survey questionnaire was used in data gathering. The instrument consisted of four parts: demographic profile, level of inventory awareness, level of disposal awareness, and problems encountered in inventory and disposal management (Table 1).

Table 1. Rating parameter for the level of awareness.

Scale	Range Interval	Verbal Interpretation
5	4.51 – 5.00	Very Highly Aware (VHA)
4	3.51 – 4.50	Highly Aware (HA)
3	2.51 – 3.50	Moderately Aware (MA)
2	1.51 – 2.50	Fairly Aware (FA)
1	1.01 1.50	Low Awareness (LA)

Data Collection Procedure

The researcher made a formal approval to conduct the study through a formal communication addressed to SUC President of Western Philippines University following the approval of the request, the researcher proceeded to obtain consent from the respective regular employees from the staff of offices and faculty of the colleges. The survey questionnaires were distributed to respondents through Google Form links and QR codes, while others were collected manually. Respondents were provided with sufficient time to answer, review, and complete the questionnaires to ensure accuracy and reliability of responses.

Data Analysis

The gathered data were analyzed using frequency counts**,** percentages**,** weighted mean, and correlation analysis. Frequency counts and percentages were employed to describe the distribution of responses and demographic characteristics of the participants. Weighted mean was used to determine the overall level of inventory and disposal awareness among WPU personnel. Finally, correlation analysis was applied to examine the relationship between inventory level and disposal awareness, as well as to test whether these variables were significantly associated when grouped according to age, educational attainment, years of service, relevant training attended, and monthly salary.

RESULTS

Demographic Profile of the Respondents

The findings revealed that most respondents belonged to the 41–46 age bracket (28.89%), followed by respondents aged 29–34 (18.89%). Most respondents were married (72.22%) and female (56.11%). In terms of educational attainment, most respondents held postgraduate degrees (66.11%), followed by college graduates (30.56%). Faculty members comprised the largest group of respondents (68.89%), followed by staff (27.78%) and administrators (3.33%). Most respondents had served for 6–10 years (23.89%), while the majority earned 50,000 pesos and below (75.00%). Regarding training, most respondents had managerial and technical training (Table 2).

Table 2. Demographic Profile of the Respondents.

Profile		**F (n=180)**	**%**
Age			
	59–64	12	6.67
	53–58	27	15.00
	47–52	25	13.89
	41–46	52	28.89
	35–40	23	12.78
	29–34	34	18.89
	23–28	7	3.89
Civil Status			0.00
	Single	36	20.00
	Married	130	72.22
	Widow/Widower	11	6.11
	Separated	1	0.56
	Cohabiting	2	1.11
Sex			0.00
	Male	79	43.89
	Female	101	56.11
Educational Attainment			0.00
	High School Level	1	0.56
	College Level	4	2.22
	College Graduate	55	30.56
	Post–Graduate	119	66.11
	Others	1	0.56
Job Position			0.00
	Faculty	124	68.89
	Staff	50	27.78
	Administrator	6	3.33
Number of years in service			0.00
	1 t 5 years	24	13.33
	6 to 10 years	43	23.89
	11 to 15 years	32	17.78
	16 to 20 years	26	14.44
	21 to 25 years	17	9.44
	26 to 30 years	5	2.78
	31 to 35 years	16	8.89
	36 to 40 years	13	7.22
	41 years and above	4	2.22
Monthly Salary			0.00
	50,000 and below	135	75.00
	60,000 – 70,000	10	5.56
	71,000 – 80,000	7	3.89

	81,000 – 90,000	15	8.33
	91,000 – 100,000	6	3.33
	100,000 and above	7	3.89
Relevant Trainings			0.00
Managerial	1	159	88.33
	2	21	11.67
Technical	1	50	27.78
	2	130	72.22

Level of Inventory Awareness

The findings indicate that respondents demonstrated a high level of inventory awareness, with an overall weighted mean of 3.74 interpreted as "Highly Aware." The highest–rated indicator was the visual inspection of materials for signs of damage, destruction, expiration, obsolescence, and irreparable conditions during physical inventory counts (4.14). Respondents were also highly aware of regular inventory counts (4.03) and quality–control inspections conducted by the Technical Inspection Committee (3.99). Moderate awareness was observed in system–based functions such as expiration–date tracking systems (3.42) and identifying materials for disposal through inventory management software (3.38) (Table 3).

Table 3. Level of inventory and disposal awareness (Very Highly Aware (VHA) – 4.51–5.00, Highly Aware (HA) – 3.51–4.50, Moderately Aware (MA) – 2.51–3.50, Fairly Aware (FA) – 1.51–2.50**,** and Low Awareness (LA) – 1.01–1.50).

A. Level on Inventory Awareness	**Mean**	**Descriptive Rating**
The University personnel used inventory management software to track and monitor their inventory in real time.	3.57	Highly Aware
Utilized inventory management software systems often include features such as bar code scanning, RFID technology, and batch tracking.	3.57	Highly Aware
Utilizing inventory management software enables suppliers to quickly identify materials that meet specific disposal criteria, such as expiration dates or damaged status.	3.38	Moderately Aware
Conducted regular/annual physical inventory counts to reconcile the quantities of equipment on hand with the quantities recorded as per card in their inventory management systems.	4.03	Highly Aware
During those physical inventory counts, employees visually inspect materials for signs of damage, destruction, expiration, obsolescence, irreparable conditions, or any items that need to be disposed of.	4.14	Highly Aware
Equipment classified as unserviceable may be scrutinized more closely for disposal.	3.91	Highly Aware
For perishable or time–sensitive items, we may implement expiration date tracking systems to ensure that expired items are promptly identified and disposed of before they become unusable.	3.51	Highly Aware
This expiration date tracking system may involve setting up alerts or reminders in inventory management software to notify staff when materials are nearing their expiration dates.	3.42	Moderately Aware
WPU Technical Inspection personnel and the Inspection Committee conducted routine quality control inspections of incoming materials and finished products.	3.99	Highly Aware
Weighted Mean	**3.74**	**Highly Aware**
B. Level on Disposal Awareness	**Mean**	**Descriptive Rating**
During these inspections, supplies and materials that fail to meet quality standards may be identified for rejection or not accepted.	3.87	Highly Aware
Quality control teams play a crucial role in identifying materials that pose quality or safety risks and in disposing of them accordingly.	4.06	Highly Aware
WPU Personnel maintain open communication channels with their suppliers to stay informed about any recalls, product changes, or quality issues that may affect the materials they have received.	4.01	Highly Aware
University suppliers may provide notifications about materials that need to be disposed of due to defects or regulatory issues.	3.57	Highly Aware
WPU Personnel use demand forecasting techniques to predict future sales and production needs.	3.48	Moderately Aware
By accurately forecasting demand, they can adjust their inventory levels, accordingly, reducing the likelihood of excess materials needing to be disposed of.	3.50	Moderately Aware

Supplies, Materials, and Equipment have a prescribed estimated useful life and must be disposed of when they expire to maintain product quality and safety.	3.94	Highly Aware
Supplies, Materials & Equipment may become obsolete due to changes in technology, consumer preferences, or regulations.	4.03	Highly Aware
Suppliers/ Manufacturers may dispose of old stock that is no longer in demand or compliant with current standards.	3.74	Highly Aware
Damaged or defective products may not meet quality standards or be safe for use. Manufacturers should dispose of such items to prevent them from reaching consumers and causing harm or negative brand perception.	3.75	Highly Aware
Suppliers /Manufacturers may have excess inventory due to overproduction, changes in demand forecasts, or canceled orders. Disposing of surplus stock helps free up warehouse space and reduces carrying costs.	3.57	Highly Aware
Suppliers/Manufacturers must comply with regulations regarding the disposal of hazardous materials, electronic waste, or other regulated substances. Failure to adhere to these regulations can result in fines or legal consequences.	3.90	Highly Aware
Keeping unserviceable items in inventory incurs storage costs, including rent, utilities, and labor. Manufacturers may weigh the cost of holding onto outdated inventory against the potential benefits of selling or disposing of it.	3.83	Highly Aware
Limited warehouse space may necessitate disposing of unserviceable equipment to make room for new inventory.	3.99	Highly Aware
Weighted Mean	**3.80**	**Highly Aware**

Level of Disposal Awareness

The result shows that respondents also demonstrated a high level of disposal awareness, with an overall weighted mean of 3.80 interpreted as "Highly Aware." The highest–rated indicators included the role of quality control teams in identifying materials that pose safety risks (4.06), awareness that supplies and equipment become obsolete due to technological changes (4.03), and communication with suppliers regarding recalls and quality issues (4.01). Respondents also showed awareness of disposal procedures related to warehouse space limitations, equipment life span, and compliance with disposal regulations. However, lower awareness was observed in demand forecasting techniques (3.48) and adjusting inventory levels based on projected demand (3.50) (Table 3).

Problems Encountered in Inventory and Disposal

The findings revealed that respondents agreed that several operational problems occur in inventory and disposal management. The highest–rated problems included untrained personnel operating equipment (3.62), failure to replace worn parts when needed (3.58), improper equipment storage (3.57), improper maintenance (3.53), and poor electrical connections (3.52). Other problems included ignoring warning signals, failure to read manuals, overrunning machine capability, improper weather–related use, and component misalignment. The overall weighted mean of 3.45 indicated that respondents moderately agreed that these problems occur within the university (Table 4).

Table 4. Problems encountered in inventory and disposal (Strongly Agree – 4.51–5.00, Agree – 3.51–4.50, Moderately Agree – 2.51–3.50, Disagree – 1.51–2.50, Strongly Disagree – 1.01–1.50).

Problems Encountered	**Mean**	**Descriptive Rating**
Untrained Personnel Operating Equipment	3.62	Agree
Not Replacing Worn Parts When Needed	3.58	Agree
Improper Equipment Storage	3.57	Agree
Improper Maintenance	3.53	Agree
Poor Electrical Connections	3.52	Agree
Ignoring Warning Signals	3.38	Agree
Failure To Read the Owner's Manual	3.36	Moderately Agree
Overrunning The Machine's Capability	3.35	Moderately Agree
Improper Weather–Related Use	3.32	Moderately Agree
Component Misalignment	3.24	Moderately Agree
Weighted Mean	**3.45**	**Moderately Agree**

Relationship Between Demographic Profile and Inventory Awareness

The findings revealed that sex, job position, and technical training had significant relationships with inventory awareness. Sex showed a highly significant relationship with inventory awareness ($r = –0.263$, $p = 0.000$), while technical training demonstrated a highly significant positive relationship ($r = 0.219$, $p = 0.003$). Job position also showed a significant relationship with inventory awareness ($r = 0.154$, $p = 0.038$). On the other hand, age, civil status, educational attainment, years in service, monthly salary, and managerial training showed no significant relationship with inventory awareness (Table 5).

Table 5. Relationship between demographic profile and inventory awareness (Not Significant – p > 0.05, Significant – p ≤ 0.05, Highly Significant – p ≤ 0.01).

Level of Inventory Awareness			
Demogfraphic Profile	**Comp Value**	**p–value**	Remarks
Age	0.002	0.978	Not significant
Civil Status	–0.135	0.072	Not significant
Sex	–0.263**	0.000	**Highly significant**
Highest Educational Attainment	–0.113	0.131	Not significant
Job Position	0.154*	0.038	**Significant**
Number of Years in Service	–0.088	0.239	Not significant
Monthly Salary	–0.132	0.077	Not significant
Training on Managerial Skills	0.004	0.959	Not significant
Training on Technical Skills	.219**	0.003	**Highly significant**

Relationship Between Demographic Profile and Dsiposal Awareness

The findings revealed that technical training demonstrated a highly significant positive relationship with disposal awareness (r = 0.283, p = 0.000). Other demographic variables such as age, civil status, sex, educational attainment, job position, years in service, monthly salary, and managerial training showed no significant relationship with disposal awareness (Table 6).

Table 6. Relationship between demographic profile and disposal awareness (Not Significant – p > 0.05, Significant – p ≤ 0.05, Highly Significant – p ≤ 0.01).

Level of Disposal Awareness			
Demographic Profile	**Comp Value**	**p–value**	**Remarks**
Age	–0.045	0.549	Not significant
Civil Status	–0.120	0.107	Not significant
Sex	–0.104	0.164	Not significant
Highest Educational Attainment	0.072	0.339	Not significant
Job Position	0.115	0.124	Not significant
Number of Years in Service	–0.062	0.412	Not significant
Monthly Salary	–0.039	0.602	Not significant
Training on Managerial Skills	–0.041	0.585	Not significant
Training on Technical Skills	0.283**	0.000	**Highly significant**

DISCUSSION

Demographic Profile of the Respondents

The demographic profile suggests that the university workforce is composed largely of mid–career, highly educated, and permanently employed personnel. This combination indicates a relatively stable and experienced organizational environment. Such stability is important because it creates favorable conditions for the consistent implementation of institutional policies, including inventory and disposal procedures. Previous studies have shown that employee experience and workforce stability contribute to improved organizational performance, planning effectiveness, and procedural compliance because experienced personnel possess a better understanding of organizational systems and operational requirements (Ng and Feldman 2010, Jonsson and Mattsson 2008).

Moreover, high educational attainment implies that employees possess strong analytical and cognitive skills, which likely facilitate understanding of procedural guidelines, compliance standards, and technical processes relevant to inventory and disposal management (Pfeffer 1998). Similarly, Legaspi (2022) reported that effective implementation of inventory management systems requires personnel who can understand inventory processes, utilize information systems, and maintain accurate records.

Additionally, the predominance of married respondents and stable employment status may positively influence employees' sense of responsibility, diligence, and organizational commitment, as family–oriented employees and permanent staff often exhibit higher adherence to policies and greater motivation to perform assigned tasks effectively (Meyer et al. 2002). In public institutions, employee commitment and accountability are essential for maintaining accurate inventory records, safeguarding assets, and ensuring compliance with government regulations governing property management (Parilla et al. 2022).

Organizational stability and employee experience are often associated with improved work performance and institutional effectiveness (Robbins and Judge 2017). While workforce stability, educational attainment, and employee experience are generally associated with improved organizational performance, these characteristics

alone may not guarantee effective inventory and disposal management practices. Studies have shown that inventory performance depends not only on employee qualifications but also on the effectiveness of inventory systems, organizational support, continuous training, and monitoring mechanisms (Rajeev 2008, Muckstadt and Sapra 2010). This implies that institutional performance in inventory management may depend more on system efficiency, training, and enforcement mechanisms rather than solely on employee qualifications or tenure.

Level of Inventory Awareness

The findings indicate that respondents demonstrate a generally high level of awareness of inventory management practices, particularly in routine and observable activities such as visual inspection, physical inventory counts, and quality control procedures. The highest–rated indicators, inspection of materials and regular inventory reconciliation, suggest that employees are highly familiar with procedural and compliance–based tasks that are consistently performed within the university. These activities are often embedded in daily or periodic operations, which reinforces familiarity and strengthens awareness through repeated practice (Chopra and Meindl 2016). This observation is consistent with the findings of Jonsson and Mattsson (2008), who reported that organizations with established inventory management practices tend to exhibit stronger planning performance and greater employee familiarity with inventory–related processes. Similarly, Parilla et al. (2022) found that regular inventory monitoring and control procedures contribute to improved operational effectiveness and accountability in public institutions.

However, slightly lower mean scores in areas such as expiration–date tracking, automated alert systems, and supplier–linked identification processes indicate a gap in system–based and technology–driven aspects of inventory management. This suggest that respondents are more accustomed to manual and observable procedures than to advanced inventory management systems that rely on automation and data integration. A possible explanation is that some advanced functions in technological features may not be fully implemented or widely utilized across all units of the university. As a result, employees may have limited exposure to some technological tools, leading to moderate rather than high awareness. This aligns with the idea that familiarity with technological systems is largely dependent on actual usage and training, rather than theoretical knowledge alone (Waters 1992). Previous studies have also shown that the successful adoption of inventory technologies depends largely on employee exposure, training, and actual system utilization. Legaspi (2022) reported that inventory management systems improve inventory accuracy and operational efficiency only when personnel are adequately trained and actively engaged in system use. Likewise, Hardgrave et al. (2011) found that technology–based inventory systems enhance inventory visibility and control but require user familiarity and organizational support to maximize their effectiveness.

The findings suggest that respondents are more familiar with routine and observable inventory procedures than with advanced technology–based inventory systems. This pattern is consistent with studies indicating that organizations often achieve higher competency in routine inventory activities than in technology–intensive inventory processes, particularly when system implementation and training opportunities are limited (Muckstadt and Sapra 2010, Rajeev 2008). Therefore, while awareness of manual inventory procedures appears satisfactory, there remains a need to strengthen employee competencies in automated inventory monitoring, predictive inventory management, and digital inventory systems through continuous training and system enhancement activities.

Level of Disposal Awareness

The findings indicate that respondents demonstrate a high level of awareness of inventory disposal practices, particularly in areas related to quality control, obsolescence, and regulatory compliance. The highest–rated indicators, such as the role of quality control teams, recognition of safety risks, and awareness of product obsolescence, suggest that employees are highly conscious of the critical function of disposal in maintaining quality standards and operational safety. These aspects are often emphasized in institutional policies and are directly linked to risk management, which likely explains their high level of awareness (Chopra and Meindl 2016). Proper disposal practices help prevent the accumulation of unusable assets, reduce operational risks, and ensure compliance with established regulations. This finding is consistent with the observations of Muckstadt and Sapra (2010), who emphasized that effective inventory management extends beyond acquisition and storage to include the proper disposition of obsolete, damanged, and excess inventory. Similarly, Parilla et al. (2022) highlighted the importance of inventory control procedures in promoting accountability, resource optimization, and compliance within public institutions.

However, slightly lower awareness in areas such a demand forecasting, adjustment of inventory levels, and predictive disposal decisions reveals a gap in strategic and forward–looking aspects of disposal management. While respondents are knowledgeable about identifying and removing unserviceable items, they appear less familiar with anticipating disposal needs based on projected demand and inventory trends. A possible explanation is that some technological tools are either not fully implemented in the institution or are handled by a limited number of specialized personnel. This also supports the idea that awareness alone is insufficient without

technological integration and proper training, as effective inventory systems rely on both human and technological capabilities (Waters 1992). Previous studies have also shown that effective inventory and asset management increasingly rely on information systems, forecasting tools, and integrated technologies that support decision–making processes (Jonsson and Mattsson 2008). Likewise, Legaspi (2022) found that technology–enabled inventory systems enhance monitoring, forecasting, and inventory control; however, their effectiveness depends on user competence, training, and actual system utilization.

The findings imply that while employees are capable of handling disposal procedures from a compliance standpoint, there is a need to improve competencies in data–driven and technology–based disposal management systems. This observation supports the view that organizational effectiveness in inventory disposal depends not only on compliance with established procedures but also on the integration of forecasting, information systems, and continuous employee development (Rajeev 2008, Hardgrave et al. 2011). Therefore, while disposal awareness among respondents appears satisfactory, there remains a need to strengthen competencies in predictive disposal planning, inventory analytics, and technology–assisted asste management to support more proactive and efficient disposal practices.

Problems Encountered in Inventory and Disposal

The findings suggest that although the overall occurrence of problems is rated as "moderately agree," the frequency of issues related to untrained personnel, improper storage, and inadequate maintenance suggests situational lapses rather than systemic deficiencies. According to Mercado (2008), effective inventory management requires proper handling, maintenance, and monitoring of equipment. Likewise, Waters (1992) explained that poor inventory control practices and operational errors can lead to equipment damage, inefficiency, and increased operational cost. Studies have shown that employee training and knowledge significantly affect inventory accuracy, compliance, and overall inventory performance. Legaspi (2022) stated that inventory systems are most effective when personnel possess sufficient training and familiarity with inventory procedures and technologies. Likewise, Parilla et al. (2022) reported that employee competence and adherence to inventory procedures contribute significantly to efficient inventory management and service delivery within public institutions. These findings suggest that inadequate training and limited exposure to inventory management practices may contribute to the operational issues observed among respondents. Additionally, Almanzor (2025) found that challenges in inventory management technology adoption include insufficient training, limited infrastructure, and user resistance, which may hinder effective inventory control and operational efficiency in institutions.

Problems related to improper storage and inadequate maintenance also highlight the importance of established control measures and continuous monitoring. According to Rajeev (2008), ineffective inventory practices may lead to increased operational costs, wastage of resources, inventory losses, and reduced organizational performance. Similarly, Hardgrave et al. (2011) observed that organizations that lack effective monitoring and inventory control mechanisms are more susceptible to inaccuracies, asset deterioration, and inefficiencies. These findings imply that maintaining proper storage conditions, conducting regular inspections, and implementing preventive maintenance programs are critical components of effective inventory management.

Furthermore, the identified problems appear to be more closely associated with implementation and compliance challenges than with the absence of institutional policies. Many identified problems are human factor related, which is a major contributor to operational inefficiencies in organizations (Reason 2000). This observation is supported by Meyer et al. (2002), who emphasized that employee commitment and adherence to organizational procedures influence operational effectiveness and policy compliance. Therefore, the findings suggest that strengthening employee training, enhancing monitoring mechanisms, and reinforcing compliance with standard operating procedures may help minimize inventory and disposal–related problems within the university.

Relationship Between Demographic Profile and Inventory Awareness

The findings suggest that specific work–related factors, particularly job position and technical training, play a more significant role in shaping inventory awareness than personal demographic characteristics. The significant relationship between technical training and inventory awareness indicates that competencies related to inventory management are primarily developed through structured learning opportunities and practical exposure rather than demographic characteristics alone. Employees occupying positions directly involved in inventory–related functions are more likely to acquire greater familiarity with inventory procedures due to their routine engagement with inventory monitoring, record–keeping, and control activities. Jonsson and Mattsson (2008) emphasized that effective inventory management practices depend largely on employee understanding of inventory processes and their active participation in planning and control activities.

The findings further demonstrate the importance of technical training in enhancing inventory awareness. Training equips employees with the knowledge and skills necessary to understand inventory procedures, utilize inventory systems, and comply with organizational policies and standards. Previous studies have shown that

employee training contributes significantly to operational performance by improving knowledge acquisition, procedural compliance, and task execution. Aguinis and Kraiger (2009) reported that training and development initiatives positively influence employee knowledge, skills, and organizational effectiveness. Similarly, Legaspi (2022) found that successful implementation of inventory management systems depends on personnel competence, familiarity with inventory processes, and continuous training opportunities.

The significant relationship between job position and inventory awareness may be attributed to differences in role responsibilities and levels of exposure to inventory–related activities. Employees assigned to positions that require direct involvement in inventory management are more likely to develop practical knowledge and awareness through regular application of inventory procedures. This observation is consistent with the findings of Parilla et al. (2022), who reported that personnel actively engaged in inventory–related functions demonstrated better understanding of inventory control practices and compliance requirements.

Therefore, the findings suggest that technical training and job position serve as important mechanisms in transforming general awareness into functional and operational competence. While demographic characteristics may provide contextual information about employees, inventory awareness appears to be more strongly influenced by opportunities for training, role exposure, and active participation in inventory management processes. This supports the view that organizations can enhance inventory awareness and operational effectiveness through continuous capacity–building programs and targeted training interventions (Aguinis and Kraiger 2009, Rajeev 2008).

Relationship Between Demographic Profile and Disposal Awareness

The findings indicate that technical training demonstrates a highly significant relationship with disposal awareness. The absence of significant relationships between disposal awareness and other demographic variables such as age, civil status, sex, educational attainment, job position, years of service, monthly salary, and managerial training further suggests that disposal awareness is primarily influenced by structured learning and targeted capacity–building rather than demographic characteristics or tenure alone. This implies that experience or length of service does not automatically translate into competence in disposal management unless reinforced through formal training interventions. Similar findings were reported by Govindan et al. (2015), who emphasized that effective reverse logistics and disposal management require specialized knowledge and organizational support rather than being dependent on employee demographics.

Technical training plays a crucial role in equipping employees with the competencies needed to properly identify obsolete or unserviceable assets, implement correct disposal procedures, and ensure compliance with institutional and regulatory standards. It also strengthens employees' understanding of the risks associated with improper disposal, including environmental hazards, safety concerns, legal liabilities, and financial losses. Krikke et al. (2013) highlighted that successful end–of–life product management relies heavily on employee competence, structured training, and systemized processes to ensure proper recovery and disposal of assets. In addition, Rogers and Tibben–Lembke (1999) emphasized that reverse logistics performance is strongly influenced by organizational capability, employee knowledge, and the presence of formal disposal systems.

Furthermore, studies have shown that training significantly enhances compliance and operational accuracy in disposal and asset management activities. Pagell et al. (2004) found that environmental and operational performance improves when employees are properly trained in sustainable disposal practices and supported by clear organizational procedures. Similarly, Parilla et al. (2022) reported that personnel competency and adherence to established inventory and asset management procedures contribute significantly to accountability and efficiency in public sector institutions.

Overall, the findings demonstrate that technical training is a key determinant of disposal awareness, as it bridges the gap between policy and practice and enables employees to execute disposal procedures in a safe, compliant, and efficient manner. This supports the view that effective disposal management is not merely a function of employee demographics but is largely dependent on structured training programs, organizational systems, and continuous capacity development initiatives (Govindan et al. 2015, Krikke et al. 2013).

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GENERATIVE AI STATEMENT

This study acknowledges the limited and supportive use of Grammarly (Free version) as a grammar and writing assistance tool. The use of Grammarly was strictly confined to language enhancement and structural support, particularly in identifying appropriate academic terminology, spelling correction, grammar refinement, substitution of words, punctuation checking, and readability improvement. It served as a supplementary proofreading aid to ensure linguistic accuracy and consistency.

No sensitive, confidential, or primary research data were input into any AI or writing assistance tools. All outputs generated by Grammarly were carefully reviewed, revised, and validated by the author prior to inclusion in the final manuscript.

It is further emphasized that the research design, methodology, data collection, statistical analysis, interpretation of results, discussion, and conclusions are entirely the original intellectual work of the author. The use of Grammarly was strictly assistive and did not influence the scientific content, findings, or claims of the study. Final responsibility for the accuracy, validity, and integrity of the manuscript rests solely with the author.

ETHICAL CONSIDERATIONS

Ethical considerations were strictly observed throughout the conduct of the study. Participation was voluntary, and informed consent was obtained from all respondents prior to data collection. The researcher ensured confidentiality and anonymity by not collecting personally identifiable information. All responses were treated with utmost confidentiality and were used solely for academic purposes. These measures were implemented to protect the rights, privacy, and welfare of the respondents.

DECLARATION OF COMPETING INTEREST

The author declares that there is no competing interest to any authors.

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Sound Patterns in the Batak Language of Palawan

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ABSTRACT

This study examines the phonological features of the endangered Batak language spoken in Maoyon, Puerto Princesa, Palawan, with particular focus on vowel quality variations, consonant quality variations, and stress pattern variations. Grounded in phonological theory, the research aims to document and analyze the sound system of Batak, which remains underdescribed despite its critical endangerment. A qualitative research design was employed, involving fifteen native Batak speakers selected through purposive stratified sampling. Data were collected through interviews, audio recordings, elicitation tasks, and field observations, and were analyzed using phonetic transcription and thematic analysis. Findings reveal that Batak exhibits a wide range of vowel quality variations, including raising, lowering, fronting, backing, centralization, lengthening, reduction, and diphthong variation, occurring in systematic phonological environments. Consonant quality variations were also observed, particularly in processes such as lenition and palatalization, reflecting both internal phonological rules and external linguistic influences. Additionally, stress pattern variation in Batak includes penultimate, final, monosyllabic, root–based, and variable stress, demonstrating both regularity and flexibility in prosodic structure. The results indicate that Batak phonology reflects both conservative Austronesian features and adaptive changes due to language contact with Tagalog, Cuyonon, and other regional languages. These findings contribute to Batak language documentation and preservation by providing a detailed account of its sound patterns. Furthermore, the study offers valuable implications for language education, orthography development, and revitalization efforts, supporting the sustainability of this endangered linguistic heritage.

Keywords: phonetic transcription; thematic analysis; language revitalization; Austronesian linguistics; prosodic structure

INTRODUCTION

The Batak language of Palawan is widely documented as a critically endangered indigenous language undergoing rapid language shift, characterized by declining intergenerational transmission and increasing influence from dominant regional languages (Tajolosa 2015a, 2015b, 2022). This situation places Batak at risk of further structural erosion, including the potential loss of phonological distinctions embedded in everyday speech. In response to such endangerment, language documentation becomes essential, as it involves the systematic recording of spoken language data to ensure that linguistic features, including sound systems, grammar, and discourse patterns, are preserved for analysis, revitalization, and long–term archiving (Himmelmann 2006; UNESCO 2003; Woodbury 2003).

Language endangerment may lead to the loss of oral traditions, cultural and ecological knowledge, and ethnic and cultural identity, underscoring the importance of language documentation and preservation efforts (UNESCO 2003). Linguistic documentation is particularly crucial for underdescribed languages, as it creates a lasting record of speech forms, sound patterns, and communicative practices that may no longer be transmitted to younger generations (Himmelmann 1998). Centuries of tradition, oral narratives, and cultural knowledge are now at risk of disappearing within a single generation. According to the latest survey of Puerto Princesa City Planning Office as of 2010, only 416 individuals identified as Batak, including those of mixed heritage, were recorded (Tajolosa 2015a). Several sociolinguistic factors, including migration, intermarriage, and the increasing influence of dominant languages, continue to accelerate the decline of Batak, particularly among younger generations (Tajolosa 2015b, 2022). Despite these challenges, Batak identity remains strong, and the language continues to hold a special place in homes, workplaces, and neighborhoods (Tajolosa 2022).

However, the core phonological features of Batak, its sounds, rhythms, and patterns, remain underdocumented. Existing research provides only limited descriptions, focusing primarily on basic vowel and consonant inventories, but missing a richer picture of how the language actually sounds in daily life (Tajolosa 2015b; Zorc 1984). While Proto–Palawan reconstructions outline consonant inventories (Zorc 1984), surface phonological variations, including vowel quality shifts, consonant alternations, and stress patterns, remain largely undescribed, necessitating empirical analysis amid multilingual contact (Tajolosa 2015b; The Katig Collective 2024). Studies on related Batak languages in Indonesia have documented complex phonological processes, uncovering processes such as ablaut reduplication and special rules for combining sounds (Ambarita and Sembiring 2025; Barus et al. 2021). Contemporary studies have yet to comprehensively document the vowel qualities, consonant variations, and stress patterns of Palawan Batak, representing a critical gap given lexical replacement from neighboring languages (Blust 2013; Lobel 2021; Tajolosa 2015b).

Current sociolinguistic conditions further intensify the urgency of documentation. Language shift often occurs when minority language speakers increasingly use dominant regional or national languages in education, public communication, and everyday interaction (Fishman 1991). In this context, documenting Batak phonology is not only a linguistic task but also a contribution to cultural preservation and language revitalization. Tagalog, Cuyonon, and Tagbanua dominate communication in education, governance, and public domains; most Batak adults have not reached Grade 1 in school (Saavedra 2025; Tajolosa 2015b). Younger generations are increasingly multilingual, and Batak is gradually being restricted to private and familial domains. Although the language remains central to Batak identity, its use is shrinking and is now mostly limited to family spaces (Tajolosa 2015b, 2022). Many Batak families face educational challenges, as formal schooling rarely incorporates indigenous linguistic and cultural knowledge, with little traditional knowledge appearing in school lessons, further distancing Batak youth from their heritage (Saavedra 2025).

These conditions highlight the urgent need for systematic linguistic documentation. This study aims to address these gaps by systematically analyzing vowel quality variation, consonant quality variation, and stress pattern variation in Batak speech. By documenting these phonological features, the study aims to support education, contribute to language revitalization efforts, and preserve the Batak language for future generations (Saavedra 2025; Tajolosa 2015b). Through the analysis of vowel quality variations, consonant quality variations, and stress pattern variations in Palawan Batak, the research preserves authentic phonological data for linguistic study, strengthens community revitalization initiatives, and helps safeguard the language's endangered sound system from further erosion. Ultimately, the study seeks to document, analyze, and preserve these phonological features to support language revitalization and future linguistic research.

METHODS

Research Design

This study employed a qualitative–descriptive phonological approach, incorporating elements of phonetic analysis to examine sound patterns in the Batak language. This design is appropriate because phonological fieldwork requires close description of actual speech forms, sound variation, and language–specific patterns that may not be captured through purely numerical analysis (Bowern 2008; Crowley 2007). The study utilized qualitative methods, including interviews and speech elicitation, to collect linguistic data, which were then analyzed through phonetic transcription and phonological analysis (Creswell 2018). Qualitative methods were used to conduct interviews with native speakers to gather speech samples and understand the cultural context of language use. The cultural significance of language practices and their influence on phonology were examined through thematic analysis, narratives, and social contexts, consistent with qualitative approaches in phonological research (Qasim et al. 2025).

Population of the Study

The study involved members of the Batak community in Barangay Maoyon, Puerto Princesa. The total number of respondents in the study was 15 members of the Batak community at Barangay Maoyon, Puerto Princesa City.

Table 1 shows the respondents' gender profile, consisting of 5 males (33.33%) and 10 females (66.67%).

Table 1. Respondents' gender profile

Gender	Respondents
Male	5 (33.33%)
Female	10 (66.67%)

Table 2 shows the respondents' age profile, consisting 6 (40%) of participants ranging 0–17 that belongs to child/adolescent, 7 (47%) 18–59 adults, and 2 (13%) identified as Senior.

Table 2. Respondents' age profile

Age	Respondents
Child/Adolescent (0–17)	6 (40%)
Adult (18–59)	7 (47%)
Senior (60+)	2 (13%)

Table 3 shows that all 15 participants speak Batak as their primary language, with 46.67% speaking only Batak and Tagalog, 20.00% also speaking Cuyonon, 13.33% speaking Batak, Tagalog, Cuyonon, and Tagbanua, another 13.33% speaking Batak, Tagalog, and Tagbanua, and 6.67% speaking Batak, Tagalog, and Bisaya.

Table 3. Language spoken

Language Spoken	Frequency (Percentage)
Batak, Tagalog	7 (46.67%)
Batak, Tagalog, Cuyonon	3 (20.00%)
Batak, Tagalog, Cuyonon, Tagbanua	2 (13.33%)
Batak, Tagalog, Tagbanua	2 (13.33%)
Batak, Tagalog, Bisaya	1 (6.67%)

Table 4 shows that among the fifteen participants, 46.67% completed elementary education, 33.33% reached junior high, and 20.00% reported no formal schooling. Overall, most respondents have some level of formal education, though a minority remain without schooling.

Table 4. Educational attainment

Educational Attainment	Frequency
Elementary (Grades 1–6/Elementary Level)	7 (46.67%)
Junior High (Grades 7–10)	5 (33.33%)
No formal education	3 (20.00%)

Sampling Method

The study employed purposive stratified sampling, with participants selected according to age, gender, and language exposure to ensure representation of linguistic variation within the Batak community. This method helps achieve balanced subgroup representation, reduce selection bias, and strengthen the accuracy of phonological analysis across social groups (Fleetwood 2023).

Instrumentation

The study used multiple instruments for comprehensive data collection, including audio recordings of speech, questionnaires for participant profiles, and elicitation tools like word lists and minimal pairs to gather phonological data. Audio recordings are important in language documentation because they preserve actual speech data for repeated listening, verification, and future analysis (Crowley 2007; Himmelmann 1998). Elicitation tasks such as word lists and minimal pairs also help researchers identify phonemic contrasts and observe how sounds behave in different phonological environments. Field notes, observations, and surveys further provided ethnographic insights and information on language use, attitudes, and the status of Batak.

Data Gathering Procedure

For data gathering, participants were clearly informed about the study's objectives, and consent was secured from both the NCIP and local barangay officials. Researchers conducted interviews to collect demographic details and explore linguistic backgrounds, use patterns, and attitudes related to Batak. All recording activities were performed in quiet environments to ensure data clarity. The administration of questionnaires and elicitation tools allowed systematic collection of relevant information. Observational methods enabled the researchers to document Batak in everyday life and cultural contexts. Collected data was then organized and categorized according to phonological phenomena identified during analysis.

Data Analysis

Data analysis involved phonetic transcription using the International Phonetic Alphabet (IPA) with diacritics to accurately represent speech sounds. The International Phonetic Alphabet was used because it provides a standardized system for representing speech sounds across languages, including fine phonetic details that ordinary spelling systems cannot capture (Vajda 2000; Zimman 2020). This allows researchers to compare sound patterns, identify variation, and describe language–specific features more systematically. Patterns of variation in vowels, consonants, and stress were identified through systematic comparison of recorded tokens and analyzed using phonological principles, including segmental and suprasegmental analysis, to determine recurring sound processes and their environments. Diacritics were used to capture fine phonetic details such as vowel raising, lowering, fronting, backing, centralization, reduction, lenition, fricativization, and palatalization that are not fully represented by basic IPA symbols as shown in Figure 1, Figure 2, and Figure 3. This ensured precise, consistent transcription and aligns with established phonetic conventions for marking secondary articulatory features.

DIACRITICS

◌̥	Voiceless	n̥ d̥	◌̤	Breathy voiced	b̤ a̤	◌̪	Dental	t̪ d̪
◌̬	Voiced	s̬ t̬	◌̰	Creaky voiced	b̰ a̰	◌̺	Apical	t̺ d̺
◌ʰ	Aspirated	tʰ dʰ	◌̼	Linguolabial	t̼ d̼	◌̻	Laminal	t̻ d̻
◌̹	More rounded	ɔ̹	◌ʷ	Labialized	tʷ dʷ	◌̃	Nasalized	ẽ
◌̜	Less rounded	ɔ̜	◌ʲ	Palatalized	tʲ dʲ	◌ⁿ	Nasal release	dⁿ
◌̟	Advanced	u̟	◌ˠ	Velarized	tˠ dˠ	◌ˡ	Lateral release	dˡ
◌̠	Retracted	e̠	◌ˤ	Pharyngealized	tˤ dˤ	◌̚	No audible release	d̚
◌̈	Centralized	ë	~	Velarized or pharyngealized	ɫ			
◌̽	Mid-centralized	e̽	◌̝	Raised	e̝ (ɹ̝ = voiced alveolar fricative)			
◌̩	Syllabic	n̩	◌̞	Lowered	e̞ (β̞ = voiced bilabial approximant)			
◌̯	Non-syllabic	e̯	◌̙	Advanced Tongue Root	e̙			
◌˞	Rhoticity	ɚ a˞	◌̘	Retracted Tongue Root	e̘			

Figure 1. IPA diacritics symbols.

VOWELS

	Front	Central	Back
Close	i • y	ɨ • ʉ	ɯ • u
	ɪ ʏ		ʊ
Close-mid	e • ø	ɘ • ɵ	ɤ • o
		ə	
Open-mid	ɛ • œ	ɜ • ɞ	ʌ • ɔ
	æ	ɐ	
Open	a • ɶ		ɑ • ɒ

Where symbols appear in pairs, the one to the right represents a rounded vowel.

Figure 2. IPA vowels symbols.

CONSONANTS (PULMONIC) © 2015 IPA

	Bilabial	Labiodental	Dental	Alveolar	Postalveolar	Retroflex	Palatal	Velar	Uvular	Pharyngeal	Glottal
Plosive	p b			t d		ʈ ɖ	c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ		n		ɳ	ɲ	ŋ	ɴ		
Trill	ʙ			r					ʀ		
Tap or Flap		ⱱ		ɾ		ɽ					
Fricative	ɸ β	f v	θ ð	s z	ʃ ʒ	ʂ ʐ	ç ʝ	x ɣ	χ ʁ	ħ ʕ	h ɦ
Lateral fricative				ɬ ɮ							
Approximant		ʋ		ɹ		ɻ	j	ɰ			
Lateral approximant				l		ɭ	ʎ	ʟ			

Symbols to the right in a cell are voiced, to the left are voiceless. Shaded areas denote articulations judged impossible.

CONSONANTS (NON-PULMONIC)

Clicks	Voiced implosives	Ejectives
ʘ Bilabial	ɓ Bilabial	’ Examples:
ǀ Dental	ɗ Dental/alveolar	pʼ Bilabial
ǃ (Post)alveolar	ʄ Palatal	tʼ Dental/alveolar
ǂ Palatoalveolar	ɠ Velar	kʼ Velar
ǁ Alveolar lateral	ʛ Uvular	sʼ Alveolar fricative

OTHER SYMBOLS

ʍ Voiceless labial-velar fricative
ɕ ʑ Alveolo-palatal fricatives
w Voiced labial-velar approximant
ɺ Voiced alveolar lateral flap
ɥ Voiced labial-palatal approximant
ʢ ʡ Simultaneous ʃ and x
ʜ Voiceless epiglottal fricative
ʖ Voiced epiglottal fricative
ʡ Epiglottal plosive

Affricates and double articulations

t͡s k͡p

Figure 3. IPA consonants symbols.

RESULTS

Vowel Quality Variations

Vowel quality refers to the articulatory and acoustic properties that distinguish vowel sounds in spoken language. The data reveal that vowel variation is prevalent in Batak speech, particularly through processes such as raising, fronting, lowering, backing, centralization, reduction, lengthening, and diphthong variation. These variations indicate a dynamic phonetic system in Batak, influenced by speaker variation and phonological environment as shown in Table 5. Batak speakers are also exposed to other Philippine languages, which may contribute to language contact effects (Tajolosa 2015a, 2022).

Vowel raising is observed in words such as ina (/ˈɪna/ → [ˈi̝na]) and pito (/piˈtu/ → [pi̝ːˈtu]), where vowels are produced with a higher tongue position in stressed syllables. Fronting occurs in items such as kayo (/kaˈju/ → [kæ̟ˈju]) and magsageb (/magˈsageb/ → [magˈsæ̟gəb]), particularly before /j/ or in medial positions. Lowering is evident in tubu (/tuˈbu/ → [tǫˈbu]), where the vowel is articulated with a lower tongue position in medial syllables.

Backing is observed in baba (/baˈba/ → [bɑ̠ˈbɑ̠]) and trabaho (/trabaˈho/ → [trɑ̠bɑ̠ˈho]), especially in stressed syllables, where vowels are produced with a retracted tongue position. Centralization appears in dələm (/ˈdeləm/ → [ˈdə̈ləm]), while vowel reduction is found in magkasulagı (/magˈkasulagı/ → [magˈkəsulagı]), both occurring in unstressed syllables. Lengthening is evident in dose (/doˈsı/ → [doːˈsıː]), where vowel duration is extended in stressed positions. Diphthong variation is observed in pagbalaygo (/pagbaˈlaıgo/), which is realized as [pagbaˈla͡i̯go] and [pagbaˈla͡e̯go] in different speech contexts.

Table 5. Vowel quality variations

Vowel Quality Variation	Example Words	Underlying Forms	Surface Forms	Phonological Environment
Raising	ina, pito	/ˈɪna/, /piˈtu/	[ˈi̝na], [pi̝ːˈtu]	Stressed syllables
Fronting	kayo, magsageb	/kaˈju/, /magˈsageb/	[kæ̟ˈju], [magˈsæ̟gəb]	Before /j/, medial position
Lowering	tubu	/tuˈbu/	[tǫˈbu]	Medial syllable
Backing	baba, trabaho	/baˈba/, /trabaˈho/	[bɑ̠ˈbɑ̠], [trɑ̠bɑ̠ˈho]	Stressed syllables
Centralization	dələm	/ˈdeləm/	[ˈdə̈ləm]	Unstressed syllable
Reduction	magkasulagı	/magˈkasulagı/	[magˈkəsulagɪ]	Unstressed syllable
Lengthening	dose	/doˈsı/	[doːˈsɪː]	Stressed syllables
Diphthong Variation	pagbalaygo	/pagbaˈlaıgo/	[pagbaˈla͡i̯go], [pagbaˈla͡e̯go]	Stressed and casual speech

Overall, the analysis identified eight types of vowel quality variation in Batak, each occurring in specific phonological environments. These results show that vowel variation occurs across both stressed and unstressed syllables, as well as in medial, final, and coarticulatory contexts, reflecting a highly dynamic and context–sensitive vowel system.

Consonant Quality Variations

Through the examination of the Batak corpus, specific consonant quality variations were identified and organized into three primary categories: stop lenition, stop secondary palatalization, and glide secondary palatalization. Rather than imposing a rigid structure, this classification highlights language–specific adaptations that reflect Batak's phonotactic constraints and phonological processes as shown in Table 6.

Stop lenition is observed in words such as tubu (/ˈtu.bo/ → [tʊ.ˈt̄bo]), tug (/ˈtug/ → [ˈtʊg̃]), taro (/ˈta.ro/ → [ˈt̄a.rʊ]), pito (/ˈpi.tu/ → [pɪ.ˈt̄ʊ]), binit (/bɪˈnit/ → [bɪˈnɪt̄]), and batu (/ˈba.tu/ → [baˈt̄ʊ]), where stops are realized as unreleased consonants [C̄] across initial, medial, final, and coda positions

Stop secondary palatalization is observed in kayo (/ˈka.ju/ → [ˈkʲa.jʊ]), pabukid (/paˈbu.kid/ → [pabʊˈkʲɪd]), kideng (/ˈki.dɛŋ/ → [ˈkʲiːdɛŋ]), and tubay (/tuˈbaı/ → [tʊˈbʲaɪ]), where stops acquire palatal secondary articulation in the presence of front vowels and glides.

Glide secondary palatalization is found in uway (/ʊˈwaı/ → [ʊˈwʲaɪ]), where the glide /w/ is realized with palatal secondary articulation in a fronted vocalic environment.

Table 6. Consonantal Quality Variations.

Consonant Quality Variation	Example Words	Underlying Forms	Surface Forms	Phonological Environment
Stop Lenition	tubu, tug, taro, pito, binit, batu	/ˈtu.bo/, /ˈtug/, /ˈta.ro/, /ˈpi.tu/, /bɪˈnit/, /ˈba.tu/	[tʊ.ˈt̄bo], [ˈtʊg̃], [ˈt̄a.rʊ], [pɪ.ˈt̄ʊ], [bɪˈnɪt̄], [baˈt̄ʊ]	Initial, medial, final, and coda positions
Stop Secondary Palatalization	kayo, pabukid, kideng, tubay	/ˈka.ju/, /paˈbu.kid/, /ˈki.dɛŋ/, /tuˈbaı/	[ˈkʲa.jʊ], [pabʊˈkʲɪd], [ˈkʲiːdɛŋ], [tʊˈbʲaɪ]	Before front vowels and glides

Consonant Quality Variation	Example Words	Underlying Forms	Surface Forms	Phonological Environment
Glide Secondary Palatalization	uway	/ʊˈwaɪ/	[ʊˈwʲaɪ]	Fronted vocalic environment

Overall, these results show that consonant quality variation in Batak occurs systematically across different positions and phonological environments, including coda, and coarticulatory contexts.

Stress Pattern Variations

Stress is a key suprasegmental feature in Batak, shaping the language's rhythm, clarity, and lexical identity. The data show that stress occurs in penultimate, final, monosyllabic, and root–based patterns, distributed across different word types and morphological structures as shown in Table 7.

Final stress is observed in words such as daun (/daˈun/), bulan (/buˈlan/), saging (/saˈgiŋ/), balay (/baˈlay/), apun (/aˈpun/), and sapa (/saˈpa/), where stress falls on the final syllable. It is also present in affixed forms such as naglabag (/nagla ˈbag/), nagdena (/nagdɪˈna/), magkaubra (/magkauˈbrɐ/), and pabukid (/pabʊˈkɪd/), where stress is realized on the final syllable of the root.

Penultimate stress occurs in words such as aldaw (/alˈdaw/), degwa (/dəˈgwa/), gata (/gaˈta/), sampulok (/samˈpulok/), and tubay (/tuˈbaɪ/), where prominence falls on the second–to–last syllable.

Monosyllabic stress is found in forms such as tug (/tug/), bay (/baj/), lang (/laŋ/), and gaw (/gaw/), where the single syllable carries stress. Additional forms such as a (/ˈa/), ay (/ˈaɪ/), and na (/ˈna/) show stress when produced in isolation or in emphatic contexts.

Root–based stress is observed in morphologically complex forms such as magluto (/magˈluto/), magbatu (/magbaˈtu/), magkuha (/magkuˈha/), magbantay (/magbanˈtaɪ/), magpaapuy (/magpaˈapoy/), magkayo (/magkaˈjo/), manilig (/manɪˈlɪg/), and magpabukid (/magpabuˈkid/), where stress is realized on the root syllable.

Table 7. Stress pattern variations

Stress Pattern	Example Words	IPA Forms	Stressed Syllable	Morphological Context
Penultimate Stress	aldaw, degwa, gata, sampulok, tubay	/alˈdaw/, /dəˈgwa/, /gaˈta/, /samˈpulok/, /tuˈbaɪ/	Second–to–last syllable	Simple and polysyllabic words
Final Stress	daun, bulan, saging, balay, apun, sapa	/daˈun/, /buˈlan/, /saˈgiŋ/, /baˈlay/, /aˈpun/, /saˈpa/	Final syllable	Simple words
Final Stress (Affixed)	naglabag, nagdena, magkaubra, pabukid	/naglaˈbag/, /nagdɪˈna/, /magkauˈbrɐ/, /pabʊˈkɪd/	Final syllable	Affixed forms
Monosyllabic Stress	tug, bay, lang, gaw, a, ay, na	/tug/, /baj/, /laŋ/, /gaw/, /ˈa/, /ˈaɪ/, /ˈna/	Single syllable	Monosyllabic forms
Root–Based Stress	magluto, magbatu, magkuha, magbantay, magpaapuy, magkayo, manilig, magpabukid	/magˈluto/, /magbaˈtu/, /magkuˈha/, /magbanˈtaɪ/, /magpaˈapoy/, /magkaˈjo/, /manɪˈlɪg/, /magpabuˈkid/	Root syllable	Affixed and complex forms

Overall, the results show that stress placement in Batak is systematic and predictable, occurring in consistent positions across both simple and morphologically complex words, particularly in final, penultimate, monosyllabic, and root–based environments.

DISCUSSION

Vowel Quality Variations

Vowel processes in Batak operate within a unified phonological system shaped by articulatory, prosodic, and sociolinguistic factors. This section addresses the research question on vowel quality variations and highlights their relevance for phonological description, orthography development, and language revitalization.

Vowel variation in Batak reflects the interaction of articulatory constraints, prosodic structure, and language contact (Bybee 2001; Lindblom 1990). The analysis is grounded in Lindblom's adaptive model, which situates vowel realization along a hypoarticulation–hyperarticulation continuum, and usage–based perspectives that emphasize frequency and communicative function (Bybee 2001). Prosodic frameworks further explain the role of stress and prominence (Beckman and Edwards 1994; Hayes 1986; Johnson 2004). Areal studies also situate these processes within Philippine languages (Keenan and Chung 2017; Lobel 2013). Together, these perspectives position Batak as a system that balances structural stability with adaptive variation.

The analysis identifies eight vowel quality variations: raising, fronting, lowering, backing, centralization, lengthening, reduction, and diphthong variation. Vowel variation is commonly influenced by articulatory effort, stress, and surrounding sounds. Cross–linguistic studies show that vowels may shift in height, backness, duration, or quality depending on prosodic prominence and phonetic environment (Jacewicz et al. 2006). These processes are systematic and context–dependent, supporting intelligibility and prosodic organization (Keenan and Chung 2017; Lindblom 1990; Lobel 2013).

Vowel raising involves higher tongue position in stressed syllables, enhancing clarity and prominence. This aligns with Lindblom's (1990) claim that speakers increase articulatory effort in contexts requiring precision, and with findings that raised vowels improve perceptual distinctiveness (Beckman and Edwards 1994; Johnson 2004). Similar patterns in Philippine languages suggest both universal tendencies and contact influence (Lobel 2021).

Vowel fronting reflects advancement of vowels influenced by coarticulation and phonological environment. It enhances contrast and precision, particularly in prominent or frequent forms. This supports the view of hyperarticulation proposed by De Jong et al. (1993) and Johnson's (2004) account of articulatory variation shaped by communicative demands. Areal evidence indicates reinforcement through contact with neighboring languages (Keenan and Chung 2017; Lobel 2013).

Vowel lowering and backing adjust tongue height and position to enhance perceptual prominence. Lowering increases acoustic weight, while backing contributes to resonance and salience. These processes are associated with stressed or emphatic speech and may reflect sociolinguistic variation across registers (Lobel 2021; Novellino 2018).

In contrast, centralization and reduction occur in unstressed syllables, where vowels shift toward mid–central positions due to reduced articulatory effort (Lindblom 1963; Manuel 1990). This supports the observation that Batak vowel quality is affected by stress and syllable position. Since unstressed syllables usually receive less articulatory energy, vowel reduction and centralization may appear as natural outcomes of prosodic weakening (Kapatsinski et al. 2022; Lindblom 1963). These processes are prosodically conditioned, with stressed syllables maintaining full quality. Acoustic and areal studies confirm that such reductions are systematic and widespread in Philippine languages (Kapatsinski et al. 2022; Keenan and Chung 2017; Lobel 2013, 2021).

Vowel lengthening functions as a prosodic feature marking stress and prominence through increased duration (Hayes 1986). It often co–occurs with spectral changes, reinforcing perceptual contrast (Johnson 2004; Kangatharan 2015; Kangatharan et al. 2022; Pierrehumbert 2002). This pattern aligns with Austronesian systems where length supports rhythm and emphasis (Keenan and Chung 2017; Lobel 2021).

Diphthong variation reflects adjustments in vowel–glide sequences influenced by stress, timing, and coarticulation (Hayes 1995; Lindblom 1963). While structurally stable, diphthongs vary in realization across contexts, supporting flexibility and perceptual contrast. Similar patterns are observed in Austronesian languages and may reflect adaptive strategies in endangered language contexts (Fitzgerald 2021; Keenan and Chung 2017; Lobel 2021).

Taken together, Batak vowel variation reflects a coordinated system shaped by articulatory mechanics, prosodic structure, and sociolinguistic factors. These processes are systematic, prosodically conditioned, and socially meaningful, aligning with theories of adaptive articulation (Lindblom 1963, 1990), prosodic organization (Beckman and Edwards 1994; Hayes 1986), and usage–based change (Bybee 2001). Comparative evidence situates Batak within broader Philippine phonological patterns (Keenan and Chung 2017; Lobel 2021).

Consonant Quality Variations

These findings show that Batak has a dynamic yet structured consonant system that supports intelligibility and phonological contrast. Documenting these patterns is important for orthography development, literacy, and broader language revitalization efforts, aligning with the objectives of the study (Grenoble and Whaley 2005). This study examines consonant quality variations in Batak Palawan, focusing on their phonological behavior and relevance for documentation and revitalization. Three core processes are identified: stop lenition, stop secondary palatalization, and glide secondary palatalization. These processes demonstrate that consonant variation in Batak is systematic and context–dependent rather than random.

From a theoretical perspective, consonant variation reflects articulatory economy and phonological conditioning. Processes such as lenition, palatalization, and secondary articulation are widely attested cross–linguistically, where consonants shift depending on phonological environment and ease of articulation (Katz and Pitzanti 2019). Lenition, in particular, is a common weakening process in which stops become unreleased or fricative in specific positions while preserving phonemic identity (Lai 2023; Wayland et al. 2024). Similar patterns in Batak Angkola, where assimilation and place changes occur in nasal–consonant sequences, further support the rule–governed nature of Batak phonology (Nadra et al. 2024).

Articulatory, prosodic, and coarticulatory factors also influence consonant variation in Batak. The analysis draws on lenition hierarchies and areal linguistics (Keenan and Chung 2017; Lobel 2021), which explain systematic weakening and strengthening across environments. Cross–linguistic studies show that secondary palatalization and labialization are typically conditioned by adjacent front vowels or glides, as observed in Romance, Bantu, and Malay dialects (Recasens 2020; Usman et al. 2021). These patterns closely parallel Batak realizations.

Stop lenition is a dominant process, where forms such as *tubu, tug, taro,* and *batu* show stops realized as unreleased [C̚] in various positions (Kochetov 2016; Melguy 2018). This reflects reduced articulatory effort while maintaining phonemic contrast. Secondary palatalization occurs in *kayo, pabukid,* and *kideng*, where stops are realized as [Cʲ] due to front–vowel or glide environments, reflecting coarticulatory anticipation (Lobel 2021). Glide palatalization is also observed in *uway*, where /w/ becomes [wʲ] in fronted contexts, which indicates a broader coarticulatory sensitivity (Himmelmann and Kaufman 2020).

The findings indicate that Batak exhibits systematic consonant variation that balances articulatory economy and phonological enhancement. Lenition occurs in weaker prosodic positions, while palatalization is conditioned by front–vowel environments. These findings align with established phonological frameworks (Keenan and Chung 2017; Lobel 2021), showing that Batak consonant variation is structured and predictable.

From an applied perspective, these results support orthography development and literacy planning. Studies on related languages show that phonological patterning informs effective teaching materials and writing systems (Ambarita and Sembiring 2025; Lai 2023; Siahaan et al. 2021). Ethnolinguistic vitality studies further indicate that Batak Palawan retains stable structural features despite language contact, making documentation timely and important. Overall, these consonant processes are systematic and meaningful, contributing directly to language maintenance and revitalization by guiding which phonetic variations should be represented in writing.

Stress Pattern Variations

Batak exhibits systematic stress patterns that align with broader Austronesian languages, where stress is generally predictable and based on word edges rather than random assignment (Hayes 1995; Irawan et al. 2024; Kaland 2019; Smith 2023). This regularity shows that Batak has an organized phonological system, which is important for both linguistic analysis and language revitalization.

The analysis identifies four major stress patterns: penultimate, final, monosyllabic, and root–based stress. Stress plays a key role in organizing rhythm and highlighting important syllables in words. Metrical stress theory explains that stress is often assigned to fixed positions, such as the final or penultimate syllable (Hayes 1995). This is consistent with Proto–Austronesian reconstructions, where penultimate stress is considered the default, with shifts to final stress occurring under certain phonological conditions, such as vowel reduction (Smith 2023). Many Austronesian languages today reflect this system, often described in terms of edge–based prominence and metrical structure.

Penultimate stress functions as the default pattern in Batak, appearing consistently in words such as aldaw (/alˈdaw/), degwa (/dəˈgwa/), gata (/gaˈta/), sampulok (/samˈpulok/), and tubay (/tuˈbaɪ/). This supports previous findings that penultimate stress is the unmarked pattern in many Austronesian languages (Hayes 1995; Smith 2023). In contrast, final stress, as seen in daun, bulan, and balay, represents a marked pattern that occurs under specific phonological or morphological conditions. Similar patterns are observed in Papuan Malay, where final stress is less common but more strongly pronounced when it occurs (Kaland 2019; Voica 2020).

Final stress occurs when prominence falls on the last syllable, as in daun (/daˈun/), bulan (/buˈlan/), saging (/saˈgiŋ/), balay (/baˈlay/), apun (/aˈpun/), and sapa (/saˈpa/). This pattern is systematic and aligns with Austronesian tendencies for edge–based prominence (Keenan and Chung 2017). In affixed forms such as naglabag (/naglaˈbag/), nagdena (/nagdɪˈna/), magkaubra (/magkauˈbrɐ/), and pabukid (/pabʊˈkɪd/), stress remains on the final syllable of the root, while prefixes are prosodically weaker. Minor variation in rapid speech reflects performance effects rather than changes in the stress system (Keenan and Chung 2017).

Monosyllabic stress applies to words with only one syllable, such as (/tug/), bay (/baj/), lang (/laŋ/), and gaw (/gaw/), where stress is inherently assigned due to the absence of other syllables (Hayes 1995). Additional forms such as a (/ˈa/), ay (/ˈaɪ/), and na (/ˈna/) also exhibit stress when emphasized. This reflects a general feature of languages with fixed or predictable stress systems, where lexical items generally carry stress (Davis 1988; Kaland 2019; Smith 2023). Additionally, this pattern reinforces clarity, particularly in minimal lexical items (Keenan and Chung 2017).

Root–based stress is observed in more complex forms, such as (/magˈluto/), magbatu (/magbaˈtu/), magkuha (/magkuˈha/), magbantay (/magbanˈtaɪ/), magpaapuy (/magpaˈapoy/), magkayo (/magkaˈjo/), manilig (/manɪˈlɪg/), and magpabukid (/magpabuˈkid/), where stress remains on the lexical root while affixes are less prominent. This pattern highlights the role of stress in marking meaning–bearing units and is consistent with other

Austronesian languages where stress is anchored to the root (Fitzgerald 2021; Irawan et al. 2024; Shryock 1993). Studies on languages like Embaloh and Cebuano show similar behavior, where stress remains stable despite the addition of affixes.

The analysis demonstrates that Batak has a structured phonological system in which stress interacts with vowel and consonant variation in predictable ways. Research in Austronesian phonology also shows that stress is closely linked to features such as vowel quality and mora structure, further supporting the idea that prosody and segmental patterns are systematically related (Irawan et al. 2024; Kaland 2019).

These results support the classification of Batak as a penultimate–based stress system with systematic variation in final, monosyllabic, and root–based patterns. Such patterns reflect reconstructed Proto–Austronesian features and demonstrate that stress in Batak is stable, predictable, and closely tied to word structure. Documenting these prosodic features is essential for orthography development, teaching materials, and language revitalization efforts. Accurate representation of stress and rhythm helps preserve not only vocabulary but also actual language use in the community (Grenoble and Whaley 2005; Hinton and Hale 2002; Leonard and Haynes 2010).

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GENERATIVE AI STATEMENT

The study used generative AI tools, specifically Perplexity AI and ChatGPT (OpenAI, GPT–based model), to assist in language refinement, summarization, and clarification of linguistic concepts through prompts related to paraphrasing, summarization, and language refinement. However, all analyses, interpretations, and final outputs were independently developed by the researchers, with AI–generated content used only as supplementary support after critical evaluation.

ETHICAL CONSIDERATIONS

Throughout the research process, ethical considerations were upheld. All participants and officials were fully briefed about the study's purpose and procedures, with informed consent obtained prior to participation. Confidentiality was maintained, ensuring that participant identities and responses remained anonymous. The principle of voluntary participation was respected, permitting withdrawal at any point without repercussion. Finally, all collected data was securely stored and used exclusively for academic purposes, adhering to required standards for data protection.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no competing interests.

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ROLE OF AUTHORS: *BLANG – design, analysis of data, revising, investigation; GSMT – concept, analysis of data, drafting, revising, investigation, timeline and task management; KSMM – design, analysis of data, revising, supervision, validation; JMVM – design, analysis of data, revising, investigation.*

Suggested citation:
Balay LANG, Garpeza SMT, Maute KSM, Vallega JMM. 2026. Sound Patterns in the Batak Language of Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, pp. 130-140). Western Philippines University, Palawan, Philippines.

Paper Presentation
MAIN Campus

SESSION 1 – AGRICULTURE, AQUATIC AND NATURAL RESOURCES (FISHERIES · AQUACULTURE · MARINE BIOLOGY · AGRICULTURE · FORESTRY · FOOD SECURITY · NATURAL RESOURCE MANAGEMENT)

Abundance and Diversity of Insects Captured by Different Colored Light Traps in Eggplant Plantations

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ABSTRACT

Insect pest infestations remain a major challenge in agricultural production, often leading to a heavy reliance on chemical pesticides despite their known environmental and health risks. However, there is limited local research on cost–effective, eco–friendly monitoring tools, particularly on how different light colors influence insect abundance and diversity in eggplant plantations. This study aimed to determine the effectiveness of four colored light traps—blue, white, yellow, and ultraviolet (UV)—in capturing insect populations in eggplant farms. The experiment was conducted at two locations, with three replications of each light trap distributed across the sites over one lunar month. Insects were collected throughout the sampling period, identified, and classified as either beneficial or pest species. Data were analyzed using descriptive statistics, the Shannon diversity index, and a general linear model (GLM) to determine significant differences among treatments. Results revealed that ultraviolet (UV) light traps captured the highest insect abundance, significantly outperforming the other light colors. White and blue traps showed moderate effectiveness, while yellow traps recorded the lowest overall capture but demonstrated selective attraction to specific pest groups. Across all treatments, pest insects dominated over beneficial insects, with Hemiptera identified as the most abundant order. In terms of diversity, all light traps showed high diversity values, with no significant differences among treatments. Among pests caught, the eggplant pest also has a larger percentage. These findings indicate that trap color significantly influences insect attraction, with UV being the most effective but least selective. It is best used in eggplant plantation, but it can be used on a selective night during the lunar period. It is recommended to use UV traps for comprehensive insect monitoring. Further studies were suggested to explore long–term application and effectiveness across different crops and environmental conditions.

Keywords: trap efficiency, entomological sampling, insect traps, light colors, pest management

Suggested citation:
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Bioactivity of Garlic (*Allium sativum* L.) Extract against Rice Bug (*Leptocorisa oratorious* Fabricius)

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ABSTRACT

Rice (*Oryza sativa* L.) is a major staple crop worldwide, yet its production is threatened by insect pests such as the rice bug (*Leptocorisa oratorius*), which feeds on developing grains and reduces yield and quality. Heavy reliance on synthetic insecticides has raised environmental and health concerns, prompting interest in botanical alternatives. This study evaluated the bioactivity of garlic (*Allium sativum* L.) extract against rice bug nymphs in terms of mortality and repellency. The study aimed to compare mortality and repellency effects of garlic extract at varying concentrations with a synthetic insecticide, and to identify the most effective concentration as a potential eco–friendly pest management option. A Factorial Completely Randomized Design (CRD) with five treatments and three replications was employed. Treatments included 10%, 30%, and 50% garlic extract, methomyl, and water as control. Mortality was recorded at 6, 12, 24, and 48 hours after application, while repellency was assessed using a dual–choice chamber at 1, 6, and 12 hours. Data were analyzed using two–way ANOVA and Tukey's HSD test at 5% significance level. Data were analyzed using two–way ANOVA and Tukey's HSD test at 5% significance level. Treatment, exposure time, and their interaction significantly affected mortality ($p < 0.001$). Garlic extract caused low mortality, evident only after 24–48 hours, whereas methomyl produced consistently high mortality. Repellency increased with exposure time ($p = 0.025$), with the highest repellency (86.67%) observed at 50% concentration after 12 hours. Garlic extract exhibited minimal insecticidal impact but strong repellency, particularly at 50% concentration. Acting primarily as a deterrent, it shows promise as a sustainable supplement to integrated pest management, reducing dependence on synthetic chemicals in rice cultivation. The findings suggest that garlic extract acts primarily as a repellent rather than a toxicant and may serve as a supplementary component in integrated pest management programs.

Keywords: botanical insecticide, garlic extract, integrated pest management, repellency, rice bug

Suggested citation:
Blancia NAD, Delos Reyes RN, Venturillo DMLC, Villarosa JRM. 2026. Bioactivity of Garlic (*Allium sativum* L.) Extract against Rice Bug (*Leptocorisa oratorious* Fabricius). In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 143). Western Philippines University, Palawan, Philippines.

Identification and Ecological Status of Seagrass Areas along the Selected Coastal Areas of East Coast, Aborlan, Palawan

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ABSTRACT

Seagrass ecosystems are among the most productive coastal habitats and play a vital role in supporting marine biodiversity, fisheries, and coastal protection. They serve as nursery grounds for fish and invertebrates, stabilize sediments, and help improve water quality. Despite their importance, seagrass beds are highly vulnerable to human activities such as coastal development, pollution, and overfishing, as well as natural disturbances. The study aimed to identify the seagrass species present in selected coastal barangays along the East Coast of Aborlan, determine the percent cover of seagrass beds in the study area, and identify the associated macroinvertebrates within the sampling area. The transect–quadrat method was employed to assess seagrass species composition and ecological status. Sampling sites were selected based on accessibility, presence of seagrass beds, and relevance to local fisheries and coastal activities. Seagrass beds in Puntod and Malunao showed distinct ecological dynamics. Enhalus acoroides is the dominant species, covering 65.67% of Puntod, indicating favorable conditions for its growth. Despite low species diversity in Puntod, E. acoroides thrives due to the suitable substrate and environment. Malunao, however, has higher species richness, with Cymodocea rotundata, Halophila ovalis, and other seagrass species present in the sampling area. Differences in species diversity between the sites are also influenced by sediment types and substrate conditions, as some species prefer sandy or muddy substrates. Regular monitoring, protection, and community awareness programs for seagrass beds in Puntod and Malunao are essential. Future research should focus on seagrass density and biodiversity to further understand these ecosystems.

Keywords: ecological status, macroinvertebrates, percent cover, seagrass species

Suggested citation:
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Records Management System of the Department of Environment and Natural Resources – Palawan

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ABSTRACT

Mining activities contribute significantly to land degradation, resulting in nutrient–deficient and unproductive soils that require effective rehabilitation strategies. This study evaluated the effectiveness of Rice Hay Compost (RHC) and Carbonized Rice Hull (CRH) as organic amendments to restore the productivity of mined–out soil collected from the mining area of Berong Nickel Corporation at Quezon, Palawan. A Completely Randomized Design (CRD) was used consisting of nine treatments with varying proportions of RHC and CRH amendments applied to mined–out soil, each replicated eight times. Growth and yield parameters, including leaf length, leaf width, number of leaves, fresh weight, and biomass, were measured over a 59–day growing period. Data were analyzed using Analysis of Variance (ANOVA), and Duncan's Multiple Range Test (DMRT) Post Hoc analysis at 1% level of significance. Results showed highly significant differences ($p < 0.01$) among treatments for all measured parameters. Treatment 9 (60% mined–out soil + 20% RHC + 20% CRH) consistently produced the highest growth and yield values, while the control (100% mined–out soil) and treatments with low amendment levels (T2–T5) exhibited the poorest performance. The combined application of RHC and CRH at higher proportions significantly enhanced plant growth and biomass production. The study concludes that the combination of 20% RHC and 20% CRH is the most effective treatment for enhancing the growth and yield of Pechay in mined–out soils. These findings highlight a sustainable and cost–effective approach for rehabilitating degraded mining areas using agricultural waste materials.

Keywords: carbonized rice hull, mined–out soil, restoration, rice hay compost

Suggested citation:
Bernardo AP, Gamilong DJC, Saldajeno HJB. 2026. Records Management System of the Department of Environment and Natural Resources – Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 145). Western Philippines University, Palawan, Philippines.

Carbon Stocks Assessment in Wetlands, Agricultural Areas, and Artificial Forests at Western Philippines University

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ABSTRACT

This study assessed and compared the carbon stock potential of wetland, agricultural area, and artificial forest within Western Philippines University, Aborlan, Palawan. The study aimed to quantify carbon stored in aboveground biomass, belowground biomass, litter, and soil organic carbon (SOC) using established field sampling methods and standard carbon estimation equations. Vegetation measurements, soil sampling, and laboratory analyses were conducted following protocols recommended by IPCC and related literature. Carbon stocks were computed on a per–hectare basis and compared among ecosystems. Results showed significant variation in carbon storage among ecosystems. The forest ecosystem recorded the highest total carbon stock (573.70 Mg C ha^{-1}), followed closely by the wetland (518.79 Mg C ha^{-1}), while the agricultural area had the lowest carbon stock (193.11 Mg C ha^{-1}). High carbon storage in forests was attributed to dense tree cover, large biomass, and continuous organic matter input. Wetlands also exhibited high carbon storage, particularly in soil, due to waterlogged conditions that slow organic matter decomposition. In contrast, agricultural areas showed reduced carbon stocks as a result of frequent land disturbance, lower biomass density, and limited organic matter input. In general, the findings highlight the critical role of forests and wetlands as major carbon sinks and emphasize their importance in climate change mitigation. The study further underscores the need for conservation of natural ecosystems and the adoption of sustainable land management practices, such as agroforestry, to enhance carbon sequestration in agricultural landscapes.

Keywords: carbon, soil organic carbon (SOC), climate change mitigation, DBH (diameter at breast height), biomass

Suggested citation:
Largavista SE. 2026. Carbon Stocks Assessment in Wetlands, Agricultural Areas, and Artificial Forests at Western Philippines University. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 146). Western Philippines University, Palawan, Philippines.

Dietary L–Tryptophan Supplementation Mitigates Heat Stress and Improves Production Performance and Meat Sensory Attributes in Broilers

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ABSTRACT

Heat stress significantly affects poultry production in the Philippines, where the average heat index reaches 39.84°C and is projected to increase by up to 4.10°C by the end of the 21st century. This environmental stress impairs broiler growth, immune function, and meat quality, resulting in substantial economic losses. L–tryptophan (Trp), an essential amino acid involved in serotonin and melatonin synthesis, may help mitigate these effects. The study investigated the effects of dietary L–tryptophan supplementation on growth performance, body temperature, economic traits, carcass yield, sensory attributes in broilers under heat stress. L–tryptophan supplementation significantly improved ($p<0.05$) broilers body weight gain, average daily gain, feed intake, water intake, and feed conversion ratio. Broilers in T1 and T2 exhibited elevated body temperatures and higher water intake, indicating thermal discomfort and stress, while birds supplemented with L–tryptophan (T3– T5) showed lower body temperatures and balanced feed and water intake, supported by strong negative correlations in heatmap analysis. Furthermore, L–tryptophan significantly enhanced ($p<0.05$) head and drumstick yields, meat tenderness, juiciness, and aroma but had no significant effects ($p>0.05$) on taste, overall acceptability, dressing percentage, and cooking loss. Return on investment (ROI) was highest in L–tryptophan treatments: T5 (87.77%), T4 (88.22%), and T3 (80.99%), compared to T2 (59.20%) and T1 (60.15%). In conclusion, dietary L–tryptophan supplementation at 0.20–0.22% improves broiler growth, thermoregulation, carcass yield, meat sensory attributes, and economic efficiency under heat stress, making it a viable nutritional strategy for hot climates.

Keywords: rectal temperature, feed intake, carcass yield, growth, economic traits, poultry nutrition

Suggested citation:
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Effects of Organic Fertilizers on the Vegetative Growth and Yield of Parsley (*Petroselinum crispum*) Grown in Greenhouse Conditions

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ABSTRACT

Parsley (*Petroselinum crispum* Mill.) is a biennial aromatic plant belonging to the Apiaceae family. This study evaluated the effects of different organic fertilizers on the vegetative growth, yield, and leaf quality of parsley (*Petroselinum crispum*) under greenhouse conditions. The study was laid out in split plot complete randomized design with five treatments and three replications. The main plot was variety of parsley and sub– plot was different organic fertilizers. Two varieties are Parsley Moss (V1) and Parsley Italian (V2), were tested under five treatments: T1 – control (no organic fertilizer), T2 – compost, 3 – vermicompost, 4 – chicken manure, and 5– inorganic fertilizer. Results revealed that Parsley Italian (V2) consistently showed superior performance in terms of plant height, tillers per plant, leaf area, and yield compared to Parsley Moss (V1), although V1 had a slightly higher survival rate. Among the fertilizer treatments, vermicompost produced the highest vegetative growth, marketable yield, and total yield, followed by compost. In contrast, chicken manure and inorganic fertilizer resulted in lower yield performance despite relatively high survival rates. Overall, the study indicates that vermicompost is the most effective fertilizer for enhancing parsley growth and productivity. The combination of Parsley Italian and vermicompost is therefore recommended for achieving higher yield and better leaf quality under greenhouse conditions.

Keywords: parsley moss, parsley italian, vermicompost, chicken manure

Suggested citation:
Arpon AP. 2026. Effects of Organic Fertilizers on the Vegetative Growth and Yield of Parsley (*Petroselinum crispum*) Grown in Greenhouse Conditions. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 148). Western Philippines University, Palawan, Philippines.

Evaluation of Locally Formulated Feed on Growth Performance of Broiler and Native Chicken

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ABSTRACT

Locally formulated feeds (LFF) on the growth performance of broiler chickens (BC) and native chickens (NC) was substantial to ensure that diets are suitable and adaptable, also support sustainable poultry production, strengthen food security, and promote the use of available local resources. This study was conducted to determine and compare the effect of LFF on broiler and native chicken growth performance, comprised the main plot with BC & NC, the sub–plot with the different levels and types of feed. A total of 27 BC and 27 NC chickens were randomly divided into 3 treatments in 9 replications for NC and 3 treatments in 9 replications for BC using CRD and Split Plot Design. The results were numerically different but not statistically distinct. The introduction of LFF did not significantly alter the growth performance of native chickens compared to CF, BC showed greater variability across treatments. Treatments 1 and 2 were statistically similar, but both were significantly lower than Treatment 3, indicating that broilers fed exclusively with CF attained the highest final weight. LFF affect weight gain, feed conversion, and overall health of poultry, ensuring that BC achieved fast growth while NC maintained their adaptability and resilience. BC and NC consumed comparable amounts of feed across treatments, indicating that the incorporation of alternative ingredients such as mabolo leaf meal and vermi meal did not deter acceptability or palatability. Findings also showed that locally formulated feeds can serve as a sustainable supplement to commercial rations and therefore ideal for low–cost rural production.

Keywords: feed consumption, feed conversion ratio, ingredients, nutrition, weight

Suggested citation:
Bollido ME. 2026. Evaluation of Locally Formulated Feed on Growth Performance of Broiler and Native Chicken. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 149). Western Philippines University, Palawan, Philippines.

Green Spaces in WPU Main Campus: Refugia for Endemic and Conservation–Priority Wildlife

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ABSTRACT

Urbanization has led to increasing habitat loss, threatening endemic and conservation–priority species. To mitigate these losses, green spaces within academic campuses can function as important habitats for wildlife. This study explores the ecological role of the green spaces of WPU Main Campus as refugia for endemic and priority species amidst increasing anthropogenic pressures. The study evaluates the wildlife assemblages utilizing the green spaces within the WPU Main Campus, with a focus on assessing the diversity and presence of endemic and conservation–priority species. The study employed a range of wildlife survey methods, including transect counts, mist netting, cage trapping, visual encounter surveys, and opportunistic observations. Data collection took place from August 2022 to September 2025. The data were analyzed using descriptive biological statistics, such as species richness, relative abundance, Shannon–Wiener diversity index, evenness, frequency, and averages. The survey recorded 144 species, including 30 endemic species, 11 endemic subspecies, and 40 conservation–priority species, highlighting the ecological importance of WPU Main Campus green spaces. These areas also support 27 species of migratory birds, indicating their role as overwintering habitats. Overall, the campus functions as a key site for local and broader biodiversity conservation. The findings demonstrate that the green spaces within the WPU Main Campus support high wildlife diversity, including endemic, conservation–priority, and migratory species, highlighting their significant role in biodiversity conservation. Consequently, conserving these areas is essential to sustain wildlife in human–dominated landscapes. It is recommended that WPU develop policies to expand and enhance campus green spaces through sustainable landscaping, such as utilizing native flora, reducing pesticides, and installing wildlife–friendly structures. Other institutions should also establish green spaces to promote biodiversity conservation in human–dominated landscapes.

Keywords: biodiversity, ecosystem function, habitat loss, landscape ecology

Suggested citation:
Bernardo Jr. AA. 2026. Green Spaces in WPU Main Campus: Refugia for Endemic and Conservation–Priority Wildlife. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 150). Western Philippines University, Palawan, Philippines.

Influence of Green Amarant (*Amaranthus viridis* L.) Densities on the Growth and Yield of Tomato (*Solanum lycopersicum* L.)

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ABSTRACT

Amaranthus viridis L. is a competitive weed closely associated with tomato (*Solanum lycopersicum* L.). Although the effects of weed competition on tomato production have been widely recognized, there is limited information on the specific threshold density of *Amaranthus viridis* that causes significant reductions in tomato growth and yield. Thus, this study was conducted to determine the effect of varying densities of *A. viridis* on the growth parameters of tomato plants; evaluate the impact of *Amaranthus viridis* density on tomato yield and fruit quality; and identify the critical weed density threshold that significantly affects tomato growth and productivity. The experiment employed a randomized complete block design with three replications and each replicate consisting of three plants assigned to treatments with varying weed density (T1– tomato alone, T2 – tomato vs. 1 green amaranth, T3 – tomato vs. 3 green amaranth, T4 – tomato vs. 5 green amaranth, T5 – tomato vs. 7 green amaranth) and results were analyzed using ANOVA through the Statistical Tool for Agricultural Research. Results showed that control treatment showed the highest growth and yield values. Even a single weed per plant significantly reduced plant growth, fruit number, and fruit weight. Increasing weed density caused greater reductions, while dry matter content was not significantly affected. This indicates that *Amaranthus viridis* has a very low threshold, as even minimal presence reduces tomato productivity. Early and effective weed management is therefore necessary to minimize yield loss in tomato.

Keywords: competition, critical threshold, weed management

Suggested citation:
Fabian F, Malagsic LL. 2026. Influence of Green Amarant (*Amaranthus viridis* L.) Densities on the Growth and Yield of Tomato (*Solanum lycopersicum* L.). In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 151). Western Philippines University, Palawan, Philippines.

Iron Slag–Based Silicate Fertilizer Enhances Soil Organic Carbon Sequestration and Stabilization in Rice Paddies

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ABSTRACT

Iron slag–based silicate fertilizer (hereafter, silicate fertilizer) has long been applied as a soil amendment in acidic paddy soils. Rich in silicon (Si) and other elements, silicate fertilizer has been reported to enhance rice yield and net primary production (NPP), thereby increasing carbon (C) inputs. In contrast, it also acts as an alkaline amendment that may stimulate microbial activity and accelerate the decomposition of soil organic matter. Meanwhile, silicate fertilizer contains high levels of calcium and metals (Al and Fe), which can contribute to the chemical and physical protection of soil organic C (SOC). However, the net effect of silicate fertilizer application on SOC stock changes has not been sufficiently evaluated. To address this gap, a field experiment under rice cultivation was conducted to assess the effects of silicate fertilizers on SOC accumulation. Silicate fertilizer was applied at rates ranging from 0 to 4 Mg ha−1, and the net ecosystem C budget (NECB) was evaluated during the rice–growing period. Silicate fertilizer application significantly improved rice productivity and soil properties. Increasing application rates enhanced NPP while substantially reducing C loss via microbial respiration. Consequently, NECB increased markedly with higher silicate fertilizer application accompanied by a corresponding increase in SOC content. Furthermore, application of silicate fertilizer improved soil aggregation and aggregate stability, which are closely associated with the physical protection of SOC. Chemical stabilization was also enhanced, particularly through metal–organic interactions, with metals playing key roles in SOC stabilization. In conclusion, silicate fertilizer effectively increased SOC stocks by enhancing NPP and reducing C loss via respiration, while also stabilizing organic matter through both chemical and physical protection mechanisms. These findings suggest that silicate fertilizer is a promising strategy for improving the sustainability of acidic paddy soils.

Keywords: soil carbon stock change, organic carbon stability, greenhouse gas, methane

Suggested citation:
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Sensory Quality and Consumer Acceptability of Banana–Based Energy Bars with Corn Crunch

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ABSTRACT

Consumers increasingly seek portable, healthy snacks that offer balanced nutrients. Energy bars are a popular choice, but maintaining sensory appeal alongside healthiness remains a challenge. This study explores the potential of locally abundant, nutrient–rich Saba banana and white corn as sustainable alternatives for functional snack development in Palawan. The main objective was to develop a white corn–banana energy bar. Specifically, it aimed to determine the effects of varying ingredient proportions on quality characteristics and sensory acceptability, including color, aroma, texture, and flavor. The study utilized a Completely Randomized Design (CRD) with five treatments: T1 (100% banana chips), T2 (25% BC: 75% CC), T3 (50% BC: 50% CC), T4 (75% BC: 25% CC), and T5 (100% corn crunch). Sensory evaluation was conducted by 60 panelists using a 9–point Hedonic Scale, supplemented by colorimetric analysis and cost estimation. Results showed that varying formulations did not significantly impact color acceptability. However, Treatment 1 (100% banana chips) received the highest mean acceptability scores across all other sensory attributes. While 100% corn crunch (T5) scored lowest in taste and texture, a balanced 1:1 mixture (T3) achieved high consumer desirability (58%). Treatment 5 was the most cost–effective, while Treatment 4 had the highest production cost. Banana chips are the primary driver of favorable sensory attributes in these energy bars. While pure banana–based bars are preferred, blending banana with corn crunch provides a viable, acceptable, and cost–effective alternative for the snack market.

Keywords: energy bar, white corn, sustainable food development, functional snacks, value–added product

Suggested citation:
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Access to Marine Resources: Implication for Small–Scale Artisanal Fishers in Narra, Palawan

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ABSTRACT

The provided background highlights the involved challenges faced by artisanal fishers in the context of resource access. It highlights the importance of effective public administration and inclusive governance in addressing these issues. By focusing on the municipality of Narra, Palawan, this research is crucial in generating practical recommendations for policy and governance reforms that protect artisanal fishers while promoting sustainable marine resource management. Such efforts are essential to achieving both community resilience and long–term ecological sustainability. The purpose of this study was to explore the accessibility factors to marine resources in Narra, Palawan. Specifically, the study focused on the profiles of artisanal fishers, the marine products they harvested, and the tools and materials they used. The study likewise determined the accessibility factors and the challenges for the artisanal fishers. Finally, this study examined the significant relationship between the profile of the respondents and the accessibility factors of artisanal fishers in the fishing areas in Narra, Palawan. Using a descriptive–correlational design, data were collected from 352 fishers across six coastal barangays through a structured survey and analyzed using descriptive statistics. The socio–demographic profile of respondents in a fishing community, predominant age group is 28–37 years, with a mean age of 39.78 years old, males, single, Roman Catholics, Tagalog, elementary graduates. The marine products harvested by artisan fisheries in Narra, Palawan, revealing that 100% of respondents engage in crab harvesting. Accessibility factors for artisanal fishers in Narra, Palawan vary significantly. Economic factors have a moderate mean score with the highest being for alternative livelihood opportunities. Socio–cultural factors scored high particularly for gender equality. Environmental factors had a very high mean indicating strong awareness of conditions and resource availability. Legal factors also scored very high reflecting positive perceptions of legal support and minimal compliance issues. Geographical accessibility is rated highly showing ease of access to fishing grounds. The Spearman Rho correlation analysis between the socio–demographic profiles of artisanal fishers and across five factors, all p–values exceed the 0.05 significance level, except environmental factor presented a p–value of 0.034 for religion. The most respondents are young males involved in crab harvesting, followed by fish and other marine products. Accessibility factors varied, with economic factors rated moderately and socio–cultural factors high, particularly gender equality and community support. Challenges include natural disasters, regulatory restrictions, and inadequate weather alerts, with a low overall challenge mean. The Spearman Rho analysis indicated weak correlations between demographic profiles and accessibility factors, except for a significant link between religion and environmental factors. The study recommends reducing economic barriers for fisherfolk, implementing subsidy programs, and supporting gender inclusivity in fisheries by ensuring equal access to resources and training for women. Establish associations or cooperatives for resource sharing. Provide regular training on sustainable fishing techniques and integrate environmental education into community initiatives, highlighting marine protected areas and ecosystem health. Promote participatory monitoring and reporting of illegal activities to empower fishers as stewards of their resources.

Keywords: small–scale artisanal fisheries; economic factors; socio–cultural factors; environmental factors; legal factor; geographical factor

Suggested citation:

Bacalangco JC. 2026. Access to Marine Resources: Implication for Small–Scale Artisanal Fishers in Narra, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 154). Western Philippines University, Palawan, Philippines. 264 pp

SESSION 2 – HEALTH, ENVIRONMENT, AND COMMUNITY WELL–BEING (HEALTH SCIENCES · PUBLIC HEALTH · EDUCATION · ENVIRONMENTAL STUDIES · COMMUNITY DEVELOPMENT)

Bioefficacy of Different Concentration of Calamansi (*Citrofortunella macrocarpa*) Peelings Scented Candle as *Anopheles* (*Anopheles flavirostris*, Diptera: Culicidae) Repellent

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ABSTRACT

Mosquito–borne diseases, particularly malaria transmitted by *Anopheles* mosquitoes, remain a major public health concern, creating a need for safer methods to prevent exposure to these pests. Plant–based repellents, such as citrus peel extracts, offer a more environmentally friendly alternative to chemical insecticides. Thus, this study was conducted to determine the bioefficacy of scented candles containing different concentrations of calamansi peel extract against Anopheles mosquitoes in terms of repellency and mortality, compare the bioefficacy of calamansi peel extract–infused scented candles with commercial scented candles and unscented candles, and evaluate the duration of effectiveness of calamansi peel extract–infused scented candles at different time intervals (20, 40, and 60 minutes) in terms of repellency and mortality, and to identify the most effective concentration. The Completely Randomized Design (CRD) was employed, with five treatments: a commercial calamansi–scented candle (positive control), a commercial unscented candle (negative control), and candles containing 10, 20, and 30 mL of calamansi peel extract. Each treatment was replicated three times, with ten adult Anopheles mosquitoes exposed per trial in a controlled indoor chamber. Mosquito repellency and mortality were recorded at 20, 40, and 60 minutes and analyzed using Analysis of Variance (ANOVA) at a 0.05 level of significance. Results showed that the candle with 20 mL calamansi peel extract exhibited the highest repellency, while the 30 mL concentration resulted in the highest percentage of mosquito mortality, which increased over time. These findings demonstrate that calamansi peel extract enhances both repellency and lethality, with higher concentrations generally producing greater effectiveness. The study supports the use of calamansi peel, a locally available and sustainable plant waste, as a natural mosquito repellent. Scented candles infused with calamansi peel extract offer a practical preventive measure at the household level. Further research may explore higher concentrations, other mosquito species, or alternative delivery methods.

Keywords: *Anopheles*, bioefficacy, calamansi peel, repellent, scented candle

Suggested citation:
Cahilig NEE, Dano JMO, Liao KT, Ruflo LG. 2026. Bioefficacy of Different Concentration of Calamansi (*Citrofortunella macrocarpa*) Peelings Scented Candle as Anopheles (*Anopheles flavirostris*, Diptera: Culicidae) Repellent. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 155). Western Philippines University, Palawan, Philippines.

Awareness and Disposal Practices on Plastic Packaging Waste among Online Shopping Consumers at Western Philippines University, Aborlan, Palawan

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ABSTRACT

This study examined the awareness and disposal practices of online shopping consumers regarding plastic packaging waste among college students, faculty, and staff of Western Philippines University, Aborlan, Palawan. A quantitative descriptive–correlational design was employed, involving 304 respondents selected through random sampling. Data were collected using a structured questionnaire and analyzed using frequency, percentage, weighted mean, and Pearson Correlation Coefficient. The findings revealed that respondents demonstrated a high level of awareness of the environmental impacts of plastic packaging waste. However, disposal practices were only moderate, indicating that proper waste management behaviors such as segregation, reuse, and recycling were not consistently practiced. The correlation analysis showed a weak but statistically significant relationship between awareness and disposal practices ($r = 0.208$, $p < 0.00$). The results indicate a gap between knowledge and actual practice, highlighting the need for improved waste management systems and behavior–focused interventions.

Keywords: plastic packaging waste, online shopping, awareness, disposal practices, waste management

Suggested citation:
Magallanes JC, Yara GY. 2026. Awareness and Disposal Practices on Plastic Packaging Waste among Online Shopping Consumers at Western Philippines University, Aborlan, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 156). Western Philippines University, Palawan, Philippines.

Development and Stability of Freeze–Dried Indian Gooseberry (*Emblica officinalis*) Alginate Microbeads and Their Application in Yogurt Fortification

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ABSTRACT

Indian gooseberry (*Emblica officinalis*) is a rich source of vitamin C and phenolic compounds, but its direct utilization is limited by high acidity, astringent taste, and nutrient instability during processing and storage. Microencapsulation and drying techniques offer promising strategies to enhance stability, mask undesirable flavors, and expand its application in functional foods. This study aimed to develop freeze–dried Indian gooseberry alginate microbeads and evaluate their storage stability, as well as their application as a functional ingredient in yogurt. Indian gooseberry juice was encapsulated using calcium–alginate ionic gelation and subsequently freeze–dried. The stability of total phenolic content (TPC), vitamin C, and antioxidant activity was monitored over 91 days at different storage temperatures (25°C, 35°C, and 45°C). The microbeads were incorporated into rehydrated yogurt at varying levels (1.5–3.0 g/150 g), followed by evaluation of bioactive properties, physicochemical characteristics, and sensory acceptability. Freeze–dried microbeads exhibited good stability, with minimal losses in TPC, vitamin C, and antioxidant activity throughout 91 days of storage across all temperatures. Incorporation into yogurt significantly enhanced TPC, vitamin C, and antioxidant capacity in a dose–dependent manner. However, increasing microbead concentration affected sensory attributes, particularly flavor and texture. Yogurt with up to 2.0 g microbeads maintained acceptable sensory scores, while higher levels reduced overall acceptability. Physicochemical properties such as pH, titratable acidity, and total soluble solids were also influenced by microbead addition but remained within acceptable ranges. Freeze–dried Indian gooseberry alginate microbeads effectively improve the stability of bioactive compounds and can be successfully utilized to fortify yogurt, enhancing its nutritional and functional value without compromising consumer acceptability at optimal levels.

Keywords: *Phyllantus emblica* Linn., microencapsulation, yogurt fortification, vitamin C, phenolic compounds, functional foods

Suggested citation:
Pablo-Limco AG, Klinkesorn U, Tongchipakdee S. 2026. Development and Stability of Freeze–Dried Indian Gooseberry (*Emblica officinalis*) Alginate Microbeads and Their Application in Yogurt Fortification. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 157). Western Philippines University, Palawan, Philippines.

Formulation and Acceptability of Tawa–Tawa (*Euphorbia hirta*) Gummies

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ABSTRACT

Tawa–tawa (*Euphorbia hirta*) is a medicinal plant widely used in the Philippines, particularly as a traditional decoction during dengue episodes. Despite its common use, its bitter taste and strong herbal aroma limit its acceptability, especially among children and individuals who do not prefer herbal drinks. This study aimed to develop tawa–tawa gummies and determine their sensory qualities and general acceptability as affected by varying levels of tawa–tawa decoction and citric acid. A 3 × 3 factorial experimental design was used, consisting of three levels of tawa–tawa decoction (10%, 20%, and 30% w/v) and three levels of citric acid (2%, 2.5%, and 3% w/v). Nine treatment combinations were evaluated by 48 panelists using a 9–point Hedonic Scale for color, appearance, aroma, mouthfeel, sourness, sweetness, bitterness, and general acceptability. Descriptive data were analyzed using frequency and mean, while inferential analysis involved analysis of variance and contour plot analysis. Results showed that all formulations were generally acceptable. No significant differences were observed in color, appearance, and aroma, while significant differences were found in mouthfeel, sourness, sweetness, bitterness, and general acceptability. Among the treatments, the formulation containing 30% w/v tawa–tawa decoction and 2.5% w/v citric acid obtained the highest overall acceptability. The findings indicate that tawa–tawa can be successfully developed into a gummy product with acceptable sensory properties. Tawa–tawa gummies may serve as a more convenient and palatable alternative to the usual herbal decoction and may offer potential as a functional food product.

Keywords: herbal gummy, sensory evaluation, acceptability, formulation, medicinal plant

Suggested citation:
Francisco FJC, Pablo-Limco AG. 2026. Formulation and Acceptability of Tawa–Tawa (*Euphorbia hirta*) Gummies. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 158). Western Philippines University, Palawan, Philippines.

Community Engagement and Involvement towards Good Governance in Aborlan, Palawan

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ABSTRACT

This study examined the level of community engagement and involvement and its contribution to good governance in the Municipality of Aborlan, Palawan. Using a descriptive research design, data were gathered from residents across different sectors through a structured survey questionnaire. The study focused on community participation, factors influencing engagement, and perceived governance outcomes. The findings revealed that community engagement in Aborlan is generally positive, particularly in supporting transparency, accountability, and improved public service delivery. Government encouragement, transparency in local programs, accessible community activities, and effective information dissemination were identified as key factors influencing citizen participation. While residents actively attend barangay assemblies and support local initiatives, involvement in planning and decision–making remains moderate. Overall, the study highlights that meaningful community engagement plays a vital role in promoting trust, accountability, and responsive governance at the local level. Strengthening inclusive and participatory mechanisms is recommended to further enhance good governance in the municipality.

Keywords: Citizen Participation, Public Accountability, Transparency, Local Governance, Civic Involvement, Community Development, Participatory Mechanisms, Public Service Delivery

Suggested citation:
Jagmis MD. 2026. Community Engagement and Involvement towards Good Governance in Aborlan, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 159). Western Philippines University, Palawan, Philippines.

Level of Satisfaction on Health services among Mothers in Isla Sombrero, Poblacion, Aborlan, Palawan

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ABSTRACT

This study was conducted in Isla Sombrero, Poblacion, Aborlan, Palawan, from March to April 2025. The primary objective was to assess the Level of Satisfaction on health services among mothers residing in Isla Sombrero, Poblacion, Aborlan, Palawan. Specifically, it sought to answer the following questions; (1) What is the Demographic profile of the respondents? (2) What are the health services availed by the respondents? (3) What is the level of satisfaction of respondents on the availed health services? (4) What are the reasons of the respondents for availing health services? (5) Is there a significant relationship between the demographic profile and availment of Rural Health Services (RHU) health services? A descriptive–correlational research design was utilized, integrating quantitative surveys. The sample consisted of fifty (50) respondents, selected through complete enumeration consisting of mothers who availed maternal and child healthcare services provided by Rural Health Unit (RHU). The data gathered through survey questionnaires were analyzed using percentages, counts, means and frequency. The Correlational analysis was used to determine the relationship between the demographic profile and availment. The findings showed that mothers were generally satisfied with the overall health services provided by the Rural Health Unit (RHU) for mothers, including prenatal check–up care, distribution of Vitamin A during pregnancy, immunization (diphtheria, tetanus, pertussis), and distribution of ferrous sulfate to increase iron levels in anemic mothers, distribution of calcium lactate to support the development of the baby's bones. In terms of health services for children, mothers also expressed satisfaction with the distribution of Vitamin A for children aged 0–5 years and the distribution of available vitamins. However, they reported dissatisfaction with the "*Garantisadong Pambata*" (deworming (*Pampurga*) for children aged 12–23 months with half a tablet, and for children aged 24–71 months with one (1) tablet), and immunizations for rotavirus, poliomyelitis, measles, and tuberculosis. The findings also revealed that demographic factors such as ethnicity, educational attainment, and age are significant predictors of maternal and child health service utilization. These results underscore the importance of developing targeted health interventions that consider the specific demographic profiles and needs of different groups within Isla Sombrero, thereby enhancing the effectiveness and accessibility of healthcare services in the community.

Keywords: satisfaction, availment, rural health unit (RHU), mothers

Suggested citation:
Pagliawan BD, Doller DJA, Pasion RB, Caabas DC. 2026. Level of Satisfaction on Health services among Mothers in Isla Sombrero, Poblacion, Aborlan, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 160). Western Philippines University, Palawan, Philippines.

Maternal Autonomy: A Phenomenological Inquiry on the Participation of Tagbanua Women in Household Decision–making

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ABSTRACT

This study examined the maternal autonomy of Tagbanua women in Barangay Cabigaan, Aborlan, Palawan, focusing on their participation in household decision–making. Specifically, it aimed to explore women's involvement in physical, social, and economic decisions; identify socio–cultural practices influencing their autonomy; and determine the challenges they encounter along with their coping mechanisms. A qualitative phenomenological research design was employed, utilizing in–depth interviews with nine Tagbanua mothers. Data were analyzed using thematic analysis to capture their lived experiences. Findings revealed that women actively participate in daily household management, caregiving, and routine decision–making, while men generally retain authority over major financial and structural decisions, reflecting persistent patriarchal norms. Shared decision–making was evident in areas such as parenting, healthcare, and household responsibilities, indicating evolving gender roles within families. However, women's autonomy remains constrained by economic dependence and deeply rooted cultural expectations. To navigate these limitations, participants employed adaptive strategies such as respectful negotiation, emotional regulation, and indirect influence to assert their roles while maintaining family harmony. The study concludes that although Tagbanua women exercise agency within traditional structures, their autonomy is still shaped by socio–cultural and economic factors. It is recommended that local government units and development organizations implement culturally sensitive programs that promote women's economic empowerment, strengthen decision–making capacities, and support gender–responsive initiatives in indigenous communities.

Keywords: Indigenous women, Decision–making, Cultural Practices, Gender Roles, Indigenous Communities

Suggested citation:
Delos Reyes RG, Cabildo RA, Cardama SB. 2026. Maternal Autonomy: A Phenomenological Inquiry on the Participation of Tagbanua Women in Household Decision–making. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 161). Western Philippines University, Palawan, Philippines.

Putting into Practice: Assessment of School Learning Action Cell (SLAC) Program among Elementary Schools in Bataraza District I

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ABSTRACT

In the Philippine context, the DepEd institutionalized the School Learning Action Cell (SLAC) through DepEd Order No. 35, s. 2016, as a school–based continuing professional development strategy. SLAC provides structured opportunities for teachers to collaboratively address instructional challenges, analyze learner data, share best practices, and align classroom strategies with national standards. This study aimed to assess the implementation of the School Learning Action Cell (SLAC) program among elementary schools in Bataraza District I, Palawan, Philippines. A descriptive research design was employed. Data were collected from 180 purposively selected elementary teachers actively involved in SLAC activities. A validated Likert–scale questionnaire was utilized to measure implementation level, organizational support, and challenges encountered. Data were analyzed using descriptive statistics and correlation analysis. Findings revealed that the SLAC program is highly implemented, particularly in fostering collaborative learning, enhancing instructional practices, and aligning professional development with classroom needs. Organizational factors moderately supported implementation, with leadership support and administrative encouragement emerging as key enabling conditions. A strong and statistically significant positive relationship was found between organizational factors and SLAC implementation, indicating that schools with stronger structural and leadership support demonstrate higher implementation quality. While teachers exhibited positive attitudes toward SLAC, moderate challenges were identified, primarily related to workload, time constraints, and limited financial resources. The SLAC program remains a viable and contextually relevant model for school–based professional development in Philippine basic education. To maximize its impact, policymakers and school leaders should strengthen organizational capacity, expanding facilitator training, ensure sustained leadership support, and enhance monitoring and evaluation mechanisms. Future studies may explore the long–term impact of the SLAC program on student performance outcomes, conduct qualitative investigations into leadership practices supporting SLAC program, or replicate the study in other districts to enhance generalizability of findings.

Keywords: department of education (DepEd), organizational support, professional learning communities, school learning action cell, teacher professional development

Suggested citation:
Butaca BR. 2026. Putting into Practice: Assessment of School Learning Action Cell (SLAC) Program among Elementary Schools in Bataraza District I. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 162). Western Philippines University, Palawan, Philippines.

STEM Education in ASEAN Countries: Practices and Way Forward

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ABSTRACT

Several countries have developed STEM education to boost global competitiveness. Studies on STEM implementation have revealed that educators and curriculum developers employ a variety of frameworks. These variances highlight the need for educators in the ASEAN community to have a shared understanding of STEM implementation to guide their teaching practice. The study used the Preferred Reporting Items for Systematic Reviews and Meta–Analyses (PRISMA) method to systematically search databases, screen studies using predefined criteria, evaluate full–text articles for eligibility, and analyze and report the final selected articles. Out of 988 identified studies, only 11 met the inclusion criteria. The findings show varied approaches and levels of STEM implementation, with teachers facing multiple challenges. Few studies have reported, limiting efforts to develop a comprehensive knowledge base on STEM implementation across ASEAN countries, and geographical and practical gaps have also been noted. The study highlights that while STEM education has been implemented across ASEAN countries, success varies by region. Overall, STEM education is shown to improve learning outcomes, but there are significant geographical disparities in its effectiveness and implementation. The emerging knowledge base related to this inquiry presents opportunities for future research, including engaging students, supporting teachers, examining government policies, and exploring parental support.

Keywords: ASEAN education, STEM approaches, STEM curriculum, STEM implementation, STEM education

Suggested citation:
Sarsale JS, Lopez ENB, Alia LC, Alejandro BA. 2026. STEM Education in ASEAN Countries: Practices and Way Forward. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 163). Western Philippines University, Palawan, Philippines.

Workload and Performance of Elementary Teachers in Narra Del Norte

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ABSTRACT

Workload refers to the amount of teaching load and other tasks incidental to regular teaching duties performed within a specific period. Teaching load especially includes the actual classroom hours rendered by teachers. Understanding teachers' workload is essential in evaluating its impact on teaching performance and overall effectiveness. The study aimed to determine the teaching load, teaching–related assignments and teaching performance of elementary teachers in Narra Del Norte. It also examined differences in workload based on school category and number of preparations, as well as the problems encountered and solutions employed in performing teaching–related assignments. A descriptive research design was utilized. Frequency counts, percentages, and means were used to assess workload and ancillary tasks. Pearson's r was applied to determine the relationships between workload and teaching performance, while the Kruskal–Wallis test was used to identify significant differences in workload across groups. Problems encountered and corresponding solutions were analyzed using frequency counts and percentages. Findings revealed that the respondents' workload and number of preparations complied with the prescribed teaching hours per week. Teachers with more teaching–related assignments tended to receive higher performance ratings. All respondents handled teaching–related assignments regardless of school category. The most common problems identified were lack of instructional materials and excessive reporting requirements. The workload and number of preparations of the respondents were within prescribed standards. No significant relationship was found between teaching load, number of preparations, and teaching performance. Lack of materials emerged as the primary challenge faced by the teachers. It is recommended that schools provide adequate instructional materials and support teachers' professional development through training programs such as INSET and SLAC. Teachers are also encouraged to strengthen time management, resourcefulness, and commitment to assigned tasks.

Keywords: ancillary task, teaching–related assignments, workload

Suggested citation:
Aquino EA. 2026. Workload and Performance of Elementary Teachers in Narra Del Norte. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 164). Western Philippines University, Palawan, Philippines.

Assessing Facility Needs for Rural School Infrastructure: A Case Study of Maruso Elementary School, Rizal, Palawan

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ABSTRACT

Rural infrastructure development in the Philippines is frequently constrained by high costs and transport dependence, resulting in inadequate facilities at public schools. This study assesses the facility deficits of Maruso Elementary School in Rizal, Palawan, and establishes engineering priorities that civil engineering can address. The study also aims to identify the most urgent facility needs, assess the local availability of specific bamboo varieties, and measure the level of community acceptance and awareness regarding bamboo–based construction. A descriptive feasibility study was conducted using surveys distributed to 72 respondents within the school and local community, mainly focusing on quantifying infrastructure dissatisfaction. The study identified the Comfort Room as the highest priority facility (89.04%), followed by the Waiting Shed (10.96%). A majority of respondents (56%) reported inadequacy in existing comfort rooms and shelters, indicating a need for additional infrastructure. Resource assessment showed that bamboo is widely available, with 94.44% of participants noting its presence in the area. Taken together, these results indicate that context–appropriate, low–cost engineering interventions using locally sourced bamboo can feasibly address the school's most pressing facility needs while building local capacity and reducing reliance on distant suppliers. However, there is a growing concern around 48% regarding the maintenance of bamboo and 33% for its degradability. Suggesting that treated bamboo is essential to improve resistance to biological decay while maintaining structural integrity. Furthermore, strategically reconfiguring the bamboo–concrete interface through mechanical interlocking maximizes the structural efficiency and economic viability of these bio–composite materials. In addition, we suggest exploring the integration of sustainable building materials in these expansions: constructions of school classrooms and waiting sheds, as it is needed and suggested by the respondents, as well as evaluating the feasibility of using bamboo as reinforcement in low–load structures.

Keywords: bamboo–concrete, degradability, bio–composite, mechanical interlocking, low load

Suggested citation:
Calites JCS, Salcedo KJE, Rubio KJM, Pacaldo AP, Acejo JR. 2026. Assessing Facility Needs for Rural School Infrastructure: A Case Study of Maruso Elementary School, Rizal, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 165). Western Philippines University, Palawan, Philippines.

Innovative Biosand Filter Communal Water Treatment at Sitio Sugod–Uno, Barangay Cabayugan, Puerto Princesa City

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ABSTRACT

Access to safe drinking water remains a pressing challenge in rural Philippine communities, where untreated sources pose chemical and microbial risks. This study evaluated the performance of a communal biosand filtration system in Sitio Sugod–Uno, Cabayugan, Puerto Princesa City, to improve drinking water quality and achieve compliance with the 2017 Philippine National Standards for Drinking Water. A longitudinal monitoring design was employed, with water samples collected at baseline and on Days 7, 17, and 67 post–installations. The system utilized a gravity–driven, multi–layered filtration configuration designed to enhance hydraulic conductivity, biological layer development, and contaminant removal, operating at an average flow rate of 0.8 L/min. Samples were analyzed for key physicochemical and microbiological parameters. Baseline analysis showed physicochemical parameters within PNSDW limits but significant microbial contamination (confluent growth with total and fecal coliforms and a heterotrophic plate count of 840 CFU/mL). By Day 67, the IBSFCWT reduced turbidity from 2.6 NTU to 0.2 NTU (92.3% removal), color from 3 ACU to 1 ACU (66.7%), TDS from 297 mg/L to 51 mg/L (82.8%), nitrate from 10.6 mg/L to 0.1 mg/L (99.1%), and heterotrophic plate count from 840 CFU/mL to 50 CFU/mL (94.1%). Total and fecal coliforms were reduced to below detectable limits (<1 CFU/100 mL) within 7 days. The levels of heavy metals (arsenic, cadmium, and lead) were below the detection limits, and the pH and residual chlorine levels were within the recommended ranges. Overall, removal efficiencies ranged from 66.7% to 99.1%, with full compliance with PNSDW standards by Day 67. The IBSFCWT demonstrated sustained improvement in both physicochemical and microbiological water quality, highlighting the importance of a ripening period for filter stabilization. Its multi–layered design, controlled flow rate, and low–maintenance operation provide a practical communal solution to enhance safe drinking water access and reduce waterborne health risks in resource–limited rural settings.

Keywords: community water treatment, microbial removal, schmutzdecke, rural water supply, water quality

Suggested citation:
Gabo MHML, Chavez CMP, Barrios JR. 2026. Innovative Biosand Filter Communal Water Treatment at Sitio Sugod–Uno, Barangay Cabayugan, Puerto Princesa City. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 166). Western Philippines University, Palawan, Philippines.

Level of Compliance with the Philippine Green Building Code (PGBC) among Mainland Municipalities of Palawan

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ABSTRACT

The Philippine Green Building Code (PGBC) was established to improve resource efficiency and minimize environmental impact in the construction sector. In Palawan, a province globally recognized for its ecological significance, localized implementation of these standards is crucial. However, there is a lack of empirical data regarding how mainland municipalities translate these national mandates into local building permit processes, especially given the unique rural–urban profile of the region. This study aimed to evaluate the level of compliance with the PGBC across its ten (10) domains: Policy and Governance, Building Application and Coverage, Energy Efficiency, Water Efficiency, Material Sustainability, Solid Waste Management, Site Sustainability, Indoor Environmental Quality, Institutional Arrangement, and Certification and Enforcement. It assessed the implementation performance of Municipal Engineering Offices among all mainland municipalities of Palawan. The study employed a descriptive–evaluative research design covering all mainland municipalities in Palawan. Data were gathered through technical site inspections, document analysis of building permits, and structured interviews with municipal engineers and building officials. A Likert–scale instrument was used to quantify the level of compliance and implementation performance, with data analyzed using weighted means to determine the overall status across the established green building domains. The evaluation revealed a critical gap in policy implementation, with an overall weighted mean of 1.47, categorizing the mainland municipalities as "Non–Compliant." Out of the ten (10) domains evaluated, nine (9) were found to be "Non–Compliant." Only the Solid Waste Management domain achieved a rating of "Slightly Compliant" with a weighted mean of 1.99. The findings highlight that specialized engineering standards and institutional arrangements remain largely unintegrated into the local building permit systems. These results indicate a significant gap in the integration of green building standards at the municipal level. The study concludes that the implementation of the PGBC among mainland Palawan municipalities is currently ineffective, with a 90% non–compliance rate across the evaluated domains. The current national compliance thresholds and lack of localized guidelines act as barriers rather than catalysts for sustainable development. Without localized mandates and improved technical capacity at the municipal level, the sustainability goals of the PGBC will remain unachieved in the region. It is recommended to develop a localized policy framework that lowers compliance thresholds to suit provincial construction scales. Further capacity–building for Municipal Engineering Offices and the adoption of a simplified green building checklist for small–to–medium scale projects are essential to enhance regional sustainability and environmental protection in Palawan.

Keywords: Philippine green building code, mainland Palawan, municipal engineering, building compliance, sustainability

Suggested citation:
Monte JMG. 2026. Level of Compliance with the Philippine Green Building Code (PGBC) among Mainland Municipalities of Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 167). Western Philippines University, Palawan, Philippines.

Community Awareness of Cybercrime and Security Measures in Rural Palawan, Philippines: Insights for Evidence–Based Policy and Local Governance

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ABSTRACT

This study assesses community awareness of cybercrime and helps the community secure itself from cyber threats. The findings show that respondents have a mean age of 43.2 years and that their income comes from small businesses they established in the barangay. Their demographic profile influences their perceptions of the community's safety needs and awareness of digital activities. The respondents believe that reporting cybercrime helps prevent future incidents. Sex significantly influences the measured variable, with females showing higher responses than males at the 0.05 level of significance. Schools teach students digital citizenship and cybersecurity, emphasizing the importance of understanding digital footprints and applicable rules. The seminar aims to raise community awareness of cyber threats, such as hacking, phishing, and scams, to help detect suspicious online activity and, in case of an emergency, report to the proper authority, such as the Anti–Cybercrime Unit or the Philippine National Police. This study recommends initiating a cybercrime awareness plan that includes studies of crime incidence, cyber best practices, cyber reporting, and implementation–related issues. This includes the adoption and formulation of policies from the local government units, the province, and the municipal government of rural areas in Palawan.

Keywords: cybercrime awareness, cybersecurity, community awareness, digital citizenship

Suggested citation:
Gabileo EC, Olano RG. 2026. Community Awareness of Cybercrime and Security Measures in Rural Palawan, Philippines: Insights for Evidence–Based Policy and Local Governance. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 168). Western Philippines University, Palawan, Philippines.

Youth With A Mission Programs in Palawan, Philippines

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ABSTRACT

NGOs and NPOs like Youth With A Mission (YWAM) are recognized by the Philippine government as partners in nation–building. This study examines the impact of YWAM programs in Palawan from the perspectives of volunteers and clients, aiming to inform program improvements and benefit the YWAM community, donors, and leadership. The study aimed to assess the levels of participation, satisfaction, and challenges encountered by volunteers and clients in YWAM Palawan programs, and to examine the relationships among these variables. A descriptive–correlational design was used with face–to–face data from 20 volunteers and 40 clients in YWAM programs. The study was conducted in Puerto Princesa, Bataraza, and Rizal, Palawan (Apr–Jun 2025), with limited client data due to restricted access to inmates at Iwahig and remote indigenous communities. Findings showed that Volunteers (avg. 45) were mostly female, college graduates, split single/married and full/part–time, many church ministers, with 15 years' service. Clients (avg. 33) were mostly single, high–school level, with 5 years' participation. Volunteers sometimes joined Mercy Ministry/Evangelism and rarely Training; clients rarely or never participated. Volunteers were satisfied, clients highly satisfied; challenges were minimal. Participation related to several demographics, while type of volunteerism influenced volunteer satisfaction, and some demographics related to challenges. The study demonstrated that YWAM programs in Palawan show high satisfaction levels and minimal challenges among volunteers and clients, with participation influenced by demographic factors. The findings highlight opportunities to strengthen program engagement and enhance overall effectiveness, supporting continued improvement in ministry impact. Enhance programs with low engagement, apply demographic–based and experience–sensitive strategies, and pursue further research using mixed methods to better understand growth and satisfaction dynamics.

Keywords: client, evangelism, mercy ministry, training, volunteer

Suggested citation:
Camacho JE. 2026. Youth With A Mission Programs in Palawan, Philippines. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 169). Western Philippines University, Palawan, Philippines.

SESSION 3 – INTEGRATED RESEARCH, INNOVATION, AND DEVELOPMENT (EDUCATION · SOCIAL SCIENCES · BUSINESS · GOVERNANCE · ICT · ENGINEERING · INTERDISCIPLINARY STUDIES)

Development of a Foot–Operated Coconut Dehusker

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ABSTRACT

This study focused on the development of a foot–operated coconut dehusker designed to improve the efficiency, safety, and usability of coconut dehusking for small–scale farmers, as traditional manual methods are labor–intensive, time–consuming, and expose workers to physical strain and potential injury. This study aimed to address these challenges by designing and fabricating a foot–operated dehusker using a lever–powered mechanism to generate sufficient force for husk removal. A quantitative experimental research design was employed to evaluate the machine's performance. The fabrication process involved machine design, material selection, and assembly of key components such as the frame, lever mechanism, blade assembly, and return spring. The machine was tested using 25 mature coconuts under controlled conditions, with five respondents participating in the trials. Performance was evaluated using a Likert–scale–based checklist measuring durability, ease of operation, safety, stability, and reliability, along with dehusking speed and efficiency. The results showed high acceptability ratings for durability (3.68), stability (3.44), reliability (3.44), ease of operation (3.44), and safety (3.56), all interpreted as strongly agree, with an overall mean of 3.51, also interpreted as strongly agree, indicating high usability. The machine achieved an average dehusking rate of 4.53 coconuts per minute and an efficiency of 92%. The findings demonstrate that the developed foot–operated coconut dehusker significantly improves performance compared to traditional methods and provides a practical, efficient, and user–friendly solution for small–scale farmers. Further studies may be conducted to enhance the design, improve efficiency, and explore the machine's applicability in larger–scale operations.

Keywords: agricultural mechanization, coconut dehusking, dehusking efficiency, foot–operated machine, small–scale farming

Suggested citation:
Caralipio MJC, Castromayor KJS, De Venecia XSA, Dulnuan BSM. 2026. Development of a Foot–Operated Coconut Dehusker. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 170). Western Philippines University, Palawan, Philippines.

Development of Pneumatic–Driven Coconut Milk Extractor

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ABSTRACT

Traditional methods of extracting coconut milk are labor–intensive and time–consuming, and often yield inconsistent results due to uneven manual pressure. This study aimed to design, fabricate, and evaluate a pneumatic–driven coconut milk extractor to reduce physical effort and make coconut milk extraction faster, easier, and more convenient. To address these limitations, a prototype that utilized compressed air to apply control and uniform pressure was developed. A developmental and experimental research design was employed. Four treatments were conducted using a fixed amount of 500 g of coconut with different grating and extraction methods. The device's performance was evaluated based on milk extraction mass, volume, extraction time, extraction capacity, and efficiency. Results showed that manual extraction required longer processing time and produced varying coconut milk recovery, while machine–assisted extraction provided faster operation and more consistent results. Treatment 4, which used machine grating and pneumatic extraction, produced 241.66 g of milk yield and 235 mL of volume, with a shorter extraction time of about 4.67 minutes, indicating the successful performance of the developed pneumatic–driven coconut milk extractor. The findings indicate that the developed device is practical and efficient, helping improve productivity and consistency in coconut milk processing for households and small food businesses. The study recommends the adoption of the pneumatic–driven coconut milk extractor by households and local processors to improve efficiency and consistency. It also encourages future researchers to enhance the machine's durability and performance, while future studies should conduct further testing to validate its efficiency. Proper guidelines for safe and long–term use are also suggested.

Keywords: agricultural innovation, coconut milk extraction, extraction efficiency, pneumatic system, small–scale processing

Suggested citation:
Reid KAA, Arga KEV, Abortigue JPB, Pamittan FM. 2026. Development of Pneumatic–Driven Coconut Milk Extractor. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 171). Western Philippines University, Palawan, Philippines.

Digital Market Ecologies and Enterprise Resilience: A Cross–Scale Analysis of Social Media Marketing Dynamics among Micro and Small Enterprises in Narra, Palawan

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ABSTRACT

This study investigates the dynamics of social media marketing (SMM) within the evolving digital market ecology of micro and small enterprises (MSEs) in Narra, Palawan, and examines its implications for enterprise resilience and performance. Integrating findings from two descriptive–correlational studies involving 237 micro enterprises and 17 small enterprises, the research adopts a cross–scale analytical approach to capture structural, behavioral, and strategic variations in SMM adoption and utilization. Results reveal that across both enterprise scales, SMM is a deeply embedded marketing practice, with Facebook emerging as the dominant platform, complemented by limited multi–platform engagement. Enterprises commonly utilize user–generated content and product–centered messaging, reflecting adaptive, low–cost marketing strategies within resource–constrained environments. Despite differences in scale, both micro and small enterprises exhibit convergent patterns in posting frequency, platform reliance, and strategic orientation, indicating a shared digital behavior shaped by local market conditions and technological accessibility. However, scale–specific distinctions are evident. Micro enterprises demonstrate higher variability in experience levels and shorter SMM adoption periods, suggesting emerging digital capabilities, while small enterprises exhibit greater maturity and stability in SMM integration. Across both groups, key constraints include time limitations, competitive pressures, and limited strategic diversification, which influence the depth of digital engagement. Statistical findings consistently indicate that SMM exerts a significant positive influence on business performance, particularly in terms of sales growth, customer engagement, and brand awareness, reinforcing its role as a critical enabler of enterprise resilience in localized economies. Reliability measures across both datasets confirm strong internal consistency of performance indicators. The study conceptualizes SMM as part of a broader digital market ecology, where enterprises co–evolve with platform affordances, consumer behavior, and competitive interactions. It argues that resilience among MSEs is increasingly contingent upon adaptive digital capabilities, platform diversification, and strategic content innovation. The findings contribute to the discourse on rural and semi–urban digital entrepreneurship by offering a cross–scale empirical synthesis, and recommend targeted capacity–building programs, ecosystem–based digital support interventions, and expanded multi–platform strategies to strengthen enterprise sustainability. The findings contribute to localized economic resilience and digital transformation, aligning with global development priorities such as the United Nations Sustainable Development Goals—particularly SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure).

Keywords: digital market ecology, enterprise resilience, social media marketing, micro and small enterprises, cross–scale analysis, business performance, Narra Palawan

Suggested citation:
Lleve Jr. EE, Daquila CL, Hamorsa JPA. 2026. Digital Market Ecologies and Enterprise Resilience: A Cross–Scale Analysis of Social Media Marketing Dynamics among Micro and Small Enterprises in Narra, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 172). Western Philippines University, Palawan, Philippines.

Automating the Approval Chain: An E–Faculty Workload System with Integrated Signatory Tracking

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ABSTRACT

Managing faculty workloads using traditional paper–based methods often leads to administrative bottlenecks, delayed approvals, and a critical lack of transparency. To address these challenges, this study aimed to design, develop, and evaluate an E–Faculty Workload System with integrated signatory tracking to automate the multi–level approval workflow at Western Philippines University. Guided by the Design and Development Research (DDR) methodology and the ADDIE model, a web–based platform was built using React.js, Node.js, and PostgreSQL. The system was evaluated by 64 purposively selected participants, including faculty and administrators, to assess its efficiency and usability. Implementation revealed an 86.2% reduction in document processing time, dropping from an average of 15.2 days manually to just 2.1 days using automated routing. User feedback indicated exceptionally high satisfaction, particularly for the signatory tracking module which scored a mean of 4.78 out of 5, alongside high system engagement and minimal error logs. The digital platform successfully eliminates the inefficiencies of manual routing, proving that automated signatory tracking significantly enhances administrative transparency, accountability, and overall operational efficiency in academic institutions. Future initiatives should focus on scaling the system across other university campuses, integrating it with existing human resource databases, and exploring mobile application deployment to further maximize accessibility and institutional resilience.

Keywords: e–faculty workload, signatory tracking, workflow automation, addie model, educational technology

Suggested citation:
Alterado FA, Acosta CJM, Golez HRD. 2026. Automating the Approval Chain: An E–Faculty Workload System with Integrated Signatory Tracking. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 173). Western Philippines University, Palawan, Philippines.

Social System Barriers of Out–of–school Youth in Accessing the Alternative Learning System

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ABSTRACT

The Philippines is among several nations that highly value education; however, the prevalence of out–of–school youth (OSY) continues to rise. In response, the Department of Education designed the Alternative Learning System in compliance with the Millennium Development Goal (MDG) of UNESCO, which is to achieve universal primary education (Baccal & Ormilla 2021). However, despite of this opportunity provided by the government, Tomacruz (2018) revealed that there were low participation and passing rates in ALS. This study aimed to explore the social system barriers impeding out–of–school youth in accessing the ALS, considering the ecological framework across multiple systemic levels: (a) Individual, (b) Microsystem, (c) Mesosystem, (d) Ecosystem, and (e) Macrosystem, within Barangay Poblacion, Aborlan, Palawan. Researchers employed a qualitative phenomenological research design. Purposive sampling was utilized to select six out–of–school youths from the target area. Thematic analysis was applied to systematically interpret the qualitative data, identifying recurring patterns and themes. The analysis revealed three primary themes reflecting social system barriers encountered by OSY in accessing ALS: (1) Intrapersonal Challenges, (2) Interpersonal Challenges, and (3) Inaccessibility. Notably, the findings indicated that intrapersonal challenges, particularly feelings of school refusal and a lack of motivation, constitute the most significant barriers preventing participants from enrolling in or continuing with ALS. This study revealed a complex interplay among intrapersonal, interpersonal, and environmental factors that influenced the educational pathways of OSY. Internal challenges, such as lack of motivation and school refusal, were compounded by external barriers like geographical distance and limited information about available programs. Findings suggested that targeted interventions focusing on individual support mechanisms and community engagement might prove highly effective in promoting sustained educational participation among OSY. Based on the findings, several recommendations were proposed: (1) intensify efforts to improve dissemination of information regarding the ALS through strengthened collaboration among local agencies; (2) upgrade existing facilities to enhance accessibility and foster a conducive learning environment; and (3) establish a systematic approach for the continuous collection and sharing of data on OSY within the barangay to facilitate targeted interventions.

Keywords: individual, microsystem, mesosystem, ecosystem, and macrosystem

Suggested citation:
Ombe BVR, Batul YGC, Arididdon JRC, Caabas DC. 2026. Social System Barriers of Out–of–school Youth in Accessing the Alternative Learning System. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 174). Western Philippines University, Palawan, Philippines.

Fingerprint Classification of Police Investigators: A Competency–Based Enhancement Program

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ABSTRACT

A police investigator must acquire the essential knowledge to perform a police investigation. Law enforcement agencies can only apprehend suspects through knowledge gathered from forensics, intelligence, and interview of victims and witnesses and by interrogating suspects. Police investigators need investigation and detective competencies to perform a police investigation. Investigative and detective competency development has a broad scope. This study determined the competence in fingerprint classification among police investigators in Southern Palawan for the year 2022–2023 as the basis for the crafting of a competency–based enhancement program in fingerprint classification. The data were obtained using a validated and pre–tested researcher–made questionnaire which assessed the competence of police investigators in terms of their knowledge and skills in fingerprint classification. Frequency count, percentage, mean and standard deviation were used for descriptive analysis of the data; Mann–Whitney U test and Spearman Rho were used for inferential analysis. The result of the study showed that the entire group of police investigators had a high level of competence in terms of knowledge as when they were classified into their educational attainment and years in service. In terms of skills in fingerprint classification, the result of the study showed that the entire group of police investigators had an average level of competence as well as when they are classified into their educational attainment and years of service. No significant difference existed in the level of competence of police investigators in fingerprint classification in terms of knowledge and skills when they were classified as to educational attainment and years in service. The findings further showed a significant relationship between the knowledge and skills competency level of police investigators in fingerprint classification. A competency–based enhancement program designed to improve the knowledge and skills of police investigators in classifying fingerprint.

Keywords: fingerprint classification, police investigators, identification, fingerprint, enhancement program

Suggested citation:
Dumdumaya GO. 2026. Fingerprint Classification of Police Investigators: A Competency–Based Enhancement Program. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 175). Western Philippines University, Palawan, Philippines.

Implementation of Duties and Responsibilities of the Barangay Anti–Drug Abuse Council in Selected Barangays of Aborlan, Palawan

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ABSTRACT

This study was conducted at five selected barangays in Aborlan namely: Barangay PlaRIDEl, Barangay Ramon Magsaysay, Barangay Poblacion, Barangay San Juan and Barangay Iraan Aborlan, Palawan from April 2025 to January 2026. It aimed to determine the implementation of the duties and responsibilities of the Barangay Anti–Drug Abuse Council (BADAC) in these barangays. The study focused on the perception of barangay residents and BADAC members. Specifically, it assessed respondents' understanding of the council's core functions, including community education on drug risks, coordination with local enforcement, support for rehabilitation programs, the frequency and effectiveness of BADAC initiated activities, and barriers to full implementation. A descriptive research design was employed, with data collected through structured questionnaires and analyze using frequency and percentage, weighted mean, and an independent samples t–test. Results revealed a notable disparity between the two groups: BADAC members perceived the implementation of duties and responsibilities to a very high extent implementation, reflecting confidence in their performance, while residents rated it as moderate implementation, indicating limited visibility and perceived effectiveness of BADAC activities. This study concludes that there is a statistically significant difference between the perceptions of BADAC members and barangay residents regarding the level of implementation of BADAC duties and responsibilities. Recommendations include strengthening monitoring and documentation systems, improving transparency and communications with residents, and enhancing capacity building programs to ensure more effective and sustainable anti– drug initiatives.

Keywords: implementation, duties, responsibilities, residents, BADAC

Suggested citation:
Ramos SM, Dayandayan CC, Aplaon RMP, Peañar AT, Dumdumaya GO. 2026. Implementation of Duties and Responsibilities of the Barangay Anti–Drug Abuse Council in Selected Barangays of Aborlan, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 176). Western Philippines University, Palawan, Philippines.

Evaluation of Teaching Effectiveness across Campuses, Colleges, and Academic Ranks at Western Philippines University: A Cross–Sectional Statistical Study

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ABSTRACT

Teaching effectiveness is a critical determinant of educational quality in higher education, commonly assessed through Student Evaluations of Teaching (SETs). In multi–campus institutions such as Western Philippines University (WPU), variations in instructional quality may arise due to contextual and institutional factors, necessitating empirical evaluation. This study aimed to assess teaching effectiveness across instructional domains, examine differences in evaluations based on demographic and institutional variables, analyze relationships among variables, and explore student perspectives on teaching performance. A descriptive–correlational design was employed, and data were collected through an online survey. The instrument measured seven domains of teaching effectiveness. Descriptive statistics, t–tests, ANOVA, and Pearson correlation were used to analyze the data. Teaching effectiveness across all domains was rated "Very Satisfactory" (M = 4.38–4.48), indicating high and consistent instructional competence. No significant differences were found based on sex or academic rank. However, significant differences were observed across campuses, colleges, and year levels. Weak but significant correlations were found between teaching effectiveness and campus (r = 0.073) and year level (r = 0.110). Qualitative feedback highlighted instructor competence as a strength, while communication issues, particularly voice clarity, were identified as areas for improvement. Instructional quality is generally consistent regardless of faculty rank. However, contextual factors such as institutional environment and student maturity influence evaluation outcomes. Institutions should adopt context–sensitive interventions, enhance instructional communication skills, address campus–level disparities, and strengthen discipline–specific pedagogical strategies to sustain and improve teaching quality.

Keywords: teaching effectiveness, student evaluations of teaching, higher education, descriptive–correlational study, Philippines

Suggested citation:
Gamozo MJD. 2026. Evaluation of Teaching Effectiveness across Campuses, Colleges, and Academic Ranks at Western Philippines University: A Cross–Sectional Statistical Study. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 177). Western Philippines University, Palawan, Philippines.

Procrastination Uncovered: Exploring Experiences, Contributing Factors, and Intervention Strategies of Education Students

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ABSTRACT

Procrastination is a habitual trait among students who delay their tasks despite knowing the negative consequences for their academic performance and well–being. In this generation, students often procrastinate academically, resort to late–night cramming, endlessly scroll on their cellphones, put off tasks, and produce low–quality output. In this phenomenological approach, an in–depth interview with six education students was conducted, and the informants shared their experiences of procrastination, including influencing factors and strategies to overcome it. The participants, both male and female, represented a diverse range of backgrounds, including working students, athletes, and online gamers. Their personal habits and environmental demands influenced procrastination. Students describe academic procrastination as lazy, a lack of motivation, and a preference for pressure–driven work as internal factors that influence it. At the same time, academic workload, submission timelines, and digital distractions such as social media and online gaming were considered as external factors. Informants delayed their tasks on written work and cognitively demanding activities that require significant mental effort. Although the students often completed their tasks on time, informants admitted that procrastination negatively impacts the quality of their work and increases their stress levels. To manage procrastination, the students employed strategies such as self–discipline and self–motivation, along with time management and productivity techniques. Support from the educational institution in being productive and managing stress can help them. Overall, both individual effort and institutional support were emphasized as key to helping students overcome academic procrastination.

Keywords: procrastination, academic procrastination, academic procrastination experiences, procrastination influencing factors, procrastination intervention strategies

Suggested citation:
Reyes AFT, Rizallosa HYV, Bacltos GMS, Betorin KB, Besoyo LC, Zabalo KAM, Lopez ENB. 2026. Procrastination Uncovered: Exploring Experiences, Contributing Factors, and Intervention Strategies of Education Students. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 178). Western Philippines University, Palawan, Philippines.

Assessing the Feasibility of a Pilot Scale Sustainable Biofiltration Systems for Greywater Treatment and Reuse

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ABSTRACT

Water scarcity and inadequate wastewater treatment are pressing challenges in the Philippines, especially in rural and island communities with limited freshwater and no centralized sewers. Greywater is frequently discharged untreated from sinks, showers, and laundry, causing environmental pollution and public health risks. This study addresses the growing need for sustainable, decentralized water treatment solutions by evaluating the feasibility of a pilot–scale biofiltration system designed to treat greywater and enable safe non–potable reuse. The system's performance was assessed using key water quality parameters, chemical oxygen demand (COD), biochemical oxygen demand (BOD), pH, turbidity, total suspended solids (TSS), and total coliform counts. The result shows significant improvement from greywater to filtered greywater, for BOD, it was reduced 93.86% from the average of 116.71 mg/L for unfiltered to 7.17 mg/L for filtered greywater. While chemical oxygen demand decreased by 94.06% from 286.83 mg/L to 16.49 mg/L. Total suspended solids showed the most significant improvement with a 98.85%reduction from 358.33 mg/L to 4.21 mg/L, and turbidity was reduced by 96.60 percent from 733.33 NTU to 25 NTU. The pH shifted slightly from 7.3 to 8.2, remaining safely within the DENR acceptable range of 6.0 to 9.0. All these physical and chemical parameters complied with the DENRDAO 2016–08 effluent standards. Following a 14–day waiting period to allow for the formation of the schmutzdecke, total coliform levels decreased by 90.42%, dropping from over 1.67×10^7 MPN/100mL to 1.67×10^6 MPN/100mL. Although this indicates a significant reduction in microbial load, it also suggests that additional disinfection is still necessary for applications involving human contact. A follow up test conducted after 28 days revealed a 99.9% reduction, with levels falling from 1.67×10^7 to less than 1 MPN/100mL, thereby meeting the standards set by DENR Administrative Order 2016–08.

Keywords: greywater characterization, biofiltration technology and mechanisms, filter media performance, greywater reuse applications, sustainability and cost–efficiency considerations

Suggested citation:
Salvador RZM, Arzaga KMD, Ransiman JM, Guitic CH, Bautista RAM, Denzon RB. 2026. Assessing the Feasibility of a Pilot Scale Sustainable Biofiltration Systems for Greywater Treatment and Reuse. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 179). Western Philippines University, Palawan, Philippines.

Assessment of Municipal Compliance with PD 1096 in Building Permit Implementation in Municipalities of Mainland Palawan

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ABSTRACT

Building permit regulation is critical for ensuring structural safety, orderly urban development, and compliance with national construction standards. In the Philippines, this is governed by Presidential Decree No. 1096 and the Local Government Code of 1991, which grants municipalities the authority to enforce these regulations. Assessing how municipalities structure their evaluation systems is essential to identify gaps and improve procedural standardization. This study examined the level of compliance of the eleven mainland municipalities in Palawan with PD 1096. It also evaluated municipal building permit evaluation tools in relation to national requirements and identified operational concerns encountered during implementation. A descriptive research design was used. Data were gathered using a structured compliance checklist derived from the Revised Implementing Rules and Regulations (IRR) of PD 1096. The checklist evaluated five dimensions: administration and staffing; permit application and processing; inspection and post–construction; enforcement, violations, and appeals; and safety, dangerous buildings, and technical assistance. Data were analyzed using mean scores, standard deviation, and frequency distribution. Results showed that all five dimensions were rated as fully compliant, indicating that the mainland municipalities have established the required administrative systems and procedures for permit issuance. However, notable variations were observed in enforcement, inspection monitoring, and safety–related activities, reflecting differences in how procedures are applied on the ground. While the legal and administrative framework for processing permits is well–established and aligned with national standards, the consistency of field implementation and monitoring varies across municipalities. The study recommends the development of structured and standardized evaluation approaches to strengthen consistency. Improving documentation practices and monitoring mechanisms will help bridge the gap between administrative procedures and actual implementation practices.

Keywords: building permit regulation, municipal implementation, regulatory enforcement, compliance assessment

Suggested citation:
Bacosa JKO. 2026. Assessment of Municipal Compliance with PD 1096 in Building Permit Implementation in Municipalities of Mainland Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 180). Western Philippines University, Palawan, Philippines.

Assessment of Project Scheduling Software on Construction Management within Mainland Palawan

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ABSTRACT

This study assessed the utilization and impact of project scheduling software on construction management within Mainland Palawan. The research focused on identifying the types of software commonly used by construction firms, determining their PCAB classifications, and evaluating the influence of scheduling software on project efficiency, resource management, collaboration, profitability, and overall project success. A descriptive research design was employed, and data were gathered from 56 PCAB–licensed construction firms using a validated survey questionnaire. Frequency distribution, percentage, mean, and standard deviation were used to analyze the responses. Results revealed that the majority of construction firms in Mainland Palawan belonged to Categories B and D, indicating predominantly small– to medium–scale contractors. Microsoft Excel was found to be the most widely used scheduling tool (100%), followed by Microsoft Project (37.5%) and Smartsheet (8.9%). More advanced scheduling tools such as Primavera P6, Procore, and ClickUp showed minimal to no utilization. Findings indicated that project scheduling software has a strong positive impact on various aspects of construction management. Respondents strongly agreed that scheduling tools contribute to timely project completion, improved communication, enhanced collaboration, better resource allocation, and increased organizational efficiency. Additionally, the software was perceived to support cost control, risk mitigation, and continuous improvement ultimately contributing to improved profitability and company performance. The study concludes that while basic tools remain the most widely used due to their accessibility and familiarity, there is significant potential for construction firms in Mainland Palawan to enhance project management performance through broader adoption of advanced scheduling software. Strategies such as training, gradual software integration, and the development of standardized scheduling procedures are recommended to strengthen software utilization within the local construction industry.

Keywords: construction management, project scheduling software, microsoft project, microsoft excel, PCAB license

Suggested citation:
Asdam JVB. 2026. Assessment of Project Scheduling Software on Construction Management within Mainland Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 181). Western Philippines University, Palawan, Philippines.

Design and Fabrication of Electric Lawn Mower with Grass Collector

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ABSTRACT

Lawns are vital to urban landscapes yet maintaining them is labor–intensive and time–consuming. Traditional fuel–powered mowers create noise, emissions, and operational costs, while manual collection prolongs the task. This study presents an eco–friendly alternative: an electric lawn mower with integrated grass collector (ELMGC), designed to cut and gather clippings simultaneously, reducing effort and environmental impact. The study aimed to design and fabricated an ELMGC using local materials, evaluate its cutting and collection efficiency across different blade types and depths, and determine its suitability for small–scale or institutional use. Developed using an experimental framework, the machine was constructed from C–channel bars, steel shafts, and DC motors. Testing took place at Western Philippines University using nylon and steel blades at depths of 1.00 in., 1.50 in., and 2.00 in. Performance was measured via cutting time, collection volume, and statistical analysis including ANOVA and T–tests. Both blade types performed similarly in cutting speed. However, collection efficiency varied: steel blades excelled at medium and deep settings, while nylon blades worked better at shallow depths. The machine operated quietly with zero direct emissions and reduced manual labor requirements. The ELMGC proved functional, reliable, and eco–friendly. It successfully combined mowing and collection. Optimize blade–to–cover fit, use vertical motors, and implement automatic height adjustments. Wider compatibility of blades, brushes, and conveyors, along with larger rear wheels and differential mechanisms, can further enhance performance.

Keywords: ELMGC, zero direct emission

Suggested citation:
Candelaria CA, Maghari EJ, Vigo JPM, Montegrejo RC, Cinches IK. 2026. Design and Fabrication of Electric Lawn Mower with Grass Collector. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 182). Western Philippines University, Palawan, Philippines.

Developing a Policy Framework for Traditional and Automated Monitoring Innovations for Efficient and Safe Construction Practices in Palawan

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ABSTRACT

This study was conducted in Palawan from June 2025 to September 2025 to assess current construction monitoring practices and develop a policy framework promoting an integrated approach to traditional and automated innovation. Using a quantitative and descriptive design, the study utilized a purposive sample of 61 construction firms, primarily focusing on smaller entities (PCAB Classes B and D) with less than ten years of industry experience. Findings confirmed a heavy reliance on traditional, manual methods (Manual Site Inspection and Logging, Excel Spreadsheets), with advanced digital solutions showing near–zero adoption. Respondents recognized that traditional methods are time–consuming, but that automation offers great potential for enhanced safety and quick problem identification. The study concluded that technical and economic factors are the most critical barriers to modernization; specifically, small firms lack financial capacity, and remote locations challenge maintenance. These constraints have a highly significant relationship with the difficulties of implementing new technology. The resultant policy framework is designed to mitigate these barriers through subsidized technology adoption programs, localized technical support networks, and the integration of digital safety standards.

Keywords: Palawan construction, monitoring innovation, small firms, automated monitoring, economic barriers

Suggested citation:
Argonzola CB. 2026. Developing a Policy Framework for Traditional and Automated Monitoring Innovations for Efficient and Safe Construction Practices in Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 183). Western Philippines University, Palawan, Philippines.

Development of Abaca Fiber Extraction Machine

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ABSTRACT

Abaca (*Musa textilis*), famously known as Manila hemp, is the strongest natural fiber in the world. While it has evolved from a traditional cordage material into a high–tech industrial resource, many farmers still rely on manual extraction because available machinery often fails to align with local farming conditions or remains financially inaccessible. This study aimed to develop, fabricate, and evaluate an Abaca Fiber Extraction Machine tailored to these needs. The machine was designed with key components including an extraction cylinder unit, roller and beater bars, a frame assembly, and intake and discharge units. Performance evaluation revealed that at an extraction cylinder speed of 1,300 rpm, the machine achieved a capacity of 6.12 kg/hr of dried fiber, an extraction efficiency of 81.90%, and a fiber recovery rate of 3.58%. Economic analysis showed a total investment cost of Php 99,315.00. With a projected annual net income of Php 59,420.00, the machine offers a favorable payback period of 1.67 years, demonstrating its technical viability and economic feasibility for local abaca farmers.

Keywords: abaca fiber, abaca fiber extraction machine, machine capacity, machine efficiency, machine fiber recovery

Suggested citation:
Tiw-an CC, Lagan Jr. HG, Lagan CS. 2026. Development of Abaca Fiber Extraction Machine. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 184). Western Philippines University, Palawan, Philippines.

Development of Bamboo Leaves Ash Eco–Bricks for Sustainable School Sanitation in Sitio Tina: A Community–Based Assessment

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ABSTRACT

Lack of sanitary facilities is a common problem that may be encountered in a developing community such as comfort rooms whereas privacy is also a concern. The use of temporary and permeable materials like *sawali* compromises the sanitation and privacy essential for the dignity and health of the students. This study aimed to assess the current state of these facilities and evaluate the feasibility of constructing a new, durable comfort room using locally sourced alternative materials. A survey was conducted among forty–five respondents, including students from grade 3 to grade 6, teachers, and non–teaching staff. The data was gathered through open–ended questions and a 4–point Likert scale to collect the opinions of the respondents. Parent consent was also provided in order to ask permission to the parents of the students to conduct a survey. The results show that over half of the respondents strongly agree that the current facilities are overcrowded, lack essential materials, and offer zero privacy. Survey results show overwhelming community support (84.44%) for constructing a new and durable structure to ensure student safety and hygiene. The survey also confirms the feasibility of using alternative building materials sourced directly from Sitio Tina. While soil is not traditionally used for local construction, respondents verified an abundance of red clay and bamboo leaves. Finally, the data validates the urgent need for replacement facilities and the logistical viability of utilizing local raw materials. The study concludes that Tina Elementary School's lack of sanitary facilities poses a critical need for new, durable infrastructure. With overwhelming community support and a confirmed abundance of local red clay and bamboo leaves, constructing a comfort room using these alternative materials is a feasible solution. Furthermore, mechanical testing to be conducted on these materials to determine their suitability for brick manufacturing.

Keywords: bamboo leaves ash, geopolymerization method, green/unfired soil bricks, seawater, soil

Suggested citation:
Dabalus PCA, Kutat DRAP, Gabo CMD, Pasignace LV, Sefil RG, Villapa JBC. 2026. Development of Bamboo Leaves Ash Eco–Bricks for Sustainable School Sanitation in Sitio Tina: A Community–Based Assessment. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 185). Western Philippines University, Palawan, Philippines.

Evaluating Okra (*Abelmoschus esculentus*) as a Plant–Derived Plasticizing Agent for Cementitious Materials

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ABSTRACT

Cement production is responsible for a considerable portion of global carbon dioxide emissions, pushing for an urgent need for eco–friendly alternatives to chemical admixtures, which present their own environmental challenges and resulted into studies on bio–based materials as viable, renewable, and biodegradable admixtures for cementitious materials. This study aimed to evaluate the potential of okra mucilage as a plasticizing agent by assessing the fresh properties: slump and setting time of the samples and determine the optimum mixture. An experimental design is adopted to evaluate seven treatments: plain control (C1), commercial plasticizer (C2), and five experimental groups (T1–T5) with incremental okra mucilage (OM) dosages from 0.10% to 1.0%. Following the casting and curing of cylindrical specimens, Statistical analysis using ANOVA and Duncan's Multiple Range Test (DMRT) revealed a significant direct correlation between the OM dosage and the enhancement of fresh properties. 1.0%OM was identified as the optimum mixture, achieving a high slump of 164.33 mm and the most extended workability window, with initial and final setting times recorded at 323.33 and 535.67 minutes, respectively. This improvement is attributed to the long–chain polysaccharides in the mucilage, which function as a lubricant to reduce internal particle friction (Oyejobi et al. 2022). Furthermore, the results indicate that the mucilage acts as a controlled retarder, extending the plastic state of the mix while remaining within standardized temporal requirements for hardening (Adebajo et al. 2021). The study concludes that 1.0% OM provides a viable, eco–friendly solution for optimizing workability, offering a renewable and biodegradable alternative to synthetic chemical admixtures in the construction industry. It is recommended to further investigate higher concentrations of okra mucilage to identify its maximum effectiveness and evaluate long–term durability properties to fully confirm its viability for structural engineering.

Keywords: okra mucilage, bio–based admixture, slump, setting time

Suggested citation:
Tayab PNP, Canilla KCS. 2026. Evaluating Okra (*Abelmoschus esculentus*) as a Plant–Derived Plasticizing Agent for Cementitious Materials. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 186). Western Philippines University, Palawan, Philippines.

Evaluating the Tensile Strength of Rattan as a Sustainable Alternative to Steel Reinforcement in Sitio Tina, Culandanum, Aborlan, Palawan

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ABSTRACT

Steel is widely used as reinforcement in concrete; however, its high cost, susceptibility to corrosion, and environmental impact limit its practicality, particularly in developing regions such as the Philippines. This study explores the potential of rattan as a sustainable and cost–effective alternative reinforcement material. Specifically, three locally abundant rattan species found in Sitio Culandanum, Aborlan, Palawan—Labsikan, Calapi, and Bugtong—were evaluated for their tensile strength properties. The study aimed to determine the tensile strength of these rattan species at varying specimen sizes and compare their performance with conventional steel reinforcement. A total of four samples per species were prepared and subjected to two conditions: untreated (sundried for three weeks) and treated (boiled in diesel and sundried for two weeks). All specimens were tested using a Universal Testing Machine (UTM), and the results were analyzed to assess the effects of species type, specimen size, and treatment condition. Findings revealed that both specimen size and rattan species had highly significant effects on tensile strength, with larger specimen sizes resulting in increased performance ($F = 672.24$, $p < 0.05$) and species type showing a strong influence ($F = 3226.82$, $p < 0.05$). Among the species tested, Bugtong consistently exhibited the highest tensile strength across all size categories. Treatment condition also significantly affected performance ($F = 456.60$, $p < 0.05$), with untreated Bugtong samples outperforming treated ones. When compared to steel, a highly significant difference was observed ($F = 30{,}361.08$, $p < 0.05$), as steel demonstrated approximately 2.5 times greater tensile strength (mean = 420) than Bugtong (mean = 168.5). In conclusion, while Bugtong rattan showed promising tensile strength and potential as a sustainable reinforcement material, it remains approximately 40% weaker than steel. The study recommends further investigation into other rattan species and treatment methods to enhance its mechanical properties and broaden its application in sustainable construction.

Keywords: mechanical properties, natural fibers, material treatment, diameter variation

Suggested citation:
Openia JVC, Marcelino JS, Pacquin IAY, Cabar RB, Escaro JG. 2026. Evaluating the Tensile Strength of Rattan as a Sustainable Alternative to Steel Reinforcement in Sitio Tina, Culandanum, Aborlan, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 187). Western Philippines University, Palawan, Philippines.

Fabrication of Cement Board Utilizing Banana Fiber (*Musa paradisiaca* L.) for Reinforcement and Coal Fly Ash as Partial Replacement to Cement

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ABSTRACT

The increasing demand for sustainable and cost–effective construction materials has driven the exploration of agricultural and industrial wastes such as banana fiber (BF) and coal fly ash (CFA) as viable alternatives in cement board production. This study aimed to evaluate the flexural strength of cement boards incorporating BF and CFA. An experimental design was employed using five treatments: T1 (0% BF and CFA) as control, and T2–T5 with 20% CFA and increasing BF content (0.75% to 1.50%). Cement boards were fabricated, cured, and tested. Data were analyzed using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT). Results showed flexural strength remained statistically unchanged across treatments (24.22 MPa to 25.24 MPa), indicating that structural integrity was maintained. The finding confirms that BF and CFA can be effectively utilized to produce cement boards without compromising its structural integrity. Further studies with longer curing days are recommended to improve its flexural strength to enhance the material's practical application.

Keywords: cement board, banana fiber, coal fly ash, flexural strength

Suggested citation:
Cuervo JJS, Esteban KMB. 2026. Fabrication of Cement Board Utilizing Banana Fiber (*Musa paradisiaca* L.) for Reinforcement and Coal Fly Ash as Partial Replacement to Cement. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 188). Western Philippines University, Palawan, Philippines.

Feasibility of a Pilot–Scale Sustainable Biofiltration System for Greywater Treatment and Reuse at Sombrero Elementary School

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ABSTRACT

Water shortage and limited access to water supply are common problems in small island schools such as Sombrero Elementary School in Aborlan, Palawan. The school relies mainly on well water, which is sometimes insufficient for daily activities. Greywater reuse through a biofiltration system offers a sustainable alternative to reduce freshwater demand and provide a supplementary source for non–potable applications. This study aimed to assess the feasibility of implementing a pilot–scale sustainable biofiltration system for greywater treatment and reuse in terms of water usage, water shortage experience, awareness of greywater reuse, community acceptance, and willingness to operate and maintain the system. A survey questionnaire was used to collect data from Grade 5 and Grade 6 students and their parents. A sample size of 33 respondents was determined with the assistance of a statistician. Parental consent was secured prior to data collection. The gathered data were analyzed using descriptive statistics such as frequency counts and percentage distribution. The results showed that 45.45% of water usage in the school is for washing, and 51.52% of respondents reported experiencing water shortage. About 93.94% of respondents were not familiar with the term greywater, and 75.76% did not reuse water for non–drinking purposes. However, after explaining the concept, 100% of respondents supported the installation of the biofiltration system. The main concern identified was the safety of treated water (69.70%), while 84.85% expressed willingness to participate in training for system operation and maintenance. The study concluded that the proposed biofiltration system is feasible due to strong community support, existing water scarcity, and readiness for participation. It is recommended to proceed with the pilot–scale implementation of the biofiltration system, conduct water quality testing to ensure the safety of treated greywater, and provide training and awareness programs for the school community regarding greywater reuse and system maintenance.

Keywords: greywater, biofiltration, feasibility study, water reuse, non–potable water, sustainability

Suggested citation:
Arzaga KMD, Bautista RAM, Guitic CH, Ransiman JM, Salvador RZM, Denzon RB. 2026. Feasibility of a Pilot–Scale Sustainable Biofiltration System for Greywater Treatment and Reuse at Sombrero Elementary School. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 189). Western Philippines University, Palawan, Philippines.

Harnessing Vehicular Energy: Design and Fabrication of a Speed Bump Power Generator using Gear and Flywheel Mechanism

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ABSTRACT

This study relates to designing, fabrication, and calculation of a Speed Bump Power Generator (SBPG) that converts vehicular kinetic energy into electrical energy in ramp using a gear and flywheel mechanism. The objective of the study was to develop a machine to harness the energy of vehicles approaching ramp. The prototype was tested across three vehicle categories motorcycle (175 kg), tricycle (250 kg), and car (900 kg) with forty (40) replications per vehicle type. Voltage and power output were measured at both front and rear wheel generator mechanisms to assess the system's energy conversion performance. Across 40 trials, the SBPG recorded a grand mean voltage of 11.87 V and a mean power of 0.49 W. The motorcycle yielded the highest outputs at 12.08 V and 0.52 W, while the car and tricycle produced nearly identical results at approximately 11.77 V and 0.48 W. Frequency distributions showed most readings clustered between 10.1–15.0 V and 0.41–0.60 W, with a total system efficiency of 23.02%. The Speed Bump Power Generator (SBPG) successfully converted vehicular kinetic energy into electricity, averaging 11.87 V and 0.49 W per pass. Rear wheels consistently outperformed front wheels due to higher axle loads, while motorcycles (the lightest vehicles) unexpectedly produced the highest power at 0.52 W likely because heavier vehicles caused mechanical vibrations and energy dispersion. Despite an average efficiency of 23.02%, the system is a feasible micro–energy harvester for low–power applications if mechanical alignment is optimized. Future SBPG iterations should adopt regulated battery storage with boost converters and replace the DC motor with a brushless generator for better efficiency and durability. To ensure outdoor reliability, the housing requires drainage and corrosion resistance. Most importantly, transitioning from a rack–and–pinion to a crankshaft mechanism is recommended to achieve sustained rotational energy.

Keywords: power generation, ramp, SBPG, renewable energy, vehicle

Suggested citation:

Gonzales JHA, Cenit EJM, Forio CJG, Abueva MKL, Angeles AD. 2026. Harnessing Vehicular Energy: Design and Fabrication of a Speed Bump Power Generator using Gear and Flywheel Mechanism. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 190). Western Philippines University, Palawan, Philippines.

Optimization of Compressed Earth Blocks using Clam Shell (*Polymesoda erosa*) Powder as a Bio–Binder and Coconut Fiber Reinforcement

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ABSTRACT

In the Philippines, Concrete Hollow Blocks (CHBs) are the predominant walling material utilized in the construction industry. To address the environmental and economic drawbacks of conventional materials, this study investigated the fabrication of Compressed Earth Blocks (CEBs) utilizing clam shell powder as a natural binder and coconut fiber as structural reinforcement. Discarded clam shells, an abundant aquaculture waste rich in calcium carbonate (CaCO3), offer a viable and sustainable substitute for commercial cement in stabilization. Laboratory tests were conducted to evaluate the mechanical performance of the fabricated CEBs (203.2 mm x 101.6 mm x 63.5 mm). The experimental design comprised five treatments: a control group (Treatment 1) containing 15% cement and 0% clam shell powder, and four experimental groups (Treatments 2–5) containing varying proportions of cement and clam shell powder, each supplemented with a constant 0.5% coconut fiber. A total of 45 samples were fabricated, subjected to a 28–day curing period, and tested for compressive and flexural strength. Statistical analysis using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT) revealed that the integration of these natural additives significantly influenced the mechanical properties of the blocks. Results indicated that Treatment 2 (10% cement, 5% clam shell powder, and 0.5% coconut fiber) exhibited the optimal structural performance, achieving the highest compressive and flexural strengths of 5.35 MPa and 3.77 MPa, respectively. However, findings demonstrated that an excessive substitution of cement with clam shell powder reduces the blocks' mechanical integrity. By optimizing these local waste products, this study successfully formulated a durable, affordable, and sustainable building material that passes structural standards while promoting a circular economy.

Keywords: compressed earth blocks, clam shell, coconut fiber, natural binder, compressive strength, flexural strength

Suggested citation:
Lucero MDL, Villapa JBC. 2026. Optimization of Compressed Earth Blocks using Clam Shell (*Polymesoda erosa*) Powder as a Bio–Binder and Coconut Fiber Reinforcement. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 191). Western Philippines University, Palawan, Philippines.

The Effect of Geopolymer Cement and Recycled Plastic Aluminates on the Flexural Strength of Roofing Materials

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ABSTRACT

The growing accumulation of plastic waste and the high carbon emissions associated with conventional Portland cement highlight the need for sustainable construction alternatives. Recycled Plastic Aluminates (RPA) combined with Geopolymer Cement (GPC), derived from coal fly ash, present a promising solution for developing eco–friendly roofing materials with enhanced performance. This study aimed to evaluate the effect of geopolymer cement on the flexural strength of RPA–based roofing materials and to determine their potential as sustainable construction materials. An experimental approach was employed using varying proportions of RPA (95%–100%) and GPC (0%–5%). A total of 48 specimens were fabricated, processed through melt–intercalation, and cured for 28 days. Flexural strength was measured using a three–point bending test, while thermal resistance, water absorption, permeability, and burn rate were also assessed. Statistical analysis was conducted using ANOVA. The findings showed that incorporating 1%–5% GPC improved the flexural strength of the composites compared to pure RPA. Specifically, the 97% RPA + 3% GPC and 95% RPA + 5% GPC mixtures exhibited superior mechanical performance and enhanced fire resistance. Thermal conductivity remained relatively stable across all mixtures. Among the samples, the 97% RPA + 3% GPC composition demonstrated the most balanced overall properties. The integration of geopolymer cement significantly enhances the flexural strength and overall performance of RPA–based roofing materials, supporting their viability as sustainable construction alternatives. Future research should focus on long–term durability, field performance testing, and scalability to further validate the material's application in real–world construction.

Keywords: geopolymer, recycled plastic aluminates, flexural strength, sustainable roofing materials, coal ash

Suggested citation:
Esteban KMB. 2026. The Effect of Geopolymer Cement and Recycled Plastic Aluminates on the Flexural Strength of Roofing Materials. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 192). Western Philippines University, Palawan, Philippines.

Poster Presentation
MAIN Campus

Session 1 – Agriculture, Aquatic and Natural Resources (Fisheries · Aquaculture · Marine Biology · Agriculture · Forestry · Food Security · Natural Resource Management)

Production and Quality Assessment of Lemongrass Powder from Stalk and Leaf Using Different Drying Methods

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ABSTRACT

Lemongrass (*Cymbopogon citratus*) is widely valued for its distinct aroma, flavor, and potential use as a natural food ingredient. However, its high moisture content makes it highly perishable, making drying an important step in extending shelf life and improving its suitability for food applications. The quality of lemongrass powder may vary depending on the drying method used and the plant part processed. Thus, this study evaluated the effect of different drying methods on the quality of lemongrass powder produced from the stalk and leaf. This study aimed to determine the effect of different drying methods on the sensory qualities and moisture content of lemongrass powder made from stalk and leaf, identify the most effective drying method, and explore its potential food applications. A two–factor experimental design under a Completely Randomized Design was used with four treatments: sun–dried leaves, sun–dried stalks, mechanically air–dried leaves, and mechanically air–dried stalks. The powders were evaluated for color, aroma, and general acceptability using a 9–point Hedonic Scale with 30 panelists and two replications. The powders were also incorporated into porridge and assessed for color, aroma, taste, flavor, and general acceptability. Moisture content was measured using a moisture determination balance. Data were analyzed through ANOVA and Tukey's test at a 5% level of significance. Results showed significant differences in the color and general acceptability of lemongrass powder. Sun–dried stalk powder obtained the highest acceptability scores and the lowest moisture content (3.73%), indicating better shelf stability. Aroma acceptability did not significantly differ among treatments. In porridge application, no significant differences were observed in aroma, taste, flavor, and general acceptability, although color acceptability varied, with mechanically air–dried stalk powder being most preferred. The stalk is more suitable than the leaf for powder production. Sun drying is recommended for dry applications, while mechanical air drying is more suitable for cooked or processed products. Further studies may focus on drying optimization, shelf life, cost–effectiveness, and other food applications.

Keywords: *Cymbopogon citratus*, drying methods, lemongrass powder, sensory quality, moisture content, food product application

Suggested citation:
Lindog SMM, Libanan JB, Pablo-Limco AG, Cuen I. 2026. Production and Quality Assessment of Lemongrass Powder from Stalk and Leaf Using Different Drying Methods. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 194). Western Philippines University, Palawan, Philippines.

Session 2 – Health, Environment, and Community Well–being (Health Sciences · Public Health · Education · Environmental Studies · Community Development)

A Functional Sip: Development of Calamansi–Flavored Black Rice Infusion Beverage

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ABSTRACT

There is increasing consumer demand for natural and functional beverages made from locally available ingredients. Black rice (*Oryza sativa* L.) is known for its anthocyanin content and antioxidant potential, while calamansi (*Citrus microcarpa*) is valued for its vitamin C, refreshing flavor, and natural acidity. Combining these two ingredients offers an opportunity to develop a nutritious ready–to–drink beverage with desirable sensory and physicochemical properties. This study aimed to develop a calamansi–flavored black rice infusion beverage and determine its sensory acceptability, physicochemical properties, and consumer preference. The study used a 3 × 3 factorial design with three levels of calamansi juice (5%, 10%, and 15% v/v) and three levels of black rice extract (5%, 10%, and 15% w/v), resulting in nine treatments. Forty–two trained panelists evaluated the samples using a 9–point Hedonic Scale for color, appearance, aroma, flavor, mouthfeel, sweetness–sourness balance, and general acceptability. Physicochemical analyses included pH, total soluble solids (TSS), and color measurement using L*, a*, and b* values. A consumer verification test involving 100 respondents was also conducted. Sensory evaluation showed significant differences among treatments. Treatment 2, containing 5% calamansi juice and 10% black rice extract, obtained the highest scores in color (7.28), appearance (7.18), aroma (7.21), flavor (7.21), mouthfeel (7.13), sweetness–sourness balance (7.55), and general acceptability (7.68), all interpreted as "like moderately." Treatment 7 received the lowest ratings due to excessive sourness and strong calamansi aroma. In terms of physicochemical properties, Treatment 8 had the lowest pH (2.14), while Treatment 9 had the highest TSS (10 °Brix). Consumer testing further confirmed the preference for Treatment 2. A calamansi–flavored black rice infusion beverage can be successfully developed as an acceptable functional drink. The formulation with 5% calamansi juice and 10% black rice extract was the most preferred and showed the best overall quality. Further studies may include shelf–life evaluation, product costing, and analysis of bioactive compounds to support commercialization.

Keywords: *Oryza sativa* L., *Citrus microcarpa*, sensory acceptability, physicochemical analysis, functional beverage, ready–to–drink beverage

Suggested citation:
Langbo DG, Yadao P, Pablo-Limco AG. 2026. A Functional Sip: Development of Calamansi–Flavored Black Rice Infusion Beverage. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 195). Western Philippines University, Palawan, Philippines.

SESSION 3 – INTEGRATED RESEARCH, INNOVATION, AND DEVELOPMENT (EDUCATION · SOCIAL SCIENCES · BUSINESS · GOVERNANCE · ICT · ENGINEERING · INTERDISCIPLINARY STUDIES)

Abundance and Diversity of Insects Captured by Different Colored Light Traps in Eggplant Plantations

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ABSTRACT

Insect pest infestation remains a major challenge in agricultural production, often resulting in heavy reliance on chemical pesticides despite their known environmental and health risks. However, there is limited local research on cost-effective and eco-friendly monitoring tools, particularly regarding how different light colors influence insect abundance and diversity in eggplant plantations. This study aimed to determine the effectiveness of four colored light traps—blue, white, yellow, and ultraviolet (UV)—in capturing insect populations in eggplant farms. The experiment was conducted in two locations with a total of three replications of each light trap distributed across the sites over one lunar month. Insects were collected throughout the sampling period, identified, and classified as either beneficial or pest species. Data were analyzed using descriptive statistics, the Shannon diversity index, and a general linear model (GLM) to determine significant differences among treatments. Results revealed that ultraviolet (UV) light traps captured the highest insect abundance, significantly outperforming the other light colors. White and blue traps showed moderate effectiveness, while yellow traps recorded the lowest overall capture but demonstrated selective attraction to specific pest groups. Across all treatments, pest insects dominated over beneficial insects, with Hemiptera identified as the most abundant order. In terms of diversity, all light traps exhibited high diversity values, with no significant differences observed among the treatments. Among pests catch, eggplant pest also have larger percentage. These findings indicate that trap color significantly influences insect attraction, with UV being the most effective but least selective. It is best used in eggplant plantation but can be used in selective night during lunar period. It is recommended that UV traps be used for comprehensive insect monitoring. Further studies are suggested to explore long-term application and effectiveness across different crops and environmental conditions.

Keywords: abundance, diversity, insects traps, light color, pest management

Suggested citation:
Agustin LZB, Anunciado JJP, Monteverde KJL, Tillo RJV. 2026. Abundance and Diversity of Insects Captured by Different Colored Light Traps in Eggplant Plantations. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 196). Western Philippines University, Palawan, Philippines.

Assessing Financial Literacy and Saving Pattern among Fisherfolks in Sitio Bayside, Barangay Alfonso XIII, Quezon, Palawan

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ABSTRACT

According to Galapin et al. (2025), beyond basic literacy, psychological factors like optimism, stress, family obligations, and risk perception heavily influence financial decision–making among fishing communities. Enema, and Quezon (2024) emphasized that more research is needed to explore these psychological dimensions and how they mediate financial literacy and savings patterns. The core issue is that a lack of financial literacy, coupled with volatile incomes and poor financial infrastructure, results in weak and inconsistent savings patterns among fisher folk, which traps them in persistent poverty and heightens their vulnerability to economic and environmental shocks. This study aimed to assess the level of financial literacy among fisherfolks in Sitio Bayside, Barangay Alfonso XIII, Quezon, Palawan. Specifically, it seeks to examine the saving patterns and financial behaviors of fisherfolk, explore the relationship between financial literacy, saving patterns, and financial behavior among fisherfolk, and to identify the challenges fisherfolk that encounter in saving and managing their finances. Using a quantitative research design, the census method was applied, involving all 96 registered fisherfolks as respondents. Data were collected through a modified survey questionnaire and analyzed using descriptive statistics and Pearson correlation analysis to determine the relationships among the major variables. Findings revealed that fisherfolks demonstrated an adequate level of financial literacy, which enabled them to practice positive financial behaviors such as budgeting, preparing for emergencies, and planning for future financial needs. Despite these strengths, saving practices remained inconsistent and were mostly informal. This inconsistently was attributed to unstable income sources, seasonal variations in fishing activities, unpredictable weather conditions, fluctuating fish prices, and limited access to formal financial institutions. As a result, fisherfolks continued to face significant financial challenges, especially in managing income irregularities and sustaining daily household expenses. Correlation analysis showed significant positive relationships among financial literacy, saving patterns, and financial behavior. This indicates that higher financial literacy is closely associated with better saving habits and more effective financial management. The researcher concludes that the fisherfolks possess an adequate level of financial literacy, particularly in basic financial practices such as budgeting, paying bills on time, understanding the importance of saving, and planning for future needs. While they fisherfolks generally demonstrate positive financial behavior and motivation to save; however, their saving practices are often inconsistent and informal due to unstable income and daily household expenses. They also face serious financial challenges, including unpredictable fishing income, seasonal variations, fluctuating fish prices, unexpected fishing and medical expenses, and limited access to formal financial institutions and government support. Lastly, the study concludes that financial literacy has a significant relationship with saving patterns and financial behavior, indicating that higher financial literacy contributes to better saving practices and more responsible financial management among fisherfolks. The study further emphasized that although fisherfolks possess basic financial knowledge and a generally positive attitude toward saving these alone are not sufficient. Strengthening financial literacy must be coupled with stable income opportunities, reliable livelihood support mechanisms, and accessible financial services to enhance their financial resilience.

Keywords: financial behavior, financial challenges, financial literacy, fisherfolk, savings pattern

Suggested citation:
Galdo AT, Tafalla MLP, Godinez DP, Roca KKP. 2026. Assessing Financial Literacy and Saving Pattern among Fisherfolks in Sitio Bayside, Barangay Alfonso XIII, Quezon, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 197). Western Philippines University, Palawan, Philippines.

RIDE Annual Conference Proceedings (Vol. 1)

Economic Impact of the Western Philippines University Rubber Production Project to its Adopters in Quinlogan, Quezon, Palawan

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ABSTRACT

Potential income from rubber farming, some workers from the local community who helped maintain the rubber plantation decided to adopt the practice and plant rubber trees on their own farms. However, there are currently no studies that examine the economic impact of rubber farming on the adopters of the WPU–Quinlogan Resource Learning Center Rubber Production Project in the municipality of Quezon. The study aimed to: (1) assess the economic impact of rubber production project on adopters in terms of household income, household assets, employment opportunities, children's education and personal health; (2) identify the issues and problems encountered by the adopters; and (3) determine the recommendation to improve the Rubber Production Project of WPU–Quinlogan Resource Learning Center. The respondents of the study were adopters of the WPU–Quinlogan Resource Learning Center Rubber Production Project in Barangay Quinlogan, Quezon, Palawan. These individuals participated in training programs and seminars on rubber farming conducted by the Resource Learning Center. The study employed a quantitative descriptive research design, using survey questionnaires to collect data from the respondents. The results showed that the WPU Rubber Production Project has made a moderately positive economic impact, particularly in improving household income. Among the five indicators assessed, the dimension "Impact of Rubber Farming on Household Income" recorded the highest mean score of 3.64, interpreted as High Impact. This indicates that many rubber farmers experienced an increase in their income after participating in the project. However, despite the improvement in income, the broader socioeconomic benefits of rubber farming remain limited. The results showed that the impact on household assets (mean = 2.46), employment generation (mean = 2.20), children's education (mean = 2.48), and personal health (mean = 2.50) were all interpreted as *Low Impact*. The results indicate that economic and environmental factors are the most significant challenges in rubber farming. While infrastructure and logistical issues were not broadly problematic, low income from cup lumps, climate hazards, and pest outbreaks significantly affect farm viability. These findings suggest that although rubber farming contributes to household income, it has not yet significantly improved other aspects of the adopters' living conditions.

Keywords: economic impact, rubber farming, rural livelihood, smallholder farmers, WPU rubber project

Suggested citation:
Maglinte MDO, Tafalla MLP, Godinez DP, Cruz LAS. 2026. Economic Impact of the Western Philippines University Rubber Production Project to its Adopters in Quinlogan, Quezon, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 198). Western Philippines University, Palawan, Philippines.

From Banana By–Products to Market Opportunities: Technology Transfer of Banana Energy Bar and Banana Peel Liquor for Cooperative Enterprise Development in Palawan

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ABSTRACT

Banana processing generates broken banana chips and banana peels that are often sold at low value or discarded as waste. In Aborlan, Palawan, where banana is a major commodity, these by–products present an opportunity for value addition, waste reduction, and livelihood enhancement. Western Philippines University developed two technologies using these materials: banana energy bar from broken banana chips and banana peel liquor from banana peels and pulp. The project was designed to transfer these technologies to local cooperatives and support their preparation for enterprise development and commercialization. This project aimed to transfer banana energy bar and banana peel liquor processing technologies to members of the Aborlan Rainbow Marketing Cooperative (ARMC) and the Aborlan Food Processors Agriculture Cooperative (AFPAC), improve their technical and entrepreneurial capacities, enhance product quality and processing protocols, and establish initial market linkages. The project used a technology transfer and capacity–building approach involving inception meetings, partnership–building, training on Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), and machine operation, as well as product optimization, prototype verification, packaging development, and intellectual property preparation. The intervention covered 40 ARMC members and 10 AFPAC members. Initial implementation resulted in the formal conduct of the inception meeting with project stakeholders, strengthening of institutional collaboration, and completion of training on GMP, SSOP, and plant machine operation. Product logo and packaging prototypes for both banana energy bar and banana liquor were developed. Initial optimization and verification trials for both products were also completed, providing baseline evidence for product consistency and readiness for further refinement. Trademark registration of the project logo was initiated, while draft utility model and patent documents were prepared. The project has established the technical, organizational, and branding foundations needed for the commercialization of banana–based value–added products. Early outputs show strong potential for transforming banana by–products into market–oriented products while building the capacities of local cooperatives. Further pilot–scale validation, market testing, regulatory compliance, shelf–life studies, and formal market linkage activities should be completed to strengthen product competitiveness and support full–scale enterprise adoption.

Keywords: banana by–products, value addition, technology commercialization, cooperative enterprise development, banana energy bar, banana peel liquor

Suggested citation:
Badilla CFN, Fernandez GJC, Jagmis RRP, Flandez CT, Pablo-Limco AG. 2026. From Banana By–Products to Market Opportunities: Technology Transfer of Banana Energy Bar and Banana Peel Liquor for Cooperative Enterprise Development in Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 199). Western Philippines University, Palawan, Philippines.

Knowledge, Attitude, and Practices on Family Planning Methods Among Married Women Residing in Sitio Ibat–ong, Barangay Aramaywan, Quezon, Palawan

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ABSTRACT

Increasing uncontrolled population growth in the Philippines has been recognized as the most crucial impediment to national development, although the Philippine Population Management Program has been implemented for decades. So, it is essential to ensure that all pregnancies are wanted or intended at the national and regional scales. (Makinano et al. 2022). The study aimed to evaluate the level of knowledge that married women possess regarding family planning methods, determine their attitudes towards these methods, and identify their current family planning practices. Furthermore, the research seeks to examine the relationship between the knowledge and attitudes of married women to their actual practices related to family planning methods. The respondents of the study were 104 married women who were current residents of Sitio Ibat–ong, selected using a total population sampling or census approach. Using a quantitative approach with a descriptive survey research design, the study gathered data through a structured survey questionnaire employing a 5–point Likert scale. The research revealed that the respondents possessed a high level of knowledge (mean = 4.01), particularly regarding where to access reliable information and the importance of correct usage. Married women in the area maintained a positive attitude (mean = 4.05) toward family planning, viewing it as a personal decision and emphasizing open communication with partners. Furthermore, actual practices were rated highly (mean = 4.28), with the most consistent behavior being strict adherence to contraceptive instructions or schedules. Statistical analysis using Pearson's Product Moment Correlation revealed a very strong positive relationship (0.79) between knowledge and practices, and a strong positive relationship (0.75) between attitude and practices, indicating that well–informed women with positive perceptions are more likely to practice responsible family planning. The level of knowledge of married women in Sitio Ibat–ong possesses "high knowledge" regarding family planning methods, with the overall mean is 4.01. The attitude of married women maintains a positive attitude towards family planning, with an overall mean of 4.05. The current practices of married women generally include practicing responsible behaviors, with an overall mean of 4.20. The statistical analysis confirms a significant relationship among the variables, showing a very strong positive relationship between knowledge and practices (ρ=0.79) and a strong positive relationship between attitude and practices (ρ=0.75). This indicates that higher awareness and favorable perceptions directly lead to better family planning application. Based on these findings, the study recommends strengthening reproductive health education to address misconceptions, fostering supportive spousal communication through counseling, and enhancing community–based outreach programs to maintain and improve long–term contraceptive use.

Keywords: knowledge, attitude, practice, family planning methods, married women, sitio Ibat–ong

Suggested citation:
Ajubul NE, Tafalla MLP, Godinez DP, Roca KKP. 2026. Knowledge, Attitude, and Practices on Family Planning Methods Among Married Women Residing in Sitio Ibat–ong, Barangay Aramaywan, Quezon, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 200). Western Philippines University, Palawan, Philippines.

Effects of Taro Root Crops (*Alocasia macrorrhizos*) with Rice Husk Ash (RHA), and Silica Sand on Soil Erosion Control

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ABSTRACT

Soil erosion is a major environmental problem that reduces soil fertility and threatens agricultural productivity, especially on sloped areas with high runoff. Materials such as taro root crops (*Alocasia macrorrhizos*), rice husk ash (RHA), and silica sand have shown potential in improving soil strength and stability, with effective ranges of up to 30% taro content, 10–12% RHA, and 8%–9% silica sand. However, existing studies mainly focus on their individual use, with limited research on their combined effects, highlighting the need for a more sustainable and efficient soil stabilization approach. This study evaluates the combined effects of taro, RHA, and silica sand on soil erosion, analyzing soil properties, effectiveness, and cost–efficiency compared to commercially available lime used for erosion control. Materials (taro root crops, rice husk ash [RHA], and silica sand) were prepared, sieved, and mixed according to the design mixture for Treatments 1 to 5 (T1–T5). T1 served as the control using commercially available hydrated lime. T2 contained 30% taro, 11% RHA, and 8.5% silica sand; T3 had 35% taro, 11% RHA, and 8.5% silica sand; T4 had 40% taro, 11% RHA, and 8.5% silica sand; and T5 had 45% taro, 11% RHA, and 8.5% silica sand, based on the actual dry weight of soil. Treatments were applied in slope–box and field setups using scaled grouting methods. After 28–day curing, erosion performance was evaluated through rainfall simulation in the laboratory and natural rainfall observations in the field. Results showed that significant differences were observed in shear stress, cohesion, and water content between setups. Treatment 5 (45% taro, 11% RHA, 8.5% silica sand) performed best. The mixture was also more cost–effective than commercially available hydrated lime. The combination of taro, RHA, and silica sand significantly improved soil strength and erosion resistance, with Treatment 5 (45% taro, 11% RHA, 8.5% silica sand) showing the highest shear stress and internal friction. These results indicate that this mixture is an effective, practical, and cost–efficient solution for stabilizing sloped soils. It is recommended to apply Treatment 5 for sloped soil stabilization, as it provides the greatest resistance to sliding and erosion. Future studies may test additional mixture ratios and soil conditions to refine effectiveness.

Keywords: soil erosion control, raro root crops, rice husk ash, silica sand, soil stabilization

Suggested citation:
Umpar SHR. 2026. Effects of Taro Root Crops (*Alocasia macrorrhizos*) with Rice Husk Ash (RHA), and Silica Sand on Soil Erosion Control. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 201). Western Philippines University, Palawan, Philippines.

Fabrication and Analysis of Coconut Coir–Reinforced Sugarcane Bagasse Fiber Composite Board

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ABSTRACT

The increasing demand for sustainable and environmentally friendly construction materials has driven interest in utilizing agricultural waste. Coconut coir and sugarcane bagasse are abundant lignocellulosic materials with potential for composite fiberboard production. However, their effectiveness within a single matrix system have not yet been fully explored. This study aimed to fabricate and evaluate coconut coir–reinforced sugarcane bagasse composite fiberboards using epoxy resin as a binder. Specifically, it assessed density, water absorption, temperature difference, flexural strength, and cost, and identified the most effective fiber proportion. The fiberboards were fabricated using hand lay–up method with varying compositions of coconut coir and bagasse fiber combined with a constant amount of epoxy resin. A commercial medium–density fiberboard served as the control. Samples were tested in three replications and analyzed using Analysis of Variance (ANOVA) followed by Duncan's Multiple Range Test (DMRT). Results showed that the fabricated boards exhibited lower density than the commercial board but were classified as medium–density fiberboard. They showed lower water absorption and comparable thermal insulation, making them suitable for humid and ceiling applications. However, flexural strength remained lower than the control, although it improved with higher coconut coir content. Treatment 4 (10% coconut coir, 60% bagasse, 30% epoxy) demonstrated the best overall performance. Fabricated boards were more costly than commercial fiberboards. Coconut coir–bagasse composite fiberboards showed promising physical and thermal properties but require improvement in mechanical strength and cost efficiency. Treatment 4 is the optimal composition. Future studies are recommended to explore wider fiber ratios, increase binder content, apply hydraulic pressing, utilize fiber treatments to enhance bonding, and investigate alternative low–cost, eco–friendly resins to improve performance and sustainability.

Keywords: agricultural waste, coconut coir, epoxy resin, fiberboard, bagasse fiber

Suggested citation:
Peralta KJB. 2026. Fabrication and Analysis of Coconut Coir–Reinforced Sugarcane Bagasse Fiber Composite Board. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 202). Western Philippines University, Palawan, Philippines.

Fabrication of Fiber Reinforced Concrete Utilizing Palawan's Pineapple Leaf Fiber (*Ananas comosus*) as Reinforcement

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ABSTRACT

In tropical regions such as the Philippines, particularly in Palawan, pineapple leaf fiber (PALF) is abundantly available as a low–cost and renewable agro–waste with high cellulose content. The general objective of this study was to evaluate the mechanical performance of concrete reinforced with Palawan pineapple leaf fiber. This study is about the reinforcement of pineapple leaf fiber (*Ananas comosus*) that aims to improve the quality of fiber–reinforced concrete. The objective is to address the growing demand for sustainable and affordable building materials. The study investigated the effects of mechanical properties and determined the most effective percentage of pineapple leaf fiber in the fiber–reinforced concrete. The cost of fabrication was also assessed. The study evaluated pineapple leaf fiber as a sustainable reinforcement and determined the effects of Alkali–treated (6% NaOH) PALF, added at 0.1%, 0.2% and 0.3% w/w of cement in a 1:2:4 mix with a constant water–cement ratio of 0.5. Workability was assessed by slump test; twenty–four (24) cylindrical specimens were cured for 28 days and tested for compressive (ASTM C39) and split–tensile (ASTM C496). Results showed that incorporating PALF significantly affected density, water absorption, and mechanical performance, with workability decreasing as fiber content increased and strength peaking at an intermediate dosage. The results showed that PALF is a viable eco–friendly reinforcement, and the 0.20% percentage (Treatment 3) yielded the most favorable combination of mechanical and physical properties. The study suggested that further research is recommended to explore long–term durability, scale up applications, and different methods of fiber extraction as well as exploring different lengths and fiber treatment for further improvements.

Keywords: pineapple leaf fiber, natural fibers, fiber reinforced concrete, compressive strength, split–tensile strength

Suggested citation:
Pacho C. 2026. Fabrication of Fiber Reinforced Concrete Utilizing Palawan's Pineapple Leaf Fiber (*Ananas comosus*) as Reinforcement. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 203). Western Philippines University, Palawan, Philippines.

Utilization of PET Bottle twisted strips for Enhancing Concrete Properties

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ABSTRACT

This study was conducted at Tagpait, Aborlan, Palawan, from December 2025 to February 2026. The main objective of this study was to determine the effects of modified concrete on its physical properties, specifically density, water absorption, compressive strength, and flexural strength. Additionally, the study aimed to identify the most cost–effective percentage of PET bottle twisted strips, comparing 0%, 2%, 4%, and 6%. To address the community's solid waste issue, PET bottles were processed into 1–2 mm twisted strips using an improvised slicer and heat treatment. A concrete mix was prepared with a 1:2:4 ratio and a water–cement ratio of 0.5, following ACI standards. The mix incorporated 0%, 2%, 4%, and 6% PET strips by weight of cement, with 0.8% superplasticizer added to selected mixes. A total of 24 samples were produced, with three replications per treatment. The samples were cured for 28 days in accordance with ASTM C31 standards. Performance evaluation included tests for workability (slump test), water absorption, compressive strength, flexural strength, and density. These tests were conducted to assess the effects of the PET bottle twisted strips on the mechanical properties and durability of the concrete. The results showed that water absorption capacity, density, and compressive strength were not significantly affected by the treatments. In contrast, flexural strength differed significantly, indicating that only flexural strength was influenced by the addition of the PET bottle Twisted Strips.

Keywords: PET (polyethylene terephthalate), concrete mix, water–cement ratio, superplasticizer, workability (slump test), water absorption, compressive strength, flexural strength, and density

Suggested citation:
Bonbon Jr. RE. 2026. Utilization of PET Bottle twisted strips for Enhancing Concrete Properties. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 204). Western Philippines University, Palawan, Philippines.

Paper Presentation
PPC Campus

SESSION 1 – AGRICULTURE, AQUATIC AND NATURAL RESOURCES (FISHERIES · AQUACULTURE · MARINE BIOLOGY · AGRICULTURE · FORESTRY · FOOD SECURITY · NATURAL RESOURCE MANAGEMENT)

Growth and Yield Performance of Soybean (*Glycine max* L.) Varieties Applied with Different Levels of Plantmate Bio–Organic Fertilizer

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ABSTRACT

Application of bio–organic fertilizer and the conduct of varietal trials are strategies to enhance crop productivity and resilience under changing climatic conditions. This study was conducted to evaluate the effects of different rates of Plantmate Bio–Organic Fertilizer (PMBOF) on soybean varieties and the chemical properties of the soil; identify the appropriate level of PMBOF that would result in optimum yield; and assess the profitability of soybean varieties under varying fertilizer rates. The experiment was laid out in a split–plot arrangement using a randomized complete block design (RCBD) with three replications. NSIC Sy 16 (Manchuria) and NSIC Sy 17 (Tudela Black) served as the main plots, while five levels of Plantmate Bio–Organic Fertilizer (0, 2, 4, 6, and 8 t ha^{-1}) were assigned as the subplots. Results showed that soil pH significantly increased, particularly at 4 t ha^{-1} of PMBOF application. Agronomic and yield observations revealed varietal differences between the two soybean varieties**.** NSIC Sy 16 (Manchuria) flowered earlier **(**44 days after sowing**),** produced longer pods (4.27 cm)**,** wider pods (0.89 cm**)**, and heavier 100–seed weight (15.41 g)**.** In contrast, NSIC Sy 17 (Tudela Black) matured earlier (45.93 days after sowing), produced more pods per plant (127.24)**,** achieved higher seed yield per plant (19.42 g)**,** and recorded the highest total seed yield (0.544 t ha^{-1})**.** Different levels of PMBOF significantly affected the number of days to flowering **(**4 t ha^{-1}**)** and days to harvest (0 t ha^{-1})**.** However, other growth and yield parameters were not significantly affected by PMBOF rates. Economic analysis revealed that NSIC Sy 17 (Tudela Black) recorded the highest profitability under the unfertilized treatment**,** with a net return of PhP 51,580.00 and a return on investment (ROI) of 269.21%. Highlighting its potential for low–input and organic farming systems in Palawan.

Keywords: growth and yield performance, plantmate bio–organic fertilizer, profitability, soil chemical properties, soybean varieties

Suggested citation:
Zabanal ZMO, Ababat AE. 2026. Growth and Yield Performance of Soybean (*Glycine max* L.) Varieties Applied with Different Levels of Plantmate Bio–Organic Fertilizer. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 206). Western Philippines University, Palawan, Philippines.

Socio–Economic Profile of Penshell (*Atrina pectinata*) Fishers and Assessment of Fisheries Vulnerability in Sorsogon City, Philippines

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ABSTRACT

The penshell (*Atrina pectinata*) fishery provides food, a living, and additional income to local communities, making it a vital component of Sorsogon's coastal economy and culture. The penshell is a high–value mollusk that contributes significantly to household income due to market demand for its flesh and shell byproducts. This study examined the socioeconomic profile of *A. pectinata* fishers and assessed the vulnerability of penshell fishery by analyzing exposure, sensitivity and adaptive capacity to environmental, economic, and institutional stressors affecting the resources and livelihood of fishing households. A descriptive research design with quantitative and qualitative approaches was used. Data collection was conducted through structured surveys and key informant interviews with active penshell fishers of the barangays, namely Bitan–O, Rizal and Buenavista. Results showed that the income distribution of penshell fishers can provide a relatively steady source of earnings; however, it does not guarantee long–term financial security, especially during periods of environmental disruption or market instability. Furthermore, the penshell production declines and market prices fluctuate, household income was highly affected, and a higher dependency rate leads to lower financial flexibility. Alternative work appears to serve as a coping mechanism. External assistance from the government provides a temporary relief; however, it does not eliminate the structural dependency of penshell fishing. The penshell fishery provides a relatively stable livelihood for fishing households, socioeconomic vulnerability persists due to declining production, price volatility, high dependency, and strong reliance on single resource–based income source. To enhance livelihood resilience and fishery sustainability, it is recommended to promote livelihood diversification, strengthen market stability mechanisms, and implement resource management strategies for pen shell stocks and develop a long–term socio–economic support programs for fishing communities.

Keywords: penshell, socioeconomic, vulnerability

Suggested citation:
Collantes MCR, Barbera WB, Belga JMB. 2026. Socio–Economic Profile of Penshell (*Atrina pectinata*) Fishers and Assessment of Fisheries Vulnerability in Sorsogon City, Philippines. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 207). Western Philippines University, Palawan, Philippines.

Acceptability of Tunapia with Different Flavors

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ABSTRACT

This study assessed the acceptability of "Tunapia," an innovative fish spring roll product made from skipjack tuna (*Katsuwonus pelamis*), as a sustainable and healthy alternative to conventional meat fillings. This study was conducted from January to December 2025 at Camarines Norte State College – Mercedes Campus to improve the economic value of underutilized fish species and to provide livelihood opportunities for coastal communities. The experiment used three treatments: control (Treatment 1), cheese–flavored variant (Treatment 2), and spicy–flavored variant (Treatment 3). The sensory attributes in terms of appearance, aroma, taste, texture, and overall acceptability were evaluated by 48 participants using 9–point Hedonic Scale. The sensory attributes in terms of appearance, aroma, taste, texture, and overall acceptability were evaluated by 48 participants using 9–point Hedonic Scale. The results showed that Treatment 3 (Spicy) was the most preferred, with the highest mean scores in most sensory attributes and general acceptability score of 7.64 ("Like Very Much"). Statistical analysis using one–way ANOVA revealed that there were no significant differences among the treatments, indicating that the flavor modifications did not affect the product quality. The study concludes that Tunapia has a high market potential, especially for small–scale businesses. Future studies should focus on optimizing the frying temperature to preserve texture and shelf–life analysis to ensure safety for commercial distribution.

Keywords: skipjack tuna (*Katsuwonus pelamis*), fish spring roll, sensory evaluation, product acceptability, flavor enhancement, value–added fish products

Suggested citation:
Carreon-Arevalo AM, Lucas MS, Solares MAY. 2026. Acceptability of Tunapia with Different Flavors. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 208). Western Philippines University, Palawan, Philippines.

Fertilization and Hatching Performance of Asian Native Catfish *Clarias macrocephalus* Palawan, Philippines

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ABSTRACT

Native catfish (*Clarias macrocephalus*) remain an important aquaculture species in the Philippines, yet their reproductive success in hatchery systems depends greatly on effective fertilization techniques and appropriate incubation environments. Optimizing these conditions is essential for improving breeding efficiency and supporting conservation efforts. This study aimed to determine the fecundity and gonadosomatic index (GSI) of C. macrocephalus broodstock and to identify the most effective egg–to–milt ratio and water medium for enhancing fertilization and hatching success. A two–factor experimental design was used to evaluate three egg–to–milt ratios (1:2, 1:3, and 1:4) across three water media: rainwater, tap water with Indian almond extract, and mineral water. Fertilization was conducted through the gravimetric method, and fertilized eggs were incubated until larval emergence. Fertilization and hatching rates were recorded and analyzed using Two–Way ANOVA to determine significant effects and interactions among factors. Both egg–to–milt ratio and water medium showed significant effects on fertilization and hatching rates ($p < 0.05$). A significant interaction between egg–to–milt ratio and water medium was also observed ($p < 0.05$), indicating that the effect of sperm concentration depended on the type of water used. The 1:2 egg–to–milt ratio in rainwater produced the highest fertilization rate ($93.33 \pm 4.04\%$) and exhibited a similarly high hatching performance compared with other treatments. Rainwater and tap water with Indian almond extract consistently outperformed mineral water, indicating better suitability for incubation. These results suggest that a 1:2 egg–to–milt ratio using rainwater is recommended for optimizing fertilization and hatching success in hatchery production of Clarias macrocephalus. The findings highlight the importance of optimizing gamete ratios and water media to improve hatchery productivity. By identifying the most effective conditions for fertilization and hatching, this study provides valuable guidance for broodstock management, hatchery operations, and the conservation of C. macrocephalus.

Keywords: aquaculture, *Clarias macrocephalus*, fertilization rate, hatching rate, induced spawning

Suggested citation:
Rosero MCC, Plasus MMG, Avillanosa AL, Catalayban HMT. 2026. Fertilization and Hatching Performance of Asian Native Catfish *Clarias macrocephalus* Palawan, Philippines. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 209). Western Philippines University, Palawan, Philippines.

From Fish Waste to Green Packaging: Formulation and Characterization of Biodegradable Film from Milkfish (*Chanos chanos*) Scale–derived Fish Gelatin

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ABSTRACT

Utilizing discarded fish scales as raw materials in developing biodegradable film aims to minimize waste and promote sustainable resource utilization. Biodegradable film from fish scales may serve as an alternative to traditional plastic wraps and emerging plant–based biodegradable film packaging. This study utilized discarded milkfish scales as the main source of gelatin to formulate biodegradable film. Formulated film was characterized and tested for practical application and biodegradability. Gelatin extracted from milkfish scales via acid hydrolysis and thermal treatment was used to formulate the film with glycerol as its plasticizer. Sensory evaluation via Quantitative Descriptive Analysis (QDA) was used to analyze the film's physical attributes. Its practical application was tested in perishable tomatoes while its biodegradability was assessed via soil burial test. Quantitative Descriptive Analysis (QDA) showed the film's moderate score in physical attributes including transparency (7.86), smoothness (8.18), and fishy odor (5.13) revealing a largely satisfactory rate in attributes. Mechanical property assessment tested the film's tensile strength at 41.264 MPa (4.204 kgf/mm2) while elongation at break scored a mean of 2.17167%. Results support the film's potential for flexible packaging application. Biodegradability through soil burial test showed the film's significant decomposition within three days while evaluation of the film's practical application showed its effectiveness in reducing moisture loss and maintaining the quality of perishable product such as tomatoes. Within 14 days, an average weight loss of 1.30g and 1.40 g was recorded for the tomatoes wrapped and unwrapped in film respectively highlighting the film's protective barrier characteristic against environmental factors and moisture loss. Despite minor odor limitations, preliminary result demonstrated a promising potential for biodegradable film derived from discarded milkfish scales gelatin as sustainable alternative to synthetic plastics for short–term food packaging. Further research and development is recommended to improve the film's stability, solubility, moisture retention, antimicrobial properties, and practical applications.

Keywords: film, biodegradability, milkfish, scales, gelatin

Suggested citation:
Bigtas DPB, Imperial CAG, Mortega MCN. 2026. From Fish Waste to Green Packaging: Formulation and Characterization of Biodegradable Film from Milkfish (*Chanos chanos*) Scale–derived Fish Gelatin. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 210). Western Philippines University, Palawan, Philippines.

Monsoonal Variation in Phytoplankton Assemblages and Selected Physicochemical Parameters in Shark Fin Bay, Taytay, Palawan

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ABSTRACT

Phytoplankton are vital biological indicators that reflect water quality and ecological health. This study investigates the seasonal variation of phytoplankton communities in Shark Fin Bay, Taytay, Palawan, with a focus on monsoonal impacts. The primary objective was to assess the composition, abundance, and diversity of phytoplankton, determine the distribution of harmful genera, and examine the effects of monsoonal shifts on their dynamics. Phytoplankton sampling was conducted monthly from July to December 2025, across six sites at Shark Fin Bay Marine Protected Area (MPA). Selected physicochemical parameters such as temperature, salinity, dissolved oxygen, pH, total suspended solids, water transparency, depth and nutrients were measured to evaluate their influence on phytoplankton communities. Results indicated significant differences in phytoplankton abundance and diversity between the Southwest and Northeast Monsoons. The Northeast Monsoon led to higher phytoplankton abundance but lower diversity, dominated by fewer taxa. In contrast, the Southwest Monsoon favored more balanced and diverse communities, despite lower overall abundance. The study also identified several harmful phytoplankton genera, including *Alexandrium* and *Prorocentrum*. This research contributes valuable baseline data essential for the development of effective monitoring and management strategies for harmful algal blooms (HABs) in the area, supporting sustainable fisheries and conservation efforts in Shark Fin Bay.

Keywords: phytoplankton, monsoonal variation, harmful algal blooms, marine protected areas, Shark Fin Bay

Suggested citation:
Reyes ND, Castro MR, Mabuhay-Omar JA, Paalan EP. 2026. Monsoonal Variation in Phytoplankton Assemblages and Selected Physicochemical Parameters in Shark Fin Bay, Taytay, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 211). Western Philippines University, Palawan, Philippines.

Occurrence and Spatial Distribution of Cyanobacteria in Recreational Waters of Honda Bay, Palawan: Influence of Environmental Factors and Public Health Implications

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ABSTRACT

The increasing occurrence of Cyanobacteria in coastal waters poses potential ecological and human safety concerns. However, baseline information in recreational areas in Honda Bay, Palawan remains limited. This study aimed to assess the occurrence and spatial distribution of Cyanobacteria, to determine the environmental factors, and to evaluate public health risks associated with Cyanobacteria. Water and Cyanobacteria samples were collected at five selected stations namely: Wharf, Cowrie Island, Pandan Island, Starfish Island, and Luli Island using vertical tow method and identified microscopically using Sedgwick–Rafter counting chamber, with densities expressed as cells/L, public health risks were evaluated by identifying potentially toxin–producing genera. Physicochemical parameters, including temperature, pH, salinity, dissolved oxygen, conductivity, ORP total dissolve solids, total suspended solids, water transparency and depth were measured on site. Results revealed that Cyanobacteria were present at all stations, exhibiting marked spatial variations ranging from 168 to 3,032 cells/L. Dominant and potentially harmful genera, including *Planktothrix* sp., *Nodularia* sp., *Trichodismium* sp., *Synecoccus* sp., and *Merismopedia* sp. These species are associated to health risks such as skin irritation, allergy reaction, and poisoning for tourism and recreation. Physicochemical analysis showed that Cyanobacterial density was potentially influence by water transparency, whereas high water transparency recorded high higher Cyanobacterial densities, clearer waters increased light penetration that enhances photosynthetic efficiency supporting Cyanobacterial growth. These findings provide a baseline data for Honda Bay and highlight the necessity of regular monitoring to support local coastal water management and risks reduction strategies.

Keywords: coastal waters, dissolved oxygen, light availability, Cyanobacterial density, spatial variation

Suggested citation:
Hisona BJE, Mabuhay-Omar JA. 2026. Occurrence and Spatial Distribution of Cyanobacteria in Recreational Waters of Honda Bay, Palawan: Influence of Environmental Factors and Public Health Implications. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 212). Western Philippines University, Palawan, Philippines.

Population Dynamics and Management Implications of Macrobrachium laevis in a Philippine Inland River System

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ABSTRACT

Inland freshwater fisheries play an important role in local food security and livelihoods but remain poorly assessed due to limited biological data. This study examined the population dynamics of the freshwater prawn *Macrobrachium laevis* in the Kilbay–Catabangan River System, Philippines, using length–based assessment approaches suitable for data–limited inland fisheries. Monthly fishery–dependent sampling was conducted from February to May 2023, during which carapace length measurements were obtained from 1,486 individuals. Length–frequency data were analyzed using FiSAT II to estimate growth parameters through the von Bertalanffy Growth Function and mortality rates using length–converted catch curve analysis. Socio–economic information was collected through semi–structured interviews with freshwater prawn fishers to contextualize biological findings. Results indicate that *M. laevis* is a fast–growing species with a moderate asymptotic size and high total mortality, reflecting a combination of short life span, environmental factors, and fishing pressure. The estimated exploitation rate suggests moderate fishing pressure; however, the population is dominated by juvenile and sub–adult individuals, indicating a truncated size structure. This pattern suggests a potential risk of growth and recruitment overfishing if current harvesting practices persist. High dependence of local fishers on prawn harvesting further underscores the socio–economic vulnerability of the fishery. Overall, the study provides baseline population information for *M. laevis* and demonstrates the utility of length–based methods for supporting precautionary, locally relevant management of inland freshwater prawn fisheries in the Philippines.

Keywords: *Macrobrachium laevis*, inland fisheries, length–based stock assessment, population dynamics, sustainable fisheries management

Suggested citation:
Gordula RP, Antenor LS, Favor CC, Plasus MMG. 2026. Population Dynamics and Management Implications of Macrobrachium laevis in a Philippine Inland River System. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 213). Western Philippines University, Palawan, Philippines.

Population Structures, Habitat Characteristics, and Local Knowledge of Freshwater Turtles in Barangay Bato, Taytay, Palawan

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ABSTRACT

Freshwater turtles in Palawan face increasing pressures from habitat loss and exploitation, yet data on their localized population structures in key areas like Taytay remains limited. This study assessed the population structures, habitat characteristics, and local knowledge of freshwater turtles in Barangay Bato, Taytay. Using the mark–recapture technique for 14–day period, freshwater turtles were collected via visual encounters and baited funnel traps. Populations were treated as "closed" to estimate size, density, and sex ratios through statistical analysis, while community awareness was evaluated via interviews. A total of 202 individuals from three species were documented: *Cuora cuoro* (formerly *Cuora amboinensis*), *Siebenrockiella leytensis*, and *Cyclemys dentata*. *Cuora cuoro* was the most abundant (78.71%) and has the highest density (0.16 ind/m²), followed by *S. leytensis* (16.83% and 0.3 ind/m²), whereas *C. dentata* showed the lowest abundance and density (4.46% and 0.007 ind/m²). Habitat analysis revealed that captures were significantly higher in undisturbed sites characterized by dense canopy cover and preferred food plants, while areas near human habitations yielded fewer captures. Although most respondents (predominantly male farmers) recognized the ecological importance of freshwater turtles, collection for food and trade persists. These findings underscore the necessity for strengthened enforcement of conservation laws and community–based initiatives to ensure population sustainability.

Keywords: freshwater turtle, population structure, morphology, population density, population size estimate, sex ratio

Suggested citation:
Francisco JA. 2026. Population Structures, Habitat Characteristics, and Local Knowledge of Freshwater Turtles in Barangay Bato, Taytay, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 214). Western Philippines University, Palawan, Philippines.

Reports of Dead Marine Mammals in the Coastal Water of Culion, Northern Palawan, Philippines

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ABSTRACT

Marine mammals play a vital role in maintaining ecological balance and serve as indicators of ocean health. In 2025, three marine mammals were reportedly found dead in different coastal areas of Culion, in northern Palawan. Since this is the first recorded instance of three marine mammal deaths in a single year, compiling these reports is crucial for future reference and for guiding appropriate intervention measures. The incidents were documented through official reports published online by the Palawan Council for Sustainable Development Staff (PCSDS) and the Local Government Unit (LGU) of Culion. Field responses from published reports included site verification, species identification, and condition assessment of the stranded animals. The first case involved a decaying Sperm whale (*Physeter macrocephalus*) reported on July 27, 2025, in Sitio Canimango, Barangay Galoc. The second was a post–rigor mortis Dugong or Sea cow (*Dugong dugon*) recorded on December 3, 2025, near an island resort in Barangay Carabao. The third was a bloated Humpback whale (*Megaptera novaeangliae*) observed on December 9, 2025, in the vicinity of Barangay Burabod. These strandings highlight the ecological significance of Culion's municipal water as a vital habitat and migratory pathway for marine mammals. Sustained educational initiatives and strengthened conservation measures across the region will be valuable in ensuring the continued protection of these species as they traverse local waters.

Keywords: dugong, dynamite fishing, humpback whale, marine life stranding, sea cow

Suggested citation:
Mecha NJMF. 2026. Reports of Dead Marine Mammals in the Coastal Water of Culion, Northern Palawan, Philippines. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 215). Western Philippines University, Palawan, Philippines.

Reproductive and morphometric characteristics of Spider Conch, *Lambis lambis* (Linnaeus, 1758) in Honda Bay, Palawan

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ABSTRACT

The spider conch *Lambis lambis*, locally called "saang" or "ranga–ranga," is heavily harvested by small–scale fisheries for its valuable meat and shell, supporting coastal communities in the Philippines, including Palawan. However, unregulated collection threatens its mature populations, and studies on its reproduction, fisheries, and population dynamics is still limited. Understanding the reproductive biology of spider conch is essential for sustainable stock management. Thus, this study aimed to determine sex ratio, gonadosomatic index (GSI), gonadal developmental stages (GDS) and the relationship between shell length, GSI and GDS. Samples were collected by commissioned gleaners from April to September 2025 in Honda Bay, Puerto Princesa City, and transported to the Western Philippines University–ABBA Center Laboratory. After cleaning and removing fouling organisms, shell dimensions and weights were measured using a vernier caliper and top–loading balance. Sex was identified through macroscopic observation (penis in males, egg groove in females), and sex ratio was calculated. The gonadosomatic index (GSI) was computed as gonad weight divided by body weight ×100. Gonadal developmental stages were classified into six macroscopic maturation phases. Data were analyzed using chi–square, ANOVA and Pearson correlation tests. The results showed more females than males. High shell length and gonadosomatic index indicate that many individuals are sexually mature. Six gonadal stages: immature, intermediate, active, ripe, spawning and spent were observed in both sexes throughout the study period. Both shell length and GSI were significant to the development of the gonads in females. Thus, evidence of year–round reproduction, partial spawning and asynchronous gonadal development suggests both seasonal and continuous reproduction. Sustainable collection should target individuals beyond the ripe stages to ensure successful reproduction. Further research on histology, peak spawning seasons and environmental factors affecting spawning is needed to guide science–based policies like size limits and closed seasons for sustainable harvesting.

Keywords: gonadal cycle, maturity stages, spawning season, *Strombidae*

Suggested citation:
Patiluna MLE, Lucasan KQ, Leopardas VE, Villarta-Lane KA, De Guzman AB. 2026. Reproductive and morphometric characteristics of Spider Conch, *Lambis lambis* (Linnaeus, 1758) in Honda Bay, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 216). Western Philippines University, Palawan, Philippines.

Spatial Distribution and Assemblages of Zooplankton during the Northeast Monsoon in Shark Fin Bay, Taytay, Palawan, Philippines

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ABSTRACT

Marine Protected Areas are vital for biodiversity conservation, yet monitoring often focuses on larger species, neglecting the microscopic organisms that form the foundation of the marine food web. This research aims to determine the spatial distribution and community assemblages of zooplankton within the Shark Fin Bay. The study specifically seeks to quantify abundance and diversity across six sampling stations to evaluate the bay's current ecological status and productivity. Field sampling was conducted at two distinct sites, four stations within MPAs (Depla, Garden, Pinnacle, and Sandoval) and two stations in non– MPAs (Depla North, and Macuao). Zooplankton were collected via five–minute horizontal surface tows using a 200–micron mesh plankton net. Laboratory analysis involved the displacement method to determine biomass and microscopic identification and quantification using a Bogorov counting chamber. Station exhibiting the highest abundance and diversity, recording a wet weight of 49.5 ml/m3, density of 1,249.79 ind/m3 and diversity of 1.808. In contrast, Depla North showed the lowest overall abundance. In terms of comparison of abundance and diversity between MPAs and non–MPAs stations, Wilcoxon signed–rank test showed no significant differences ($p > 0.05$). The taxonomic composition was consistently dominated by Calanoid copepods and Cyclopoida, indicating a stable but localized community structure. Moreover, Garden station was dominated by Appendicularia which is a significant portion in the diet of many nekton species. The findings demonstrate that Shark Fin Bay supports a robust zooplankton community. This research provides a critical baseline for the MPA's management, suggesting that conservation efforts must account for these "invisible" foundational species to ensure the long–term sustainability of the bay's fisheries and overall marine productivity. Further study is recommended to cover temporal variability of zooplankton in the bay.

Keywords: appendicularia, marine protected area, zooplankton, diversity

Suggested citation:
Malagum HKM, Paalan EP, Mabuhay-Omar JA. 2026. Spatial Distribution and Assemblages of Zooplankton during the Northeast Monsoon in Shark Fin Bay, Taytay, Palawan, Philippines. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 217). Western Philippines University, Palawan, Philippines.

Assessment of Competencies and Training Needs of Agritourism Extension Workers in Puerto Princesa City, Palawan

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ABSTRACT

Agritourism drives sustainable rural development, but in Puerto Princesa City there is limited evidence on extension workers' competencies and training needs, particularly the agritourism competencies required, hindering targeted capacity–building; thus, this study provides a data–driven basis to address this gap. This study assessed the competencies and training needs of Agritourism Extension Workers in Puerto Princesa City, Palawan, focusing on program planning, program evaluation, and technical skills to support sustainable agritourism development. A researcher–adapted questionnaire, based on validated instruments, was administered to 49 extension workers selected through purposive sampling. Respondents rated competencies based on knowledge and importance. Data were analyzed using the Borich Needs Assessment Model, Rank Discrepancy Score (RDS), and the Wilcoxon signed–rank test via IBM SPSS Version 27. All competencies were rated highly important, with program planning and technical skills ranked highest. Significant gaps were identified in program evaluation competencies, particularly in developing metrics, integrating evaluation results, and ensuring accountability. This study confirms that while Agritourism Extension Workers in Puerto Princesa City demonstrate strong recognition of the importance of key competencies, notable gaps persist—particularly in program evaluation skills. The findings highlight that despite high levels of perceived importance across program planning, technical, and evaluation domains, the ability to effectively design metrics, utilize evaluation results, and ensure accountability remains insufficient. These competency gaps may limit the effectiveness and sustainability of agritourism initiatives if left unaddressed. A structured training program integrating evaluation, technical, and planning competencies, supported by mentorship and field application, is recommended.

Keywords: agritourism, extension workers, competency assessment, capacity building, program evaluation

Suggested citation:
Panganiban KM. 2026. Assessment of Competencies and Training Needs of Agritourism Extension Workers in Puerto Princesa City, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 218). Western Philippines University, Palawan, Philippines.

Climate Change Adaptation Strategies Employed by Small–Scale Rice Farmers in Barangay Burirao, Narra, Palawan

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ABSTRACT

Climate change presents significant governance and policy challenges, particularly in rural agricultural communities where small–scale farmers remain highly vulnerable. This study examined the implementation of climate change adaptation programs among small–scale rice farmers in Barangay Burirao, Narra, Palawan, focusing on their actual implementation and effectiveness at the community level. This study analyzed the socio–demographic profile of small–scale rice farmers in Barangay Burirao, Narra, Palawan, identified adaptation programs and practices, assessed the level of implementation, examined challenges encountered, and determined the relationship between socio–demographic factors and adaptation strategies. A descriptive–correlational research design was employed, with data collected from 375 respondents using a researcher–developed questionnaire. Farmers primarily relied on accessible and low–cost practices such as using organic fertilizers, adjusting planting schedules, and improving water management, while participation in training programs and investment in irrigation infrastructure were limited. The study also identified key challenges, including limited access to agricultural technology, financial constraints, insufficient institutional support, and inadequate knowledge on climate change adaptation. Furthermore, the results showed that age, educational attainment, and land ownership significantly influenced the implementation of adaptation strategies, highlighting the importance of experience, access to information, and resource availability in shaping farmers' adaptive capacity. This study concludes that while small–scale rice farmers in Barangay Burirao, Narra, Palawan have begun adopting climate change adaptation strategies, their implementation remains constrained by socio–economic and institutional factors. The findings emphasize the importance of strengthening governance mechanisms, improving access to agricultural resources, and enhancing local government support to promote climate resilience among farming communities. Strengthened policy implementation and increased local government engagement are necessary to support resilience, sustainable agricultural development, and effective climate governance at the community level.

Keywords: climate change adaptation, small–scale farmers, climate governance

Suggested citation:
Palañigo E, Dalumpine DDD, Oab EM, Talagtag CJP, Heredero EV. 2026. Climate Change Adaptation Strategies Employed by Small–Scale Rice Farmers in Barangay Burirao, Narra, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 219). Western Philippines University, Palawan, Philippines.

Rice Competitiveness Enhancement Program of the Department of Agriculture in Palawan

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ABSTRACT

Following the enactment of the Rice Tariffication Law, smallholder rice farmers faced heightened challenges such as limited financial access, rising production costs, and vulnerability to various risks. In response, the government implemented the Rice Farmer Financial Assistance (RFFA) Program. However, there is a need to assess how effectively this intervention addresses the actual needs of farmers at the grassroots level. This study assessed the socio–demographic characteristics, awareness, perceived effectiveness, satisfaction, problems encountered, and recommended interventions related to the RFFA Program. Using a descriptive–correlational research design, data were gathered from 379 smallholder rice farmers in Palawan through a structured survey and analyzed statistically to determine patterns and relationships among variables. Findings revealed that most respondents were middle–aged, male, married, and engaged in small–scale rice farming with basic educational attainment. Farmers demonstrated high awareness of the RFFA Program, particularly regarding eligibility requirements, though awareness of the Registry System for Basic Sectors in Agriculture (RSBSA) verification was relatively lower. The program was generally rated effective, especially in boosting farmers' confidence for the next cropping season and improving access to farm inputs. Satisfaction levels were likewise high, particularly in terms of productivity improvement, income stabilization, and operational support. The primary issue identified was the untimely release of financial assistance, while technical concerns were minimal. Farmers recommended assigning regular payout merchants at the barangay level to enhance accessibility and ensure timely distribution of funds. Correlational analysis showed no significant relationship between socio–demographic characteristics and perceived program effectiveness, suggesting inclusivity of benefits. However, minimal significant relationships were observed between selected demographic variables and satisfaction components. Overall, the study recommends strengthening implementation strategies, communication systems, monitoring mechanisms, and service delivery, while encouraging farmer participation and further research to enhance the effectiveness of the RFFA Program.

Keywords: financial assistance, smallholder rice farmers, program, effectiveness, farmer satisfaction, Palawan

Suggested citation:
Quisto-Mirallo YJ. 2026. Rice Competitiveness Enhancement Program of the Department of Agriculture in Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 220). Western Philippines University, Palawan, Philippines.

SESSION 2 – HEALTH, ENVIRONMENT, AND COMMUNITY WELL–BEING (HEALTH SCIENCES · PUBLIC HEALTH · EDUCATION · ENVIRONMENTAL STUDIES · COMMUNITY DEVELOPMENT)

Stories of Resilience among Mothers Affected by a Fire Incident

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ABSTRACT

This qualitative–exploratory study investigated the experiences particularly on the roles, challenges, and coping strategies of mothers affected by a devastating fire in Barangay Bagong Silang, Puerto Princesa City. Utilizing narrative inquiry through face–to–face interviews with ten mothers from large families, the research explored maternal resilience in the aftermath of displacement. Findings revealed that mothers performed multifaceted roles as primary caregivers, resource managers, and community helpers while facing emotional trauma, financial hardships, and inadequate shelter conditions. Despite these challenges, they utilized problem–focused and emotion–focused coping mechanisms, including budgeting, community solidarity, and prayer. The study highlights the critical role of mothers in family recovery and recommends that government agencies like the City Disaster Risk Reduction and Management Office (CDRRMO) and City Social Welfare and Development Office (CSWD) of Puerto Princesa provide holistic, gender–sensitive support and improved infrastructure at relocation sites.

Keywords: maternal resilience, fire incident, coping strategies, disaster recovery, social work intervention

Suggested citation:
Abrea JLT, Cebuano SKL, Gabayan MLD, Genialope MJB, Jongay NSP. 2026. Stories of Resilience among Mothers Affected by a Fire Incident. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 221). Western Philippines University, Palawan, Philippines.

Challenges Encountered by Female Officers of Puerto Princesa City Police Office

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ABSTRACT

Female police officers face significant challenges within male–dominated law enforcement environments, affecting their well–being and career progression. The study aimed to identify the challenges encountered by female officers, their effects, and the coping mechanisms employed. A descriptive research design was used, with data collected from thirty (30) female officers of Puerto Princesa City Police Office via quota sampling and analyzed using weighted mean. The findings revealed that the primary challenges included disproportionate assignment to administrative or desk duties, difficulty managing shift work alongside childcare and household responsibilities, and societal pressure to prioritize career over family. These challenges negatively affected morale, resulting in increased stress, burnout, and anxiety among respondents. Despite these difficulties, the female officers employed various positive coping mechanisms, such as positive thinking, self–care practices, and family and peer support, to overcome the challenges they faced. These findings contribute to the field of criminology and criminal justice by highlighting the important role of informal support systems and positive coping in navigating gender barriers, offering practical insights for developing targeted resilience programs and gender–inclusive policies within law enforcement organizations.

Keywords: strain, coping mechanisms, female police officers, Philippine National Police, gender equality

Suggested citation:
Gabayeron RA, Pascubillo AC, Taguas CIB, Mejia MB. 2026. Challenges Encountered by Female Officers of Puerto Princesa City Police Office. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 222). Western Philippines University, Palawan, Philippines.

Welfare and Development Programs for Inmates or Persons Deprived of Liberty at the Bureau of Jail Management and Penology (BJMP)

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ABSTRACT

This study described the welfare and development programs for inmates and persons deprived of liberty in BJMP Puerto Princesa City. Specifically, the level of satisfaction with the welfare and development program of the BJMP PPC, and the issues and concerns affecting the welfare and development program of the BJMP, as perceived by the respondents. The study used the Descriptive Survey Method. The 40 female inmates or PDL who were incarcerated at the BJMP–Puerto Princesa City Jail in Puerto Princesa, Palawan. The purposive sampling technique was used in identifying the respondents on the basis of their category as female inmates or PDL. The findings reveal that the Level of Satisfaction with the Welfare and Development Programs for Inmates or Persons Deprived of Liberty the rating of the Inmate Welfare and Development Programs being offered by the BJMP PPC was satisfactory. As to the issues and concerns affecting the implementation of the welfare and development program of the BJMP, the inmates strongly agree that the BJMP–PPC recognizes the importance of inmates communicating with their loved ones and relatives. The rating of the Inmate Welfare and Development Programs being offered by the BJMP PPC was satisfactory, yet there is always room for improvement. As to the issues and concerns affecting the implementation of the welfare and development program of the BJMP, the inmates strongly agree that the BJMP–PPC recognizes the importance of inmates communicating with their loved ones and relatives, which is why visitation schedules are critical to inmate reformation. The BJMP should also be transformed into a seamless income generation and livelihood training hub that will mainly cater to the needs of all persons deprived of liberty (PDL), especially women inmates; and the BJMP should request the Department of Budget and Management (DBM) through the DILG for an additional or supplemental budget to support inmates' welfare and development.

Keywords: inmates, PDL, BJMP, Puerto Princesa

Suggested citation:
Gonzales GP. 2026 Welfare and Development Programs for Inmates or Persons Deprived of Liberty at the Bureau of Jail Management and Penology (BJMP). In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 223). Western Philippines University, Palawan, Philippines.

Wildlife Trading in Selected Barangays of Puerto Princesa City

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ABSTRACT

Illegal wildlife trade remains a serious environmental concern in biodiversity–rich areas of the Philippines, particularly in Puerto Princesa City. This study examined the main reasons for illegal wildlife trade, identified the types of networks involved, and determined the law enforcement techniques used to combat such activities in selected barangays of the city. A mixed–methods research design was employed, combining qualitative data from semi–structured interviews and secondary data obtained from the Palawan Council for Sustainable Development (PCSD). Seven key informants were selected through purposive sampling, including one member of the Philippine National Police (PNP), three Wildlife Enforcement Officers from PCSD, and three barangay kagawads serving as chairpersons of the Committee on Environmental Protection in the selected barangays. Data were collected through face–to–face interviews lasting approximately 10–15 minutes, while printed questionnaires were administered to the WEO participants due to their work responsibilities. The collected data were transcribed, organized, and analyzed using thematic analysis to identify patterns and recurring themes aligned with the study objectives. Findings revealed that illegal wildlife trade in the selected barangays was primarily driven by economic needs, demand for exotic species, and limited awareness of wildlife protection laws. The study also identified networks involving local collectors, intermediaries, and traders. Law enforcement techniques included monitoring, enforcement operations, inter–agency coordination, and community awareness programs. These findings highlight the importance of stronger collaboration among law enforcement agencies, barangay officials, and the community to enhance wildlife protection efforts in Puerto Princesa City. Strengthen inter–agency coordination, intelligence–driven enforcement, and community reporting systems to improve detection and prevention. Implement sustainable livelihood programs to reduce dependence on illegal activities. Enhance monitoring of establishments, improve data management, and expand environmental education to raise awareness. Support vulnerable households and encourage community participation.

Keywords: demand, networks, poverty, techniques, trends

Suggested citation:
Palma H, Maat JJL, Mosteiro GJR, Encela RS. 2026 Wildlife Trading in Selected Barangays of Puerto Princesa City. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 224). Western Philippines University, Palawan, Philippines.

Experiences of Senior High School Teachers and Students in Teaching and Learning Physics: Basis for the Development of an Instructional Module in Physics

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ABSTRACT

Physics is a foundational subject in basic education that helps students better understand natural phenomena while strengthening their critical thinking and problem–solving skills. Despite its importance, many students perceive Physics as challenging due to its abstract concepts and reliance on mathematical reasoning. Considering this, the present study explores the lived experiences of Senior High School students and teachers in the STEM track regarding the teaching and learning of Physics. Using a qualitative research design grounded in a descriptive–phenomenological approach, the study sought to capture the perception, challenges, and coping mechanisms of both teachers and learners. Data were collected through a guided questionnaire and analyzed using Colaizzi's method. The findings revealed that difficulties in teaching and learning Physics included complex topics, limited foundational knowledge from earlier years, and weak problem–solving skills. Other difficulties included students' lack of interest in the subject and limited access to restricted access to learning resources during the pandemic. Nevertheless, the study also highlights the resilience and adaptability of teachers, who implemented various strategies to foster student engagement and improve learning outcomes. Based on these insights, the study recommends adopting more interactive, student–centered teaching approaches that are both effective and feasible, particularly in resource–constrained classroom settings.

Keywords: instructional strategies, phenomenology, physics education, teaching and learning difficulties, STEM education

Suggested citation:
Salmo JM, Mercado JC, Alejandro BA. 2026 Experiences of Senior High School Teachers and Students in Teaching and Learning Physics: Basis for the Development of an Instructional Module in Physics. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 225). Western Philippines University, Palawan, Philippines

Antibiotic–Resistant Bacteria and Microplastic Contamination in Blood Cockles (*Anadara* sp.) from Cowrie Island, Puerto Princesa City, Palawan

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ABSTRACT

Antibiotic–resistant bacteria (ARBs) and microplastics represent escalating global threats to marine ecosystems and public health. Cowrie Island, despite its rich marine biodiversity, is subject to frequent anthropogenic pressures that compromise its coastal ecology. Blood cockles (*Anadara* sp.), among the most commonly gleaned shellfish in the area, are particularly vulnerable to contamination by pathogenic bacteria and microplastics. This study aimed to determine the coliform load and isolate and identify putative pathogenic bacteria from *Anadara* sp., characterize their antibiotic resistance profiles, determine the concentration of live heterotrophic bacteria, and detect and characterize microplastic contamination in the same organism. Thirty samples each were collected for microbiological and microplastic analyses. Total coliform load was determined using the Most Probable Number (MPN) method, heterotrophic bacteria were enumerated via Heterotrophic Plate Count, and antibiotic resistance was assessed using the Kirby–Bauer disc diffusion method. Microplastics were characterized by particle type, shape, and color. MPN values ranged from 23 to 64 MPN/100 g, indicating low coliform levels, while total colony counts ranged from 25.9 × 105 to 35.1 × 105 CFU/g. Among the bacterial isolates, 7 exhibited resistance to Cefuroxime and Cotrimoxazole, while all isolates were sensitive or moderately sensitive to Ciprofloxacin and Tetracycline. A total of 45 microplastic particles were recovered, of which 40% were fibers. These findings raise significant public health concerns regarding the consumption of *Anadara* sp. from Cowrie Island and underscore the need for regular water quality monitoring and expanded studies employing more advanced detection methods.

Keywords: antibiotic–resistant bacteria, microplastics, pathogenic bacteria, blood cockles

Suggested citation:
Sanchez JAB. 2026 Antibiotic–Resistant Bacteria and Microplastic Contamination in Blood Cockles (*Anadara* sp.) from Cowrie Island, Puerto Princesa City, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 226). Western Philippines University, Palawan, Philippines.

Gut Microbial Profile of the Common Spider Conch (*Lambis lambis*) in Cowrie Island, Honda Bay, Palawan: Implication to Public Health

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ABSTRACT

This study investigated the gut microbial profile of the Common Spider Conch (*Lambis lambis*) collected from Cowrie Island, Honda Bay, Palawan, with emphasis on microbial abundance, determining coliform level, presence of pathogenic bacteria, and antibiotic susceptibility. A total of ten (10) adult specimens were collected and analyzed using culture–based microbiological techniques. Bacterial and fungal populations were quantified using the serial dilution and plate count method, while coliform levels were determined through the Most Probable Number (MPN) method. Selective media were used to identify putative pathogenic bacteria, and antibiotic susceptibility was assessed using the disc diffusion method. Results revealed that bacterial populations (19.5×10^4 to 57.1×10^4 CFU/mL) were consistently higher than fungal populations (1.67×10^4 to 7.7×10^4 CFU/mL), indicating bacterial dominance in the gut microbiota. Coliform counts ranged from 150 to 460 MPN/100 mL, exceeding standard limits and suggesting environmental contamination. Five putative pathogenic bacteria were detected, including Pseudomonas aeruginosa, Escherichia coli, Salmonella sp., Vibrio furnissi, and Vibrio parahaemolyticus. All isolates were sensitive to Amoxicillin, Cotrimoxazole, and Ciprofloxacin, with Ciprofloxacin exhibiting the highest antibacterial activity. These findings demonstrate that the gut microbiota of *L. lambis* is influenced by environmental conditions and anthropogenic pressures. The presence of coliforms and pathogenic bacteria highlights potential ecological and public health concerns. This study provides baseline information and supports the use of *L. lambis* as a bioindicator species for assessing coastal environmental quality.

Keywords: gut microbiota, microbial abundance, coliform bacteria, pathogenic bacteria, antibiotic susceptibility

Suggested citation:
Remiendo EC, Mabuhay-Omar JA. 2026 Gut Microbial Profile of the Common Spider Conch (*Lambis lambis*) in Cowrie Island, Honda Bay, Palawan: Implication to Public Health. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 227). Western Philippines University, Palawan, Philippines.

Little Wanderers in Recreational Waters: Seasonal Dynamics of Phytoplankton Communities and Potentially Toxic Species in Bacuit Bay, El Nido, Palawan

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ABSTRACT

Phytoplankton play a critical role in the ecological health and management of recreational waters, as their composition and abundance are influenced by environmental and anthropogenic factors with implications for water quality and public health. This study assessed seasonal variations in phytoplankton communities and potentially toxic species in Bacuit Bay, El Nido, Palawan. Sampling was conducted in May (Intermonsoon, IM) and September 2025 (Southwest Monsoon, SWM), and in January 2026 (Northeast Monsoon, NEM). Phytoplankton were collected through vertical hauls using a 20 µm plankton net, while physicochemical parameters were measured using a multiparameter device and nutrients (nitrate and phosphate) were analyzed using a portable photometer. Identification and enumeration were performed using a Sedgewick–Rafter counting chamber under a compound microscope. A total of 59 genera were recorded. *Oscillatoria* dominated during IM and SWM, whereas *Chaetoceros* was dominant in NEM. In addition, significant seasonal variations were observed (Kruskal–Wallis, $p < 0.05$) in community structure and water physicochemical parameters. Potentially toxic genera, including *Oscillatoria, Alexandrium, Gonyaulax*, and *Pseudo–nitzschia*, were present across seasons. Canonical Correspondence Analysis indicated that temperature and pH were the primary drivers of community variation, with IM associated with warmer waters and nitrate availability, SWM influenced mostly by physical factors of the water, and NEM characterized by higher dissolved oxygen, pH, and phosphate levels. Phytoplankton dynamics in Bacuit Bay exhibit strong seasonal patterns driven by key environmental variables, with conditions that may favor the proliferation of potentially toxic species. It is recommended that regular monitoring of phytoplankton and water quality be implemented, particularly during high–risk seasons, alongside the development of early warning systems and strengthened coastal management strategies to ensure the safety and sustainability of recreational waters.

Keywords: *Oscillatoria*, *Alexandrium*, harmful algal blooms, water quality, Bacuit Bay

Suggested citation:
Paalan EP, Sahawi EJ, Hasan AYM, Mabuhay-Omar JA. 2026 Little Wanderers in Recreational Waters: Seasonal Dynamics of Phytoplankton Communities and Potentially Toxic Species in Bacuit Bay, El Nido, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 228). Western Philippines University, Palawan, Philippines.

The Impact of Concepcion–Sagrada–Bogtong Marine Reserve on Community Well–Being

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ABSTRACT

This study evaluated the community impact and perceptions of the Concepcion–Sagrada–Bogtong Marine Reserve in Busuanga, Palawan, using the Socio–Economic Assessment Tool (SEAT). The framework analyzed output indicators or management interventions by the local government and community and input indicators, including financial, human, and social capital aimed at enhancing human well–being. The MPA achieved maximum scores across all input indicators, including budget allocation, revenue generation, trust fund establishment, business planning, and incentive and disincentive schemes. This is driven by a significant increase in the local government's annual budget for MPA operation from Php 500,000 in 2012 to Php 3,000,000 in 2025. Household survey results (n=91) on output indicators revealed high levels of community engagement and support, with 88% of respondents were knowledgeable about the MPA and 86% perceived tangible environmental improvements. The implementation of the Pamanang Busuanga ecotourism project in 2022 fostered positive economic shifts, with 81% of respondents noting an increase in MPA–related employment as it engaged three fisherfolk associations as primary service providers. On enforcement, 79% of residents reported a decrease in illegal fishing, attributed to 24/7 patrols. These perceptions corroborated with enforcement reports citing zero encroachment within the MPA. The results also confirmed the participation and engagement of various stakeholders in the co–management of the MPA, with more than 75% agreed involvement of various stakeholders and have participated in MPA related activities. The increased management inputs were consistent with positive community perceptions and enhanced socio–economic benefits.

Keywords: marine reserve, socio–economic impacts, well–being, MPA management

Suggested citation:
Baobao J, Rabe MT, Facula V, Guenares R. 2026 The Impact of Concepcion–Sagrada–Bogtong Marine Reserve on Community Well–Being. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 229). Western Philippines University, Palawan, Philippines.

Barangay Development Plan in El Nido, Palawan

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ABSTRACT

This study was conducted to determine the barangay development plan in El Nido, Palawan. Specifically this study aims to identify the profile of the barangay and the respondents, determine the existing barangay development plan of selected barangay in El Nido, Palawan. This covers the terms of infrastructure, water sanitation and education. Also in order to determine the level of implementation of barangay planning in terms of economic development, environmental, institution, infrastructure. Likewise, this study also identified the problems encountered by the officials of implementing barangay development plan in selected barangay of El Nido Palawan. The study used a quantitative research design and a structured survey questionnaire was distributed to the respondents which are the elected official in selected barangays in El Nido Palawan. The data was collected and analyzed using a checklist–style questionnaire. Based on the analysis conducted majority of the respondents were 36–51 years old; male. Barangay development plans for infrastructure, water and sanitation, and education lists programs with details of the programs and plans that each barangay have done. The statistical analysis reveals varying degrees of effectiveness, highlighting strengths in infrastructure while noting challenges in economic and institutional areas. Overall, the plan demonstrates moderate implementation, emphasizing community–driven priorities for sustainable rural development. Findings also suggest that limited funding and poor coordination are top concerns, underscoring the need for targeted interventions to overcome these hurdles. Ultimately, addressing these problems is essential for advancing local development goals effectively.

Keywords: barangay, development, plan, infrastructure, economic, development goals

Suggested citation:
Peñaflor GA, Latube RJC, Radam EF, Sigalat MJA, Tucay CA. 2026. Barangay Development Plan in El Nido, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 230). Western Philippines University, Palawan, Philippines.

Barangay Parliamentary Procedures in Puerto Princesa City, Palawan

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ABSTRACT

The study examines the comprehension and application of parliamentary procedures among barangay elected officials. The study aims to determine the profile; age, sex, civil status, years in service, educational attainment; To measure their level of awareness of parliamentary procedures, assessed the extent to which these officials adopt such procedures in the conduct of meetings and sessions, and examine whether significant relationships exist between their socio–demographic profile and both their level of awareness and extent of adoption. In addition, the study analyzed the significant relationship between awareness and adoption to determine whether awareness influences actual practice. The study employed a descriptive– correlational research design using a mixed–method approach to determine the 150 barangay elected officials. Finding reveals that on the socio–demographic profile, they are within the middle–aged group, predominantly male, married, college graduates, and have served for one to five years. The results revealed that in terms of awareness level, the respondents were generally "Fully Aware". In terms of adoption level, the respondents consistently adopt in their official functions, "Always". In terms of level of awareness, educational attainment has a significant relationship with the socio–demographic profile, while the others are not significant. While on the adoption level, there is no significant relationship to their socio– demographic profile. All in all, the respondents are aware and knowledgeable in terms of the parliamentary implementation in Barangay. It is recommended that the Local Government unit should develop a localized parliamentary Procedure manual and facilitate inter–barangay collaboration to promote consistency, best practice sharing, and improved governance standards.

Keywords: parliamentary procedures, barangay elected officials, awareness, adoption, local governance

Suggested citation:
Ortiz KRS, Barrogo KT, Cabanillas JCM, Garcia AJG, Magbanua RT. 2026. Barangay Parliamentary Procedures in Puerto Princesa City, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 231). Western Philippines University, Palawan, Philippines.

Decoding Gen Z: Structural equation modeling of attitudes, intentions, and behaviors toward environmental sustainability

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ABSTRACT

Sustainable development has become a critical global concern, requiring active participation from individuals across all sectors of society. Achieving the goals outlined in the Agenda 2030 depends not only on policy and technological solutions but also on people's attitudes, intentions, and everyday environmental practices. While previous studies have examined sustainable behavior in various populations, limited research has focused on Generation Z in a multi–university Philippine context. This study investigated the attitudes, intentions, and behaviors of Generation Z university students toward environmental sustainability. It also examined whether gender influences the relationship between intention and sustainable behavior. Data were collected from 881 college students enrolled in higher education institutions in the Philippines. The analyses were conducted using Partial Least Squares Structural Equation Modeling (PLS–SEM). The results show that attitude, subjective norms, perceived behavioral control, and intention, although with varying strengths of influence, significantly affected students' environmental sustainability behavior. These findings supported the relevance of Ajzen's Theory of Planned Behavior in explaining environmentally responsible actions among Generation Z. The nuanced moderating effect of age, clearly supported by the confidence intervals, further enriched this understanding, highlighting the differential impact of intentions on behavior across various age groups within the sample. The findings collectively provided a comprehensive understanding of the psychological and demographic factors that drive environmentally responsible behavior. The Gen Zs also saw the significant influence of their family/friends, political leaders, co–workers, and professors when it came to being environmentally responsible individuals. The study offers policy recommendations for university management to develop strategies and sustainable practices that encourage environmentally responsible behavior not only among its employees, but most especially its students.

Keywords: agenda 2030, gender, influencers, multigroup analysis, theory of planned behavior

Suggested citation:
Malolos CF, Atienza RP, Arispe VJ, Go AMD, Ignacio JJJ. 2026. Decoding Gen Z: Structural equation modeling of attitudes, intentions, and behaviors toward environmental sustainability. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 232). Western Philippines University, Palawan, Philippines.

Entrepreneurship by Choice or Circumstance: Enrollment Motivation and Career Intentions Among Bachelor of Science in Entrepreneurship Students

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ABSTRACT

Understanding whether students pursue entrepreneurship education by "choice" or "circumstance" is vital for improving curriculum effectiveness. In regions like Palawan, student motivations ranging from genuine passion to a lack of other available academic options significantly influence their long–term commitment to the local economy. This study aimed to examine the enrollment motivations and career intentions of Bachelor of Science in Entrepreneurship (BSE) students at Western Philippines University – PPC Campus. Specifically, it sought to assess whether students intend to pursue business ventures or seek traditional employment post–graduation. The research utilized a descriptive survey design involving BSE students across all year levels at the Puerto Princesa Campus. Data were collected using a structured 27–item questionnaire covering respondent profiles, enrollment motivation (Likert scale), entrepreneurial intentions, and career plans. The platform successfully supported offline species. The study evaluated key drivers such as parental influence, perceived career opportunities, and personal passion versus external constraints like course availability. Initial findings focus on identifying the primary career paths business ownership, private sector work, or government service and the specific barriers that prevent students from launching startups. The findings offer a clearer understanding of the 'entrepreneurial mindset' among BSE students, distinguishing between those with high risk tolerance and those pursuing the degree primarily for general employment. This distinction is crucial for tailoring education to better support actual business creation, while still providing quality instruction for students aiming for corporate careers. It is recommended that the program enhance practical incubation support for students who are "actively preparing" for business. Future studies should track these cohorts five years post–graduation to measure the actual impact of their professional choices.

Keywords: enrollment motivation, career intentions, entrepreneurship education, BSE students, entrepreneurial mindset

Suggested citation:
Besorio JO, Calanday FJB, Luceñara LM. 2026. Entrepreneurship by Choice or Circumstance: Enrollment Motivation and Career Intentions Among Bachelor of Science in Entrepreneurship Students. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 233). Western Philippines University, Palawan, Philippines.

SESSION 3 – INTEGRATED RESEARCH, INNOVATION, AND DEVELOPMENT (EDUCATION · SOCIAL SCIENCES · BUSINESS · GOVERNANCE · ICT · ENGINEERING · INTERDISCIPLINARY STUDIES)

Optimizing University Canteen Operations Using Queuing Theory: A Multi–Counter Service Analysis

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ABSTRACT

Efficient management of university canteens is essential to enhance service quality, satisfy customers, and optimize operational costs (Jiao et al. 2022). However, overcrowding, and long waiting times, often reduce service efficiency and result in customer dissatisfaction and sales loss. Queuing theory offers a mathematical approach to evaluate and improve service systems by balancing demand and service capacity (Sharma, 2013; Medhi, 2009). This study evaluates the operational performance of the university canteen, focusing on three main counters (L1, L2, L3) during peak and non–peak hours, to identify bottlenecks and propose data–driven improvements. Purposive sampling was conducted over four consecutive days during morning, lunch, and afternoon periods. Structured observation forms and stopwatches recorded arrival rates, service times, queue lengths, and customer behaviors (balking and reneging). Data were analyzed using Little's Law and M/M/s models to determine waiting times, service efficiency, and staffing needs. During peak hours, L1 had the longest service time (5 minutes) and waiting time (11 minutes), indicating congestion due to high demand. L2 and L3 had shorter service times (2–3 minutes) but still experienced long waiting times, with L3 reaching 12 minutes. During non–peak hours, L2 was the most efficient (1–2 minutes service; 0–8 minutes waiting), followed by L1 (3 minutes service; 2–11 minutes waiting), while L3 remained least efficient (3–4 minutes service; 9–10 minutes waiting). Customer abandonment ranged from 4% to 31%, contributing to sales loss. Findings revealed that improving staffing and service methods can significantly reduce waiting times and enhance efficiency. Based on queuing model computations (λ/μ), optimal staffing levels are proposed as follows: Line 1 requires 5 servers during lunch and 2 during non–peak hours; Line 2 requires 2 servers during lunch and 1 during breaks; and Line 3 requires 3 servers during lunch and 2 during other periods.

Keywords: queuing theory, optimization, canteen operation, waiting time, service time

Suggested citation:
Venturillo ET. 2026. Entrepreneurship by Choice or Circumstance: Enrollment Motivation and Career Intentions Among Bachelor of Science in Entrepreneurship Students. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 234). Western Philippines University, Palawan, Philippines.

Capabilities of Barangay Police Security Officers (BPSO) in the Maintenance of Peace and Order in Barangay San Pedro, Puerto Princesa City

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ABSTRACT

Maintaining peace and order is essential in rapidly growing communities like Puerto Princesa City, where increasing population and diversity contribute to public safety challenges. Barangay Police Security Officers (BPSOs) play a crucial role in community–based peacekeeping; however, concerns regarding their capabilities, training, and resources remain. This study aimed to: (1) assess the capabilities of BPSOs in terms of duties and responsibilities, equipment availability, personal development, interdisciplinary action, and honoraria and benefits; (2) determine the relationship between respondents' socio–demographic profiles and their assessment of BPSO capabilities; and (3) identify the problems encountered by BPSOs in maintaining peace and order. A descriptive–correlational research design was employed. Data were gathered through survey questionnaires from 147 respondents, including residents, BPSOs, and barangay officials. Cluster random and purposive sampling techniques were used, and data were analyzed using frequency, percentage, weighted mean, and correlation analysis. Findings revealed that BPSOs were generally assessed as "very capable" in performing duties and responsibilities. Equipment such as radios, batons, and flashlights were widely available, though some issues in functionality and usage were noted. Training opportunities existed but gaps in participation and skill development remained. No significant relationship was found between socio–demographic profile and most capability indicators, except age in relation to honoraria and benefits. Problems included limited training exposure, communication gaps, and insufficient or non–functional equipment encountered. BPSOs are effective in maintaining peace and order; however, improvements in training, resource allocation, and coordination are necessary to enhance performance and community safety. It is recommended that barangay officials strengthen stakeholder participation, establish regular coordination and dialogue with BPSOs, and review honoraria and benefits. Continuous training programs, improved equipment availability and maintenance, and the creation of a BPSO Development Committee are also suggested to enhance operational effectiveness.

Keywords: barangay police security officers (BPSO), peace and order, community policing, crime prevention, public safety

Suggested citation:
Cena JJ. 2026. Capabilities of Barangay Police Security Officers (BPSO) in the Maintenance of Peace and Order in Barangay San Pedro, Puerto Princesa City. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 235). Western Philippines University, Palawan, Philippines.

Influence of Social Media on Investigation

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ABSTRACT

Social media has become an important tool in modern criminal investigations, influencing how crimes are reported, monitored, and solved. Its widespread use allows faster communication and access to real–time information, making it relevant in law enforcement operations. This study aimed to identify the types of crimes commonly reported on social media, determine its effectiveness in criminal investigations, examine the challenges encountered by law enforcement, and identify best practices to ensure the admissibility of digital evidence. A mixed–methods research design was employed, combining quantitative data from a survey of 60 law enforcement officers with qualitative data gathered through interviews. The study was conducted in six Philippine National Police stations in Puerto Princesa City. Data were analyzed using descriptive statistics and thematic analysis. Findings revealed that property crimes (83.3%) and traffic–related incidents (78.3%) were the most frequently reported on social media, followed by financial crimes (68.3%) and violent crimes (63.3%). Social media was rated as "very effective" (79.3%) in enhancing investigations through faster information dissemination, public engagement, and lead generation. However, challenges such as privacy restrictions (81.7%), difficulty in identifying anonymous users (78.3%), and issues in verifying digital content (66.0%) were identified. Best practices include cyber patrolling, online profiling, proper documentation, use of timestamps and hash values, and strict adherence to chain–of–custody procedures. The study concludes that social media significantly enhances criminal investigations but requires proper regulation, verification, and ethical use to ensure reliability and legal admissibility. The study recommends that the Philippine National Police strengthen continuous training programs on social media investigation, focusing on legal, ethical, and technical aspects. It also suggests enhancing coordination and data–sharing with social media platforms, promoting public awareness on responsible reporting, and encouraging academic institutions to integrate cybercrime and digital investigation into their curriculum.

Keywords: social media, criminal investigation, Philippine National Police, investigation process, digital evidence

Suggested citation:
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Online Shopping Experience: Basis against Scam Victimization

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ABSTRACT

Online shopping scams involve scammers pretending to be legitimate online sellers with fake website, fake ads on a genuine retailer site. Many online sellers are legitimate, unfortunately, scammers can use the anonymous nature of the internet to rip off unsuspecting shoppers. Study determined online shopping experiences such online platform, frequency and reason for buying, mode of delivery/preferred courier, mode of payment, items usually bought, online shopping scams encountered, effects of online shopping scams. Learned strategy from experience and proposed measure to eliminate online shopping scams on seller, buyer, and service review. Utilizing descriptive quantitative research, data collected through survey questionnaire administered to 200 students randomly selected. Data were analyzed using frequency counts, and percentages. Findings revealed that students, aged 16–24 are active online shoppers started year 2020. Majority are monthly shoppers, 51.5% are victim of online scams, such as Shopee, Lazada, and TikTok, they encountered scams like fake sellers, fake products, reviews or ratings, took payment but never sent the item (36%). 25% have been scammed three or more times. Despite online shopping's convenience, was the key motivation of students. Common mode of delivery is J&T (84.5%). Secure payment method is cash on delivery. Most item bought was clothing (95%). Students are cautious after losing money, others experienced anxiety, frustration, and loss of trust in online platforms. Reading seller reviews and ratings before buying is one of their learned strategies. Online shopping literacy, the ability to evaluate sellers, identify red flags, secure payment, and verify authenticity, reduced risk of scam victimization. Literacy makes online shopping safer and more secure. Create audio visual presentation and poster to educate students, faculty & staff to avoid online scams and secure online purchases.

Keywords: online platform, online buying, mode of delivery, mode of payment, financial loss, victim, seller review, buyer review, service review

Suggested citation:
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Students' Knowledge on the Process for Filing Cybercrime Incidents

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ABSTRACT

Cybercrime incidents have rapidly increased due to the widespread use of the internet, particularly among students who rely on digital platforms for communication, education, and transactions. While laws such as Republic Act No. 10175 or the Cybercrime Prevention Act of 2012 exist, many students remain vulnerable due to limited knowledge of proper reporting procedures, which may result in underreporting and ineffective response to cybercrime incidents. This study assessed the level of knowledge of students at Western Philippines University, Puerto Princesa City Campus regarding the types of cybercrime cases and the process for filing cybercrime incidents. A descriptive quantitative research design was utilized in this study. Data were collected through a structured survey questionnaire administered to 250 students selected using quota sampling from five colleges. The data were analyzed using frequency counts and percentages. The findings revealed that students are generally knowledgeable about common cybercrime offenses such as cyberbullying, identity theft, and illegal access. However, their knowledge of cybercrime reporting procedures including identifying appropriate agencies such as the PNP Anti–Cybercrime Group, NBI Cybercrime Division, and DOJ Office of Cybercrime, preparing required evidence, and understanding the step–by–step filing process, was found to be limited. This gap in procedural knowledge may contribute to hesitation and ineffective reporting among potential victims. The study concludes that while students possess basic knowledge of cybercrime types, there is a significant deficiency in their understanding of the proper reporting process. Enhancing students' knowledge in this area is essential to promote effective reporting and strengthen cybercrime prevention efforts. It is recommended to conduct awareness programs, training, and audio–visual presentations to educate students on proper cybercrime reporting procedures.

Keywords: cybercrime, cybercrime reporting, student knowledge, cybercrime process, awareness

Suggested citation:
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Exploring Sound Patterns in the Batak Language: A Phonological Analysis of an Endangered Language in Palawan

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ABSTRACT

This study examines the phonological features of the endangered Batak language spoken in Maoyon, Puerto Princesa, Palawan, with particular focus on vowel quality variations, consonant quality variations, and stress pattern variations. Grounded in phonological theory, the research aims to document and analyze the sound system of Batak, which remains underdescribed despite its critical endangerment. A qualitative research design was employed, involving fifteen native Batak speakers selected through stratified random sampling. Data were collected through interviews, audio recordings, elicitation tasks, and field observations, and were analyzed using phonetic transcription and thematic analysis. Findings reveal that Batak exhibits a wide range of vowel quality variations, including raising, lowering, fronting, backing, centralization, lengthening, reduction, and diphthong variation, occurring in systematic phonological environments. Consonant quality variations were also observed, particularly in processes such as lenition, fricativization, and palatalization, reflecting both internal phonological rules and external linguistic influences. Additionally, stress pattern variation in Batak includes penultimate, final, monosyllabic, root–based, and variable stress, demonstrating both regularity and flexibility in prosodic structure. The results indicate that Batak phonology reflects both conservative Austronesian features and adaptive changes due to language contact with Tagalog, Cuyonon, and other regional languages. These findings contribute to the documentation and preservation of Batak by providing a detailed account of its sound patterns. Furthermore, the study offers valuable implications for language education, orthography development, and revitalization efforts, supporting the sustainability of this endangered linguistic heritage.

Keywords: Batak language, phonology, vowel quality variation, consonant variation, stress patterns, language documentation, Palawan

Suggested citation:
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Linguistics Flair: A Comparative Study of Morphological Construction in Popular and Cuyonon Swardspeak

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ABSTRACT

This study addresses the lack of documentation on regional swardspeak by examining how popular and Cuyonon swardspeak function as creative, identity–affirming sociolects within the Filipino LGBTQ+ community. It aims to describe the morphological constructions of popular and Cuyonon swardspeak, compare their similarities and differences, and examine how these distinctions shape social inclusion and exclusion among speakers. Using the qualitative design, employed purposive sampling of 21 Cuyonon LGBTQ+ students from Western Philippines University and gathered data through fill–in forms and interviews on swardspeak usage. The responses were subjected to thematic and morphological analysis to identify word formation processes and their perceived social functions in everyday communication. Findings show that both varieties share key morphological processes such as clipping, borrowing, affixation, blending, derivation, reduplication, compounding, and morpheme use, yet Cuyonon swardspeak displays higher complexity, multiple synonyms, and stronger local phonological coloring. These distinctive formations serve as both bridges and barriers: they strengthen in–group solidarity and shared identity, but also create communication gaps and misunderstanding with non–users. Findings show that both varieties share key morphological processes such as clipping, borrowing, affixation, blending, derivation, reduplication, compounding, and morpheme use, yet Cuyonon swardspeak displays higher complexity, multiple synonyms, and stronger local phonological coloring. These distinctive formations serve as both bridges and barriers: they strengthen in–group solidarity and shared identity, but also create communication gaps and misunderstanding with non–users. This study concludes that Cuyonon swardspeak is not only linguistically richer than popular swardspeak but also a powerful marker of cultural belonging whose use can simultaneously foster intimacy and social distance. The researchers recommend further phonological, semantic, and comparative studies on regional swardspeak varieties systematic documentation of Cuyonon swardspeak through lexicon or primers, and the integration of these outputs into gender–sensitive and exclusive programs.

Keywords: language identity, word formation, gender inclusivity, regional linguistics, sociolinguistics

Suggested citation:
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Statistical competency of Grade 12 senior high school learners in selected secondary schools in Palawan

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ABSTRACT

Statistics is a fundamental mathematical discipline essential across various professions and closely integrated with research and decision–making processes. This study examined the statistical competence of Grade 12 senior high school learners in selected secondary schools in Palawan and identified factors influencing their competence. A descriptive–correlational design was employed, utilizing a 5–point Likert–scale questionnaire to collect quantitative data. Findings revealed that learners achieved outstanding academic performance in Statistics and Probability. However, their overall statistical competence was at a "Competent" level, with stronger performance in fundamental areas, particularly measures of central tendency. Among the factors examined, teacher–related variables obtained the highest ratings, while only student–related factors showed a significant relationship with competence. Additionally, academic performance and strand were significantly associated with statistical competence. The findings suggest that statistical competence is primarily learner–driven, shaped by engagement, motivation, and the ability to apply knowledge critically, while external factors serve as supportive conditions. Developing statistical competence as a key 21st–century skill requires alignment among curriculum, instruction, assessment, and policy, supported by continuous research to inform responsive and evidence–based educational practices.

Keywords: literacy, senior high school, statistical competency, academic track, TVL track

Suggested citation:
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The Traditional Dances of the Tagbanua: Basis for Cultural Preservation

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ABSTRACT

Traditional dances are quintessential, place–based forms of Tagbanua identity and spirituality but are inherently vulnerable to cultural decline and disconnection from the young generation because of modernization. This study aimed to investigate the processes of dance preservation and documentation among the Tagbanua in Palawan. It sought to provide an understanding of how the Tagbanua preserved their culture through dance, as well as how the dances were executed and performed according to their purposes. This study employs a qualitative–ethnographic approach to explore the ethnic dances of the Tagbanua people of Palawan for cultural preservation. The study emphasized community engagement by highlighting the active collaboration and participation of the researcher within the Tagbanua communities. Documentation methods, including face–to–face interviews, video recordings, and filming, were utilized to analyze how these ethnolinguistic groups perform and preserve their cultural dances. Analysis demonstrates that though the tradition is naturally resilient and influenced by its specific ecological environment, its survival is being challenged by escalating youth migration, widespread cultural assimilation, and absence of systematic documentation. Traditional preservation efforts, such as documentation or performance workshops alone, are insufficient. The root of the crisis is not a failure of pedagogy but a failure of motivation, driven by systemic feelings of inferiority and a lack of social validation. The very "why" of carrying the tradition forward has been compromised. Furthermore, this study concludes that a critical methodological limitation exists in the current understanding of this phenomenon: the absence of youth voices in the data. Without a thorough grasp of these challenges from the perspective of the youth themselves, any proposed intervention will be based on assumptions rather than evidence. Therefore, sustainable revitalization is contingent upon addressing both the psychosocial dimensions of this "shame" and directly engaging the generation tasked with the tradition's future. The results emphasize the absolutely vital role of traditional dances as archive materials and point towards an urgent need for action. This research ends with recommendations for contextually appropriate, community–based interventions that enhance strong intergenerational transmission, reinforce internal cultural pride, and assist in safeguarding Tagbanua heritage within its native social and ecological context in Palawan.

Keywords: quality education, sustainable cities and communities, Tagbanua dances, Tagbanua cultural preservation, indigenous knowledge systems and practices

Suggested citation:
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A Level of Financial Literacy among Small and Medium–Sized Enterprises in Barangay San Miguel, Roxas, Palawan

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ABSTRACT

The primary objective of this study was to determine the level of financial literacy among small and medium–sized enterprises (SMEs) in Barangay San Miguel, Roxas, Palawan. It aimed to describe the socio–demographic profile of these business owners and analyze the relationships between financial literacy, financial behavior and attitude, financial awareness and utilization, and debt management patterns. The study employed a quantitative descriptive–correlational research design. Data were gathered through a survey questionnaire adapted from Mutengezanwa (2018) and distributed via face–to–face surveys to 31 SME owners. A full enumeration sampling method was used, covering all registered SMEs in the locale. Statistical tools used for data analysis included frequency, percentage, weighted mean, standard deviation, Analysis of Variance (ANOVA), and the Chi–Square Test of Independence. Key findings, Socio–Demographic Profile the typical SME owner is a middle–aged female (mean age of 42) and single. Most businesses operate in the wholesale and retail sector, have 6 to 10 years of operation, and started with a capital of less than ₱29,190.00. Financial Literacy the respondents demonstrated a moderate level of overall financial literacy (mean = 5.65). Statistical analysis showed that educational level significantly impacts financial literacy, while age, sex, and years of operation do not. Financial Behavior and Attitude the SMEs exhibited a high level of positive financial behavior and attitude (mean = 3.68), suggesting consistency in budgeting and expense monitoring. Awareness and Utilization: While basic financial awareness exists, there is a significant gap in the actual utilization of formal financial services. Many owners prefer keeping savings at home rather than in banks. Debt Management the respondents generally showed responsible debt management practices, though some still experience financial constraints that highlight a need for better financial planning. The study concludes that while local entrepreneurs possess a high behavioral intent toward managing finances, their formal financial knowledge and use of professional financial products remain moderate to limited. The researchers recommend that SME owners attend financial workshops and adopt digital payment platforms. Furthermore, the university should enhance its curriculum by integrating practical financial management concepts and forming alliances with local government and financial institutions to provide accessible education.

Keywords: socio demographic profile, financial literacy, financial behavior and attitude, financial awareness and utilization, debt management patterns, SMEs, San Miguel, Roxas, Palawan

Suggested citation:
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Analysis of Internal Migration in Brooke's Point, Palawan: Implications for Policy Formulation

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ABSTRACT

Internal migration is a significant driver of demographic and socio–economic change in the Philippines, particularly in emerging rural growth centers like Brooke's Point, Palawan, where increasing internal migration shapes local development outcomes. This study examines the socio–economic demographic profile of internal migrants, the key factors and patterns influencing migration, and its economic, social, and environmental implications for local development. A descriptive–empirical survey design was employed, involving 381 respondents from eight barangays with high migrant populations. Data were analyzed using descriptive and inferential statistics, including Pearson's r and Chi–square tests, to determine relationships between socio–economic variables and migration patterns. Findings reveal that internal migration is primarily economically driven, dominated by working–age, married, and male individuals seeking better livelihood opportunities. Brooke's Point's role as an emerging agro–industrial hub attracts migrants from Luzon and the Visayas. Most migrants are semi–skilled and engaged in informal or self–employed work. The study affirms Lee's Push–Pull Theory, with lack of jobs as the main push factor and employment availability as the primary pull factor, while De Haas' Migration Transition Theory explains the shift from survival–driven to opportunity–driven migration. Migration has stimulated business growth, expanded markets, and enhanced cultural diversity; however, challenges such as job competition, underemployment, social integration gaps, and environmental strain from unregulated settlement expansion persist. Internal migration in Brooke's Point is both transformative and opportunity–driven, contributing to local economic dynamism while posing governance, social, and environmental challenges that require integrated policy responses. The study recommends integrating the Balik Probinsya, Bagong Pag–asa (BP2) framework into local governance, strengthening skills training and livelihood programs, promoting social cohesion, and enforcing sustainable land–use planning.

Keywords: internal migration, socio–demographic profile, push–pull theory, economic opportunity, policy formulation

Suggested citation:
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Barangay Justice System in Taytay, Palawan

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ABSTRACT

The Barangay Justice System, also known as Katarungang Pambarangay, is a community–based dispute resolution mechanism that helps decongest formal courts by promoting amicable settlement of disputes at the barangay level. In Taytay, Palawan, this system plays an important role in maintaining peace and order, especially in communities with limited access to legal services. However, concerns remain regarding its effectiveness, the level of knowledge of Lupon members, and the challenges they encounter in resolving disputes. This study aimed to evaluate the Barangay Justice System in Taytay, Palawan by determining the demographic profile of the respondents, their duties and responsibilities, the common cases filed, their level of knowledge, and the problems encountered in resolving disputes. The study employed a descriptive research design using a survey questionnaire. Data were gathered from 132 respondents composed of 120 Lupon Tagapamayapa members and 12 Barangay Captains from 12 selected barangays in Taytay, Palawan. The data were analyzed using frequency counts, percentages, and weighted mean. Results revealed that most respondents were 55–64 years old, male, married, and high school educated. Most had served for 2–5 years, attended DILG mediation trainings, and commonly received ₱300 honorarium. Their most frequent functions included collaboration with barangay officials, mediation, documentation of resolutions, and monitoring settlements. A total of 485 cases were recorded, with family conflicts as the most common. Respondents also showed high knowledge in handling, recording, and monitoring cases. However, major challenges included lack of training, Insufficient funds, and non–appearance of parties Involved. The Barangay Justice System in Taytay, Palawan remains an important and functional community–based mechanism for dispute resolution. It contributes significantly to maintaining peace and order; however, its effectiveness is influenced by the knowledge, capability, and available resources of Lupon members. It is recommended that regular training and legal education for Lupon members be strengthened, financial and logistical support be increased, and stricter compliance with mediation procedures and party attendance be encouraged to improve the overall effectiveness of the Barangay Justice System.

Keywords: conflict resolution, community justice, dispute mediation

Suggested citation:
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Emergency Response of Barangay Irawan Puerto Princesa City, Palawan

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ABSTRACT

This study examines the emergency response of Barangay Irawan in Puerto Princesa City, Palawan. It is specifically aimed to determine the socio–demographic profile of the respondents in terms of age, sex, civil status, educational attainment, and length of residency. It also measured the level of responsiveness of the barangay in handling health, accident, and calamity–related emergencies and examined whether significant relationships exist between the respondents' socio–demographic profile and their perception of the barangay's emergency responsiveness. The study employed a descriptive research design using a survey questionnaire as the primary instrument for data collection. A number of respondents from Barangay Irawan participated in the study. Data gathered were analyzed using frequency, percentage, mean, and correlation analysis. The findings revealed that the respondents were mostly middle–aged adults, predominantly female, married, and high school graduates, with many having lived in the barangay for several years. Common emergencies experienced in the community include dengue and malaria for health–related cases, physical altercations and road accidents for accident–related incidents, and flooding as the most common calamity. In terms of the level of responsiveness, the respondents generally rated the barangay as "Less Responsive," indicating that improvements are needed in emergency services, resource availability, and communication during emergency covered situations. Based on the findings, it is recommended that Barangay Irawan strengthen its emergency preparedness and response programs by improving health services, increasing emergency resources, enhancing communication systems, and providing regular training for barangay personnel and volunteers to better respond to emergencies in the community.

Keywords: emergency responsiveness, calamity, emergency, preparedness

Suggested citation:
Sonio RAB, Aguhayon IDS, Gabuat ST, Dalogoc CB, Tucay CA. 2026. Emergency Response of Barangay Irawan Puerto Princesa City, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 246). Western Philippines University, Palawan, Philippines.

Records Management System of the Department of Environment and Natural Resources – Palawan

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ABSTRACT

The Department of Environment and Natural Resources (DENR), as a primary government agency tasked with the management and protection of the country's natural resources, relies heavily on an efficient and reliable Records Management System (RMS) to support evidence–based decision–making, ensure regulatory compliance, and deliver quality public service. Palawan—a province known for its rich biodiversity and environmental significance—the need for a functional and responsive RMS becomes even more critical. This study aimed to evaluate the effectiveness of the Records Management System (RMS) of the Department of Environment and Natural Resources in Palawan. This study utilized a descriptive–correlational research design to evaluate the effectiveness of the Records Management System (RMS) of the Department of Environment and Natural Resources in Palawan. The study found that personnel of the Department of Environment and Natural Resources in Palawan are young, highly educated, and adaptable, but lack sufficient records management training. Clients reported high satisfaction, confirming an effective RMS in record–keeping, access to information, and compliant to regulations. However, issues in internet connectivity, resources, system capacity, and training remain. Most demographics had no significant impact, except training exposure and employment status, highlighting the need for better infrastructure and capacity building. The DENR Palawan RMS is generally effective in record–keeping, access, and compliance, supporting public service delivery. However, its performance is limited by inadequate resources, unstable internet, and insufficient staff training. Effectiveness depends more on institutional support than demographic factors, highlighting the need to strengthen infrastructure, capacity building, and policy implementation for a more efficient and sustainable system. The Department of Environment and Natural Resources in Palawan should prioritize improving technological infrastructure, including internet connectivity and system resources, while providing regular, targeted training to enhance personnel competencies. Strengthening policy implementation, standardizing RMS procedures, and establishing continuous monitoring mechanisms will further improve system efficiency, reliability, and client–centered service delivery.

Keywords: records management system, effectiveness, access, compliance, and public service

Suggested citation:
Juab RD. 2026. Records Management System of the Department of Environment and Natural Resources – Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 247). Western Philippines University, Palawan, Philippines.

Service Delivery of Barangay Officials in Barangay Babuyan, Puerto Princesa City

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ABSTRACT

The study focused on the implementation of service delivery of barangay officials in Barangay Babuyan Puerto Princesa city. It aimed to assess the services that were being delivered by the officials to their constituents. A total of about 148 respondents were chosen from all purok of the said barangay. The services that were focused on are the agricultural support services, health and social welfare services, services and facilities related to environmental sanitation, infrastructure facilities, information and reading center and service delivery skills/ training program. Among the mentioned programs, it is the infrastructure facilities that is composed of community health center and schools day care center who got the highest mean with a description of fully implemented. And the study who got the lowest mean is the services and facilities related to environmental sanitation. The absence of health waste management and ecological sanitation were among those who got the lowest mean. The overall implementation program of Barangay Babuyan got an average of 2.35 which means partially implemented. There are deliverables that are partially implemented and those who got the implemented description are just the health and social welfare and infrastructure facilities program. Among the problems that were presented by the respondents, it is the problem on the source of potable waters that stood out. Next to this is the lack of insufficient budget for the implementation of projects and programs, lack of equipment and supplies and lack of leadership. The mandate of the local government units includes first and foremost of the delivery of the basic services that needs to be given. The study mirrored the performance of the barangay officials in terms of the said programs.

Keywords: services, service delivery, constituents, programs, projects

Suggested citation:
Tucay CA 2026. Service Delivery of Barangay Officials in Barangay Babuyan, Puerto Princesa City. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 248). Western Philippines University, Palawan, Philippines.

The Impact of Influencer Marketing on the Buying Behavior of Consumers: A Comparative Study Across Generations, Puerto Princesa City

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ABSTRACT

This study examined the impact of influencer marketing on the buying behavior of consumers in Barangay Manggahan, Puerto Princesa City, with emphasis on the differences across Generation X, Millennials, and Generation Z. Using a quantitative research design, data were gathered from 200 respondents through survey questionnaires and was analyzed using weighted mean and inferential statistics. The findings revealed that the respondents were mostly from Generation Z (40%), followed by Millennials (39%), indicating that younger consumers are more active in social media exposure and influencer–related content. In terms of platform use, Facebook emerged as the most commonly used platform for following influencers, making it the leading source of influencer content among consumers in the area. Among the factors that contributed to the effectiveness of influencer marketing, Awareness and Engagement emerged as the strongest factor, showing that influencer content plays a major role in introducing products, increasing familiarity, and keeping consumers interested. Trust and Influence, Purchasing Behavior, and Content and Platform Impact were also found to contribute to consumer buying behavior, but the results showed that consumers responded most strongly when they were highly exposed to and actively engaged with influencer content. The study further found that Generation Z was the most affected by influencer marketing, as they showed the highest level of awareness, trust, engagement, and willingness to purchase products endorsed by influencers. Millennials were also influenced, but they were more cautious and selective before making purchasing decisions. In contrast, Generation X was the least affected, showing lower engagement, lower trust, and greater skepticism toward influencer endorsements. Statistical results confirmed that there was a significant difference in the effectiveness of influencer marketing across Generation X, Millennials, and Generation Z, leading to the rejection of the null hypothesis. These findings indicate that influencer marketing affects consumer buying behavior differently across generations, with younger consumers—particularly Generation Z—being the most responsive.

Keywords: influencer marketing, buying behavior, generation z, millennials, generation x, consumer behavior, social media marketing

Suggested citation:
Tañedo MFR, Ricare JP, Villacorta RO, Meniano RAA. 2026. The Impact of Influencer Marketing on the Buying Behavior of Consumers: A Comparative Study Across Generations, Puerto Princesa City. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 249). Western Philippines University, Palawan, Philippines.

Unified After–Care Programs of Iwahig Prison and Penal Farm, Palawan

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ABSTRACT

This study comprehensively evaluated the effectiveness of the Unified After–Care Program at Iwahig Prison and Penal Farm under the Bureau of Corrections in facilitating the reintegration of released Persons Deprived of Liberty (PDLs), while addressing critical gaps in existing literature that largely focus on in–custody rehabilitation and recidivism rather than structured post–release support, particularly within the Philippine correctional context. The main purpose of this study is to evaluate or assess the effectiveness of the Unified After–Care Program of IPPF as perceived by the respondents focusing on the impact on employment, personal development, sustainable livelihood, community acceptance and over–all satisfaction on the program. The descriptive–survey method, to assess the effectiveness of the Unified After–Care Program of the Iwahig Prison and Penal Farm (IPPF) as perceived by its beneficiaries. The design determined the level of effectiveness of the programs in terms of employment, sustainable livelihood, and community acceptance. It also measured the level of satisfaction of the respondents in terms of relevance, accessibility, and overall effectiveness. The results highlight the need to strengthen job placement initiatives, enhance livelihood assistance, improve monitoring and evaluation mechanisms, and foster stronger collaboration among stakeholders to achieve more sustainable and inclusive reintegration outcomes for released PDLs. Both correctional officers and PDLs reported substantial program coverage in spiritual/moral programs, livelihood programs, skills training, employment referral, and monitoring/follow–up, while family counseling and educational assistance were less implemented, highlighting areas that require enhancement for holistic reintegration. Future studies are recommended to address the identified challenges such as limited job opportunities, lack of capital, insufficient monitoring, staffing shortages, and weak inter–agency coordination. It aims to enhance program responsiveness, improve service delivery, and ensure that interventions translate into tangible outcomes for released Persons Deprived of Liberty (PDLs).

Keywords: unified after–care program, reintegration, persons deprived of liberty (PDLs), program effectiveness

Suggested citation:
Rigor RG. 2026. Unified After–Care Programs of Iwahig Prison and Penal Farm, Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 250). Western Philippines University, Palawan, Philippines.

WildALERT: Design and Nationwide Implementation of a Digital Intelligence System for Enhancing Wildlife Crime Reporting in the Philippines

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ABSTRACT

Illegal wildlife trafficking is a major global threat, often operating in the shadows due to fragmented reporting, misidentification of species, and delayed data transmission. In biodiversity–rich countries like the Philippines, enforcement agencies face challenges translating field observations into actionable intelligence. Digital tools have the potential to bridge this visibility gap, enabling timely reporting and coordinated responses. The WildALERT platform was conceived to integrate design thinking, mobile–enabled species identification, geotagged incident reporting, and centralized data management into a single system to strengthen enforcement capacity. The study aimed to design, develop, and implement the WildALERT digital intelligence system for the Department of Environment and Natural Resources – Biodiversity Management Bureau (DENR–BMB), and to assess its feasibility and adoption potential across nationwide enforcement units. WildALERT was developed using a human–centered design thinking approach, incorporating iterative feedback from 30 DENR participants representing policy–making and frontline offices. The platform includes offline species identification, geotagged reporting, and a centralized database for incident tracking. Field deployment and workshops were conducted across multiple Philippine regions to guide system development, address operational challenges, and optimize functionality for diverse environmental contexts. The platform successfully supported offline species identification, geotagged incident submission, and centralized data aggregation. Participants reported high readiness and acceptance for digital adoption, with feedback guiding 113 specific enhancements to the system. WildALERT enabled isolated field encounters to be converted into structured, actionable intelligence, demonstrating improved visibility of wildlife crime incidents across multiple regions. The WildALERT platform represents a practical, scalable solution to the systemic invisibility of wildlife trafficking in the Philippines. Its design–thinking–based development and nationwide deployment illustrate the potential of digital intelligence systems to strengthen enforcement capacity, facilitate real–time reporting, and promote data–driven decision–making. Future studies should explore integration with transnational reporting networks, assess long–term user engagement, and evaluate impacts on enforcement outcomes. Expanding the platform to incorporate additional species databases, AI–assisted identification, and automated alerts can further enhance global wildlife crime visibility and intelligence–led enforcement.

Keywords: WildALERT, wildlife crime, digital intelligence system, species identification, DENR–BMB, technopreneurship, design thinking

Suggested citation:
Calanday FJB. 2026. WildALERT: Design and Nationwide Implementation of a Digital Intelligence System for Enhancing Wildlife Crime Reporting in the Philippines. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 251). Western Philippines University, Palawan, Philippines.

Poster Presentation
PPC Campus

SESSION 1 – AGRICULTURE, AQUATIC AND NATURAL RESOURCES (FISHERIES · AQUACULTURE · MARINE BIOLOGY · AGRICULTURE · FORESTRY · FOOD SECURITY · NATURAL RESOURCE MANAGEMENT)

Physicochemical Drivers and Temporal Dynamics of Red Tide Events in Batan Bay Estuary, Aklan, Philippines

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ABSTRACT

Harmful algal blooms (HABs), commonly known as red tides, pose significant ecological, economic, and public health risks in coastal and estuarine systems. Despite reported occurrences in the Batan Bay Estuary (BBE), there is limited understanding of the physicochemical drivers influencing bloom dynamics in the area. Addressing this gap is essential for improving monitoring and management of red tide events. This study aimed to assess the influence of physicochemical water parameters on the occurrence of red tide events in the Batan Bay Estuary. Physicochemical data, including surface water temperature, chlorophyll–a, salinity, turbidity, dissolved oxygen, and pH were obtained from Landsat 8 and 9 which were processed through Google Earth Engine. Red tide occurrences were compiled from BFAR shellfish bulletins, local advisories, and secondary reports. Spatial maps were generated for each timeframe for the physicochemical data using QGIS 3.44.6, and temporal patterns were analyzed using descriptive statistics and correlation analysis. Red tide events were recorded within July to December 2015, January to June 2016, and July to December 2023 timeframe, indicating episodic occurrence. Turbidity and salinity index showed moderate turbidity and moderate salinity in coastal areas. Chlorophyll–a concentration is relatively higher in the offshore areas, in contrast to temperature that is consistently higher in coastal and estuarine environments. These conditions suggest nutrient enrichment, estuarine mixing, and favorable thermal environments that support phytoplankton proliferation. The study demonstrates that red tide occurrence in BBE is influenced by the interaction of multiple physicochemical factors rather than a single driver. Temporal variability and environmental conditions play critical roles in bloom initiation and persistence. Continuous monitoring integrating remote sensing and in–situ validation is recommended to improve early warning systems. Further studies incorporating nutrient analysis and hydrodynamic modeling are also suggested to enhance predictive capabilities.

Keywords: harmful algal blooms, Batan Bay estuary, physicochemical parameters, GIS, remote sensing

Suggested citation:
Casibo AB, Leyson SJB. 2026. Physicochemical Drivers and Temporal Dynamics of Red Tide Events in Batan Bay Estuary, Aklan, Philippines. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 253). Western Philippines University, Palawan, Philippines.

Status and Fisheries of Cephalopods in Palawan Waters

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ABSTRACT

Cephalopods are a vital component of Philippine fisheries, yet information on their status and fisheries remains limited, particularly in Palawan. This study assessed the biology and fisheries of cephalopods in Honda Bay (Puerto Princesa), Rizal, and Linapacan, Palawan. Data were collected from June to November 2025 through market surveys, fisheries profiling, and catch–and–effort monitoring. A total of nine cephalopod species were documented across sites, mainly from the families Octopodidae, Loliginidae, Sepiidae, and Thysanoteuthidae. Key commercial species identified include *Octopus cyanea, Sepia latimanus, Thysanoteuthis rhombus,* and *Uroteuthis bartschi*. Results also showed spatial and temporal variations in species composition, fishing practices, and utilization, influenced by gear types and market demand. Cephalopod fisheries are often integrated into multi–species fisheries targeting small pelagic fishes, with catch rates ranging from 2 to 700 kg per trip. The study established baseline information on species composition, catch–per–unit effort, and seasonal trends. These data provide essential inputs for stock assessment, including analyses of growth, mortality, and exploitation using length–based and statolith–based approaches. Overall, the findings contribute to strengthening the scientific basis for the sustainable management and conservation of cephalopod fisheries in Palawan and the Philippines in general.

Keywords: cephalopods, cephalopod fisheries, stock assessment, catch–per–unit effort (CPUE)

Suggested citation:
Tumalac-Camias K, Galicia PJS, Balisco RAT, Palla HP. 2026. Status and Fisheries of Cephalopods in Palawan Waters. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 254). Western Philippines University, Palawan, Philippines.

SESSION 2 – HEALTH, ENVIRONMENT, AND COMMUNITY WELL–BEING (HEALTH SCIENCES · PUBLIC HEALTH · EDUCATION · ENVIRONMENTAL STUDIES · COMMUNITY DEVELOPMENT)

Pagtatangkal: A Narrative Inquiry into Youth Livelihood, Cultural Identity, and Experiences in Traditional Fishing

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ABSTRACT

Youth participation in small–scale fisheries remains underexplored, particularly in localized traditional practices such as pagtatangkal in Barangay Lucbuan, Puerto Princesa City, Palawan. While fishing serves as both a livelihood and a form of cultural heritage, limited studies have examined how youth navigate its economic demands, risks, and social implications. This study addressed this gap by examining youth engagement in pagtatangkal as a pivotal experience shaped by cultural, economic, and environmental factors. The study aimed to explore youth participation in pagtatangkal by (1) documenting its process and challenges, (2) understanding the motivations behind youth engagement, and (3) examining its implications in terms of livelihood, cultural preservation, and skill development. A qualitative research design using narrative inquiry was employed. Eight (8) youth participants aged 15–24 from Barangay Lucbuan were purposively selected. Data were collected through semi–structured interviews and analyzed using thematic analysis, involving transcription, coding, categorization, and interpretation of narratives. Findings revealed three major themes: (1) pagtatangkal as a fishing process involving physically demanding labor and exposure to risks such as adverse weather, equipment failure, low catch, and sleep deprivation; (2) motivations for participation, including economic necessity, personal choice, and family and peer influence, alongside cultural continuity; and (3) implications, highlighting financial support, strengthened cultural identity, and acquisition of practical skills. Youth engagement in pagtatangkal reflected a dual role as both an economic necessity and a cultural practice. Despite significant challenges, the youth demonstrated resilience in balancing livelihood and education, underscoring the need for supportive interventions. Stakeholders, including barangays, schools, parents, and social workers, should implement safety measures, flexible educational support, and livelihood programs to protect youth while sustaining traditional fishing practices.

Keywords: youth participation, cultural identity, coastal livelihood, traditional fishing, narrative inquiry

Suggested citation:

Magbanua IA, Ruiz SJM, Zarsadias SM, Paguia SM, Guinez R, Garobo CS. 2026. Pagtatangkal: A Narrative Inquiry into Youth Livelihood, Cultural Identity, and Experiences in Traditional Fishing. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 255). Western Philippines University, Palawan, Philippines.

Composition and Spatial Distribution of Potentially Toxic Phytoplankton and Dynamics of Water Quality in Recreational Waters in Palawan, Philippines

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ABSTRACT

Marine recreational waters serve as vital economic and ecological resources, particularly in tourism–dependent regions like Palawan. However, these environments are increasingly vulnerable to the proliferation of potentially toxic phytoplankton (PTP), which pose serious risks to public health, marine biodiversity, and coastal livelihoods. This study investigated the composition, dynamics, and distribution of PTP, along with key water quality parameters, in two major recreational waters of Palawan (Bacuit Bay in El Nido and Honda Bay in Puerto Princesa City). Phytoplankton samples were collected bimonthly from March 2025 to January 2026 at five stations per site using the vertical tow method with a plankton net. Water quality parameters were measured *in situ* using a multiparameter water quality probe, except for Total Suspended Solids (TSS), nitrate, and phosphate, which were analyzed *ex situ*. Taxa were identified through conventional microscopy and were classified as PTP if their genera appeared on the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC–UNESCO) Taxonomic Reference List of Harmful Microalgae. A total of ten (10) PTP genera were recorded, eight (8) in Bacuit Bay and nine (9) in Honda Bay. Seven (7) genera (*Alexandrium*, *Dinophysis*, *Gonyaulax*, *Nitzschia*, *Oscillatoria*, *Prorocentrum*, and *Pseudo–nitzschia*) were common to both areas. *Trichodesmium* was recorded only in Bacuit Bay, while *Akashiwo* and *Pyrodinium* were observed exclusively in Honda Bay. Temperature, pH, TSS, and phosphate levels exceeded the threshold limits set by the Department of Environment and Natural Resources (DENR) during certain sampling months. Spatial distribution patterns varied considerably between the two bays and among sampling stations, reflecting differences in local environmental conditions. Sustained monitoring programs are strongly recommended, as these findings provide critical baseline data for monitoring PTP in Palawan's tourism–dependent coastal waters and serve as a foundation for developing early warning systems and evidence–based management strategies to protect public health.

Keywords: harmful microalgae, coastal monitoring, physicochemical parameters, public health risk, tourism

Suggested citation:
Sahawi EJ, Mabuhay-Omar JA, Paalan EP, Hasan AYM, Reyes ND, Cayabo J, Sajorne RE, Marohomsalic JS, Aquino JJB, Patiluna MLE. 2026. Composition and Spatial Distribution of Potentially Toxic Phytoplankton and Dynamics of Water Quality in Recreational Waters in Palawan, Philippines. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 256). Western Philippines University, Palawan, Philippines.

Spatiotemporal Variation in Coliform Load and Presence of Putative Pathogenic Bacteria in Recreational Waters of Palawan

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ABSTRACT

Microbial contamination in recreational coastal waters poses serious environmental and public health concerns, particularly in tourism–driven ecosystems such as Honda Bay and Bacuit Bay, Palawan. This study aimed to quantify total and fecal coliform loads, compare contamination levels among different sites in each bay, and determine the presence of putative pathogenic bacteria in two major recreational bays of Palawan. Water samples were collected from five sites each in Honda Bay and Bacuit Bay. Total and fecal coliform loads were quantified through the 3–tube fermentation method, while putative pathogenic bacteria were isolated using selective culture media. Statistical analyses were performed to determine significant differences among sites and between bays. Results showed that Site 1 (Wharf) consistently had the highest total and fecal coliform loads in both bays, indicating intense microbial pollution associated with tourism and boat activities. In Honda Bay, Cowrie Island had the next highest coliform load and exceeded the wharf during summer, likely due to increased tourist influx. In Bacuit Bay, the lagoon ranked second after the wharf, followed by Helicopter Island and Commando Beach. Significant differences among sites were observed in both bays. Between locations, Bacuit Bay (El Nido) consistently showed higher coliform loads than Honda Bay. Coliform loads also varied across seasons, with higher levels observed during peak tourist months and rainy months, suggesting the combined influence of intensified recreational activities and land–based runoff. Putative pathogenic bacteria such as *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella* spp., *Klebsiella aerogenes*, *Vibrio parahaemolyticus*, and *Vibrio furnissii* were also identified, with their occurrence varying across sites. Results showed that the wharf consistently had the highest coliform load in both bays, while other high–tourism sites also exhibited elevated contamination. Bacuit Bay consistently showed higher coliform loads than Honda Bay, indicating stronger tourism–related pollution pressure. The isolation of putative pathogenic bacteria further highlights potential public health risks in these recreational waters. The findings confirm that tourism hotspots contribute to microbial water pollution, increasing potential health risks to swimmers and tourists. Routine microbial monitoring, improved wastewater management, and stricter sanitation measures are recommended to protect public health and sustain the ecological quality of Palawan's recreational waters.

Keywords: Palawan, recreational waters, coliform, bacteria

Suggested citation:
Hasan AYM, Mabuhay-Omar JA, Sajorne RE, Paalan EP, Sahawi EJ. 2026. Spatiotemporal Variation in Coliform Load and Presence of Putative Pathogenic Bacteria in Recreational Waters of Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 257). Western Philippines University, Palawan, Philippines.

SESSION 3 – INTEGRATED RESEARCH, INNOVATION, AND DEVELOPMENT (EDUCATION · SOCIAL SCIENCES · BUSINESS · GOVERNANCE · ICT · ENGINEERING · INTERDISCIPLINARY STUDIES)

Management Practices in Public Construction Projects in Department of Public Works and Highways in Palawan

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ABSTRACT

Effective management of public construction projects is essential to ensure quality, efficiency, and accountability in infrastructure development. In the Philippines, the Department of Public Works and Highways (DPWH) plays a vital role in implementing such projects. Despite established standards and procedures, challenges such as project delays, contractor inefficiencies, and bureaucratic constraints persist. Moreover, the growing demand for data–driven decision–making highlights the need to assess existing management practices and control mechanisms employed by engineers in project implementation. This study aimed to assess the management practices and control mechanisms employed in the implementation of construction projects in 2024 by the DPWH across the three District Engineering Offices in Palawan. Specifically, it described the socio–demographic characteristics of engineers, evaluated their management practices and control mechanisms, identified challenges encountered, and determined the relationships among these variables. A descriptive–correlational research design was utilized. Data were collected from DPWH engineers using a structured survey questionnaire covering socio–demographic profiles, management practices, control mechanisms, and challenges encountered. Statistical tools such as frequency, percentage, mean, and correlation analysis were used. Findings revealed that respondents were generally experienced, technically competent, and well–educated. Management practices were effectively observed, particularly in inspection, cost of quality, and cost–benefit analysis, while advanced analytical tools were less utilized. Control mechanisms, including monitoring, standardization, and documentation, were consistently applied. Common challenges included contractor performance issues, project delays, and bureaucratic constraints. Correlation analysis showed no significant relationship between socio–demographic characteristics and management practices, but age and work designation were significantly related to control mechanisms. A significant positive relationship between management practices and control mechanisms was also established. The study concludes that DPWH engineers demonstrate strong adherence to standard practices, contributing to effective project implementation. Strengthening data–driven approaches, enhancing capacity–building programs, adopting technology–based control systems, and improving contractor performance monitoring are recommended to further improve efficiency, accountability, and overall project performance.

Keywords: project monitoring, quality assurance, public infrastructure

Suggested citation:
Badilla JMC. 2026. Management Practices in Public Construction Projects in Department of Public Works and Highways in Palawan. In: Dolorosa RG, Trestiza KAJ, Mabuhay-Omar JA, Diamante JT, Mecha JPF, Gimarangan JA and Espartero SAM (Eds.), RIDE Annual Conference Proceedings (Vol. 1, p. 258). Western Philippines University, Palawan, Philippines.

Project Construction Scheduling in Department of Public Works and Highways in Palawan

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ABSTRACT

Project construction scheduling is a critical component in ensuring the timely and efficient completion of public infrastructure projects. In the Department of Public Works and Highways (DPWH) in Palawan, scheduling practices are influenced by various technical, managerial, and environmental factors. Despite its importance, challenges such as delays, resource constraints, and coordination issues continue to affect project timelines. This study aimed to examine the factors affecting construction project scheduling among engineering professionals in the DPWH across the three District Engineering Offices in Palawan. It also sought to determine the relationship between engineers' profiles and their perception of scheduling challenges. A descriptive–correlational research design was employed. Data were collected from 95 engineers using a structured questionnaire covering socio–demographic characteristics, project–related factors, and scheduling practices. Descriptive statistics and correlational analyses were used to interpret the data and identify significant relationships. Findings revealed that the majority of respondents were middle–aged male engineers with considerable field experience but limited formal training in modern project management tools. Key factors affecting project scheduling included environmental conditions, management efficiency, technical competence, financial capability, and resource availability. Common challenges encountered were frequent change orders, labor shortages, procurement delays, limited equipment, and weak stakeholder coordination. Correlation analysis showed that years of experience and training significantly influenced how engineers perceive and manage scheduling issues. Effective construction scheduling in DPWH projects requires an integrated approach that considers technical expertise, management practices, financial resources, and environmental conditions. Addressing these factors is essential to improving project performance and ensuring timely completion. It is recommended to strengthen continuous professional training, adopt modern scheduling tools, improve resource and financial management systems, enhance stakeholder coordination, and implement proactive risk mitigation strategies to improve overall project efficiency and sustainability.

Keywords: public infrastructure, construction scheduling, engineering management practice

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Main Campus

Category	CAFES	CAS	CCJE	CED	CET	CFiNS	CPAM	***Category Total***
Competing Oral	15	3		9	7	2	1	***37***
Non–competing Oral	1	3	2	3	10		3	***22***
Competing Poster	7			2	1			***10***
Non–competing Poster					4			***4***
College Total	***23***	***6***	***2***	***14***	***22***	***2***	***4***	**73**

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Competing Oral		1	5	2		11	2	***17***
Non–competing Oral	2	1		3		3	14	***29***
Competing Poster		1				2		***3***
Non–competing Poster			2			2	2	***4***
College Total	***2***	***3***	***7***	***5***	***0***	***18***	***18***	**53**
Grand Total	25	9	9	19	22	20	22	**126**

INVOLVEMENT OF UNDERGRADUATE, GRADUATE, AND PROFESSIONALS

Main Campus

Category	CAFES	CAS	CCJE	CED	CET	CFiNS	CPAM	***Category Total***
Undergraduate	11	3	1	9	20		1	***45***
Graduate	1	1	1	2			2	***7***
Professional	11	2		3	2	2	1	***21***
College Total	***23***	***6***	***2***	***14***	***22***	***2***	***4***	**73**

PPC Campus

Category	CAFES	CAS	CCJE	CED	CET	CFiNS	CPAM	***Category Total***
Undergraduate		2	5	2		5	5	***19***
Graduate	2					5	7	***14***
Professional		1	2	3		8	6	***20***
College Total	***2***	***3***	***7***	***5***	***0***	***18***	***18***	**53**
Grand Total	25	9	9	19	22	20	22	**126**

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Oral Presentation:

Particulars	Percentage
1. Relevance and Timeliness	15
2. Quality of Research	50
Organization	*10*
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