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ABOUT THE COVER

The front cover of this special issue emphasizes the diverse yet interconnected dimensions of coastal and marine research in the Philippines, particularly in the West Philippine Sea. It reflects the important role of the Philippine Coast Guard in maritime safety, security, search and rescue, and environmental protection, while showcasing studies on marine biodiversity, fisheries, disaster risk reduction, and the health and well-being of coastal communities. It also highlights traditional coastal livelihoods, particularly salt-making practices, and the challenges local producers face. Collectively, the featured papers emphasize the critical role of scientific research, community knowledge, and institutional efforts in comprehending and addressing the challenges facing coastal and marine environments. The issue celebrates the people, resources, and practices that contribute to the long-term management and development of the Philippine coastal and marine landscape.

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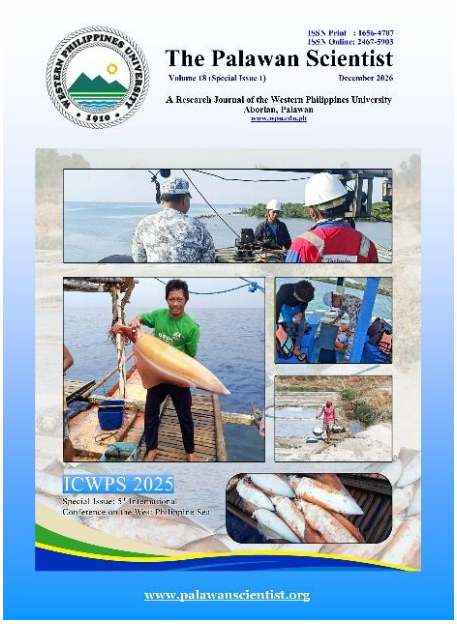

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EDITORIAL

Beyond the Waters of Palawan: Science, Communities, and Resilience in the West Philippine Sea

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Dear Readers,

Understanding the West Philippine Sea requires looking beyond its waters to examine the biodiversity it sustains, the people who depend on its resources, the institutions responsible for its protection, and the coastal communities exposed to environmental and climate-related risks.

The West Philippine Sea (WPS) is a complex social–ecological system in which marine biodiversity, fisheries, livelihoods, human well-being, maritime governance, and environmental risks are closely interconnected. Its waters support marine food production and coastal livelihoods and form part of important international maritime navigation routes. Sustaining these resources is therefore essential to ecological integrity, socioeconomic well-being, and long-term regional resilience.

Despite research undertaken by various institutions, significant knowledge gaps remain that constrain evidence-based conservation and resource management. Understanding the WPS requires more than documenting its marine ecosystems and species; it also demands an assessment of the human activities, institutional capacities, and environmental pressures that shape the region. Reported concerns include habitat degradation, changes in island morphology, pollution, climate vulnerability, fishing pressure, and challenges in law enforcement. Addressing these concerns requires sustained scientific investigation, coordinated governance, and effective implementation of conservation and management measures.

Government agencies and research institutions have initiated efforts to address some of these challenges. Among them are the Palawan Council for Sustainable Development Staff (PCSDS) initiatives associated with the *Integrated Management and Protection Strategies for Lawak Island Critical Habitat (LICH)* and *Safeguarding Ecological Abode for Turtles at Haven (SEA-TH): Initiatives for Likas Island Ecological Development*. These initiatives support conservation efforts for migratory bird populations on Lawak Island and sea turtles on Likas Island. Nevertheless, challenges remain in systematic ecological and pollution monitoring, climate resilience, law enforcement, and the management of maritime and jurisdictional disputes. These concerns underscore the need for integrated, sustained, and science-based approaches to marine and coastal management.

The studies assembled in this special issue contribute to this broader understanding by examining fisheries, marine biodiversity, maritime services, disaster risk reduction, public health, coastal engineering, and coastal industries. Collectively, they demonstrate that knowledge of the WPS cannot be developed through a single discipline. Rather, it emerges from the convergence of diverse scientific approaches that generate local evidence for sustainable resource use, safer communities, stronger institutions, and more resilient coastal systems.

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Biodiversity and Fisheries: Strengthening the Scientific Basis for Conservation

Reliable biodiversity assessments and fisheries information are fundamental to sustainable resource management. The study of the diamondback squid (*Thysanoteuthis rhombus*) fishery in Rizal, Palawan, provides baseline information on a locally recognized, high-value species known as "dalupapa." Such documentation can inform future investigations of the fishery, including its exploitation patterns, ecological significance, and management requirements.

Similarly, the first documented record of the keeltail pomfret (*Taractes rubescens*) from Palawan expands the known marine biodiversity of the region, particularly its deeper and less-explored habitats. The study also demonstrates the potential value of local fish markets as sources of information on species occurrence and distribution. When supported by reliable identification and documentation, such records can contribute to biodiversity inventories, guide further research, and inform conservation assessments.

Together, these studies highlight the continuing need for taxonomic documentation, fisheries monitoring, and ecological research. Even in a region recognized for its rich marine resources, important questions remain about species distribution, population status, exploitation, and conservation. Translating these findings into management action requires sustained monitoring and the integration of scientific evidence into fisheries and coastal resource policies.

Coastal Livelihoods and Human Well-being

The sustainability of marine resources is inseparable from the socioeconomic conditions of the people who depend on them. The study of salt-making practices highlights the challenges confronting coastal producers, including exposure to climate and weather variability, limited access to larger distribution networks, inadequate storage, and insufficient post-harvest improvements. These constraints point to opportunities for climate-resilient infrastructure, appropriate technologies, improved storage and product handling, traceability systems, secure tenure arrangements, and stronger market linkages. Such interventions should be responsive to local production conditions and the needs of coastal livelihood groups.

The health-related study adds another dimension to coastal sustainability by examining the occupational and health concerns of people living and working in marine environments. The findings identify marine accidents, musculoskeletal complaints, and infections or skin diseases as important health-related concerns. More than half of the respondents had physical health scores at or below the study's specified threshold, while musculoskeletal complaints were particularly prevalent. The study also identified greater risks among women and respondents in lower marine-based income groups, underscoring the importance of gender-responsive safety measures, ergonomic support, accessible health services, and stronger social protection.

These findings broaden the understanding of coastal resource sustainability. Healthy marine ecosystems are essential, but so are the health, safety, and livelihood security of the people who depend on them. Fisheries management, occupational safety, public health, disaster preparedness, and livelihood development should therefore be addressed as interconnected components of coastal management rather than as separate policy concerns.

Maritime Institutions and Governance

Effective maritime governance depends not only on policies and institutional mandates but also on the capacities and working conditions of the personnel responsible for implementing them. The study examining the human dimension of Philippine Coast Guard personnel highlights their commitment to maritime service alongside challenges that include equipment deficiencies and unfavorable public perceptions.

The findings point to the importance of continuing professional development, adequate operational resources, evidence-informed decision-making, and stronger partnerships among maritime agencies, local governments, nongovernmental organizations, academic institutions, and coastal communities. Institutional capacity is particularly important in maritime areas where environmental protection, public safety, resource management, and the enforcement of applicable laws and regulations intersect.

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Strengthening maritime governance consequently requires sustained investment in personnel, equipment, inter-agency coordination, and community engagement. Scientific research can support these efforts by providing information for planning, identifying operational and environmental concerns, and helping institutions develop responses that are appropriate to local conditions.

Environmental Change, Disaster Risk, and Coastal Resilience

Coastal resilience depends on institutional preparedness, community participation, and an understanding of the environmental risks affecting coastal areas. The assessment of disaster risk reduction and management awareness and practices among barangay officials in San Vicente, Palawan, found generally high awareness of search and rescue, official responsibilities, and evacuation facilities. However, limited training, inadequate funding, and low community participation remained important challenges. The reported relationship between disaster experience and disaster risk reduction practices also suggests that lessons from previous events can inform local preparedness and planning.

These findings highlight the importance of strengthening local capacity to respond to environmental hazards. While awareness among local officials provides an important foundation, effective disaster risk reduction also requires sustained institutional support, adequate resources, and meaningful community participation. In coastal areas exposed to environmental and climate-related risks, preparedness must be supported by locally grounded evidence and translated into practical measures that address the needs and vulnerabilities of affected communities.

More broadly, strengthening coastal resilience requires connecting scientific knowledge with local planning and decision-making. Research on disaster preparedness can help identify gaps in institutional capacity, inform targeted interventions, and support more responsive risk communication. Integrating these insights into local development planning and community-based initiatives is essential to reducing vulnerability and building resilience in coastal communities.

From Scientific Evidence to Integrated Action

Viewed collectively, the contributions in this special issue present a multidimensional picture of the WPS and its associated coastal environments. Their methods range from interviews and surveys to biodiversity documentation, statistical analysis, and hydrological modeling. Although the studies address different subjects and geographic settings, they share a common contribution: generating evidence that can help identify ecological conditions, socioeconomic constraints, institutional needs, and environmental risks.

A central lesson is the importance of locally grounded research. Challenges affecting marine ecosystems and coastal communities are experienced in specific places and under particular environmental, economic, and institutional conditions. Data derived from these settings can complement broader regional and national assessments by revealing local circumstances that generalized analyses may overlook. Continued research is therefore necessary not only to fill knowledge gaps but also to establish baselines, monitor change, evaluate interventions, and identify emerging management priorities.

However, scientific evidence alone does not guarantee effective conservation or improved community well-being. Research findings must be translated into practical decisions and sustained interventions. Fisheries data should inform resource assessment and management; biodiversity records should support continued monitoring and conservation; health research should guide improvements in occupational safety and access to health services; and disaster assessments should strengthen preparedness, early warning, and land-use planning. Likewise, research on coastal industries should inform appropriate technologies and livelihood development, while studies of maritime personnel should help identify priorities for institutional capacity-building.

Achieving these outcomes requires an integrated, interdisciplinary, and multisectoral approach to marine and coastal management in the WPS. Researchers, government agencies, maritime institutions, local governments, coastal industries, and communities must work collaboratively to connect scientific knowledge with policy formulation, enforcement, resource allocation, and community-based action. Such collaboration is particularly

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important where ecological conservation, livelihood security, climate adaptation, and maritime governance intersect.

Conclusion

The WPS demands scholarship that is scientifically rigorous, interdisciplinary, and responsive to the realities of coastal communities. The studies presented in this special issue contribute to that goal by documenting fisheries and biodiversity, examining the conditions of people who work in marine environments, assessing institutional challenges, and investigating coastal hazards and livelihood concerns. Individually, they provide findings relevant to specific research questions; collectively, they demonstrate the value of viewing marine and coastal environments as interconnected social–ecological systems.

This special issue of the *International Conference on the West Philippine Sea* represents a contribution to the continuing effort to understand these systems. Its significance lies not only in the findings of individual studies but also in the opportunities they create for further research, collaboration, and evidence-informed decision-making. From marine species and fisheries to maritime personnel, coastal health, disaster preparedness, and local industries, the studies emphasize that environmental sustainability and human well-being must be pursued together.

Ultimately, understanding the West Philippine Sea means understanding both its waters and the people whose lives are connected to them. Continued scientific investigation, systematic monitoring, institutional collaboration, and the translation of research into practical action are essential to safeguarding marine biodiversity, sustaining coastal livelihoods, strengthening maritime governance, and improving resilience to environmental and climate-related risks. The studies in this special issue should therefore be viewed not as a complete account of the WPS, but as a foundation for further inquiry and coordinated action toward a more informed, resilient, and sustainable future for its ecosystems and communities.

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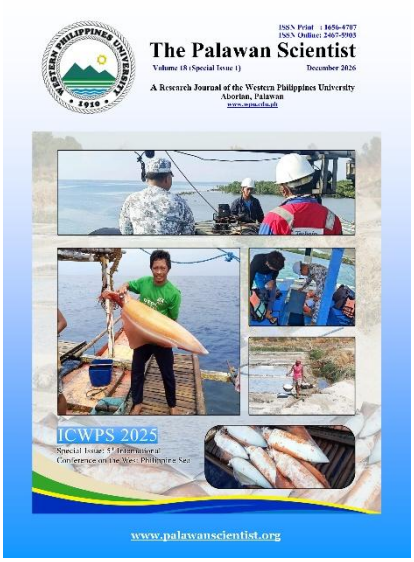

Waves of duty: Lived experiences of Philippine Coast Guard personnel

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ABSTRACT

This study explored the lived experiences of Philippine Coast Guard (PCG) personnel in the performance of their maritime functions in Region VII, Philippines. This qualitative study employed a transcendental phenomenological approach. A total of ten informants with more than three years of service, participated in the study: four joined individual interviews, while six engaged in a focus group discussion. Data were gathered through a validated interview guide, field notes, and audio recordings, and were analyzed using Colaizzi's method. Ten themes emerged. Positive experiences included Pride in Life-Saving Service, Supportive Environment, and Green Education, while negative experiences involved Equipment Gaps and Unpleasant Public Sentiments. In addressing these challenges, themes such as Knowledge-Driven Solutions and Joint Efforts were identified. Moreover, three key themes emerged regarding aspirations for improvement, namely Continuous Growth, Resource Enhancement, and Stronger Partnerships. The study recommended continuous professional development, investment in modern equipment, and enhanced collaboration with the Maritime Industry Authority (MARINA), the Department of Transportation (DOTr), Local Government Units (LGUs), Non-Governmental Organizations (NGOs), the academe, and other maritime agencies, alongside stronger community engagement to reinforce the PCG's mission.

Keywords: maritime environmental protection, maritime functions, maritime law enforcement, maritime safety, maritime search and rescue, maritime security

INTRODUCTION

As a cornerstone of maritime governance, the Philippine Coast Guard (PCG) carries a tripartite mission: strengthening coastal security, ensuring maritime safety, and promoting maritime stewardship. In a nation with vast and porous maritime borders, these maritime functions are not static but are continually shaped by evolving geopolitical tensions and environmental pressures (Kim 2020). However, the Philippines as an archipelagic country, faces a complex matrix of maritime challenges, ranging from geopolitical conflicts in the South China Sea to the operational demands of securing its vast coastline (Abad et al. 2023; PMEP 2022). In Region VII (Central Visayas), the PCG faces ongoing challenges posed by security threats such as terrorism and drug trafficking, as well as environmental crises including devastating oil spills and the ecological degradation caused by unsustainable commercial fishing (Capistrano 2019; Piquero 2024). Furthermore, the escalating impacts of climate change, specifically sea-

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level rise and coastal erosion, necessitate an increasingly swift and vigilant response (Queaño et al. 2021). Together, these multifaceted domestic and international urgencies create a high-stakes operational environment that tests the resilience and adaptability of PCG personnel in the performance of their maritime functions.

While previous studies have examined the role of organizational and operational stressors in the mental health of coast guard personnel (Andrews et al. 2022), the need for continuous training and professional development (Abanilla 2024), psychological resilience during high-risk operations (Santos 2023), and the relationship between courage, personality traits, and organizational commitment among coast guard personnel (Mert and Koksal 2022), no research has comprehensively explored the lived experiences of PCG personnel across the full spectrum of their maritime functions, particularly in Region VII, encompassing search and rescue, environmental protection, maritime security, maritime safety, and maritime law enforcement. This lack of qualitative, experience-based understanding creates a critical gap. Without capturing the voices and narratives of those on the frontlines, policymaking, training programs, and welfare initiatives risk being misaligned with the realities of service.

To bridge this gap, this study explored the lived experiences of PCG personnel in the performance of their maritime functions in Region VII, Philippines. Specifically, it aimed to decribe the experiences of the informants in the performance of their maritime functions, identify how the informants addressed the challenges they encountered in the performance of their maritime functions, and determine the aspirations of the informants for improving their services in the performance of their maritime functions. The findings were expected to provide useful insights to support improvements in maritime operations, training, and personal development, as well as contribute to the enrichment of academic literature on maritime law enforcement. Furthermore, this study served as a basis for understanding the realities of PCG service in the field.

METHODS

Research Design

This study utilized a qualitative research method, particularly transcendental phenomenology. This form of inquiry seeks to understand human experience. The goal of this qualitative research methodology is to comprehend how individuals perceive the world. Transcendental phenomenology was particularly suitable for this study because it allowed for an in-depth exploration of the lived experiences of PCG personnel in performing their maritime functions, focusing on their positive and negative experiences, strategies used to address the challenges encountered, and aspirations for improvement while minimizing researcher assumptions. This approach helped capture a clearer and more genuine picture of their roles in Bohol Province and Cebu City.

Research Environment

The study was conducted in Region VII, specifically in the provinces of Bohol and Cebu. The primary areas of interest were the main ports of Bohol Province and Cebu City. The Coast Guard Station Western Bohol is situated in Tabilaran City, Bohol, while the Coast Guard District Central Visayas is located in Cebu City. At the time of the study, these stations comprised personnel assigned to maritime safety, security, and law enforcement operations in their respective areas. These stations were chosen because they served as the main headquarters in the region.

Research Informants

The key informants of this study were 10 purposively selected PCG personnel from the Coast Guard Station Western Bohol and the Coast Guard District Central Visayas. A purposive sampling technique was used to select informants who could provide relevant and in-depth information for the study. These informants had been serving in the PCG organization for more than three years. They were grouped into two groups. The first group consisted of four PCG personnel from Cebu who participated in individual interviews, while the second group consisted of six PCG personnel from Bohol who participated in a focus group discussion.

Research Instrument

The researcher developed and employed an interview guide as the study's instrument. It consisted of three parts. Part I focused on the experiences of the informants in the performance of their maritime functions, part II explored how they addressed the challenges encountered in the performance of their maritime functions, and part III focused on the aspirations of the informants for improving their services in the performance of their maritime functions. The interview guide was validated by the panel members before data collection. Participants were formally invited, and their voluntary and unrestricted participation was ensured through informed consent procedures. In addition to conducting interviews, field notes and audio recordings were used to provide more accurate documentation of the informants' responses.

Research Procedure

A transmittal letter, duly signed by the adviser and the dean of the graduate school, was first sent to and received by the heads of each PCG station, requesting permission to conduct the study. This

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transmittal, along with other necessary documents, was submitted to the ethics committee for review. After receiving protocol approval, the researcher identified the key informants and sought permission from selected PCG personnel to participate in the study. Following the identification of the key informants, the potential participants were contacted to confirm their willingness to participate, with a clear assurance that their responses would be kept confidential. The researcher then coordinated the schedule for both the focus group discussion and the individual in-depth interviews. Data collection began only after the request was approved by the station commander.

During the interview phase, the researcher made sure that each session was conducted in a comfortable and suitable environment where participants could freely share their experiences. The interviews were semi-structured, using open-ended questions designed to gather detailed responses and rich insights into the participants lived experiences. Efforts were also made to build rapport and establish trust to encourage honest and meaningful responses. With the participants' consent, audio recordings were made to ensure accurate documentation of the discussions for transcription and later analysis. All collected data were securely stored to maintain confidentiality and comply with ethical research standards.

After each interview, the researcher expressed sincere gratitude to the participants for their valuable contributions, addressed any questions or concerns they raised, and conducted a brief debriefing.

Data collection

Data were collected through individual interviews and focus group discussions, with informants encouraged to respond honestly and comprehensively. The study involved PCG personnel as key informants. During the in-depth interviews and focus group discussions, the researcher ensured a comfortable and welcoming environment to help participants feel at ease and encourage open and genuine responses. All responses were recorded, transcribed, and coded to identify common themes and insights.

Data Analysis

The researcher used Colaizzi's method, which involved seven phases designed for flexibility, allowing for an in-depth exploration of the meaning of the phenomenon (Wirihana et al. 2018). First, the researcher transcribed and repeatedly read the interview transcripts to gain a comprehensive understanding, ensuring that participants' statements remained the focus of the analysis. Next, significant statements related to participants' experiences were identified and carefully extracted to maintain context and anonymity. These statements were linked to participant numbers, page numbers, and paragraph numbers. In the third phase, meanings were formulated from these statements. In the fourth step, similar statements and their corresponding meanings were grouped to form theme clusters, which were further organized into broader themes. Data saturation was achieved when recurring patterns and commonalities emerged across participants' responses, and no new themes or significant insights were identified during subsequent analysis. During the fifth step, the researcher integrated the findings by repeatedly reviewing the transcripts, thematic clusters, and identified themes. In the sixth step, a concise description of the essential structure of the phenomenon was developed by removing unnecessary or repetitive details. Finally, in the seventh phase, member checking (participant validation) was conducted to verify and refine the results, ensuring that the analysis accurately reflected the participants' experiences.

RESULTS

Experiences of the Informants in the Performance of their Maritime Functions

The experiences of PCG personnel from Region VII in performing their maritime functions were shaped by both challenges and successes that influenced their professional lives. These individuals encountered a mix of positive and negative experiences, ranging from fulfilling moments of ensuring maritime safety to the difficulties of handling complex rescue and enforcement operations. While their work often involved high-pressure and stressful situations, it also brought a sense of fulfillment from contributing to public safety. The following emergent themes were identified from their experiences:

Positive Experiences

Pride in life-saving service. This theme reflects the service and assistance provided to the people in the community, which brought satisfaction and happiness to PCG personnel.

> "*With regards to the satisfaction of performance of the duty experiences was we successfully rescued a person or a vessel na in distress at sail"* ("With regards to the satisfaction of performance of duty experiences, it's when we successfully rescued a person or a vessel in distress at sea.") Informant 5
>
> *"Upon a responding for more than search and rescue we provide maam maayo nga maam ba good sa pag handling sa pag response nimo unya sa mayo pud nga pag initiate sa trabaho maam mao na nga maam murag ma appreciate pud among trabaho maam maayo na"* ("When responding to more

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than just search and rescue, we provide good handling and response. We also initiate tasks well, and because of that, our work is appreciated.") Informant 9

"Well, sa positive maam based sa experience siguro maam kanang maka ma successful among kintahay makatabang mi sa among tao within term sa mga barko masira ang then ma respondihan namo og dali ang then nindot sa feeling nga kanang after successful rescue. And then, makita nimo nga tao nga luwas lang gyud kaayo sila maam" ("On the positive side ma'am, based on my experience, it feels rewarding when we are able to successfully help people, especially during incidents like when a ship breaks down, and we can respond quickly. The feeling is fulfilling when a rescue operation is successful, and seeing the people we helped is safe.") Informant 2

"Especially when I was assigned in the barko, we have a lot of search & rescue operations so were able to respond to some distress calls of some vessels like there are distress fisherman" ("Especially when I was assigned to the ship, we had a lot of search and rescue operations, so we were able to respond to distress calls from vessels, like when fishermen were in distress.") Informant 3

Support driving environment. This theme reflects the role of positive relationships with stakekolders and shipping companies, which contributed to smooth inspections and efficient performance. Additionally, emotional support from family, camaraderie with colleagues, and a positive work environment enabled PCG personnel to remain focused, motivated, and productive in their duties.

"Before we conduct, that naa mi pulong, pulong sa among kaugalingon kung unsaon namo pag conduct ang situation para lang na ma successful. Nindot sa feeling kay dili lang as personal sa ako, pati pud sa akong kauban nga kami tanan ga team up, teamwork maam" ("Before we conduct, we have a meeting among ourselves to discuss how we will handle the situation to ensure its success. It feels great because it's not just personal for me, but also for my colleagues, as we all team up—teamwork, ma'am.") Informant 2

"*Then sa trabaho pud sa mga stakeholders or sa mga shipping company so maka ingon tag positive kung ilang mga barko is compliant so malipay pud ta during inspection nato is nindut atong performance sa inspection aside pud ana ang barko pud nindut pud og performance sa ilang trabaho compliant pud sila sa mga requirements or kinahanglan para sa coast guard"* ("In terms of work with stakeholders or shipping companies, we can say it's positive when their vessels are compliant. We feel good during our inspections when everything goes smoothly, and our performance in the inspection is solid.") Informant 4

"Nafeel nako nga naa diay mga coast guard personnel nga kauban nako nga kanang ni volunteer, willing gyud sila mutabang sa isig ka coast guard nila. So, nalipay ko ato nga time ka na feel nako nga willing sila mutabang bisag beyond na sa ilang Area of Responsibility" ("I realized and felt that there were PCG personnel with me who volunteered and were truly willing to help their fellow PCG members. I was happy at that time because I saw their willingness to extend help even beyond their designated area of responsibility.") Informant 1

"Same pud sa ilang giingon maam, we are motivated ba to do our tasks. Malipay imong gitabangan so mas ganahan ka mo aw hinuon mandated man gyud na nga trabaho pero naa pay dagdag nga ano ba dagdag push nga mag porsigi gihapon" ("Same as they said, ma'am, we are motivated to do our tasks. Seeing the person you helped happy, makes you want to do more. Although it's part of our mandated job, but there's an extra push that makes us strive even harder.") Informant 10

Green education. This theme reflectss proactive environmental awareness and safety education through active community engagement to promote safe maritime practices.

"So, we go to the islands, and we conducted information and education dissemination that during bad weather, naa mi mga reminders, mga paalala sa mga mangingisda sa panahon nang tag ulan to avoid or to prevent from ahh maritime incidents. So, with that, na inform na namo sila na educate na namo sila not to go at sea during bad weather so we have to monitor at any time thru social media weather update" ("We go to the islands to conduct information and education dissemination. During bad weather, we give reminders to fishermen, especially during the rainy season, to avoid going to sea and prevent maritime incidents. Through this, we inform and educate them not to go to the sea during bad weather. We also monitor weather updates through social media at all times.") Informant 5

"With that, atong malikayan atong mga maritime incidents with that education and information campaign particularly as I have said to the island barangays" ("We can prevent maritime incidents through our education and information campaign,

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particularly in the island barangays.") Informant 2

"Aside sa oil spill, conduct pud mi og coastal clean-up, mangrove planting, conduct pud mi og information education campaign sa mga LGU nga e educate pud namo sila when it comes to solid waste management" ("Aside from addressing the oil spill, we also conduct coastal clean-ups, mangrove planting, and information education campaigns with the local government units (LGUs). We educate them on solid waste management to raise awareness and promote environmental responsibility.") Informant 4

Negative Experiences

Equipment gaps. This theme reflects the PCG's challenges and struggles resulting from the lack of sufficient equipment and resources needed to effectively perform their maritime functions.

"Unfortunately, katong basic lang nga tangke, what do you call this one, oxygen tank. We have limited rescue equipment" ("Unfortunately, the only basic equipment we had was an oxygen tank, and we had limited rescue resources.") Informant 5

"So, again, kulang mi sa water asset or the floating asset, barko, and then the area, the coastal areas from the Province of Bohol, wala mi naka standby gyud nga rubber boats or small boats to respond immediately nga nahitabo sa dagat and to include also sa mga even life jackets night mission, paraphernalia bitao nga maka detect og GPS" ("So again, we lack water assets or floating assets, like ships. In the coastal areas of Bohol, we don't have rubber boats or small boats on standby to respond immediately if something happens at sea. This also includes basic equipment like life jackets, night mission gear, GPS and other paraphernalia.") Informant 6

"Sa law enforcement nako, we don't have equipment like floating asset, lifesaving appliances" ("In my experience in law enforcement, we don't have equipment like floating assets and lifesaving equipment.") Informant 1

Unpleasant public sentiments. This theme reflects the PCG's experiences of being subjected to public misunderstanding, negative perceptions, and unfair criticism despite their efforts to perform their duties.

"Naa nay nakasampa na mga pasahero and then the thing is kung dili nimo sya payagan, panaogon ang mga pasahero diba, so karon na age of technology nga dali ra kaayo ang mga pasahero mureklamo "unsa mani, tungod ni sa coast guard", "wala nami naka byahe, nadelay mi" ("The passengers are already onboard. If departure is not allowed, the passengers must be disembarked. In today's age of technology, it is easy for passengers to complain, saying things like, "What's going on?" or "It's because of the PCG, our trip was delayed.") Informant 3

"Negative comments of the passengers, stranded passengers everytime nay PAGASA bitao, gail warning nga dili pwede mo byahe bitao. Tapos ilang mga negative comments is nganong dili magpa larga ang mga coast guard and uban stranded passengers kay dili kasabot nga nag implement raman pud unta mi sa among trabaho para mao lagi na malikayan ang mga maritime incidents so mao na sya ang usa sa mga negative" ("One negative aspect is the criticism from stranded passengers whenever Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) issues a gale warning and travel is prohibited. This feedback often comes from passengers who do not understand that the PCG is simply performing its duty to prevent maritime incidents.") Informant 6

"Naay mga feedback sa uban like social media like news maam nga nagkulang ang coast guard. Kita mig comment maam ba nga "asa mag mga coast guard" ug mga basher" ("Sometimes, we see public feedback on social media and in the news where people say that the PCG is lacking. There were comments such as "Where are the PCG?" and other negative remarks.") Informant 2

Addressing the Challenges Encountered in the Performance of Their Maritime Functions

Knowledge-driven solutions. This theme reflects the importance of utilizing expertise, insights, and informed decision-making to address challenges and improve outcomes. It highlights the role of knowledge in formulating effective strategies and solutions that enhance performance and contribute to improved service delivery.

"So, I study, I conduct a research and then tanang mga maritime laws akong gibasa then I seek advice sa mga lawyers" ("I studied and conducted research, ma'am. I read all the maritime laws, and I also sought advice from lawyers to guide me and help me with my concerns.") Informant 1

"You deal with them based on existing policies gyud existing regulations & policies, law, statues, any regulations, memorandum circular, issued by the Department of the Transportation and the National Headquarters kay you based your action lang naman doon sa existing policies" ("To address incidents and accidents, the PCG strictly

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follows existing laws, regulations, and memorandum circulars issued by the Department of Transportation and the National Headquarters.") Informant 3

"So, dili muabot sa punto maam nga ma discourage, but those negative comments, sa comments sa mga tao, will bring it to our office and we will discuss it unsa atong failures unsa atong mga gikinahanglan. Then, we have to level it up so that the moment nga maka encounter mig balik, so naa na mi solution" ("We do not allow ourselves to become discouraged. Instead, the negative comments are brought to our office, where we discuss our shortcomings and identify what needs improvement. We then work on these areas so that when similar situations arise, we already have solutions in place.") Informant 5

Joint efforts. This theme reflects the importance of collaboration and teamwork in achieving common goals, particularly in addressing challenges and improving performance. It emphasizes the value of working together with various stakeholders, such as LGUs, agencies, and communities, to develop effective solutions and enhance overall outcomes.

"We have also our PCGA, Philippine Coast Guard Auxiliary natin yung volunteer organization under PCG na grabe pud na kaayo silag support sa atoa for the performance in our functions and the mandated functions like pahuwam silag mga floating assets, persons with the certain skills needed, mga divers mga swimmers, mga nurses apil sila ana specially katong sinulog ma'am" ("We also have, the Philippine Coast Guard Auxiliary (PCGA). It's a volunteer organization under the PCG, and they provide tremendous support for us in performing our functions and mandated duties. They lend floating assets, as well as personnel with specific skills, like divers, swimmers, and even nurses.") Informant 3

"Then, niduol ta sa LGU, they provided floating asset for us. Their own motorbangka ba like lifesaving appliances, may e rescue operation, ilang ipagamit ang ilahang pagamit lang kay sa LGU" ("We approached the LGU, and they provided us with floating assets, such as their own motorized boats. These include lifesaving appliances that they allow us to use during rescue operations. The equipment is provided for our use, but it remains under the LGU's ownership.") Informant 1

"Pananglitan katong Odette, nahutdan mig uban material so ang uban nga barko or vessels nga naka dock, ilang materials ang ilang gipagamit so ang mga ship owners open pud na sila nga mo tabang everytime nay mga incidents, especially pag makita mig nay oil spill nya makakita mig barko nga nay naka dock so ilang gamit ilang ipagawas" ("For example, during Odette, we ran out of some materials, so the other ships or vessels that were docked offered their materials for us to use. Ship owners are very open to helping, especially when they see an oil spill and notice that there are ships docked. They would then provide their materials for use.") Informant 4

Mga local residents maam, sa akong experience maam, makaduol gyud sa LGU and other agencies. Pero naay mga times gyud nga kailangan sya og quick response ba so syempre ang among office naka station sa duol dagat. Kung kinsa tong mga residente duol sa dagat, maoy ma dali dali og pangayog assistance" ("Also, from my experience ma'am, we can coordinate with the LGU and other agencies. However, there are times when quick responses are needed. Since our office is situated near the sea, the residents living close to the coast are the ones we can ask for assistance.") Informant 5

Aspirations of the Informants to Improve their Services in the Performance of their Maritime Functions

Continuous growth. This theme reflects the PCG's commitment to ongoing professional development, the acquisition of new skills, and adaptation to evolving challenges in maritime operations.

"High quality of service, mao ra gihapon, to study kay diman ta kahatag og saktong serbisyo kung wala tay idea. Pagtuon, pagpractice kung unsay natun-an then mangopya og mga idea sa ubang agency" ("A high quality of service can only be provided if we study, because we cannot give proper service without knowledge. We need to study, practice what we learn, and adopt ideas from other agencies.") Informant 1

"Continue professional development maam and then seeking mentorship and guidance in terms of professional development" ("Continuous professional development and seeking mentorship and guidance in terms of professional development is essential for improving skills and knowledge in the maritime security field.") Informant 2

"Sa training pud kay diman gyud ingon nga bag o graduate ma absorb dayon ang mga balaod mga pamaagi or pag enforce sa mga balaod so dapat naa gyud mga regular training sa coast guard personnel para pareho og stand gani with it comes to enforce law" ("In terms of training, it's not expected that

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fresh graduates can immediately absorb all the laws, procedures, or how to enforce them. So, it's crucial to have regular training for PCG personnel to ensure everyone is on the same page when it comes to law enforcement.") Informant 4

Resource enhancement. This theme reflects the aspirations of PCG personnel to acquire essential assets, resources, and equipment that are necessary to stregthen their capacity to effectively perform their maritime functions.

"As I have said, limited lang atong gamit. So, with that mga panghitabo, siguro mahatagan ta anang dugay ra namong gipangayo nga madungagan unta tungod kay wala namo na perform perfectly or medyo more than half sa among performance of duty" ("Our equipment is limited. So, with these incidents, we are hoping that we will be provided with the resources we have long been requesting. We were not able to perform our duties perfectly due to the lack of necessary equipment.") Informant 5

"Actually, there are a lot of aspects or factors for the PCG to improve. Para mas ma perform namo properly among maritime functions in terms of logistics, assets, personnel, infrastructure, daghan kayo" ("Actually, there are a lot of aspects or factors that need improvement for the PCG. To perform our maritime functions properly, we need improvements in terms of logistics, assets, personnel, and infrastructure—there's really a lot to work on.") Informant 3

"Sa maritime security, lifesaving equipment, floating assets" ("In maritime security, lifesaving equipment and floating assets are essential.") Informant 9

"Sa maritime security maam, pila mi kabuok, equipment maam, more on assets" ("In maritime security, ma'am, it's not just about the number of personnel, but also the equipment and assets we have.") Informant 10

"Kuan maam like technology, update like karon naa nay drone, need kaayo namo" ("Like in terms of technology, updates such as drones, we really need those") Informant 2

Stronger partnerships. This theme reflects the importance of collaboration and cooperation with various stakeholders, such as LGUs, private sector organizatoons, and other maritime agencies. It emphasizes the value of cultivating relationships that contribute to enhancing service delivery, resource sharing, and joint efforts in addressing maritime challenges effectively.

"Sample sa law enforcement namo ang expert ana gani, mas expert pa ang police so mao na, handling of evidence so need gyud mi mu coordinate nila kay para mas mugaan ang trabaho. Daghan ang joint operation ba" ("In our law enforcement operations, the experts, such as the police, are more experienced in handling evidence. Therefore, coordination with them is important to make our tasks easier. Many joint operations are conducted as well.") Informant 1

"We are in our developing stage. So, inter-agency collaboration, interoperability with our partnered agencies- LGU's, NGO's, private stakeholders, mas nakatabang sya in our performance sa functions kay if we have meager resource, kulang imong floating assets, pwede ka nila pahulamon. So, mas naka perform ka more" ("We are in our developing stage, so inter-agency collaboration and interoperability with our partnered agencies—LGUs, NGOs, and private stakeholders—really help improve our performance. If we have limited resources and lack floating assets, they can lend us theirs. This way, we can perform our functions more effectively.") Informant 3

"Kinahanglan gyud nga ipa lig-unon gyud ang tie up with other agencies" ("It is essential to strengthen the tie-up with other agencies.") Informant 2

"Dapat man gud sad regular ang meeting sa mga inter agency, coast guard, Navy, PNP, maritime. So, kana sila involved nana sila sa atong jurisdiction sa atong dagat" ("Regular meetings should be held between inter-agency groups like the PCG, Navy, PNP, and maritime agencies. They are all involved in our jurisdiction over the seas, and coordination between them is fundamental.") Informant 4

DISCUSSION

Experiences of the Informants in the Performance of Their Maritime Functions.

Positive Experiences

Pride in life-saving service. This theme reflects the strong sense of pride and fulfillment that PCG personnel feel when providing life-saving services to the community. Successfully rescuing individuals in distress during critical situations gives them a deep sense of achievement and satisfaction. Their involvement in search and rescue operations not only boosts their confidence but also reinforces their commitment to their duties. Moreover, the appreciation and recognition they receive from the community further strengthen their sense of value and accomplishment. The pride they derive from successfully carrying out rescue missions creates a strong emotional connection to their role, which fosters a deep sense of purpose in their work.

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Philippine Coast Guard personnel feel a deep sense of pride in saving lives and responding to distress calls, which enhances their self-esteem and sense of accomplishment. This feeling of success not only boosts their morale but also strengthens their commitment to their duties, directly reflecting of Herzberg's assertion that motivation is driven by the meaningfulness and impact of the work itself (Herzberg 1959). Likewise, Abad et al. (2023) emphasized that being devoted to a cause involves commitment and prioritizing objectives, often putting others first before oneself. Similarly, PCG personnel experience a strong sense of fulfillment and satisfaction because they consider their work to be more than just a job (Palconit and Sabijon 2025).

Furthermore, McClelland's Theory of Acquired Needs explains motivation based on socially learned needs, including the need for achievement, affiliation, and power. In the context of this study, these needs help explain the motivation of PCG personnel, as their sense of fulfillment may be driven by achievement in saving lives, working together as a team, and taking responsibility for performing their duties within a challenging environment (McClelland 1961).

Support driving environment. This theme reflects how positive relationships with stakeholders, shipping companies, and internal team members contribute to the effective performance of PCG personnel. Emotional support from family, camaraderie among colleagues, and a positive work environment play a crucial role in empowering personnel to stay focused, motivated, and productive. Effective collaboration with stakeholders and shipping companies creates a strong support system that enhances personnel's sense of empowerment in performing their duties. Additionally, the spirit of volunteerism and willingness to help among colleagues create a supportive environment that strengthens their resolve, enabling them to carry out their tasks with dedication and commitment.

According to the need for affiliation proposed in McClelland's Theory of Acquired Needs, individuals with a strong need for affiliation prioritize maintaining social connections, joining groups, and seeking positive interactions. In the context of PCG personnel, the emotional support from family, camaraderie among colleagues, and positive relationships with stakeholders and shipping companies all play a key role in fostering a supportive environment. This sense of belonging and connection enhances the personnel's motivation and job satisfaction, making them more engaged in their work. The support system created through teamwork and collaboration strengthens their resolve and ability to perform their duties with dedication, reflecting McClelland's idea that individuals who value social connections contribute to collective success and are more likely to excel in group settings (McClelland 1961). Furthermore, Humphrey et al. (2009), through Team Performance Theory, emphasized that teams with individuals who have different areas of competence and expertise are more likely to perform better because of their collaborative efforts.

Green education. This theme reflects the proactive environmental awareness and safety education initiatives undertaken by PCG personnel. They promote safe maritime practices and environmental responsibility by actively engaging with the community. These efforts raise awareness about the importance of protecting marine ecosystems and help individuals understand their role in safeguarding the environment.

This theme is closely related to the study conducted by Empinado et al. (2023), which emphasized the PCG rescuers' commitment to both personal and professional development. One of the main components of this expansion is their dedication to community outreach and education activities, which are consistent with the concept of Green Education—education aimed at encouraging environmental awareness and sustainable habits. In their research, rescuers emphasized the necessity of participating in public awareness campaigns and educating the community about safety and resilience, reflecting Green Education's role in encouraging environmental stewardship. In addition, Palconit and Sabijon (2025) emphasized the importance of strengthening information-sharing and community initiatives. These efforts demonstrate the role of education in promoting awareness and preparedness, which can enhance community understanding and response during maritime emergencies.

Equipment gaps. This theme reflects the struggles and challenges faced by PCG personnel due to insufficient equipment and resources. The lack of proper tools and gear hinders their ability to effectively perform their maritime functions, particularly during high-pressure situations such as rescue operations. These limitations hinder operational readiness and often result in slower response times, which can significantly impact the outcome of critical missions. The need for improved resources is evident, as having better equipment would enhance their ability to carry out their duties more effectively and safely.

According to Weilant (2024), the Coast Guard faces operational risks due to shortages in both personnel and equipment, which hinder its ability to meet domestic and international demands. These capacity issues limit the service's ability to achieve strategic objectives and maintain stakeholder confidence. Despite ongoing recruitment and recapitalization efforts, shortages in both personnel and platforms are expected to persist for years. The PCG's strong culture of mission commitment often leads it to take on tasks even when resources, including equipment, are insufficient, which stakeholders

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recognize as a long-standing challenge requiring increased personnel and assets across the service. Palconit and Sabijon (2025) also found out that PCG personnel encountered operational challenges, including limited personnel and equipment, such as floating assets, as well as a lack of comfortable facilities for personnel. Similarly, Tomi (2025) significant challenges, including limited funding, inadequate facilities, and insufficient training duration, which hinder the effectiveness of the PCG training program.

Unpleasant public sentiments. This theme reflects the experiences of PCG personnel who were subjected to public misunderstanding, negative perceptions, and unfair criticism despite their continuous efforts to carry out their duties. Despite their commitment to ensuring safety and enforcing necessary protocols, personnel were sometimes met with resistance or misunderstanding from the public, especially during challenging operations or when resources were limited. Public criticism, particularly from individuals who may not fully understand the complexities of maritime safety or the importance of certain regulations, placed an emotional burden on personnel.

The theory that best relates to this theme is Herzberg's Two-Factor Motivation Theory (Herzberg 1959). This theory distinguishes between motivational factors that lead to job satisfaction and hygiene factors that, if absent, can cause dissatisfaction. Motivational elements—such as acknowledgment, recognition for a job well done, personal accomplishments, opportunities for advancement, and promotions—enhance fulfillment when present but do not necessarily cause discontent when lacking (Herzberg 1959). However, hygiene factors like working conditions, job security, and interpersonal relationships must be adequately addressed to prevent dissatisfaction. In this case, unpleasant public sentiments represent a deficiency in hygiene factors, specifically those related to working conditions and interpersonal relationships, which can significantly lower morale and emotional well-being. In addition, Palconit and Sabijon (2025) found that PCG personnel experienced negative community perceptions, with some members of the public questioning their honesty and integrity in performing their duties.

Addressing the Challenges Encountered in the Performance of Their Maritime Functions

Knowledge-driven solutions. This theme emphasizes the importance of utilizing expertise, insights, and informed decision-making to effectively address challenges and improve outcomes in the performance of maritime functions. The PCG personnel actively engage in research, consult with legal experts, and follow established policies to ensure that their actions align with maritime laws, thus enhancing their decision-making capabilities. Furthermore, adherence to existing regulations provides a clear framework for addressing maritime incidents, reducing the likelihood of errors. The continuous learning from negative feedback allows personnel to improve their strategies and solutions, ensuring that they are better prepared for future challenges.

The theme is aligned with McClelland's Knowledge-Driven Solutions aligns with the Theory of Acquired Needs (McClelland 1961), particularly the need for achievement, which is marked by individuals' desire to set and attain challenging goals and their commitment to high performance. When it comes to marine operations, PCG members demonstrate this quality by conducting extensive study, seeking legal advice, and rigorously following established guidelines and maritime regulations. These behaviors reflect the characteristics of achievement-motivated people, including a strong desire to make well-informed decisions and minimize errors. Additionally, their readiness to learn from criticism and continuously improve their strategies shows a dedication to both individual and group achievement, which McClelland highlights as essential to successful problem-solving and teamwork.

Joint efforts. This theme highlights the collaborative nature of maritime operations, emphasizing the importance of cooperation between various stakeholders, including LGUs, shipping companies, the private sectors, local residents, and volunteers. LGUs provide essential resources like boats and lifesaving equipment, while shipping companies and agencies provide additional equipment and support in addressing crime-related issues. Ship owners lend materials during emergencies, such as oil spills, showing their commitment to maritime safety. Private stakeholders offer boats for search and rescue, and the PCGA contributes specialized skills and assets. Local residents, particularly those living near the coast, also provide immediate assistance during emergencies, strengthening the community's response to maritime challenges.

This theme is supported by Team Performance Theory (Humphrey et al. 2009). This theory emphasizes that team roles, collaboration, and the composition of roles within a group significantly influence overall performance. In the context of maritime operations, the cooperation among LGUs, private stakeholders, shipping companies, volunteers, and local residents reflects the essence of team role composition and interdependence. Each stakeholder contributes uniquely by providing equipment, skills, or quick response, reflecting the theory's assertion that the synergy of diverse yet complementary roles is critical for team effectiveness and mission success, particularly in high-stakes, complex environments like maritime safety and emergency response. On top of that, Aliyah et al. (2024) stressed the need for fostering partnerships with educational institutions. Similarly,

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McCabe (2019) pointed out that international partnerships have improved the maritime security sectors of coastal states.

Aspirations of the Informants to Improve Their Services in the Performance of Their Maritime Functions

Continuous growth. This theme points out the importance of continuous learning and professional development in maritime operations. Personnel emphasize the need for ongoing education, training, and mentorship to ensure high-quality service and effective performance. The lack of adequate training can hinder personnel's ability to handle tasks, making regular training sessions essential for them to stay updated on laws and procedures. Self-education, through studying circulars and other references, helps avoid mistakes and ensures compliance with maritime regulations. Overall, continuous growth is key to enhancing the effectiveness and readiness of maritime personnel in fulfilling their duties.

Abanilla (2024) stressed the importance of professional development and training, improved legal foundations, operational competence, and adaptability for PCG personnel to enhance their effectiveness in maritime law enforcement. To address these needs, the study recommended revising the Program of Instruction for the Maritime Security and Law Enforcement Course, aiming to better equip personnel for their roles. These improvements are vital for reinforcing governance and upholding the rule of law in maritime domains. Furthermore, strengthening training programs supports global maritime security initiatives and aligns with international maritime standards. Similarly, Aliyah et al. (2024) emphasized the need to modernize training programs by integrating digital technologies, cybersecurity, and contemporary maritime operations to better equip Bakamla (the Indonesian Coast Guard) personnel to address current and future maritime challenges. Moreover, Tiongson (2025) concluded that targeted training is essential to ensuring operational effectiveness among sea marshals.

Resource enhancement. This theme demonstrates the need to improve and expand the resources available for maritime security operations. This includes acquiring more equipment, assets, and technological tools to ensure that personnel can perform their duties efficiently and respond to emergencies effectively. Enhancements in infrastructure, including better office spaces and specialized vessels, are also crucial for supporting maritime functions. There is a strong call for investments in both human and material resources, as the lack of proper equipment and facilities hinders the overall performance of maritime agencies.

The theme of Resource Enhancement is best supported by Herzberg's Two-Factor Motivation Theory (Herzberg 1959), which emphasizes the significance of hygiene factors—such as working conditions, equipment, and infrastructure—in preventing employee dissatisfaction. In maritime security operations, the lack of proper tools, advanced technologies, and adequate facilities negatively impacts personnel efficiency and morale.

Moreover, this aligns with the findings of Sunko et al. (2018), who found a considerable rise in maritime operations, underlining the necessity for continued investment equipment and human resources to maintain maritime safety. Palconit and Sabijon (2025) revealed that the PCG substations need of additional personnel, equipment, and facilities to ensure the safety and security of maritime operations. Likewise, Tomi (2025) emphasized the need to enhance training facilities, increase budget allocation, and standardize policies to effectively institutionalize human resource development.

Stronger partnerships. This theme depicts the pivotal role of collaboration among various agencies in the performance of maritime functions. Inter-agency cooperation ensures a more effective response to emergencies and incidents by combining the expertise and resources of different organizations. Agencies can share essential assets and equipment by working together, which is particularly important during periods of resource limitations. Regular communication and coordination through seminars and meetings help align enforcement practices and avoid confusion. This collaborative approach enhances overall performance and bolsters the collective capacity to effectively tackle challenges in maritime functions.

This theme is supported by Team Performance Theory proposed by Humphrey et al. (2009), which emphasizes that collaboration, coordination, and the integration of diverse skills and resources among team members and organizations lead to effective performance. The concept stresses that collaboration and partnership are essential to enhancing operational effectiveness, especially in resource-limited environments. In this study, inter-agency cooperation at the local level strengthens the PCG's capacity to perform maritime functions by maximizing available resources, sharing expertise, and fostering collective responsibility in addressing maritime challenges.

Similarly, this practice is evident in the global context. McCabe (2019) presents significant findings on the enhancement of maritime security and governance in the region, highlighting how international partnerships and capacity development have bolstered the maritime security sectors of coastal states. In Kenya, initiatives like the establishment of the Coastguard Service and the coordination of the blue economy coordination reflect a strategic shift towards more secure and sustainable maritime practices.

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Overall, this study revealed that the lived experiences of PCG personnel in Region VII encompassed both rewarding and challenging aspects of the performance of their maritime functions. The informants expressed pride in their life-saving services, supportive driving environment, and environmental education initiatives as sources of fulfillment, while also highlighting equipment gaps and negative perceptions and criticism as significant obstacles. To address these challenges, they emphasized the importance of knowledge-driven solutions and joint efforts. Their aspirations for continuous growth, resource enhancement, and stronger partnerships underscore the need to strengthen both individual competencies and institutional capacities. These findings provide a deeper understanding of the realities experienced by coast guard personnel and reflect the importance of integrating personnel perspectives into organizational planning, policy development, and maritime governance.

In view of these findings, the PCG may further strengthen continuous professional development through regular training, simulation exercises, mentoring programs, and community engagement initiatives while prioritizing investments in modern equipment, vessels, and operational infrastructure. Likewise, stronger collaboration with relevant government agencies, local government units, academic institutions, non-governmental organizations, and other maritime stakeholders is encouraged to enhance resource sharing, coordinated responses, maritime education, and environmental protection. Public awareness initiatives should also be intensified to strengthen community trust and understanding of the PCG's mandate. Although this study offers meaningful perspectives into the lived experiences of PCG personnel, its findings are limited to a small group of participants from Region VII and may not represent other operational contexts. Future studies may explore experiences across different coast guard districts, inter-agency collaboration, work-life balance and family support, particularly among female personnel, or employ mixed-methods and comparative designs to further enrich the understanding of maritime service and organizational development within the PCG.

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GENERATIVE AI STATEMENT

The author used ChatGPT (GPT-5, OpenAI, 2025) to assist in refining the language, structure, and overall readability of the manuscript. The AI tool was not used for data collection, analysis, interpretation, or drawing conclusions. The author takes full responsibility for the content and integrity of this publication.

ETHICAL CONSIDERATIONS

The study strictly adhered to established ethical research standards to ensure the protection, privacy, and dignity of all informants. Prior to data collection, formal approval was obtained from the University of Cebu Academe Research Ethics Committee, University of Cebu–Main Campus, under approval number GS(1)-2025-03-106.

All participants, who are active PCG personnel, voluntarily took part in the study and signed an Informed Consent Form, signifying their willingness to participate without any form of coercion or threat. Their identities were kept strictly private, and all collected data were handled with the utmost care.

Participant validation (member checking) was conducted by returning the summarized findings and identified themes to the informants, allowing them to review, confirm, or clarify the interpretations to ensure accuracy and credibility of the findings. Throughout the research process, participants were continuously reminded of the voluntary nature of their involvement and the confidentiality of the information they shared.

DECLARATION OF COMPETING INTEREST

The author declares no competing interests.

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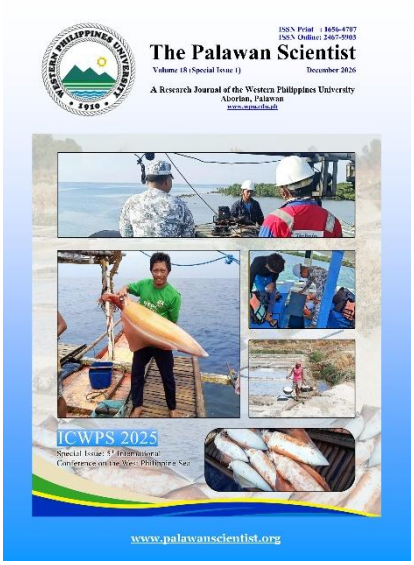

Capture fishery profile of Diamondback squid *Thysanoteuthis rhombus* (Troschel, 1857) in Rizal, Palawan, Philippines

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ABSTRACT

The diamondback squid, locally known as "dalupapa," is a high-value marine species commonly landed in Rizal, Palawan, Philippines. However, essential fishing information remains limited. Hence, this study provides the first documentation of the *Thysanoteuthis rhombus* (Troschel, 1857) fishery, specifically its focused were on fishing operation, seasonality, bait types, monthly catch per unit effort, gear characteristics, and fishing grounds. Data were collected through face-to-face interviews using printed questionnaires from 16 respondents with more than five-year experiences for diamondback squid fishing. All data were processed and analyzed using MS Excel, while fishing grounds were mapped with QGIS software. Fishing operations typically begin between 0300H and 0500H and end between 1300H and 2300H, resulting in a total fishing duration of nine to 18 hours per day. These operations occur five to 10 days per month, totaling 54 to 126 hours of fishing time monthly. Commercial fishing vessels with 3.02 to 9.03 gross tonnage are loaded with 52-160 jig sets, capable of catching 35-400 individual squid. The fishing season spans from February to November, with peak activity occurring between May and September. Commonly used baits include *Rastrelliger kanagurta*, *Exocoetus* sp., and *T. rhombus* fins. Monthly CPUE ranges from 0.03 to 0.08 kg/js/hr. Fishing gear typically consists of two jiggers attached to a hanger, with a 545 m long mainline connected to three Styrofoam buoys. Most fishing grounds are located in the southern part of West Philippine Sea waters. Further research is recommended to deepen understanding of the diamondback squid fishery in Rizal, Palawan.

Keywords: fishing ground, giant squid, seasonality, West Philippine Sea, squid jig gear

INTRODUCTION

The diamondback squid, scientifically known as *Thysanoteuthis rhombus* (Troschel, 1857), is the sole species in the family Thysanoteuthidae (MFMRA 2020), belonging to the class Cephalopoda. Its name is derived from its distinctive, large diamond-shaped fin that spans the entire length of the mantle (MFMRA 2020). It can grow to a maximum mantle length of 130 cm and weigh up to 30 kg (Roper and Jereb 2010; Carpenter and De Angelis 2014). This species inhabits tropical and subtropical oceanic waters around the

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world (Bower and Miyahara 2005; Miyahara et al. 2007; Sajikumar et al. 2020; Rajkumar et al. 2022; Kamaruzzaman et al. 2025), residing at depths of 600–800 meters during the day and ascending near the water surface at night for feeding and reproductive purposes (Nigmatullin et al. 1995; Bower and Miyahara 2005). *Thysanoteuthis rhombus* spends a significant portion of its life in pairs—male and female of similar size—typically for one year (Carpenter and De Angelis 2014). Its diet includes crustaceans, other pelagic squid, octopuses, and planktivorous fishes (Bower and Miyahara 2005; Sajikumar et al. 2020).

Although *T. rhombus* is globally distributed (MFMRA 2020), fishery information such as annual market demand for its mantle and fishing distribution has only been reported in Japan, the Maldives, India and Malaysia indicating that fishing activities are not well documented elsewhere (Bower and Miyahara 2005; Miyahara et al. 2007; Sajikumar et al. 2020; Rajkumar et al. 2022; Kamaruzzaman et al. 2025). In the Philippines, the only available information pertains to the origin of *T. rhombus* fishing, which began in Masbate and was later introduced to Negros Oriental and Cebu in 1988 (Lamayo et al. 2008). Dickson et al. (2000) also conducted experimental fishing from 1991 to 2000 in various parts of the country, including Calauag Bay in Quezon Province, Ormoc Bay in Leyte Province, and the West Philippine Sea (WPS). There is also documentation of *T. rhombus* fishing in the province of Marinduque, where small-scale fishers rely on it as a source of food and livelihood (De Chavez et al. 2021). More recently, Amihan and Daita (2025a, b) reported existing fishing operation including gear types, fishing distribution, and CPUE in the southern Tañon Strait, Cebu, Philippines.

In the province of Palawan, particularly in the municipality of Rizal, *T. rhombus* is also locally referred to as "dalupapa", similar in Cebu (Amihan and Daita 2025a). It represents a new and emerging fishery in the region, as the fishing operation is conducted by larger fishing vessels using a unique gear design in commercial open-water fishing grounds, which can contribute to the previous data of Dickson et al. (2000) and Amihan and Daita (2025a, b) on *T. rhombus* in the Philippines. Hence, this study was conducted to provide foundational data on the diamondback squid fishery in Palawan, specifically its focused were on fishing operation, seasonality, bait types, catch per unit effort (CPUE), gear characteristics, and fishing grounds.

METHODS

Study Site

This study was conducted in Sitio Sicud, Barangay Candawaga, Rizal, Palawan. Rizal is a municipality located in the southwestern part of Palawan, facing the WPS (Figure 1). Currently, this is the only area in Palawan with a higher concentration of active fishers—approximately 25 registered commercial fishing vessels with outriggers and around 70 fishers—engaged in *T. rhombus* fishing. The fishery began in 2017, when several fishers from Negros Oriental arrived aboard a vessel anchored in the area and introduced the techniques. These methods were subsequently adopted by a local fisher operating a 3-ton vessel previously used for catching smaller squid species. After a week of exploratory fishing, they successfully caught 25 individual *T. rhombus*, which encouraged many other fishers to adopt the diamondback squid fishing techniques.

Respondents and Data Collection

A total of 16 respondents with over five years of experience in *T. rhombus* fishing were interviewed in the area (Table 1) on December 2024. Among them, seven are both vessel owners and captains, one is solely a vessel owner, and eight are vessel captains. These respondents operate commercial fishing vessels with carrying capacities ranging from 3.02 to 9.30 gross tonnage (GT). Additionally, eight respondents utilize skiff boat to support their fishing operations, while the remaining eight operate without auxiliary support. The number of people onboard each fishing vessel ranges from three to nine, depending on the carrying capacity (Table 1).

Data were gathered through face-to-face interviews using a Tagalog-language survey questionnaire accompanied by a consent form. This includes the start and end time of fishing operations (in hours), total duration of fishing trips (number of days spent at the fishing grounds, including travel), number of jig sets deployed per vessel, and number of squid caught (both in individual count and total weight). It also covered fishing seasonality based on the number of boats operated per month, bait types, gear characteristics, and fishing grounds. Since fishers do not maintain proper records of their daily operations throughout the year, the data collected were based on a single-recall survey conducted on a monthly basis and assumed to remain constant across the year, particularly with respect to the number of jig sets and squid caught (both individual counts and equivalent total weight). Photos of fishers handling *T. rhombus* were also solicited for size reference (Figure 2).

Data Presentation and Computation

The data collected were encoded and computed using MS Excel to generate descriptive statistics such as frequency and count, which were then converted into graphical representations whenever applicable. The total daily fishing time (TDFT) per month were calculated by subtracting the start of fishing time (SFT) from the end of fishing time (EFT). The daily monthly fishing operation (DMFO) was based from fishers' information on the number of days a fishing vessel operated within a month. To compute

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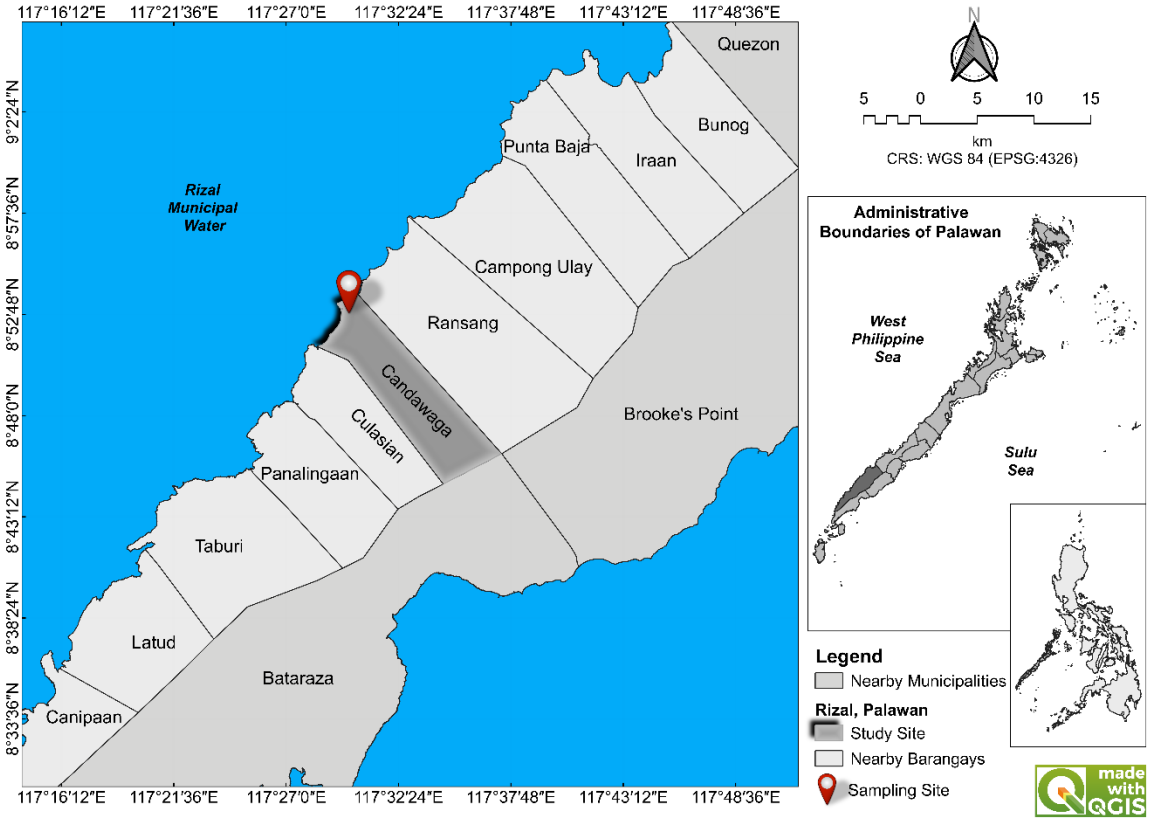

Figure 1. The administrative boundaries of Rizal, Palawan showing the location of study area.

Tabel 1. Profile of respondents based on fishing vessel type used in *Thysanoteuthis rhombus* fishing in Candawaga, Rizal, Palawan.

Respondent	Name of Fishing Vessel	Status of the Respondent	Number of Skiff Boat Support	Gross Tonnage	Number of People Onboard
1	Jeboy	Owner and Vessel Captain	1	5.11	4
2	Princess	Owner	0	6.35	3
3	Jasmine3	Vessel Captain	1	6.51	4
4	Mark ivan2	Vessel Captain	1	6.26	5
5	Precious joy1	Owner and Vessel Captain	1	5.04	4
6	Danelyn1	Vessel Captain	3	9.30	9
7	Bodek	Vessel Captain	2	5.19	5
8	Danelyn2	Owner and Vessel Captain	0	4.03	3
9	Princess mae	Owner and Vessel Captain	0	3.02	3
10	Jaira	Owner and Vessel Captain	0	3.02	3
11	Precious joy4	Vessel Captain	0	4.36	4
12	Princess Aira	Owner and Vessel Captain	0	5.58	4
13	Precious Joy2	Vessel Captain	2	5.43	7
14	Mark ivan5	Vessel Captain	0	3.42	4
15	Jericho	Vessel Captain	0	3.04	4
16	Eillish	Owner and Vessel Captain	1	6.64	4

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Figure 2. The size of *Thysanoteuthis rhombus* in reference to the fisher's height (~165 cm) in Candawaga, Rizal, Palawan, Philippines.

the monthly fishing time (MFT), the TDFT was multiplied by the DMFO. Catch per unit effort (CPUE) was also computed based on the collected data, following the method of Morgan and Burgess (2005). In this approach, the monthly catch of *T. rhombus* (in kilograms, kg) was divided by the total number of jig sets (js), and subsequently divided by the MFT per fishing vessel per operation.

Meanwhile, the design of the jig set was documented through photographs and accompanied by a realistic illustration. Each component of the gear was labeled and provided with corresponding dimensions. The fishing grounds were plotted using coordinates obtained from vessel captains and processed through QGIS software, incorporating a submarine topography layer sourced from the OpenTopography website (https://portal.opentopography.org/raster).

RESULTS

Fishing Operation of *T. rhombus*

The fishing operations of 16 respondents for *T. rhombus* typically began between 0300H and 0500H, with the majority (56%) started at 0400H and 6 (37%) at 0500H (Figure 3). The end of operations varied widely, ranging from 1300H to 2300H, although some (37%) fishers preferred to conclude at 1400H and (19%) at 1800H. Overall, the total fishing duration per day ranged from 9 to 18 hours, with the majority (25%) of fishers operating for approximately 13 hours per vessel (Figure 3).

The fishing operations per vessel lasted between five and 10 days per month, with the majority (31%) reported eight fishing days, resulting in a total fishing time of 54 to 126 hours monthly (Figure 4). Meanwhile, the number of jig sets deployed per vessel ranged from 52 to 160, with most (31%) vessels used between 100 jig sets. This setup yielded catches of 35 to 400 individual *T. rhombus*, equivalent to 200 to 1,000 kg (Figure 5).

Fishing Seasonality

There was an annual fishing seasonality of *T. rhombus* in Rizal, Palawan based on the number of fishing vessels operated which started every January (Figure 6). However, the peak season was observed from April to September (93% to 100% of fishers) and started to fall in October until December (Figure 6).

Type of Baits

There were three types of bait used by fishers in Candawaga, Rizal, Palawan to catch *T. rhombus*. These were *Rastrelliger kanagurta* (Cuvier, 1816), *Exocoetus* sp., and the fins of *T. rhombus* (Figure 7). Among baits, the *R. kanagurta* and the fins of *T. rhombus* were the most (56%) preferred by fishers, respectively.

Catch-per-Unit Effort (CPUE)

The CPUE of *T. rhombus* fishing per vessel in Candawaga, Rizal, Palawan ranged from 0.03 to 0.08 kg/js/hr for 5 to 10 days fishing operation per month. However, majority (19%) of the fishers have 0.05 and 0.06 kg/jig/hr, respectively (Figure 8).

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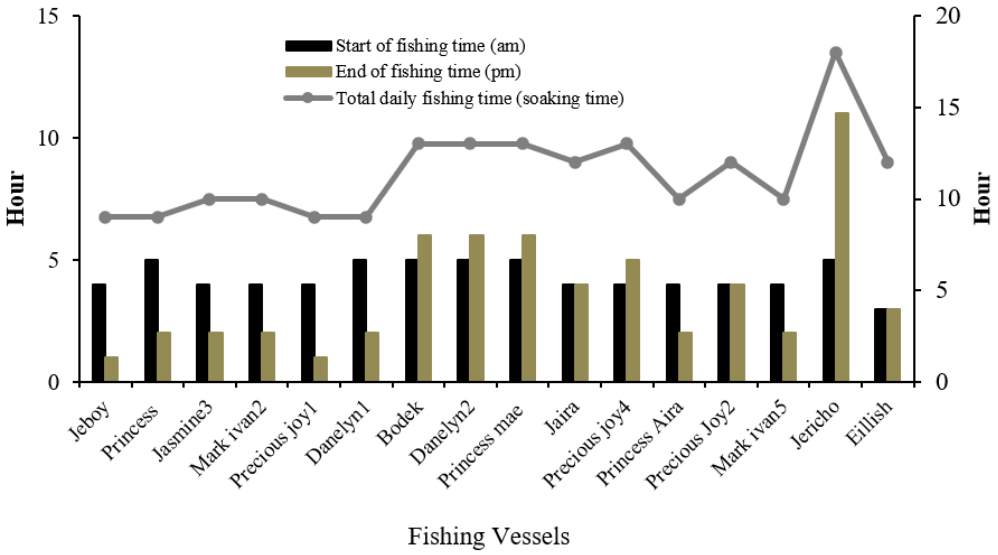

Figure 3. The fishing time of *Thysanoteuthis rhombus* fishery per fishing vessel in Candawaga, Rizal, Palawan, Philippines.

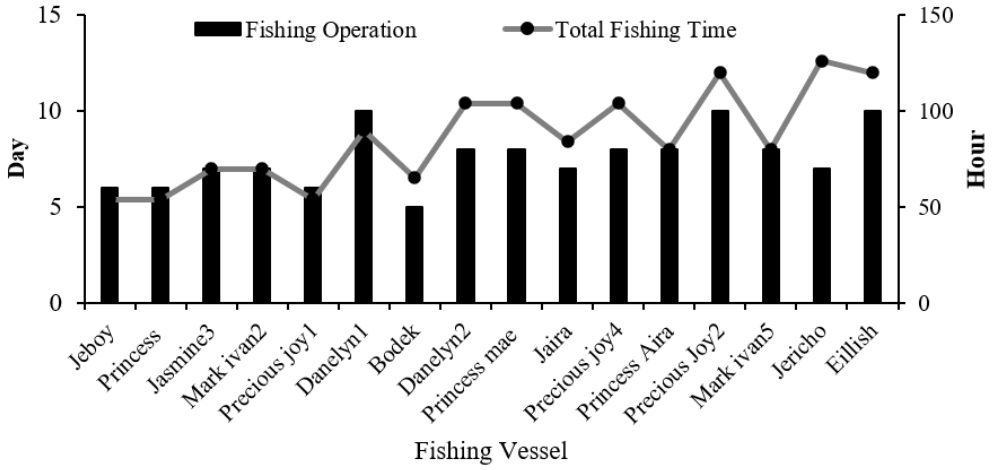

Figure 4. Total fishing operation (day) and monthly fishing time (hour) per fishing vessel in Candawaga, Rizal, Palawan, Philippines.

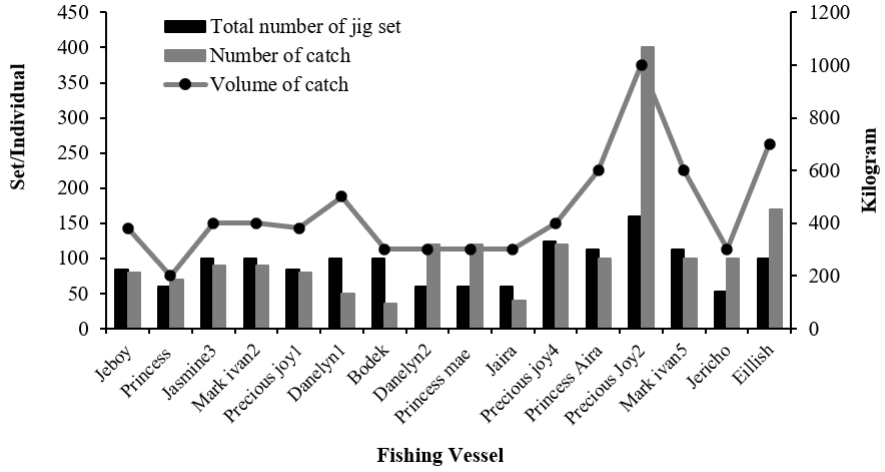

Figure 5. Number of the jig set and catches (individual and kg) per fishing vessel in Candawaga, Rizal, Palawan, Philippines.

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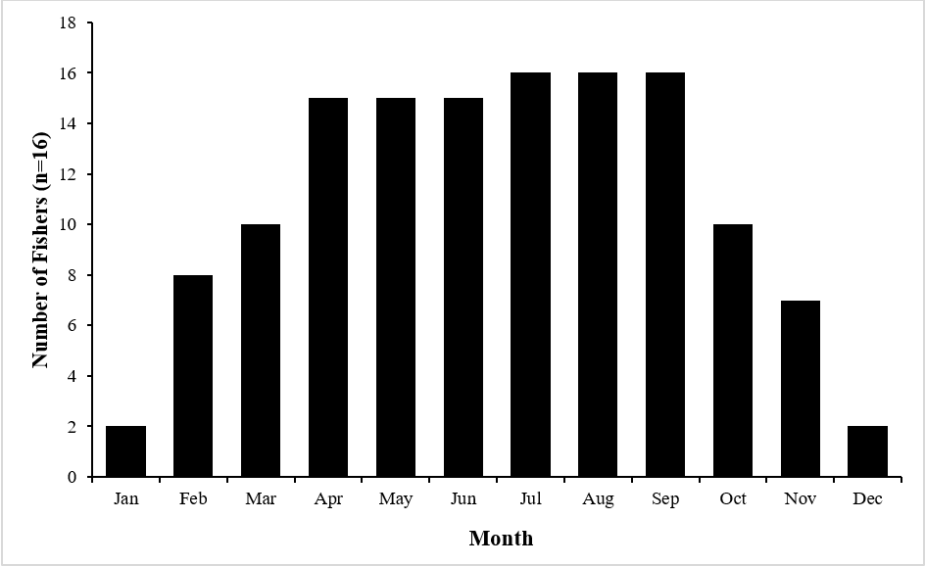

Figure 6. Fishing seasonality of *Thysanoteuthis rhombus* in Candawaga, Rizal, Palawan. (multiple response).

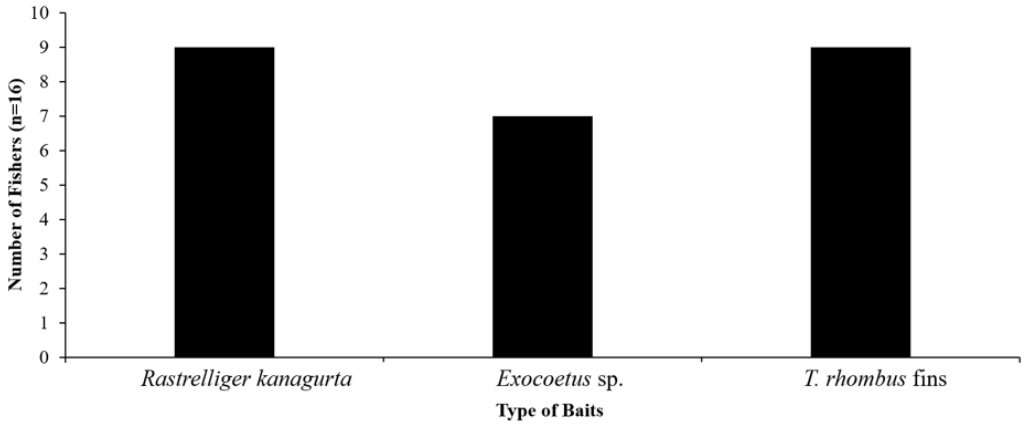

Figure 7. Type of baits for *Thysanoteuthis rhombus* fishing in Candawaga, Rizal, Palawan, Philippines (multiple response).

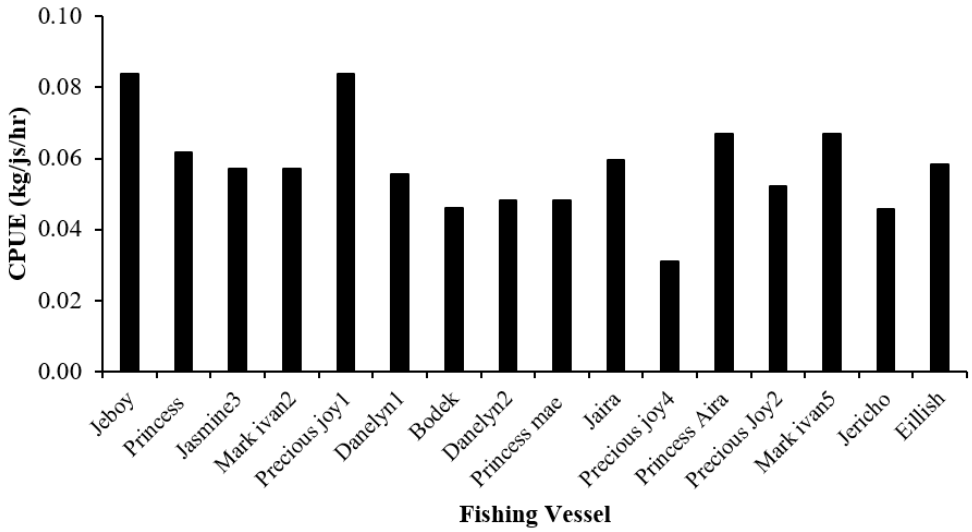

Figure 8. Catch-per-unit effort (kg/jig/hr) of *Thysanoteuthis rhombus* fishing per fishing vessels in Candawaga, Rizal, Palawan.

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Fishing Gear Characteristics

The fishing gear used for *T. rhombus* fishing in Candawaga, Rizal, Palawan consist of two major parts (Figure 9). These were the jig set and the squid jig. The jig set consists of a marker flag attached to a wooden pole measuring 290 cm in total length, and a fixed steel bar sinker with dimensions of 45.7 cm in length and 4 cm in diameter. The setup includes three Styrofoam buoys: two spherical (20.3 cm in diameter) and one rectangular (24.4 cm in length, 12.7 cm in width, and 8.9 cm in height). One of the spherical buoys is used to attach the wooden pole marker flag, the other is used as reserve, while the rectangular buoy is used as spool for the 545 m mainline comprises of a nylon (#100, 1 mm), commercial flasher light, 21 cm steel hanger, rope line (#7, 7 mm), swivel (swivel ball loop #0/3), and 4 and 5 m hanging line (nylon #140, 1.40 mm) and stainless clip. The squid jig is consisted of steel (17.9 cm in length) with sinkers (12.7 cm in length and 1.9 cm in diameter) equipped with an umbrella hook (7.6 cm in diameter) (Figure 9).

Fishing Ground of *T. rhombus*

The fishing grounds of *T. rhombus* are distributed beyond the municipal waters of Rizal and Balabac, Palawan (Figure 10). Most (63%) fishing activities occur along the continental slope near Bataraza and Balabac, within the WPS, at depths ranging from approximately 1,000 - 3,250 m. Additionally, some fishers operate beyond the boundaries of the Philippine Exclusive Economic Zone (Figure 10).

DISCUSSION

Fishing Operation

The fishing operation for *T. rhombus* introduced by fishers from Negros Oriental in Candawaga, Rizal, Palawan are similar to those observed in Cebu (Amihan and Daita 2025a, b). According to Amihan and Daita (2025a), the fishing operation in Cebu were likewise introduced by fishers from Negros Oriental. These methods also align with operations documented in Japan (Bower and Miyahara 2005). Fishing operations typically begin at 0300H by

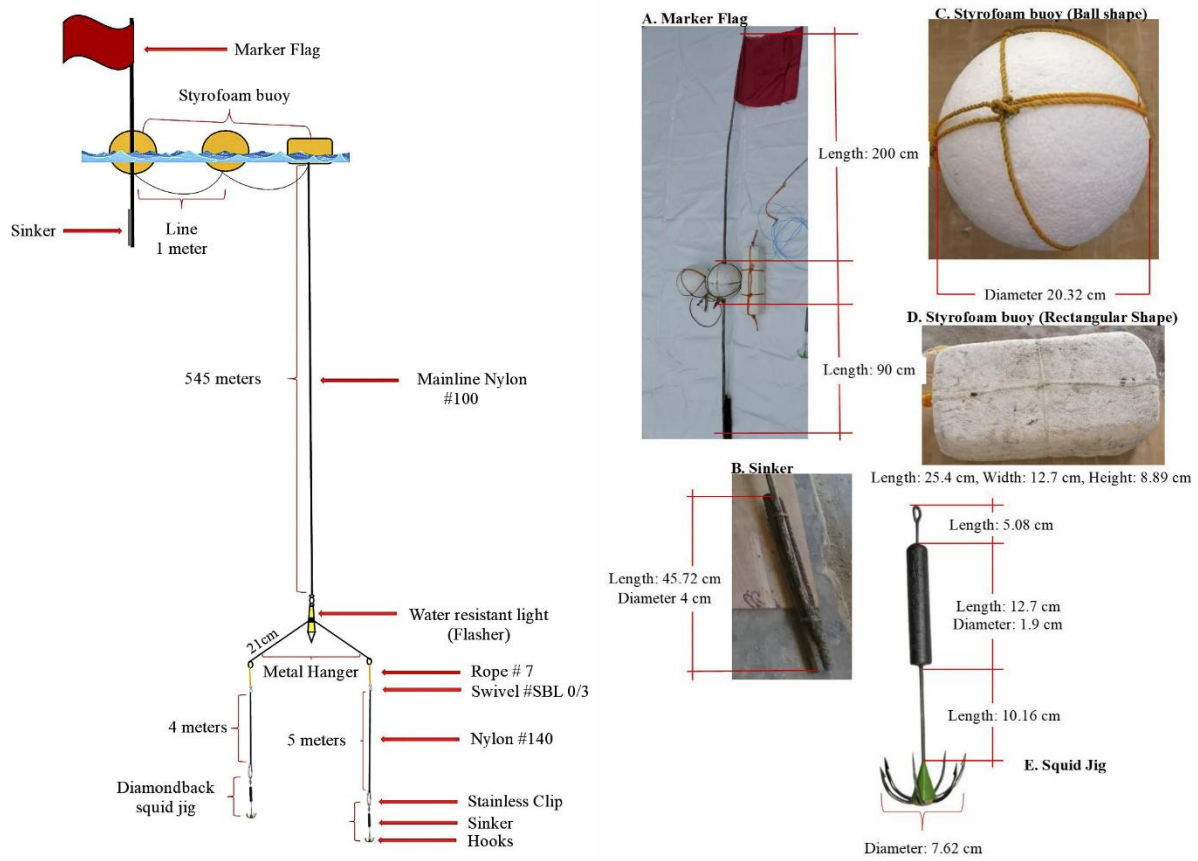

Figure 9. Illustration layout and parts of fishing gear used for *Thysanoteuthis rhombus* fishing.

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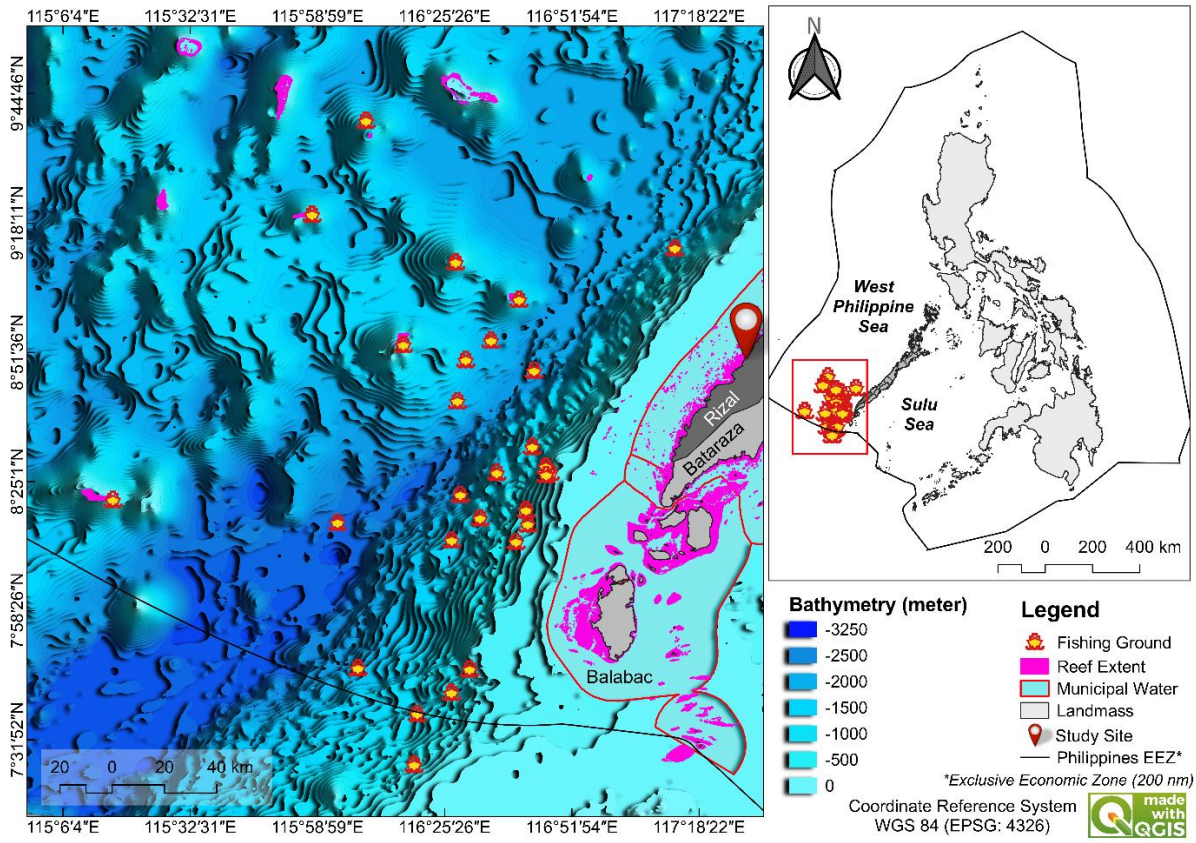

Figure 10. Distribution of *Thysanoteuthis rhombus* fishing ground in the southwest water of Palawan, Philippines.

baiting of all jig sets onboard followed by deployment from 0400H until 0500H. According to fishers, jig sets are deployed early in the morning to allow the gear to settle at depths exceeding 500 m, giving *T. rhombus* time to detect the bait before dawn. This approach coincides with the species' natural behavior of ascending near the water surface at night to mate and feed (Nigmatullin et al. 1995). Once all jig sets are deployed, fishers wait approximately five hours before checking for a catch. A catch is indicated when the buoy moves up and down or when the main buoy becomes submerged, prompting manual retrieval. Larger fishing vessels may redeploy jig sets with fresh bait to maximize effort. This process is repeated until around 1300H to 1500H, when all jig sets are hauled in regardless of catch due to the intense midday heat. After hauling, fishers begin dismantling and storing the *T. rhombus*, continuing until around 2300H.

Fishing operations for *T. rhombus* in Candawaga, Rizal, Palawan typically lasted five to 10 days per trip, with two to four trips conducted monthly. This resulted in a total fishing time of 54 to 126 hours, or approximately nine to 18 hours of operation per day per month. This duration is notably longer than the fishing operations in Cebu, which range from 8 to 12 hours per day (Amihan and Daita 2025a). The variation in fishing time is attributed to the extended process of dismantling and storing the catch, as fishers in Candawaga remain in their preferred fishing grounds to maximize effort and reduce expenses. In contrast, most fishers in Cebu return to port daily once the midday heat becomes unbearable, as their fishing grounds are located much closer to shore. However, some fishers in Cebu operating larger vessels also choose to stay in the fishing grounds to minimize travel-related costs (Amihan and Daita 2025a, b).

Meanwhile, the variation in the number of jig sets depends on the carrying capacity of the fishing vessel. Fishers engaged in *T. rhombus* fishing in Candawaga, Rizal utilize vessels ranging from 3.02 to 9.30 GT (see Table 1), which is considered an ideal size for commercial fishing in offshore waters, particularly in the WPS. Each vessel can carry between 52 and 160 jig sets, influencing catch volumes that range from 35 to 400 individuals per month, or 5 to 40 individuals per day, with individual weights ranging from 1 to 15 kg. In contrast, fishers in Cebu operate smaller vessels with capacities between 0.02 and 1.98 GT, which can accommodate only 4 to 10 jig sets. These vessels typically caught 5 to 15 individuals per day, with an average weight of approximately 7 to 8 kg (Amihan and Daita 2025a).

Fishing Seasonality

Thysanoteuthis rhombus fishing in Candawaga, Rizal, Palawan operates year-round, although the majority of fishers conduct operations from March to September. These peak months of *T.*

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rhombus in the southern part of WPS align with observations from other regions in the Philippines, such as the Camotes Sea (Dickson et al. 2000), the Tañon Strait in Central Visayas (Amihan and Daita 2025b), and Ormoc Bay, Leyte (Dickson et al. 2000). In contrast, fishing seasonality in areas like Calauag Bay, Quezon Province is much shorter, lasting only five months from June to October (Dickson et al. 2000). Similar variations in fishing seasonality are also observed in Japan: in the Sea of Japan, the season runs from July to February; in Okinawa Prefecture, from November to June; and in Bonin Island, from November to March (Bower and Miyahara 2005). Although these reports provide insights into seasonal fishing patterns, there remains limited information explaining the environmental factors that influence catch rates. In Candawaga, Rizal, seasonality is primarily based on local ecological knowledge (LEK) of their catch per month in a year, a method also noted in other studies (Bower and Miyahara 2005; Miyahara et al. 2007; Rajkumar et al. 2022; Amihan and Daita 2025a). Bower and Miyahara (2005) and Miyahara et al. (2007) suggest that the seasonality of *T. rhombus* is influenced by environmental conditions, particularly seawater temperature in specific fishing grounds. For instance, Miyahara et al. (2007) reported that catch rates off Hyogo Prefecture in the western Sea of Japan peak from September to October, coinciding with the presence of a cold-water mass in the area. Although peak season aligns with colder months in this study and other reports in the Philippines, high catch rates during warmer periods (March–April) merit investigation into the spatial and temporal migration of *T. rhombus* similar to the other species report (Samson 2019). A monthly assessment of length and weight variation in *T. rhombus* catches also merits further investigation to determine which fishing months yield larger and heavier individuals, which could serve as a reference for evaluating the condition of the wild population. It is also recommended to further investigate fishers' observations regarding the factors underlying the low fishing catch from October to February, including the breeding cycle of *T. rhombus* and presence of large deep-water predators. Fishers reported the presence of swordfish, *Xiphias gladius* (Linnaeus, 1758), and other large deep-water squid during these months to their catches, which are believed to prey upon the hooked *T. rhombus*. This perceived increase in predation pressure particular by *X. gladius* (Abid et al. 2017) which has prompted fishers to modify their gear by attaching a snare trap made of nylon (#150) beneath the hanger's angle to target and capture the fish attacking *T. rhombus*. Such adaptive fishing practices warrant further investigation to better understand the gear modifications and fishing strategies employed by fishers in response to catch fluctuations in *T. rhombus* availability.

Type of Baits

The three bait types used for *T. rhombus* fishing in Candawaga, Rizal is typically abundant in the area. Among them, *R. kanagurta* is the easiest to catch, while *Exocoetus* sp. is more difficult to obtain. The fins of *T. rhombus*, although commonly used, have low market value. In other areas such as Cebu, *R. kanagurta* and parts of *T. rhombus* are also used as bait, along with *Selar crumenophthalmus* (Bloch, 1793), *Chanos chanos* (Fabricius, 1775), *Loligo* sp., *Mene maculata* (Bloch & Schneider, 1801), *Sardinella* sp., *Auxis* sp., and *Decapterus* sp. (Amihan and Daita 2025a). Among these, the most preferred baits are *T. rhombus* parts, *S. crumenophthalmus*, and *C. chanos*. Notably, *C. chanos* was used exclusively as bait in Japan (Bower and Miyahara 2005) and in the experimental fishing exploration conducted by Dickson et al. (2000) in the WPS.

Catch-per-Unit Effort (CPUE)

The monthly CPUE for *T. rhombus* fishing in this study ranges from 0.03 to 0.08 kg/js/hr, which is significantly lower than the CPUE reported in Cebu, ranging from 0.49 to 1.07 kg/js/hr per day (Amihan and Daita 2025a). Even when recalculated for daily operations, the CPUE in Candawaga, Rizal, Palawan remains lower at approximately 0.01 to 0.02 kg/js/hr. This low CPUE is attributed to longer fishing durations and the use of a higher number of jig sets. Fishing vessels in Candawaga deploy 52 to 160 jig sets, whereas vessels in Cebu typically carry only 4 to 10 (Amihan and Daita 2025a). Another contributing factor is the differences in how fishing time is computed across regions. According to Amihan and Daita (2025a), CPUE in diamondback squid fishing can vary due to multiple factors, including the behavior of the target species, gear characteristics, fishing operation, environmental conditions, and the spatial distribution of the wild stocks. To obtain more robust and reliable information on *T. rhombus* CPUE and the status of its wild population, extended and actual data collection over a longer period is strongly recommended. Additionally, the profitability of this fishing activity merits further investigation.

Fishing Gear Characteristics

The fishing gear used for *T. rhombus* fishing in Candawaga, Rizal, Palawan consists of two major components: the jig set, locally known as "palayaw," and the squid jigs, referred to as "saranggat." This gear setup is similar to those reported by Amihan and Daita (2025a) in Cebu and the experimental fishing conducted by Dickson et al. (2000) in the WPS, which were adaptations from Japanese fishing operation. The main differences lie in the number of Styrofoam buoys used, the length of the mainline, and the number and design of squid jigs attached to the mainline.

Unlike in this study, the jig set used in Cebu (Amihan and Daita 2025a) features only two

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Styrofoam buoys, with both the marker flag and mainline attached to a single buoy similar to the design described by Dickson et al. (2000). The differences in the number and configuration of buoys may be attributed to the size of *T. rhombus* caught in each area and the prevailing conditions of the fishing grounds. In Cebu, the fishing grounds are located within the more protected waters of the Tañon Strait, and the average catch size is smaller, ranging from 7 to 8 kg (Amihan and Daita 2025a). In contrast, catches in this study reach up to 15 kg, and the fishing grounds are situated in the WPS, which is characterized by harsher environmental conditions. The relatively larger catches reported in this study may be attributed to fishing grounds targeting *T. rhombus* in open waters, where individuals are more likely to be at adult stages. In contrast, the species is known to migrate to shallower waters for spawning, with juveniles occurring higher in the water column (Nigmatullin et al. 1995; Bower and Miyahara 2005; Miyahara et al. 2007).

Additionally, the length of the mainline used by fishers in the study area can reach depths of up to 545 meters. According to local fishers, this depth has proven to be the active zone for *T. rhombus* in the WPS. In Cebu, where *T. rhombus* fishing has been reported since 1997, the mainline length typically ranges from 151 to 200 meters (Amihan and Daita 2025a). In contrast, experimental fishing conducted by Dickson et al. (2000) recorded catches at depths of 720 meters. These variations in mainline length across different regions suggest a vertical distribution behavior of *T. rhombus*, which has also been observed in Okinawa, Japan (Bower and Miyahara 2005; Miyahara et al. 2007). This behavior significantly influences catch rates during fishing operations, as documented in several studies (Miyahara et al. 2007; Amihan and Diata 2025a).

On the other hand, the metal hanger used by fishers in the study area to attach two squid jigs is a unique feature of the fishing gear which was not found in other studies (Dickson et al. 2000; Bower and Miyahara 2005; Amihan and Daita 2025a). The head of the metal hanger is tied to the mainline, where the flasher light is also secured using a strip cut from an old bicycle inner tube. This gear set-up was the original design introduced by fishers from Negros Oriental. This metal hanger supports the squid jigs in a horizontal orientation, unlike the vertical arrangement of multiple squid jigs used in Cebu, which is an adaptation from Japanese fishing operation. Although the design of squid jigs varies across studies, there remains a gap in understanding which design yields the highest catch rate, particularly since no published research has been conducted in Negros Oriental to substantiate the findings of this study. Therefore, an experimental trial comparing different jig-set configurations is strongly recommended to determine the most effective design.

Fishing Ground of *T. rhombus*

Fishers in Candawaga, Rizal, Palawan primarily target *T. rhombus* in the southern part of the WPS, with most fishing activities concentrated along the continental slope between Bataraza and Balabac, Palawan, extending toward Malaysian waters (Figure 10). According to the fishers, the selection of fishing grounds was based on catch records. Once a particular area yielded catches, they marked it and returned during each *T. rhombus* season. These practices led to the expansion of *T. rhombus* fishing grounds from the eastern to the western part of the WPS (Figure 10). Additionally, this section of the WPS was not included in the fishing expedition conducted by Dickson et al. (2000), which deployed jig sets from the northwest of Babuyan Islands to the western section of Linapacan, Palawan. Although a single *T. rhombus* was caught west of Mindoro during that expedition, this study suggest that *T. rhombus* distribution could be found in southern part of WPS, as indicated by the concentration of fishing activities in the area. According to some fishers in Candawaga, they also venture west of Quezon, Palawan, particularly when catch rates is low in their usual fishing grounds. This distribution is similar to the report of Amihan and Daita (2025b) in Cebu, where *T. rhombus* fishing grounds are widely distributed throughout the Tañon Strait, although certain areas show higher concentrations of fishing activity. According to Miyahara et al. (2007), the horizontal distribution and abundance of *T. rhombus* are strongly influenced by environmental conditions, especially water temperature driven by ocean currents. Although various oceanographic studies have been conducted in the WPS (Arceo et al. 2024), environmental monitoring in relation to *T. rhombus* fishing grounds in the southern WPS is highly recommended (Dickson et al. 2000). Such efforts could yield valuable insights into the species' habitat characteristics in tropical waters (Sajikumar et al. 2020), aiding in the identification of other potential fishing grounds across the Philippines. Conducting similar studies in other municipalities of Palawan, particularly in areas reporting *T. rhombus* landings, is strongly encouraged to broaden knowledge of the species' fishing ground distribution, which is essential for effective fisheries management.

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GENERATIVE AI STATEMENT

This study employed Copilot AI tool solely for coherence and grammar checking. No portion of the content was generated entirely by any AI platform.

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ETHICAL CONSIDERATIONS

The study secured informed consent from all respondents prior to data collection, and participation in the interviews was entirely voluntary. No animals were collected or involved in this study.

DECLARATION OF COMPETING INTEREST

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

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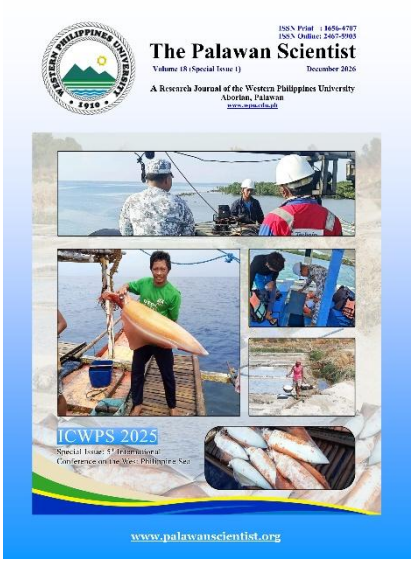

Level of awareness and practices of the barangay officials towards disaster risk reduction and management in San Vicente, Palawan, Philippines

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ABSTRACT

Barangay officials have a significant role in local disaster management in the Philippines, where natural hazards such as typhoons frequently occur. This study assessed the level of awareness and practices of barangay officials towards disaster risk reduction and management (DRRM). A descriptive-correlational research design was employed using a structured questionnaire. Gathered data from a total of 75 barangay officials in San Vicente, Palawan were analyzed using descriptive statistics and correlation tests. The results found that most of the respondents are male (53%), with ages between 39-48 years old, have attained college level education, a long-term resident of San Vicente, and had more than six years in government service. The respondents have identified typhoons, flooding, and landslides as the most common disasters experienced within the municipality. Results also revealed that the barangay officials showed high awareness particularly in search and rescue operations, their roles in DRRM, and designated evacuation centers. They also showed regular participation in DRRM activities, specifically training on first aid, search and rescue, and disaster management and information dissemination. However, they identified lack of training, lack of funds, and low community participation as the primary challenges to DRRM implementation. Moreover, results showed that there was no significant correlation between demographic profile and awareness, but disaster experience and DRRM practices did. These findings suggest that prior disaster experiences increase awareness, which in turn increases DRRM involvement. Though, barangay-level DRRM implementation necessitate institutional, financial, and participatory improvements.

Keywords: climate, community-based, disaster management, hazards, resilience, vulnerability

INTRODUCTION

A disaster is a major disturbance that affects a community's capacity to prosper (UNDRR 2017). It may result in significant human, environmental, and economic losses and impacts (UNDRR 2017). Although the impact of a disaster can be abrupt and localized, they are often extensive and may last for a long time (UNDRR 2017). Some communities require assistance externally, if the impact is beyond its ability to manage with its own resources (Republic Act No. 10121 2010). The Sendai Framework for Disaster Risk Reduction (DRR) emphasizes the importance of knowledge in disaster mitigation, claiming that increasing comprehension at different levels and in different domains strengthens the success of the strategy (UNDRR 2015).

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The Philippine Disaster Risk Reduction and Management Act of 2010 (Republic Act 10121 2010) highlight the roles of the local government in disaster management requiring a barangay disaster risk reduction and management (BDRRM) plan. The law specifies a proactive disaster management such as the early warning systems, evacuation protocols, risk assessments, and community engagement. It also emphasizes the creation of BDRRM committee (BDRRMC) which is tasked with the implementation of DRRM at the barangay level (DILG 2010; NDRRMC 2011). In addition, the law is strengthened through the Department of the Interior and Local Government (DILG) Memorandum Circular No. 2025-035 through implementation of Listo si KAP. The Listo si KAP (Komunidad at Punong Barangay) encourages barangay officials and the community to accomplish their responsibilities in disaster risk reduction and management (DRRM). This set of regulations emphasizes the importance of barangays in DRRM by highlighting their local needs and vulnerabilities, their potential to mobilize local resources, and their role in educating and involving the community in DRRM initiatives. At the barangay level, officials play a key role in DRRM through the BDRRMC, supporting preparedness, risk assessment, early warning, evacuation, response, and community information activities within their respective jurisdictions. Their responsibilities are coordinated with the municipal government and relevant agencies when risks exceed barangay-level capacity. Although barangay officials have defined DRRM responsibilities, their technical expertise in emergency response may vary according to their training and experience.

The geographical location of the Philippines within the Pacific typhoon belt and the "Pacific Ring of Fire" makes it highly susceptible to natural hazards, including typhoons, earthquakes, volcanic eruptions, storm surges, landslides, flooding, and drought (ADRC 2019; DOST-PHIVOLCS 2022). Palawan, a province in the Philippines known for its natural beauty, is also susceptible to hazards. For instance, San Vicente, in northern Palawan, is prone to storm surges, floods, and landslides typically due to tropical storms and prolonged rainfall (DOST-PHIVOLCS 2022). Previous events such as the tropical depression Usman (in 2018) and powerful typhoons like Quinta (in 2020) and Odette (in 2021) known to have caused widespread flooding and damage in the area (PAGASA 2021).

While Republic Act 10121 establishes local disaster governance standards, studies show varying levels of community preparedness across Philippine local government units. Villanueva and Villanueva (2017) found high awareness but training gaps among BDRRMC members in Nueva Ecija, while Tanguid and Tanguid (2023) highlighted the role of local disaster exposure in response capacity. Nacaya et al. (2023) likewise emphasized structured local networks for effective disaster response. However, studies examining both the awareness and practices of barangay officials in vulnerable coastal areas such as San Vicente, Palawan remain limited. Hence, this study aimed to assess the level of awareness and practices of barangay officials towards DRRM in San Vicente, Palawan. It sought to determine their demographic profiles, disaster experiences, awareness levels, practices, and challenges in DRRM implementation, as well as examine the correlations among these variables. The study recognizes the critical role of barangay officials in community-based disaster management. This study may contribute to the formulation of the local DRRM programs of San Vicente especially at the barangay level.

METHODS

Study Area

The study was conducted in San Vicente, Palawan. San Vicente is located along the northwestern side of mainland Palawan (10°24′45″N, 119°10′39″E), 186 km from Puerto Princesa City. It is found between the municipalities of Taytay (northeast), Roxas (east), and Puerto Princesa City (southwest). Its northwestern side is where the West Philippine Sea is found. It has a total land area of 165,797 ha and has jurisdiction over 10 barangays. It also has 22 islands/islets included within its borders (Figure 1).

Research Design

The study used quantitative research through a correlational descriptive method to investigate the relationship between awareness and disaster experience, demographic profile and DRRM awareness, and awareness and practices of the barangay officials.

Respondents of the Study

The study used total enumeration of barangay officials across the 10 barangays of San Vicente, Palawan. A total of 75 respondents were recruited through coordination with the municipal disaster risk reduction and management office and barangay captains during regular barangay council sessions. Participation was voluntary, with written informed consent obtained before administering the structured questionnaire.

Survey Questionnaire and Data collection

The study utilized a structured, 42-item questionnaire adapted and modified from established national DRRM assessment framework guidelines (NDRRMC 2011). Part I contained 5 items on demographic profiling. Part II consisted of 1 checklist item on disasters experienced and 22 items assessing

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DRRM awareness. Part III evaluated DRRM practices across 15 items and 1 checklist item on implementation challenges. The study used a 5-point Likert scale to assess the level of awareness and practices of the respondents (Table 1).

Data Analysis

The study used statistical tools such as frequency counts, means, percentages for data analysis and Pearson r coefficient for the correlation tests (Table 2).

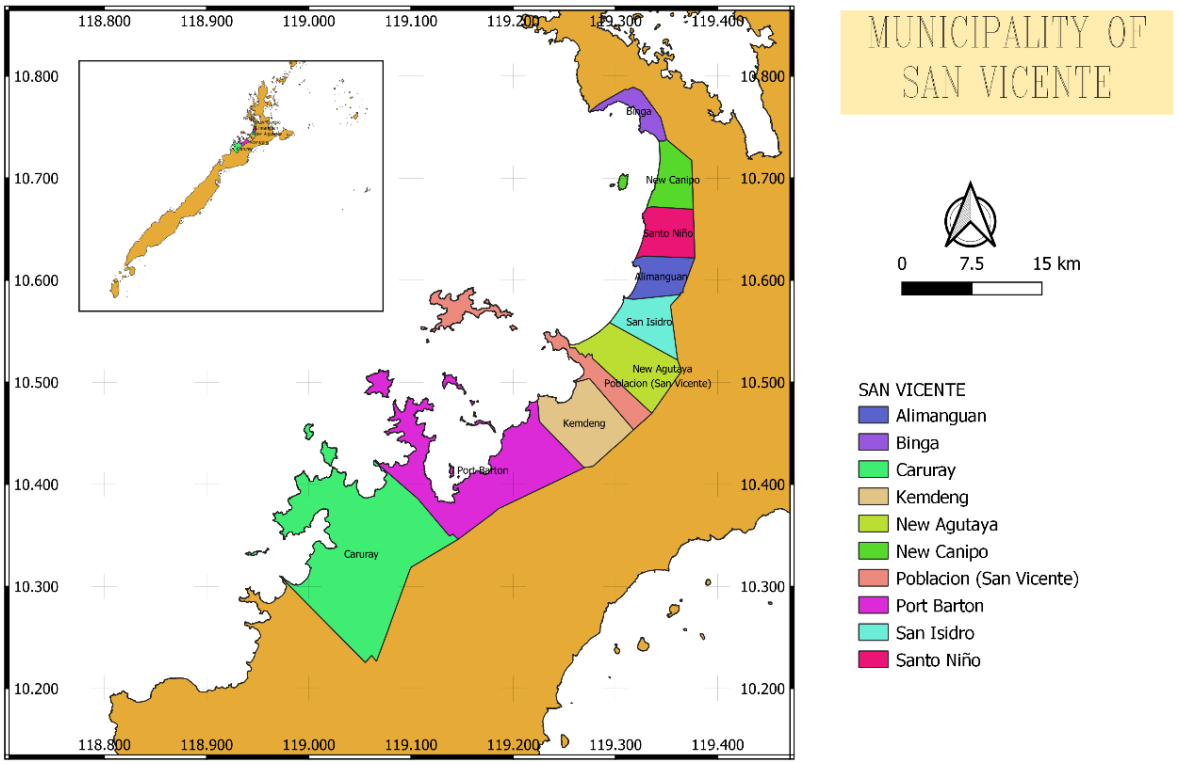

Figure 1. Map showing the barangays of San Vicente, Palawan.

Table 1. Likert scale and their description used in the study.

Rating	Statistical range	Descriptive Equivalent			
		Awareness		Practices	
		Item definition	Interpretation	Item definition	Interpretation
5	4.50 – 5.00	Fully aware	Very High	Very Often	Very good
4	3.50 – 4.49	Aware	High	Often	Good
3	2.61 – 3.49	Neither	Average	Sometimes	Poor
2	1.81 – 2.60	Not Aware	Low	Seldom	Very Poor
1	1.00 – 1.80	Fully Not Aware	Very Low	Never	Needs Improvement

Table 2. Pearson coefficient and their interpretation used in the study.

R values	Interpretation
0.90 – 1.00	Very high positive (negative) correlation
0.70 – 0.90	High positive (negative) correlation
0.50 – 0.70	Moderate positive (negative) correlation
0.30 – 0.50	Low positive (negative correlation)
0.00 – 0.30	Negligible correlation

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RESULTS

Demographic Profile of the Barangay Officials

The majority of the respondents are male, aged 39–48 years old, and long-term residents of San Vicente. Most had attained college education and have been in government service for over six years (Table 3). These suggest that most respondents already have a strong familiarity and experience in the local community's conditions.

Disasters Experienced in San Vicente

The respondents have identified typhoons, floods, and landslides as the most common disasters experienced in the municipality (Figure 2). These are in line with the local DRRM plan, which acknowledges the geographic susceptibility of the municipality to a range of hazards according to DRRMO Plan of San Vicente (2024).

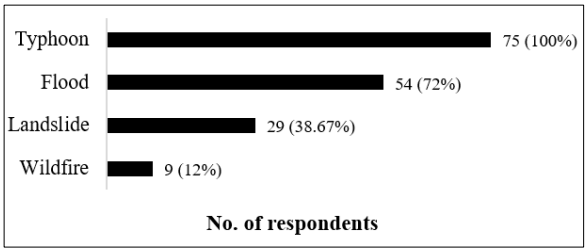

Figure 2. Disasters experienced by the respondents within the municipality.

Table 3. Socio-demographic profile of the respondents (n = 75).

Profiles	n	Percent (%)
Sex		
Male	40	53.33
Female	35	46.67
Age		
18 – 28	6	8.00
29 – 38	12	16.00
39 – 48	27	36.00
49 – 60	24	32.00
61- Above	6	8.00
Educational Attainment		
Elementary	2	2.67
High School	16	21.33
College Level	35	46.67
College Graduate	15	20.00
Vocational/Technical	7	9.33
Years of residence		
1 – 5	1	1.33
6 – 10	2	2.67
11 – 15	5	6.67
16 – 20	10	13.33
21-Above	57	76.00
Years in government service		
Less than 1	9	12.00
1 – 3	16	21.33
4 – 6	16	21.33
6-Above	34	45.33

Level of Awareness Towards DRRM

The respondents showed high awareness regarding DRRM (overall mean = 4.49). They revealed a clear understanding on procedures on search and rescue operations, their roles and responsibilities in DRRM, and the designated evacuation centers in their barangay. In addition, respondents have very high awareness on the resources in their barangay, communication systems and the procedures for distributing relief goods. Awareness regarding the disaster preparedness drills and trainings, availability of disaster response equipment, and procedures for activating the barangay disaster response plan was somewhat diminished (Table 4).

Practices Towards DRRM

The respondents frequently participated in DRRM activities (overall mean = 4.23). High levels of practice were observed in the use social media and other communication channels to disseminate information, and training the barangay officials, tanods, and volunteers on first aid, search and rescue and disaster management. A relatively lower levels of practice were noted in evacuation planning and drills and early warning systems (Table 5).

Problems and Challenges Towards DRRM Implementation

Respondents identified the lack of funds (77.33%), low community participation (60%), and lack of training (41.33%) as the major challenges in DRRM implementation (Figure 3). These reflect that the primary constraints in barangay-level DRRM implementation could both instutional and financial even though RA 10121 and DILG MC 35-25 is in place.

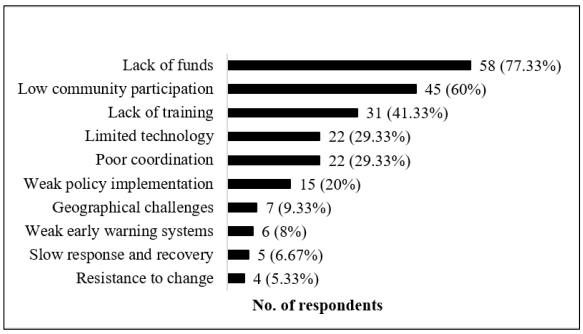

Figure 3. Problems and challenges encountered by the respondents in disaster risk reduction and management (DRRM) implementation.

Correlational Findings

The results revealed a significant positive, although weak relationship between the prior disaster experiences and awareness ($r = 0.25$, $P = 0.03$) (Table 6). This suggests that respondents with prior disaster

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experiences tended to have more awareness of DRRM, although the observed association was modest.

Additionally, findings showed no significant correlation between demographic variables and awareness (Table 7). In contrast, awareness was strongly correlated with DRRM practices, especially in Barangay Disaster Risk Reduction and Management Planning (r = 0.873, P = 0.00), early warning systems (r = 0.897, P = 0.00), and evacuation planning and drills (r = 0.904, P = 0.00) (Table 8). These findings indicate that awareness was positively associated with prior disaster experience while higher awareness was also associated with more frequent DRRM practices.

Table 4. Level of awareness of the respondents towards disaster risk reduction and management (DRRM) (n=75).

Statements	Mean	Descriptive Rating
Familiarity with DRRM concepts		
Different types of disaster	4.47	Aware
Barangay Disaster Risk Reduction and Management Plan (BDRRMP)	4.53	Fully Aware
Early Warning System	4.53	Fully Aware
Designated evacuation centers in the barangay	4.60	Fully Aware
Roles and responsibilities of the barangay officials in DRRM	4.69	Fully Aware
Available resources in the barangay for disaster response	4.57	Fully Aware
Community participation in DRRM	4.49	Aware
Legal framework related to DRRM in the Philippines	4.45	Aware
Average	**4.54**	**Fully Aware**
Preparedness Measures		
Conduct of disaster preparedness drills and trainings	4.32	Aware
Updated list of vulnerable residents	4.55	Fully Aware
Communication systems during disasters	4.55	Fully Aware
Disaster preparedness planning meetings and activities	4.41	Aware
Dissemination disaster preparedness information	4.47	Aware
Importance of preparing household emergency go-bags	4.41	Aware
Availability of disaster response equipment	4.36	Aware
Average	**4.44**	**Aware**
Response and Recovery Mechanisms		
Procedures for activating the barangay disaster response plan	4.40	Aware
Procedures for search and rescue operations	4.75	Fully Aware
Coordination mechanisms with other agencies during a disaster	4.47	Aware
Procedures for distributing relief goods	4.55	Fully Aware
Post-disaster damage assessment processes	4.48	Aware
Post-disaster recovery and rehabilitation resources	4.43	Aware
Support and counselling services for affected residents	4.44	Aware
Average	**4.50**	**Fully Aware**
OVERALL	**4.49**	**Aware**

Table 5. Practices of the respondents towards disaster risk reduction and management (DRRM) (n = 75).

Activities	Mean	Descriptive Rating
Barangay Disaster Risk Reduction and Management Planning (BDRRMP)		
Developing and regular updating of a comprehensive BDRRMP	4.25	Often
Mapping of hazard prone areas within the barangay	4.25	Often
Identifying of evacuation centers and routes	4.41	Often
Maintaining a resource inventory (equipment, personnel and supplies)	4.13	Often
Implementing communication protocols and early warning systems	4.33	Often
Average	**4.27**	**Often**
Early Warning Systems		
Installing of warning devices for different hazards	4.25	Often
Establishing of a system for disseminating warnings to residents (e.g. through text messages, social media, announcements)	4.25	Often
Training of community members on how to recognized and respond to warnings	4.07	Often
Average	**4.19**	**Often**
Evacuation Planning and Drills		
Conducting evacuation drills to familiarize residents with procedures	3.87	Often
Equipping evacuation centers with essential supplies	3.85	Often

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Activities	Mean	Descriptive Rating
Identifying and training evacuation volunteers	3.87	Often
Average	**3.86**	**Often**
Training and Capacity Building		
Training barangay officials, *tanods*, and volunteers on first aid, search and rescue and disaster management	4.77	Very Often
Conducting community-based training on disaster preparedness skills	4.23	Often
Information Dissemination and Education		
Holding community assemblies and meetings on discuss disaster preparedness	4.28	Often
Distributing information materials (e.g., pamphlets and posters on disaster preparedness)	4.29	Often
Using social media and other communication channels to disseminate information	4.56	Very Often
Average	**4.38**	**Often**
Vulnerable groups		
Developing special evacuation and assistance plans for vulnerable populations (elderly, PWD's pregnant women, children)	4.44	Often
Maintaining a registry of vulnerable residents	4.37	Often
Average	**4.41**	**Often**
Resource Mobilization		
Securing funding for disaster preparedness and response activities	4.37	Often
Establishing partnerships with other organizations for assistance	4.13	Often
Average	**4.25**	**Often**
OVERALL	**4.23**	**Often**

Table 6. Relationship between socio-demographic profile of the respondents and their level of awareness towards disaster risk reduction and management (DRRM) at 5% significance level. ns – not significant.

Demographics	r	*P*-value
Sex	0.106^{ns}	0.367
Age	0.153^{ns}	0.190
Educational Attainment	-0.081^{ns}	0.489
Years of Residence	0.066^{ns}	0.572
Years in Government Service	-0.062^{ns}	0.597

Table 7. Relationship between the awareness and practices of the respondents towards disaster risk reduction and management (DRRM) at 5% significance level. *Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed).

Themes	r	*P*-value
Barangay Disaster Risk Reduction and Management Planning (BDRRMP)	0.873^{**}	0.000
Early Warning Systems	0.897^{**}	0.000
Evacuation Planning and Drills	0.904^{**}	0.000
Training and Capacity Building	0.253^{*}	0.029
Resource Mobilization	0.616^{**}	0.000
Community Preparedness Organization	0.794^{**}	0.000
Information Dissemination and Education	0.763^{**}	0.000
Vulnerable Groups	0.654^{**}	0.000

DISCUSSION

Sociodemographic Background

The composition of the demographic profile of the barangay officials in San Vicente suggests a group of officials equipped with local background, community conditions and risks since mostly are middle-aged and long-term residents of the area. This reflects other Philippine studies where experience and tenure heightened the pressure on disaster responsibilities (Villanueva and Villanueva 2017; Tanguid and Tanguid 2023). The objectives of RA 10121, particularly its emphasis on strengthening local DRRM capacity and preparedness, are consistent with the respondents' educational and training background. The relatively high proportion of officials with tertiary education and training also supports the priorities of the UNDRR (2019), particularly in advancing knowledge, capacity-building, and evidence-based disaster risk governance under the Sendai Framework for Disaster Risk Reduction 2015–2030.

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Disasters Experienced within the Municipality

The disasters identified by the respondents confirm the vulnerability of the municipality to weather-related risks. This agrees with national assessments which specified that the Philippines is highly vulnerable to the disasters from hazards. In addition, the occerence of disasters like Typhoon Odette in 2021 illustrates the necessity for localized preparedness programs. This finding is consistent with the results of Nacaya et al. (2023), which indicate that barangays with frequent hazard exposure tend to develop more robust disaster response networks.

Awareness and Experiential Learning

The high level of DRRM awareness among the respondents indicates that barangay officials demonstrated substantial knowledge of DRRM principles. This is one of the outcomes of the decentralization efforts under RA 10121 and the National Disaster Risk and Reduction Management Plan (NDRRMP), which institutionalize local DRRM responsibilities and emphasize preparedness and capacity-building at the community level. Based on the studies of Tanguid and Tanguid (2023) and Villanueva and Villanueva (2017), systematic orientations and community drills are believed to help officials better grasp their duties in disaster preparedness. The correlation analysis revealed a statistically significant, positive relationship between disaster experience and DRRM awareness. This empirical result directly grounds the discussion, suggesting that firsthand exposure to major local hazards—such as typhoons and flooding—serves as a primary driver of hazard awareness among barangay leaders. Kato (2021) stressed that reflecting on prior disasters is very important for how ready a community is and how well it adapts. A study of evacuation behavior during the 2020 Taal Volcano eruption (Lim and Anabo 2025) showed that families with past disaster experience were more likely to respond quickly to evacuation alerts and adopt preparatory steps. These findings indicate that direct experience with disasters contributes greatly to the development of risk consciousness and determines how local stakeholders respond to future hazard situations. In San Vicente, recent exposure to typhoons may have contributed this experiential learning process. This kind of learning is similar to the experiential and community-based resilience paradigm that Matthies (2017), discussed about, in which small groups of people in a community create adaptive knowledge by working together and being socially connected.

Practical Engagement and Institutional Dynamics

The BDRRMC system works at the community level because officials take part in drills, meetings, and response measures. This matches the findings of Cuya-Antonio and Antonio (2017) and Nacaya et al. (2023), both of whom indicated that distinct assignments and roles within BDRRMCs improve coordination and response to disasters. However, the effectiveness of performance is still dependent on the culture of the organization and the commitment of its leaders. Matthies (2017) emphasized that participative leadership facilitate mobilization and fosters mutual trust which are also observed among the officials of San Vicente. Moreover, the use of social media platforms enhances information dissemination and promotes greater engagement in community-based DRRM activities. As Congjuico (2014) observed, municipal governments were increasingly reliant on social media for immediate communication and coordination, supporting the findings of this research that social media and mobile messaging are essential for disseminating early warnings.

Systemic and Resource Limitations

Despite high levels of awareness and engagement among barangay officials, the findings indicate persistent constraints related to financial resources and technical capacity. These challenges are widely documented across local government units in the Philippines. The Commission on Audit (2020) reported under-utilization and delayed expenditure of the local DRRM Fund, indicating systemic deficiencies in fund management and program implementation. Similarly, Geronimo and Gonzaga (2021) stated that rural communities typically require assistance from external parties since they lack the necessary technical skills. These align with the results of this study, in which respondents viewed resource limitations as the main challenge to maintaining DRRM operations. Moreover, Bawagan (2011) stressed that real community participation and engagement in local government systems are necessary for DRRM initiatives to persist.

Barangay officials in San Vicente demonstrate significant awareness and engagement in disaster risk reduction and management, however, they continue to encounter institutional and resource-related challenges. The consistency of the current findings with research from other provinces (Villanueva and Villanueva 2017; Nacaya et al. 2023; Tanguid and Tanguid 2023) indicated that local DRRM systems throughout the Philippines exhibit similar patterns of development and constraint. Reyes et al. (2021) asserted that using indigenous and experience knowledge in formal planning processes can enhance the cultural relevance of preparedness initiatives and strengthen community ownership.

Strengthening coordination across barangays, providing regular education and training, and encouraging communication methods that are tailored to the area would help local efforts better match the goals set forth in the Sendai Framework for Disaster Risk Reduction (UNDRR 2015).

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GENERATIVE AI STATEMENT

The authors used ChatGPT (GPT-5, OpenAI, 2025) and QuillBot Premium to assist in improving the grammar, structure, and clarity of the manuscript. These tools were employed solely for language refinement and organization. All data analyses, interpretations, and conclusions are the original work of the authors, who reviewed and verified the accuracy and integrity of the final text prior to submission.

ETHICAL CONSIDERATIONS

The authors secured an inform consent from the respondents and the participation was voluntary prior to data collection. No additional ethical approval was required beyond the use of consent forms.

DECLARATION OF COMPETING INTEREST

The authors declare that there is no conflict of interest relevant to the publication of this paper.

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ROLE OF AUTHORS: ***MFJPB*** *– conceptualization, data collection, and drafting of the manuscript;* ***KFPE*** *– study design, data analysis and interpretation, critical revision of the manuscript.*

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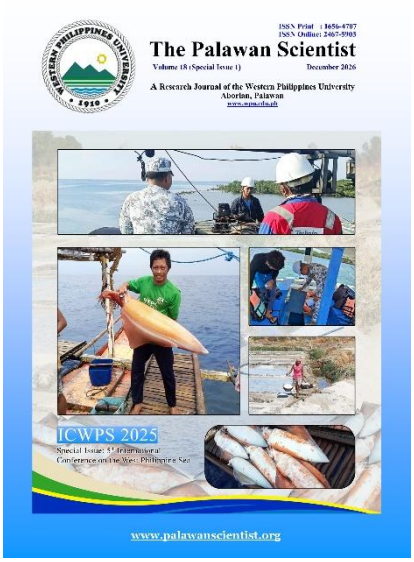

Health-related quality of life and marine-related health risks in coastal communities of Palawan, Philippines

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ABSTRACT

Coastal fishing communities depend on marine resources yet face significant occupational and environmental health risks. This study asssessed health-related quality of life (HRQoL) and self-reported accidents and health outcomes among adults in three coastal municipalities of Palawan, Philippines. A cross-sectional survey recruited 431 adults across 10 barangays, with 401 complete responses analyzed. The HRQoL was assessed using the Philippine Short Form-12 (SF-12), producing Physical Component Summary (PCS-12) and Mental Component Summary (MCS-12) scores. Fifteen self-reported health items were examined using exploratory factor analysis, identifying three domains: marine accidents, musculoskeletal complaints, and infections and skin diseases. Women had higher odds of reporting marine-related accidents compared than men (OR = 2.07; 95% CI: 1.87–2.54). More than half of respondents (56.9%, n = 228) had PCS-12 ≤50 (mean 48.3 ± 5.7), indicating poor physical health, while 26.4% (n = 106) scored MCS-12 ≤42 (mean 47.3 ± 8.3), suggesting possible mental health concerns. Musculoskeletal complaints were the most prevalent health outcome, affecting up to 71.1% of respondents, while those in the poorest marine-based income bracket had nearly twice the odds of reporting infections and skin diseases (OR = 1.87; 95% CI: 1.22–3.86). The HRQoL varied by study site, gender, age, and education, whereas ethnicity, religion, and coastal proximity were not significantly associated. These findings showed that women and low-income fishers face greater occupational and environmental health risks. Interventions should prioritize gender-responsive safety, ergonomic support, accessible healthcare, and stronger social protection. Further qualitative research is needed to clarify the pathways that drive these disparities.

Keywords: general well-being, marine exposure, musculoskeletal disorders, occupational health risk, small-scale fisheries

INTRODUCTION

Approximately 62% of the Philippine population depends directly or indirectly on marine resources for livelihood and sustenance, with small-scale fishing forming a cornerstone of both the economy and social identity in coastal communities (Wijayanti and Pratomo 2016; Canlas and Mula 2021). While fisheries contribute substantially to food security and local economies, fishers are increasingly

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recognized as a vulnerable occupational group with elevated health risks. Evidence from Norway shows that small-scale fishers report poorer self-rated health than non-fishing populations (Hjorthen et al. 2021). However, there is a notable lack of comparable empirical studies in the Global South, including Southeast Asian and Philippine coastal communities, leaving the health and well-being of these populations comparatively underexamined (Weeratunge et al. 2013; Miñarro et al. 2022).

In the Philippines, health is constitutionally recognized as a fundamental human right, yet barriers to accessing primary care remain, particularly among geographically isolated and underserved populations. These challenges may be compounded in coastal areas by geographic isolation, environmental hazards, livelihood insecurity, and socioeconomic marginalization (Dayrit et al. 2018; Kramer et al. 2019). Moreover, the combined pressures of climate change, declining fish stocks, and fluctuating fisheries productivity create unique vulnerabilities for coastal populations, highlighting the absence of systematic health assessments in these settings (White et al. 2020; Asthana and Gibson 2021). Self-reported health measures, including health-related quality of life (HRQoL), are strong predictors of healthcare utilization and long-term morbidity (Demakakos et al. 2008), making them particularly relevant for understanding the lived experiences of coastal populations in Asia (Fleming et al. 2021, 2023, 2024). These challenges are particularly relevant to universal health coverage (UHC), primary healthcare access, and health equity in geographically isolated and underserved communities. The Philippine Universal Health Care Act emphasizes equitable access to quality and affordable healthcare, accessible primary care, and a whole-of-government and whole-of-society approach to health policy and service delivery (Republic Act No. 11223 2019). In this context, evidence on HRQoL and marine-related health risks may contribute to evidence-informed planning for primary healthcare and occupational and environmental health protection in coastal communities. Given the interconnected nature of livelihood, environmental, and socioeconomic conditions in coastal settings, coordinated action across health, fisheries, environmental management, and social protection sectors may be needed to address health risks that extend beyond the health sector alone.

Environmental and social contexts shape health outcomes, well-being, behavior, and environmental stewardship, particularly through ecological and economic pressures such as overfishing, habitat degradation, and commercial fleet encroachment, which reduce fish stocks and heighten livelihood insecurity (MRAG Asia Pacific and Oceana 2022). Combined with weak social safety nets and persistent poverty, these stressors create multifactorial vulnerability, where physical labor, ecological uncertainty, and psychosocial strain converge to impact health and quality of life (Maliao et al. 2023; Obligar 2025). Socio-demographic factors–gender, age, education, income, ethnicity, and coastal proximity–further modulate vulnerability and resilience in coastal communities (Hjorthen et al. 2021).

To address these knowledge gaps, this study pursued three primary objectives: (1) to assess the HRQoL of coastal populations in Palawan, Philippines, using the culturally adapted Philippine Short Form-12 (SF-12) instrument; (2) to document the prevalence and nature of self-reported marine-related accidents and health outcomes; and (3) to identify socio-demographic factors associated with these health outcomes, thereby providing an evidence base for context-specific well-being and resilience strategies.

METHODS

Study Area

Palawan, southwestern Philippines, spans approximately 14,896 km^2 with a population density of ~58 persons/km^2, increasing to ~107 persons/km^2 in Puerto Princesa City. In 2021, the province had 431 registered health facilities, including hospitals, rural health units, infirmaries, and community health stations. This study focused on three coastal communities: Puerto Princesa City (central Palawan), Aborlan (69 km south), and Taytay (206 km north) (Figure 1).

Sample Population and Data Collection

This cross-sectional study was conducted under the GCRF-funded Blue Communities Project (University of Plymouth 2026). The survey received ethical approval from the National Ethics Committee of the Philippines (2-19-002-Creencia-Blue) and the University of Exeter Medical School Research Ethics Committee (May19/B/1985). A total of 431 respondents were recruited using convenience sampling from June to July 2019 across 10 barangays in Aborlan, Puerto Princesa City, and Taytay. Convenience sampling was used to recruit participants who were available and willing to participate within the selected study communities during the survey period. Data were collected through face-to-face interviews in Filipino or English using a tablet-based computer-assisted personal interviewing (CAPI) system.

Outcome Measures

Two primary outcomes were assessed. First, HRQoLwas measured using the Short Form-12 (SF-12) health survey, a validated instrument generating Physical Component Summary (PCS-12) and Mental

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Component Summary (MCS-12) scores on a 0–100 scale, with higher scores indicating better health (Ware et al. 1996; Burholt and Nash 2011). The validated Philippine version of SF-12 covers eight domains: physical functioning, role limitations due to physical health, bodily pain, general health, vitality, social functioning, role limitations due to emotional problems, and mental health (Resnick and Nahm 2001). PCS-12 ≤50 indicated potential physical limitations, and MCS-12 ≤42 suggested possible clinical depression. Scores were computed using Quality Metric Health Outcomes Scoring Software 2.

Second, self-reported accidents and health outcomes associated with marine exposure were assessed using 15 items with responses originally coded as "no," "yes, but did not consult health workers," and "yes, and consulted health workers." For analysis, the two affirmative categories were combined. Exploratory factor analysis identified three constructs: directly marine-related accidents, muscle aches, and infections and skin diseases (Kılıç 2020).

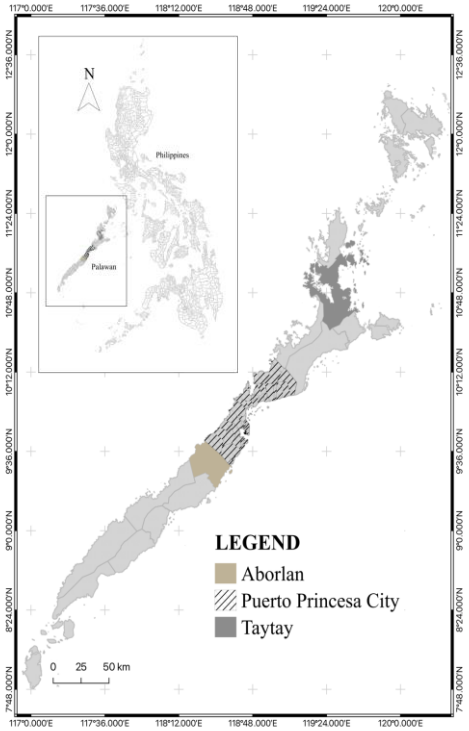

Figure 1. Map of the Philippines showing Palawan and the three case study sites of the Blue Communities Philippines project: Aborlan, Puerto Princesa City, and Taytay.

Data Analysis

Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize the socio-demographic characteristics. The PCS-12 and MCS-12 scores were computed using Quality Metric Health Outcomes Scoring Software 2. Multiple linear regression assessed associations between socio-demographic variables and PCS-12 and MCS-12 scores (Al-Shehri et al. 2008). All predictors were entered as categorical variables to facilitate comparisons across socio-demographic groups, consistent with the approach of Gupta et al. (2021) for capturing group-level differences rather than continuous dose–response effects. A stepwise backward elimination procedure improved model parsimony and interpretability. Analyses were conducted in R (v3.6.2) using the *lm* function, with supplementary group comparisons via Welch's t-tests (Lu and Yuan 2010) and one-way ANOVA (Mishra et al. 2019). Model diagnostics (residual normality, homoscedasticity, and multicollinearity checks) confirmed estimate robustness.

Logistic regression models were fitted to evaluate socio-demographic predictors of dichotomous self-reported health outcomes. This approach quantifies the likelihood of experiencing directly marine-related accidents, muscle aches, and infections and skin diseases across population subgroups, allowing for assessment of which factors increase vulnerability while controlling for other covariates. Predictor multicollinearity and residual patterns were examined before model interpretation. Model performance and discrimination ability were evaluated using receiver operating characteristic (ROC) curves and the area under the curve (AUC; Sarkar and Midi 2010). Analyses were again conducted in R (v3.6.2) using the *glm* function. Multiple linear regression models diagnostics supported assumptions of linearity, residual normality, and homoscedasticity for all regressions (Supplementary Material).

RESULTS

Characteristics of the Study Population

Of the 431 individuals interviewed across 10 communities in Palawan, 401 with complete data were analyzed (Table 1). The sample is predominantly female (60.1%) with a mean age of 44.97 ± 13.66 years. The ages were distributed as 40–49 (26.7%), 30–39 (23.2%), and 50–59 (20.0%). Education was mainly secondary (46.4%) or elementary (39.2%). Participants identified primarily as Visayans (42.1%), "Others" (37.7%), or Cuyonon (19.7%); 80.0% identified as Roman Catholic. The large proportion of households living below poverty threshold (63.6%) reflects the limited and often unstable livelihoods common in rural Palawan.

Health-Related Quality of Life

The mean PCS-12 was 48.3 ± 5.65 and the mean MCS-12 was 47.3 ± 8.26 (Table 2). Over half of respondents (56.9%, n = 228) had PCS-12 scores ≤ 50,

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and 26.4% (n = 106) had MCS-12 scores ≤ 42. Group comparisons revealed significant differences in mental health by gender and age and in physical health by study site and ethnicity, while most other socio-demographic variables were not significantly associated with HRQoL (Table 2, Figure 2). Women had lower mean MCS-12 scores than men (46.6 ± 7.98 vs. 48.4 ± 8.59, $P = 0.04$), and participants aged 60–90 scored lower than those aged 19–29 (44.3 ± 8.09 vs. 48.4 ± 8.06, $P = 0.03$). PCS-12 scores were lower in Puerto Princesa City (46.1 ± 5.97) than in Aborlan (49.6 ± 4.45) and Taytay (49.8 ± 5.18, $P < 0.01$). Scores were also lower among Visayans (47.4 ± 5.83) than among Cuyonon (49.4 ± 5.41) or "Others" (48.7 ± 5.51, $P = 0.02$).

In the final PCS-12 model (Table 3), study site was the strongest predictor: residents of Aborlan ($\beta_i = 3.55$, $t = 4.44$, $P < 0.001$) and Taytay ($\beta_i = 3.79$, $t = 6.08$, $P < 0.001$) reported higher PCS-12 scores than residents of Puerto Princesa City. Secondary education was marginally associated with higher PCS-12 scores compared with elementary education ($\beta_i = 1.17$, $t = 1.94$, $P = 0.05$). No other socio-demographic variables retained significance in the final PCS-12 model.

Table 1. Socio-demographic characteristics of adult participants from coastal communities involved in the Blue Communities Project in Palawan, Philippines, used to analyze health-related quality of life and marine-associated health outcomes.

Predictors	Aborlan (n = 72)	Puerto Princesa (n = 154)	Taytay (n = 175)	Total (N = 401)
	n (%)	n (%)	n (%)	n (%)
Gender				
Female	31 (43.06)	59 (38.31)	69 (39.43)	241 (60.10)
Male	41 (56.94)	95 (61.69)	105 (60.00)	159 (39.65)
Missing			1 (0.57)	1 (0.25)
Age Group				
Age 19-29	14 (19.44)	22 (14.29)	21 (12.00)	57 (14.21)
Age 30-39	16 (22.22)	42 (27.27)	35 (35.00)	93 (23.19)
Age 40-49	17 (23.61)	44 (28.57)	46 (26.29)	107 (26.68)
Age 50-59	16 (22.22)	30 (19.48)	34 (21.14)	80 (19.95)
Age 60-90	9 (12.50)	16 (10.39)	37 (21.14)	62 (15.46)
Missing			2 (1.4)	2 (0.50)
Education				
Elementary	9 (12.50)	61 (39.61)	60 (32.29)	157 (39.15)
Secondary	36 (50.00)	75 (48.70)	84 (48.00)	186 (46.36)
Tertiary	27 (37.50)	17 (11.04)	28 (16.00)	54 (13.47)
Missing		1 (0.65)	3 (1.71)	4 (1.00)
Marine-based Income				
Poor (< PHP 9,520)	55 (76.39)	87 (56.49)	113 (64.57)	255 (63.59)
Low Income (PHP 9,520-19,040)	14 (19.44)	52 (33.77)	37 (21.14)	103 (25.69)
Middle-Upper Income (> PHP 19,040)	2 (2.78)	9 (5.84)	14 (8.00)	25 (6.23)
Missing	1 (1.39)	6 (3.90)	11 (6.29)	18 (4.49)
Ethnicity				
Visayan	47 (65.28)	96 (62.34)	26 (14.86)	169 (42.14)
Cuyonon	2 (2.78)	6 (3.90)	71 (40.57)	79 (19.70)
Others	23 (31.94)	52 (33.77)	76 (43.43)	159 (37.66)
Missing			2 (1.14)	2 (0.50)
Religion				
Roman Catholic	46 (63.89)	130 (84.32)	143 (82.66)	319 (79.95)
Non-Roman Catholic	26 (36.11)	24 (15.58)	30 (17.14)	80(19.95)
Missing			2 (1.14)	2 (0.50)
Proximity to the Coast				
< 1 km	56 (77.78)	105 (68.18)	134 (76.57)	295 (73.57)
> 1 km	7 (9.72)	31 (20.13)	22 (12.57)	60 (14.96)
Missing	9 (12.50)	18 (11.69)	18 (10.86)	45 (11.47)
Cigarette Smoker				
No	42 (58.33)	85 (55.19)	114 (65.14)	241 (60.10)
Yes	30 (41.67)	69 (44.81)	61 (34.86)	160 (39.90)
Liquor Drinker				
No	29 (40.28)	58 (37.66)	77 (44.00)	164 (40.90)
Yes	43 (59.72)	96 (62.34)	98 (56.00)	237 (59.10)

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For mental health, gender and age were significant predictors in the final MCS-12 model. Women had lower MCS-12 scores than men (β_i = −2.06, t = −2.51, P < 0.05), and respondents aged 60–90 had lower mental health scores compared with the reference group aged 19–29 (β_l = −5.05, t = −3.14, P < 0.01). Other variables, including religion and proximity to the coast, were retained in the model but did not reach statistical significance. These results indicate that study site and education level were associated with physical health, whereas gender and older age were the primary predictors of mental health in this coastal population. The models explained a modest proportion of variance in HRQoL (*Adj.* R^2 = 0.10 for PCS-12, P < 0.001; *Adj.* R^2 = 0.04 for MCS-12, P < 0.001), indicating that substantial variation in physical and mental health remained unexplained by the socio-demographic variables included in the models.

Table 2. Health-related quality of life among adults in coastal communities of Palawan, Philippines, presenting the mean, standard deviation, and range of the physical component summary (PCS-12) and mental component summary (MCS-12) from the SF-12, disaggregated by socio-demographic characteristics. †Significant difference in means.

Predictors	Physical Composite Scale (PCS-12)				Mental Composite Scale (MCS-12)			
	n	**Mean ± SD**	**Min / Max**	***P*-value**	***n***	**Mean ± SD**	**Min / Max**	***P*-value**
Gender								
Male	158	48.4 ± 5.59	30.6 / 60.1	0.91	158	48.4 ± 8.59	28.0 / 67.7	**0.04**†
Female	234	48.3 ± 5.50	29.5 / 59.4		235	46.6 ± 7.98	29.1 / 66.5	
Age Group								
Age 19-29	53	47.9 ± 6.16	33.8 / 60.1	0.35	54	48.4 ± 8.06	33.8 / 64.4	**0.03**†
Age 30-39	93	48.1 ± 5.26	35.8 / 58.0		93	48.1 ± 8.34	28.0 / 65.6	
Age 40-49	104	49.3 ± 5.67	32.4 / 59.3		104	47.8 ± 8.37	32.3 / 67.7	
Age 50-59	79	47.9 ± 5.97	30.6 / 57.9		79	47.5 ± 8.05	29.0 / 66.5	
Age 60-90	61	47.7 ± 5.38	29.5 / 56.0		61	44.3 ± 8.09	29.1 / 66.2	
Study Site								
Puerto Princesa City	150	46.1 ± 5.97	29.5 / 58.5	**0.00**†	150	48.6 ± 8.04	30.4 / 66.5	**0.03**†
Aborlan	69	49.6 ± 4.45	40.4 / 59.3		69	47.3 ± 7.88	28.0 / 64.4	
Taytay	173	49.8 ± 5.18	30.6 / 60.1		174	46.2 ± 8.48	29.0 / 67.7	
Education								
Elementary	155	47.8 ± 5.81	29.5 / 59.3	0.09	155	46.9 ± 7.57	29.1 / 66.2	0.54
Secondary	180	48.9 ± 5.32	30.6 / 60.1		182	47.3 ± 8.77	28.0 / 67.7	
Tertiary	52	47.4 ± 6.30	33.2 / 57.6		52	48.4 ± 8.63	35.3 / 65.6	
Marine-based Income								
Poor (< PHP 9,520)	246	48.6 ± 5.52	29.5 / 59.4	0.23	245	47.6 ± 8.43	28.0 / 67.7	0.90
Low Income (PHP 9,520-19,040)	103	47.5 ± 6.02	33.0 / 60.1		103	47.2 ± 8.00	29.1 / 66.5	
Middle-Upper Income (> PHP 19,040)	25	48.2 ± 6.16	32.4 / 57.6		25	47.1 ± 8.87	29.0 / 63.1	
Ethnicity								
Visayan	164	47.4 ± 5.83	29.5 / 59.4	**0.02**†	154	47.7 ± 8.71	28.0 / 67.7	0.81
Cuyonon	77	49.4 ± 5.41	33.2 / 58.7		79	47.5 ± 8.45	29.0 / 66.2	
Others	149	48.7 ± 5.51	30.6 / 60.1		139	47.1 ± 7.84	29.1 / 66.5	
Religion								
Roman Catholic	310	48.4 ± 5.74	29.5 / 60.1	0.58	311	47.6 ± 8.32	28.0 / 67.7	0.17
Non-Roman Catholic	80	48.0 ± 5.41	33.0 / 58.3		80	46.2 ± 8.10	29.0 / 66.5	
Proximity to the Coast								
< 1 km	285	48.3 ± 5.81	29.5 / 60.1	0.38	288	47.2 ± 8.30	28.0 / 67.7	0.07
> 1 km	58	47.6 ± 5.66	32.4 / 56.5		58	49.4 ± 8.54	34.4 / 66.5	
Cigarette Smoker								
Yes	235	48.2 ± 5.93	32.4 / 58.7	0.73	235	46.8 ± 7.87	29.0 / 67.7	0.16
No	157	48.4 ± 5.22	29.5 / 60.1		158	48.1 ± 8.79	28.0 / 66.5	
Liquor Drinker								
Yes	230	48.5 ± 5.65	30.6 / 60.1	0.47	230	47.4 ± 7.93	28.0 / 65.6	0.85
No	162	48.1 ± 5.67	29.5 / 59.4		162	47.2 ± 8.74	29.1 / 67.7	

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Table 3. Summary of the physical component summary (PCS-12) and mental component summary (MCS-12) health models for adults in coastal communities in Palawan, Philippines. † Indicates the reference category. β_0, β_1, SE, and AIC denote y-intercept, regression coefficient, standard error, and the AIC as an unbiased estimator of predictive accuracy. †† Marks significant association ($P < 0.05$).

Predictors	β_i (β_0)	SE	*t*-value	*P*-value (variable)	Adj. R-squared	AIC	*P*-value (model)
PCS-12							
(Intercept)	(45.58)	0.57	79.65	**0.00**††			
Study Site [Puerto Princesa City†]							
Aborlan	3.55	0.80	4.44	**0.00**††			
Taytay	3.79	0.62	6.08	**0.00**††	0.10	1569.78	**0.00**††
Education [Elementary†]							
Secondary	1.17	0.61	1.94	**0.05**††			
Tertiary	-0.98	0.90	-1.10	0.27			
MCS-12							
(Intercept)	(52.19)	1.68	31.10	**0.00**††			
Gender [Male†]							
Female	-2.06	1.43	-0.33	**0.02**††			
Age Group [Age 19-29†]							
Age 30-39	-0.63	1.43	-0.44	0.66			
Age 40-49	-1.38	1.41	-0.98	0.33			
Age 50-59	-1.28	1.49	-0.86	0.39	0.04	1260.17	**0.00**††
Age 60-90	-5.05	1.67	-3.14	**0.00**††			
Religion [Roman Catholic†]							
Non-Roman Catholic	-1.55	1.05	-1.47	0.14			
Proximity to the Coast [> 1 km†]							
< 1 km	1.99	1.19	-1.67	0.10			

Self-Reported Accidents and Health Outcomes

Exploratory factor analysis of self-reported health items revealed three distinct domains: directly marine-related accidents, muscle aches, and infections and skin diseases. The factor structure demonstrated strong reliability, with Cronbach's α ranging from 0.844 to 0.949, and correlations between factors ranging from $r = 0.293$ to $r = 0.830$. Sampling adequacy was excellent (KMO = 0.92), and Bartlett's test was significant, indicating that the correlation matrix was suitable for factor analysis ($\chi^2 = 14{,}068.2$, $P < 0.05$).

Descriptive statistics indicated that directly marine-related accidents were generally rare among participants (mean ± standard deviation = 1.12 ± 0.35; Table 4). When accidents did occur, 22.7% of respondents reported cuts or stings, 2.5% with no parasitic infections, 8.0% experienced near-drowning events, 11.5% disclosed diving-related problems, and 16.0% experienced sunburn or sunstroke. Muscle aches (1.46 ± 0.59) were more commonly reported, with 49.6% reporting fever or headache, 71.1% experiencing leg cramps, and 49.6% with other body pains. Infections and skin diseases (1.28 ± 0.56) affected 24.7–53.4% of respondents, with vomiting, diarrhea, or stomach ache reported by 24.7%, ear problems by 7.2%, eye problems by 18.4%, new skin issues by 11.5%, urinary tract infections by 27.4%, and breathing difficulties by 7.5%.

Binary logistic regression identified socio-demographic predictors of self-reported accidents and health outcomes. Women had higher odds of marine-related accidents than men (OR = 2.07; 95% CI: 1.87–2.54; Table 5). Respondents in the lowest income group (poor marine-based) were more likely to report infections and skin diseases than those in the low or middle–upper income groups (OR = 1.87; 95% CI: 1.22–3.86). No significant associations were found for age, education, ethnicity, religion, coastal proximity, smoking, or alcohol use. Model performance was strong for marine-related accidents and infections and skin diseases (93% accuracy for both), while the muscle aches model showed moderate accuracy (65%) (Figure 3). Accuracy was calculated at the ROC-derived optimal probability cutoff, with AUC values indicating overall model discrimination.

DISCUSSION

Characteristics of the Study Population

The study sample consisted predominantly of middle-aged coastal residents with low income and limited educational attainment, characteristics that are recognized as socioeconomic factors increasing vulnerability to occupational and environmental health risks in Philippine fishing communities (De Guzman et al. 2021; Labayo and Preña 2021). The high proportion of households living below the poverty

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threshold also indicates limited economic capacity among the study population. With incomes below PHP 9,520/month, households may face constraints in meeting food and other basic needs, potentially affecting the quantity, diversity, and types of foods they can afford. Although dietary intake was not directly assessed in the present study, these economic constraints provide important context for understanding the broader socioeconomic vulnerability of coastal households.

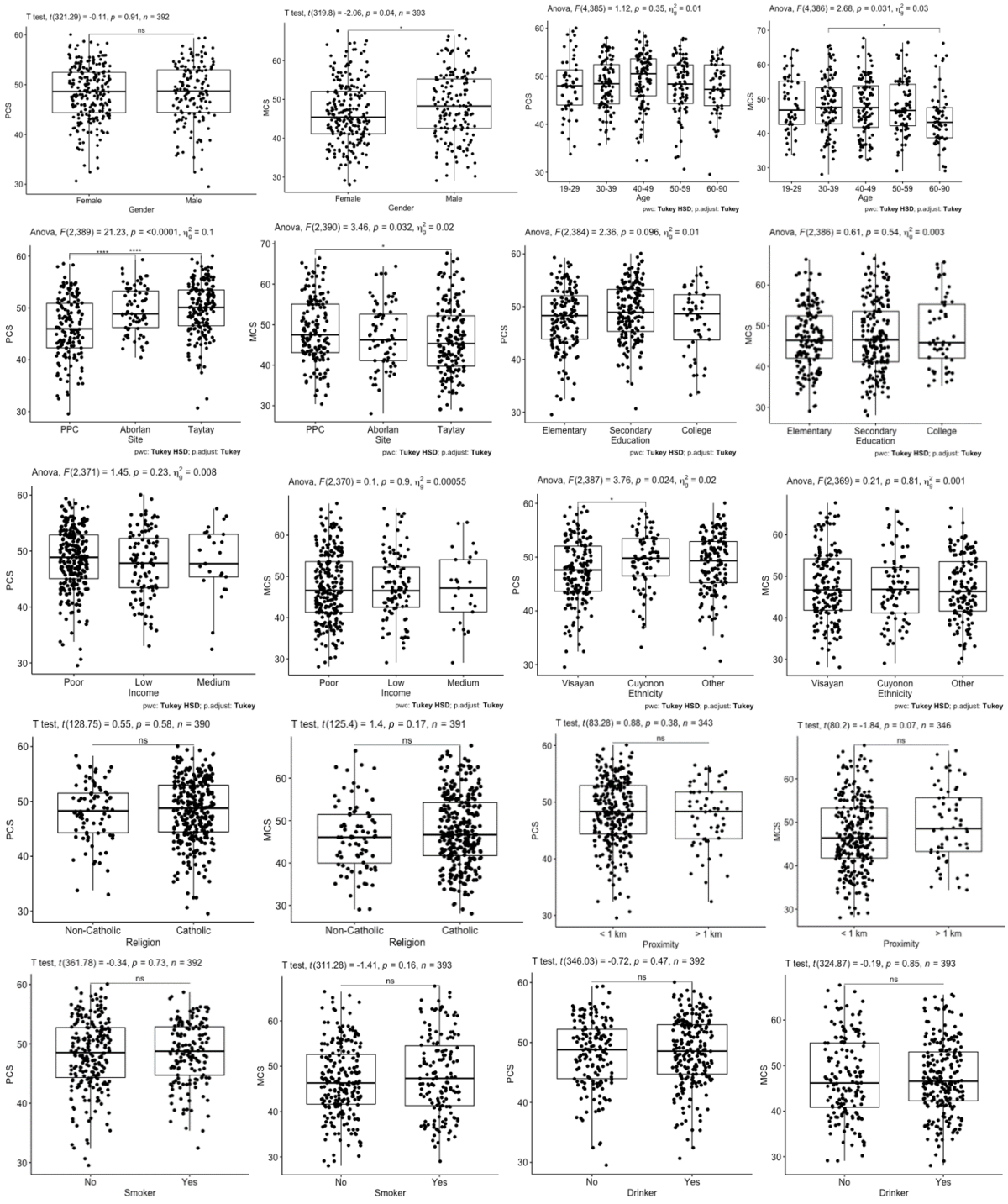

Figure 2. Distribution of the sampled data and statistical tests of mean differences in physical component summary (PCS-12) and mental component summary (MCS-12) scores across socio-demographic groups among adults in coastal communities in Palawan, Philippines.

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Table 4. Descriptive statistics for Section 4, Question 5 of the Blue Communities Project survey, summarizing marine-related health risks among adults in coastal communities of Palawan, Philippines.

Marine environment and health and well-being	Mean ± Standard Deviation	Response frequencies (Valid %) (*N* = 401)			
		No	Yes – but did not talk to health worker	Yes + talked to health worker	Don't know/Prefer not to answer
Directly marine-related accidents	**1.12 ± 0.35**				
Got cut/stung/bitten by something in/by the water	1.28 ± 0.53	295 (73.57)	91 (22.69)	12 (2.99)	3 (0.75)
Picked up a parasite from the sand/water	1.01 ± 0.19	386 (96.26)	10 (2.49)		5 (1.25)
Got into difficulties in water/came close to drowning	1.07 ± 0.30	369 (92.02)	27 (6.73)	2 (0.50)	3 (0.75)
Had diving-related problems (e.g., decompression sickness/the bends	1.10 ± 0.37	355 (88.53)	37 (9.23)	4 (1.0)	5 (1.25)
Got sunburn/sunstroke at the sea/on the beach	1.15 ± 0.38	337 (84.04)	60 (14.96)	1 (0.75)	3 (0.75)
Muscle aches	**1.46 ± 0.59**				
Had fever/headache	1.58 ± 0.66	199 (49.63)	163 (40.65)	36 (8.98)	3 (0.75)
Had cramps in legs or other areas	1.26 ± 0.51	285 (71.07)	103 (25.69)	5 (1.25)	8 (2.00)
Other muscular/body pains	1.53 ± 0.59	199 (49.63)	182 (45.39)	17 (4.24)	3 (0.75)
Infections and Skin diseases	**1.28 ± 0.56**				
Vomiting, diarrhoea, or stomach ache	1.41 ± 0.66	263 (65.59)	99 (24.69)	35 (8.73)	4 (1.00)
Had earache or discharge from ears	1.12 ± 0.42	357 (89.03)	29 (7.23)	11 (2.74)	4 (1.00)
Had red, painful eyes or discharge from eyes	1.22 ± 0.49	313 (78.05)	74 (18.45)	10 (2.49)	4 (1.00)
Had a new skin problem (e.g., itchy/allergic reaction)	1.18 ± 0.50	335 (83.54)	46 (11.47)	16 (3.99)	4 (1.00)
Had a urinary tract infection	1.61 ± 0.79	214 (53.37)	110 (27.43)	70 (17.46)	7 (1.75)
Had breathing difficulties/infection	1.16 ± 0.51	345 (86.03)	30 (7.48)	20 (4.99)	6 (1.50)

Table 5. Binary logit models (exponentiated odds ratios, OR, 95% CI) for socio-demographics, directly marine-related accidents, muscle aches, and infections and skin diseases, summarizing marine-related health risks among adults in coastal communities of Palawan, Philippines. † Indicates the reference category. †† Marks variables whose odds-ratio confidence intervals exclude 1.0, indicating statistical significance ($P < 0.05$).

Predictors	Directly marine-related accidents	Muscle aches	Infections and Skin diseases
	OR (CI)	OR (CI)	OR (CI)
(Intercept)	**2.09 (1.22, 2.52)**†	2.52 (0.41, 4.65)	**1.89 (1.33, 2.76)**†
Gender			
Male†			
Female	**2.07 (1.87, 2.54)**††	1.39 (0.39, 2.76)	1.32 (0.42, 3.54)
Age Group			
Age 19-29†			
Age 30-39	1.32 (0.89, 2.87)	1.31 (0.98, 2.76)	0.86 (0.02, 1.91)
Age 40-49	0.75 (0.01, 1.69)	1.38 (0.61, 2.95)	0.94 (0.21, 2.53)
Age 50-59	0.52 (0.04, 1.97)	0.62 (0.03, 2.45)	0.20 (0.05, 1.75)
Age 60-90	1.63 (0.98, 3.92)	1.41 (0.87, 2.75)	1.32 (0.53, 3.26)
Study Site			
Puerto Princesa City†			
Aborlan	0.94 (0.04, 1.76)	1.65 (0.24, 2.74)	1.45 (0.53, 4.69)
Taytay	1.72 (0.45, 2.64)	0.30 (0.02, 2.11)	1.69 (0.73, 3.21)
Education			
Elementary†			
Secondary	1.87 (0.58, 2.79)	0.64 (0.09, 1.96)	0.42 (0.11, 2.63)
Tertiary	1.73 (0.49, 2.87)	0.53 (0.20, 1.93)	1.43 (0.85, 4.87)
Marine-based Income			
Poor (< PHP 9,520)	2.97 (0.35, 3.74)	0.87 (0.21, 3.75)	**1.87 (1.22, 3.86)**††

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Predictors	Directly marine-related accidents	Muscle aches	Infections and Skin diseases
	OR (CI)	**OR (CI)**	**OR (CI)**
Low Income (PHP 9,520-19,040) †			
Middle-Upper Income (> PHP 19,040)	1.52 (0.76, 6.89)	2.87 (0.69, 3.87)	3.52 (0.75, 5.57)
Ethnicity			
Visayan	1.75 (0.65, 2.91)	1.72 (0.54, 2.86)	1.51 (0.61, 3.75)
Cuyonon	2.55 (0.85, 5.84)	2.91 (0.53, 3.87)	1.54 (0.54, 4.82)
Others†			
Religion			
Roman Catholic†			
Non-Roman Catholic	1.66 (0.74, 4.29)	2.86 (0.31, 5.47)	2.82 (0.50, 4.84)
Proximity to the Coast			
> 1 km†			
< 1 km	2.84 (0.74, 5.95)	1.72 (0.54, 2.48)	1.98 (0.54, 3.81)
Cigarette Smoker			
No	1.64 (0.75, 3.91)	0.98 (0.02, 2.53)	1.51 (0.92, 4.61)
Yes†			
Liquor Drinker			
No	2.29 (0.41, 4.46)	1.21 (0.74, 2.64)	1.84 (0.65, 4.76)
Yes†			
Null deviance (DF)	261.45 (400)	377.57 (400)	206.66 (400)
Akaike Information Criterion	267.34	401.30	254.21
N	401	401	401

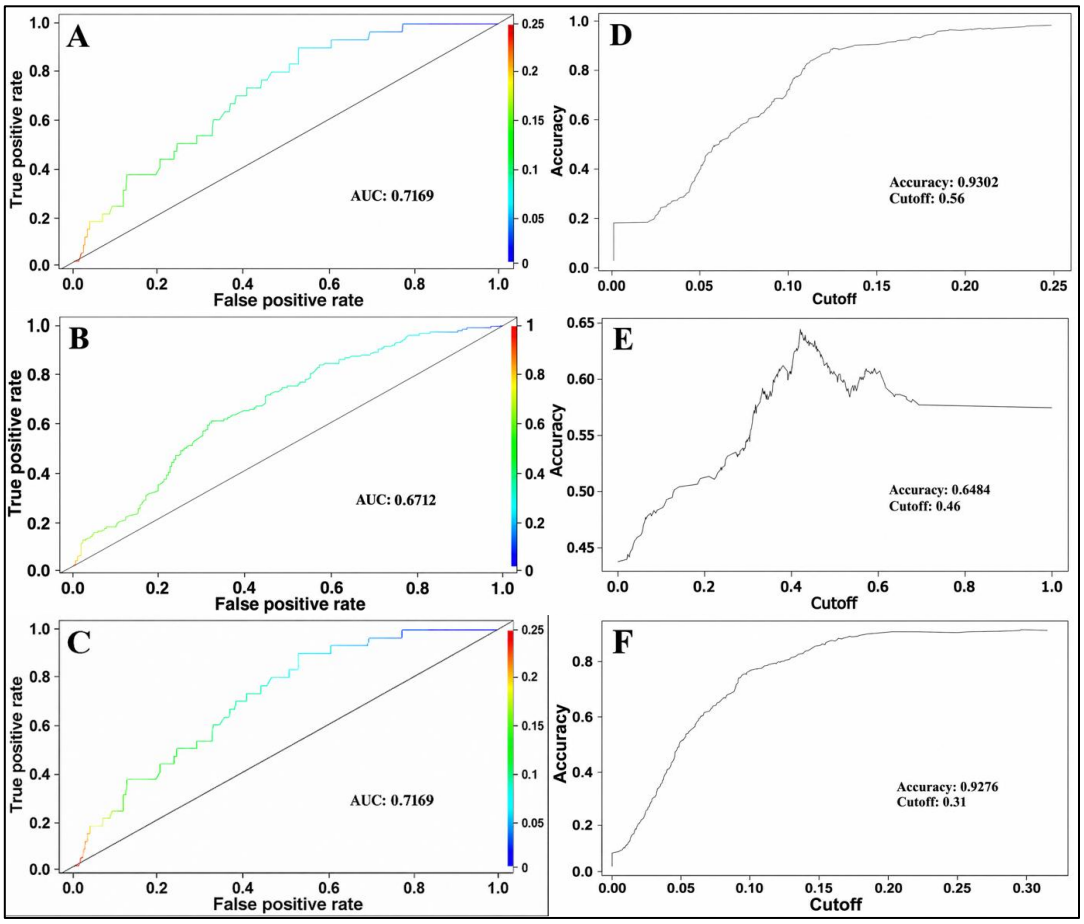

Figure 3. Plot of area under the receiver operating characteristic (ROC) curve (AUC) as a measure of classifier performance for the three binary logit models: (A) directly marine-related diseases; (B) muscle aches; and (C) infections and skin diseases. Optimal Cutoff values plotted against the accuracy of the three models: (D) directly marine-related diseases; (E) muscle aches; and (F) infections and skin diseases.

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Structural factors such as persistent poverty, constrained healthcare access, and environmental exposures may contribute to HRQoL and vulnerability to occupational hazards, although in the present study, self-reported accidents and health outcomes were largely unrelated to most socio-demographic factors except for gender and low income (for infections and skin diseases). Similar associations between income instability and reduced psychosocial well-being have been reported in artisanal fishing communities in Aklan during the COVID-19 pandemic (Maliao et al. 2023), highlighting the potential role of structural determinants in shaping health outcomes even when not detected in cross-sectional self-reports.

One of the clearest findings is the lower physical health status of respondents in Puerto Princesa City compared with those in Aborlan and Taytay. Mean PCS-12 scores were 46.1 in Puerto Princesa, compared with 49.6 in Aborlan and 49.8 in Taytay, and study site remained the strongest predictor in the final PCS-12 model. This pattern suggests that differences in the local context of the three study sites may be relevant to physical health. Puerto Princesa represents the more urban setting among the three study sites, whereas Aborlan and Taytay are comparatively less urbanized coastal settings. Such differences may shape the types and intensity of livelihood activities, daily mobility, occupational demands, and environmental exposures experienced by coastal residents. The lower PCS-12 scores in Puerto Princesa may therefore reflect the combined influence of coastal livelihood demands and the pressures associated with an urban coastal environment. However, occupation type, workload, commuting, environmental exposure, and access to preventive health services were not directly measured in this study; these mechanisms therefore remain plausible explanations rather than demonstrated causes of the observed site difference.

Gender and age-related livelihood roles shape health risks in coastal fishing communities. Women, often described as "invisible producers of fishing sector," are typically engaged in gleaning, processing, and household labor, which increases their exposure to waterborne hazards and occupational risks due to prolonged contact with marine environments, manual handling of seafood, and limited access to protective equipment or healthcare (Rubin 2021). Older adults showed reduced physical and mental health, reflecting cumulative vulnerability from aging, repeated environmental hazards, the physical demands of fishing, and heightened climate-risk perceptions (Alcantara et al. 2023). These patterns mirror global evidence that older populations in coastal and small-island settings experience disproportionate health risks due to climate variability, extreme events, and fragile health systems (Balikuddembe et al. 2024; Prina et al. 2024), further exacerbated by repetitive manual labor and limited occupational safety and health measures (Agyekum et al. 2025).

Health-Related Quality of Life and Marine-Related Health Risks

The present findings indicate that health risks in the Palawan coastal communities are multidimensional, encompassing marine accidents, musculoskeletal complaints, and infections and skin conditions. These patterns are consistent with the broader understanding that coastal fishing communities experience overlapping occupational, environmental, socio-economic, and socio-cultural pressures (King et al. 2015; Rezaee et al. 2016). Physical strain arises from repetitive, labor-intensive tasks such as hauling nets, boat maintenance, and heavy lifting, leading to cumulative musculoskeletal stress and chronic pain (Laraqui et al. 2024). Limited occupational safety measures in the Philippines exacerbate these risks (Sibulan and Reyes 2023; Cadiz et al. 2024), while constrained healthcare access in coastal areas prolongs recovery from injuries and increases long-term disability (Iqbal 2019; Dahlui et al. 2020). In the present study, musculoskeletal complaints were the most frequently reported health concern, particularly leg cramps and other body pains. Musculoskeletal disorders are similarly common among fishers elsewhere, where repetitive labor, heavy lifting, and awkward postures are recognized contributors (Nørgaard Remmen et al. 2020). While this quantitative approach captures prevalence and clustering, future research employing qualitative methods is warranted to explore why certain groups experience specific risks, the context of exposure, and the mechanisms linking occupational activities to physical and mental health outcomes.

Mental health also varied across demographic groups in the present study. Women had lower MCS-12 scores than men, while respondents aged 60–90 years had lower scores than those aged 19–29 years. These differences may reflect the combined demands associated with livelihood and household responsibilities among women and the cumulative effects of aging among older coastal residents. Women in fishing communities may experience a dual burden of physically demanding livelihood activities and household responsibilities, which can amplify psychosocial stress and restrict opportunities for recovery (Rodríguez-Romero et al. 2013). Aging may similarly increase vulnerability through the cumulative effects of prolonged labor, environmental exposure, and potential social isolation (Noto 2023). High-dependence fisheries can expose households to additional stressors, including resource competition, seasonal variability, and socioeconomic pressures, which have been associated with anxiety and depression in artisanal fishing populations (Rodrigues et al. 2004; Bastos and Petrere 2010).

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The present findings highlight that occupational health risks in small-scale fisheries are multidimensional, encompassing marine accidents, musculoskeletal complaints, and infections and skin conditions (Alayyannur et al. 2023). Although marine-related accidents were relatively uncommon, women had more than twice the odds of reporting these accidents compared with men (OR = 2.07; 95% CI: 1.87–2.54), reflecting possible gendered differences in exposure to ergonomic, chemical, and biological hazards inherent to coastal livelihoods (Halder et al. 2024). Musculoskeletal complaints appear to result from cumulative microtrauma and repetitive labor, with minimal variation across socio-demographic groups, suggesting that these burdens are pervasive and warrant universal ergonomic and workload interventions. Infections and skin conditions were concentrated among lower-income participants, emphasizing the interaction between socioeconomic disadvantage and occupational/environmental exposures, including prolonged wet conditions, saltwater contact, and UV exposure (Alayyannur et al. 2023; Halder et al. 2024). Other socio-demographic factors, such as age, education, and coastal proximity, were not predictive, reinforcing that gender and income are the principal determinants of vulnerability (Guillot-Wright et al. 2025).

These findings have practical implications for coastal public health in Palawan. The observed differences in HRQoL across study sites, lower mental health scores among women and older adults, higher odds of marine-related accidents among women, and greater odds of infections and skin diseases among participants in the poorest marine-based income group suggest the need for targeted rather than uniform health interventions. Community-based occupational health initiatives could incorporate gender-responsive safety measures, ergonomic support, health education, early recognition of musculoskeletal and skin conditions, and accessible referral pathways to primary healthcare services (WHO 2011, 2017, 2019). Such approaches are particularly relevant in geographically isolated and disadvantaged communities in the Philippines, where differences in health-worker availability, workload, geographic access, and local health-system capacity can affect the delivery of primary care (Parial et al. 2024). Philippine evidence from marine-based livelihoods also demonstrates the importance of recognizing occupational health hazards and developing context-specific measures to reduce work-related health risks (Dumilag et al. 2024).

Addressing these health concerns will require coordination between local governments, primary healthcare providers, fisheries and environmental agencies, and the communities themselves. Evidence from geographically isolated and disadvantaged communities in the Philippines suggests that local health-system needs vary by context and require coordination among the Department of Health, local government units, and health facilities (Parial et al. 2024). For coastal communities, this could include linking occupational health activities with primary healthcare, environmental health measures, and social protection, particularly where health risks are closely tied to livelihood conditions.

This study is constrained by its relatively small sample, use of non-local SF-12 scoring norms, and reliance on self-reported data that may reflect cultural or situational bias. The reliance on self-reported accidents and health outcomes may have introduced recall and reporting bias, particularly for previous marine-related incidents and health conditions. In addition, the use of convenience sampling may have introduced selection bias because participation depended on respondents' availability and willingness to participate, which may limit the generalizability of the findings beyond the study communities. Its cross-sectional design also limits causal interpretation. Despite these constraints, the findings provide an initial empirical baseline for understanding HRQoL, musculoskeletal complaints, and infection risks in coastal Palawan fishing communities.

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GENERATIVE AI STATEMENT

Generative AI (Grammarly) was used only for minor language editing. All ideas, analyses, and interpretations are the authors' own.

ETHICAL CONSIDERATIONS

Approved by the Philippine National Ethics Committee (2-19-002-Creencia-Blue) and the University of Exeter Medical School Ethics Committee (May19/B/1985).

DECLARATION OF COMPETING INTEREST

The authors declare no competing interests.

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ROLE OF AUTHORS: ***CBC*** *- led conceptualization, data curation, analysis, and manuscript writing;* ***KMLAC*** *- supervised analyses and revisions;* ***LEF*** *- supervised analyses and revisions;* ***LAC*** *- secured funding.*

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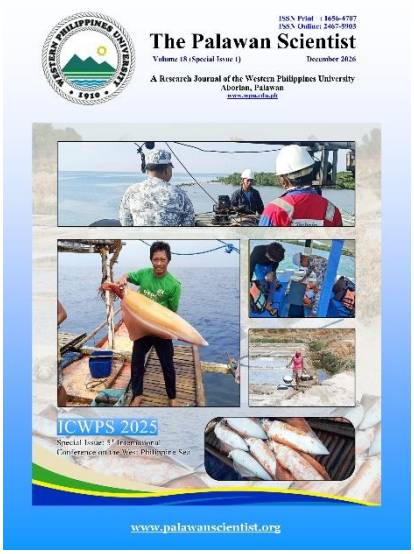

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First record of Keeltail pomfret *Taractes rubescens* (Jordan & Evermann, 1887) in Palawan, Philippines

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ABSTRACT

Palawan is widely recognized for its shallow-water fish biodiversity, however, the diversity of deep-sea species remains poorly documented. This paper documents the first verified record of the Keeltail pomfret *Taractes rubescens* (Jordan & Evermann, 1887) in Palawan waters. One specimen displayed for sale was purchased on 27 April 2024 at the Puerto Princesa City New Market. According to the fish vendor, the fish was caught off the city's eastern coastline. It weighed around 3.0 kg and measured 610 mm in total length. Other measurements included a standard length of 475 mm, a fork length of 530 mm, and a body depth of 175 mm. Additional key measurements included a 290 mm distance from snout to anal fin, a 145 mm head length, and a 175 mm pectoral fin length. Meristic features recorded include 29 dorsal fin rays, 20 anal fin rays, 42 lateral line scales, and a gill raker count of 4 + 12 gill rakers (upper limb + lower limb) on the left arch compared 3 + 14 gill rakers on the right arch. This new record adds to the growing list of deep-sea species found in the region and highlights the valuable role of local fish markets in uncovering and documenting marine biodiversity, particularly for species from less-explored deep-sea habitats.

Keywords: aquatic biodiversity, Bramidae, deep sea fish, ichthyofauna, morpho-meristic analysis

Palawan is globally known for its rich fish biodiversity, particularly within shallow waters and reef ecosystems (Balisco et al. 2023). However, deep-sea fish species are poorly documented. Here, the first verified record of the Keeltail pomfret *Taractes rubescens* is reported (Jordan & Evermann, 1887) in Palawan waters, highlighting its significance as part of the region's deep-sea biodiversity. One specimen displayed for sale (Figure 1) was purchased from a fish vendor on 27 April 2024, at the Puerto Princesa City New Market (9°46'59"N, 118°44'41"E), Palawan, who indicated that the fish was caught off the eastern coastline of the city, specifically in the West Sulu Sea. Morphometric and meristic analyses were conducted to document the species' key features, following Lee et al. (2019).

Meristic counts and morphometric measurements (Table 1) were taken. The specimen measured 610 mm in total length, shorter than the reported maximum length of 890 mm, but twice the size of the commonly reported length of 300 mm (Froese and Pauly 2026). The specimen had 4 + 12

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(upper and lower) gill rakers on the left side (Figure 2A) and 3 + 14 on the right side (Figure 2B), including the rudimentary rakers, which aligns closely to the report of Koeda and Ho (2020). This also represents the second Philippine record of the species, following its first documentation from Panay Island (Hata et al. 2016; Motomura et al. 2017). This finding constitutes the second pomfret species recorded from Palawan; the first being Sickle Pomfret *Taractichthys steindachneri* (Döderlein, 1883), previously documented from the same fish market (Dolorosa et al. 2025). However, *T. rubescens* appears to be uncommon in local fish markets and social media reports compared to *T. steindachneri*. Ichthyofaunal surveys of local markets are essential to further expand the biodiversity records of the province (Huang and Balisco 2025).

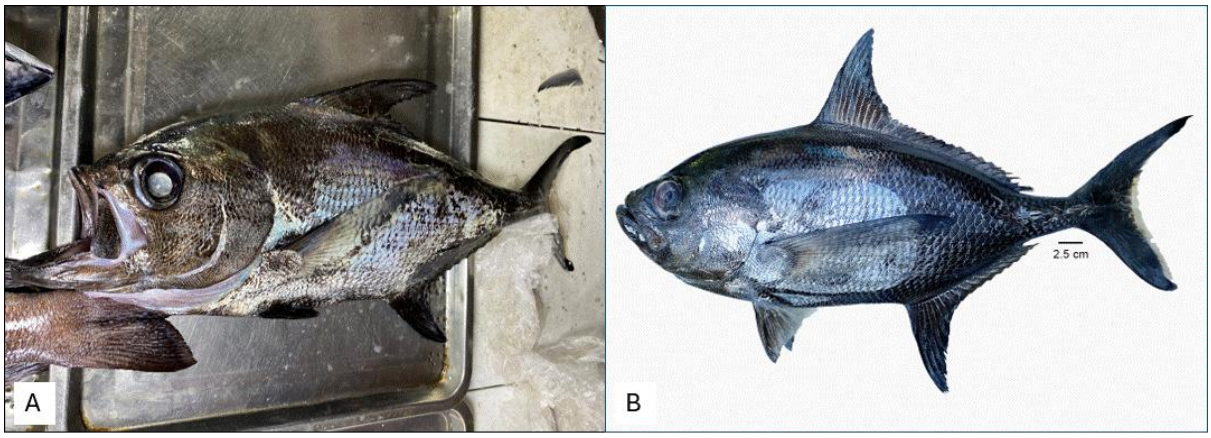

Figure 1. Photo of the Keeltail pomfret *Taractes rubescens* (Jordan & Evermann, 1887) displayed for sale at Puerto Princesa City New Market (A); and polished photo of the same specimen (B).

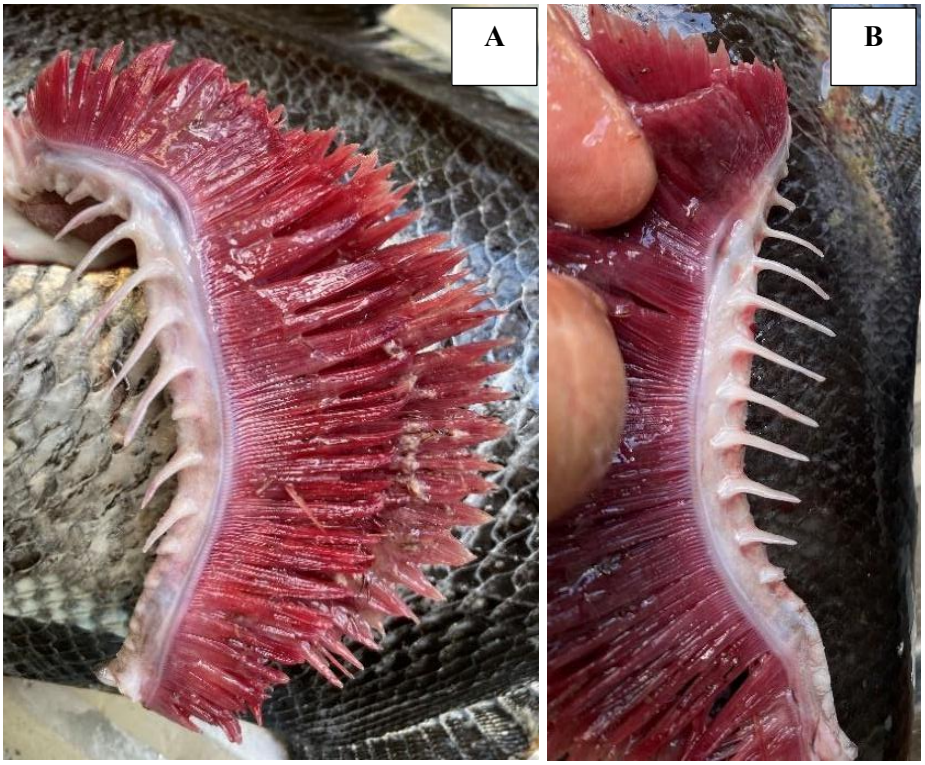

Figure 2. The gills rakers of Keeltail pomfret *Taractes rubescens* (Jordan & Evermann, 1887) purchased at Puerto Princesa City New Market: A. Left gill arch (A); and, Right gill (B).

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Table 1. Comparison of morphological characters of *Taractes rubescens* (Jordan & Evermann, 1887) from different regions.

Morphological character	**Jordan & Evermann (1887)**	**Mead (1972)**	**Yoshida (1973)**	**Roul et al. (2018)**	**Lee et al. (2019)**	**Hata et al. (2016)**	**Present study**
Locality	**Gulf of Mexico (holotype)**	**Gulf of Mexico and West Pacific**	**Hawaii**	**Arabian Sea**	**Korea**	**Panay Island, Phil.**	**Palawan, Phil.**
Number of specimens	1	2	2	4	2		1
Standard length (SL, mm)	96	620–690	660–663	701–722	302–448	389.8	475
Meristic counts							
Dorsal fin rays	30	30–32	30	28–30	30	31	29
Anal fin rays	21	21–23	20	20–21	21–22	21	20
Pectoral fin rays	20	19–22	20–21	20–21	19–20	19	18
Lateral-line scales	-	41	45–47	45–46	42–43	13-16	42
Gill rakers	13	9–12	10	10	9-10	11	16-17
In % SL							
Pectoral length	-	-	42.7–43.4	36.9–37.0	-	33.2	36.8
Pelvic length	-	-	15.2	12.3–12.5	-	35.1	-
Snout to dorsal fin	41.8	38.8–41.6	38.6–39.5	37.1–37.5	38.9–41.5	41.0	35.8
Snout to pectoral fin	36.7	31.4–34.1	31.7–32.6	31.1–31.9	30.6–31.7	33.2	30.5
Snout to pelvic fin	37.8	35.2–39.1	-	30.0–30.7	32.9–34.6	35.1	33.7
Snout to anal fin	66.9	61.3–63	60.5–62.7	60.4–61.1	58.0–62.1	62.9	61.1
Length of dorsal fin base	45.5	44.6–47.8	-	-	46.8–47.4	48.1	45.3
Head length	17.8	30.2–30.8	31.8–32.3	32.9–33.2	29.4–31.2	33.1	30.5
Eye diameter, horizontal	12.3	5.5–6.8	6.4–6.6	5.9–6.1	5.5–6.9	7.1	6.3
Upper caudal fin length	-	31.2	-	-	22.3–29.3	33.7	37.9
Lower caudal fin length	-	26.1	-	-	21.8–24.1	30.2	29.5

Like other pomfret species, *T. rubescens* is a highly migratory, circumglobal species widely distributed in the tropical and subtropical waters (Masuda et al. 1984; Fricke et al. 2026). It is a marine, benthopelagic species occurring at depths of up to 600 m. Although this represents only the second confirmed record of the species in the Philippines, *T. rubescens* may also occur in other parts of the country, considering that eight pomfret species are currently recorded from Philippines and there is an emerging small-scale fishery for pomfrets nationwide (Dolorosa et al. 2025). Securing of specimen for museum display is suggested.

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GENERATIVE AI STATEMENT

The authors declare that this manuscript was prepared without the use of artificial intelligence (AI) tools at any stage of the research or writing process.

ETHICAL CONSIDERATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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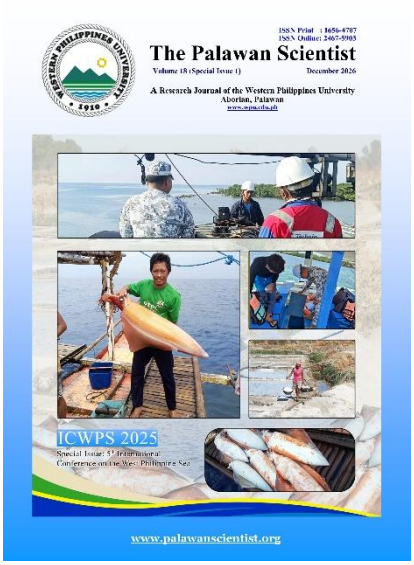

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Baseline characterization of salt-making practices and constraints in selected Philippine coastal provinces

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ABSTRACT

The Philippine salt industry supports coastal livelihoods but has declined amid import dependence, climate-sensitive production, limited modernization, and fragmented support. This descriptive cross-sectional study characterized salt-making practices, producer profiles, post-harvest practices, and reported constraints in selected major salt-producing provinces. Data were gathered from 590 salt producers, owners, operators, caretakers, and workers across Regions I, III, IV-B, VI, and X using a structured, pretested survey, field observations, and site documentation during the early and peak production periods. Data were analyzed using descriptive statistics, frequency distributions, percentages, and province- and region-based cross-tabulations. Most respondents were male (69.5%), married (80.8%), aged 46 years or older (68.8%), and had more than 20 years of salt-making experience (58.1%), indicating a sector largely sustained by experienced, middle-aged and older producers. Salt production was dominated by solar evaporation systems, including conventional crystallization beds and those with high-density polyethylene (HDPE) lined crystallization beds (78.81%), while cooking-based production accounted for 21.19% and was concentrated in the Ilocos provinces. Post-harvest practices showed limited upgrading: sacks were the dominant packaging material (93%), 72% of respondents reported that their products had no farm-level packaging labels, and 35% had no storage facility. The most frequently reported primary production constraint was climate- and weather-related risks (63.39%), while the leading marketing constraint was limited access to large-scale distribution channels (47.97%). The findings provide baseline evidence to inform targeted interventions in climate-resilient infrastructure, improved storage, appropriate technology transfer, traceability, tenure support, and market linkages to promote a more sustainable and resilient Philippine salt industry.

Keywords: coastal livelihoods, Philippine salt industry, production constraints, salt-making practices, solar evaporation

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INTRODUCTION

Salt is an essential commodity used in households, food processing, water treatment, animal feeds, chemical industries, and various agro-industrial applications (EuSalt 2025). Globally, salt production systems differ based on climate, geomorphology, brine sources, energy access, and production technology. Solar evaporation is common in dry coastal and inland areas, while boiling or cooking methods are used where climatic conditions, cultural practices, or small production scales make direct solar crystallization less feasible (Patel 2024; Salt Industry Center of Japan 2026).

In the Philippines, salt production has historically relied on coastal solar evaporation, particularly in areas with dry-seasons, such as Pangasinan and Occidental Mindoro, while cooking-based and artisanal methods persist in some localities. Recent studies have documented production systems, value-chain issues, profitability, and demographic patterns in selected salt-producing areas (Tan et al. 2022; Banicod et al. 2024; Barba and Delos Reyes 2024; Montojo et al. 2024). These studies consistently point to declining production, an aging producer population, low technology adoption, limited market integration, and vulnerability to weather variability. Trade data likewise reflect sustained import dependence for salt and related sodium chloride products (Observatory of Economic Complexity 2024).

Despite renewed national attention under the Philippine Salt Industry Development Act of 2024 (Republic Act No. 11985 2024), important knowledge gaps remain. Comparative baseline documentation linking producer characteristics, production systems, post-harvest practices, and reported constraints across selected salt-producing provinces remains limited, particularly documentation using a common survey instrument and field observation protocol. This gap is important because developing interventions for the salt industry requires location-specific baseline evidence. Such evidence provides information about the people engage in salt production, the method they use, and the operational and market constraints they encounter at the production level.

This study is therefore framed as a baseline characterization and documentation study rather than a direct assessment of empowerment outcomes or industry development impacts. It does not assess household income effects, market value, or intervention effectiveness. Instead, it generates descriptive evidence that can inform subsequent socioeconomic, technological, and policy studies and guide the prioritization of industry support initiatives.

The study links the production context, producer profile, salt-making systems, post-harvest practices, and reported constraints to potential intervention areas. It is premised on the assumption that systematically documenting these baseline conditions can help identify gaps in technology, infrastructure, market linkages, and institutional support. However, the actual effectiveness of these interventions requires separate evaluation, which falls outside the scope of the present study.

The general objective of this study was to document and characterize salt-making practices and constraints in selected major salt-producing provinces in the Philippines. Specifically, the study aimed to: (1) describe the socioeconomic profile and respondent role/land access arrangement of salt makers; (2) document production systems, including solar evaporation, HDPE-lined solar crystallization beds, and cooking-based production, as well as packaging, storage, and marketing-related practices; and (3) identify the primary production, processing, distribution, and marketing constraints reported by salt producers.

METHODS

Research Design, Study Areas, and Respondent Selection

The study used a descriptive cross-sectional research design supported by field observation and site documentation. The documentation and assessment were conducted in selected salt-producing provinces in the following regions: Ilocos Norte, Ilocos Sur, La Union, Pangasinan, Zambales, Bulacan, Occidental Mindoro, Iloilo, Guimaras, Negros Occidental, and Misamis Oriental. These provinces were purposively selected because they are recognized salt-producing areas and were included in the project field documentation plan.

Two data sources were used to guide respondent coverage. The BFAR master list (N=1079) was first used to identify the indicative population of salt producers and farm-size categories in the target provinces. This list provided the basis for estimating the minimum sample requirement using Slovin's formula at a 5% margin of error: $n = N / (1 + N e^2)$, where n is the required sample size, N is the population size, and e is the margin of error. The formula was applied to the BFAR-listed population and farm-size categories to determine the minimum target coverage. During field implementation, however, the Provincial Local Government Unit (PLGU) and municipal/city agriculture offices provided updated operational lists and assisted in locating active producers. The final 590 respondents (Table 1) therefore represent the actual number of accessible and consenting salt producers identified during PLGU-assisted fieldwork, exceeding the minimum sample size (n = 292) estimated from the BFAR list.

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Table 1. Number of respondents by region and province based on field implementation assisted by Provincial Local Government Units.

Region	Province	Respondents
I	Ilocos Norte	33
I	Ilocos Sur	54
I	La Union	20
I	Pangasinan	132
III	Bulacan	13
III	Zambales	8
IV-B	Occ. Mindoro	35
VI	Iloilo	41
VI	Guimaras	71
VI	Negros Occ.	136
X	Misamis Or.	47
TOTAL		590

Respondents were selected through stratified purposive sampling to maximize coverage of accessible active producers in each province. Large, medium, and small operations were represented where present. The criteria for respondents selection included: (1) at least 18 years old; (2) currently involved in salt production, post-harvest handling, or farm operations as an owner, co-owner, renter, caretaker, or worker; (3) knowledgeable about the production process and farm practices; (4) located in one of the selected provinces; and (5) willing to participate. Persons who were not directly involved in salt production, were unavailable during the survey visits, or did not provide consent were excluded from the survey. The field survey was scheduled within the approved research period and covered early and peak production stages so that production practices could be observed under different seasonal operating conditions. The exact field visit dates, however, varied by province depending on the production calendar, LGU coordination, farm accessibility, and weather conditions.

Field Visits, Survey Instrument, and Ethical Safeguards

Field visits were undertaken in coordination with LGUs. Prior to interviews, the purpose of the study was explained to respondents, and voluntary informed consent was obtained. To ensure compliance with ethical standards, the respondents were assured that their participation was voluntary and that they could refuse to answer any question. The information gathered from the study would be reported in aggregated form to protect confidentiality.

The survey instrument covered the respondents' profile, roles or land access arrangements, salt-making experience, production systems, packaging, storage, marketing-related practices, and problems encountered in production, processing, distribution, and marketing. The instrument was pretested with salt farmers and operators in Dasol, Pangasinan, and Pasuquin, Ilocos Norte. This was done to ensure the clarity, appropriate sequencing, and completeness of the instrument in capturing the required information and data. In addition, field observations were recorded during the field survey to validate and supplement survey responses on production and post-harvest practices.

The study protocol was reviewed by the University Research Ethics Review Board of Mariano Marcos State University. Ethical clearance was granted for the approved study period.

Data Processing, Statistical Analysis, and Limitations

The data gathered from the survey were encoded, cleaned, and tabulated in MS Excel. The data were analyzed using descriptive statistics, while frequencies and percentages were computed for categorical variables. Cross-tabulations by province or region were used for production systems and selected practice variables. Because the study was a baseline characterization and field implementation depended on the accessibility of and willingness to participate among salt producers, inferential tests were not applied. Overall, the analysis emphasized descriptive patterns rather than population-level causal inference.

Meanwhile, pooled analysis was used to describe overall patterns across selected producing provinces. Province- and region-level summaries were presented where the data supported meaningful comparison, particularly for production systems. However, the pooled results of this study should not be interpreted as a statistically representative estimate of all Philippine salt producers because the sampling frame and field access varied by site. Nonetheless, to reduce potential bias, the study used updated local lists, field observations, pretested instruments, and respondent inclusion criteria that required direct knowledge of salt production. Some variables, including storage duration, were recorded using categorical response options. Therefore, they are interpreted as survey-recorded categories rather than precise continuous measurements.

For constraints, respondents were asked to identify the primary problem they experienced in each domain. After review by the research team, responses were grouped into thematic categories. This coding approach simplified complex constraints and is interpreted as a ranking of the most salient issues rather than a complete inventory of all problems experienced by each respondent.

RESULTS

Respondent Profile and Salt-making Experience

A total of 590 respondents were included across Regions I, III, IV-B, VI, and X (Table 1). Region I accounted for the largest number of respondents because it included Ilocos Norte, Ilocos

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Sur, La Union, and Pangasinan. Western Visayas also contributed a large share through Iloilo, Guimaras, and Negros Occidental.

Most respondents were male (410, 69.5%), while females accounted for 180 (30.5%) of the sample (Table 2). Married respondents comprised the largest share (477, 80.8%), followed by single respondents (78, 13.2%) and widowed respondents (35, 5.9%). The age distribution further showed that salt production was largely undertaken by older working-age respondents. The largest proportion belonged to the 46–59 age group (245 or 41.5%), followed by those aged 60 years or older (161 or 27.3%) and those aged 31–45 years (159 or 26.9%). Only 25 (4.2%) respondents were 18–30 years old. This age structure suggests that the salt-making workforce is sustained mainly by middle-aged and older producers, with relatively limited participation from younger workers.

Educational attainment was concentrated at the elementary and high school levels. High school graduates formed the largest group (193 or 32.7%). This was followed by elementary graduates (149 or 25.3%), respondents with a high school-level education (80 or 13.6%), respondents with elementary-level and college-level education (60 or 10.2% each), and college graduates (45 or 7.6%). Only one respondent reported postgraduate education, while two reported having vocational training. These results indicate that most respondents had basic to secondary-level education, which may reflect the experiential and practice-based nature of salt-making knowledge in the surveyed communities.

Among the respondents, owners comprised the largest group (193 or 32.7%), followed closely by renters (178 or 30.2%). Laborers accounted for 115 respondents (19.5%), caretakers for 71 (12.0%), and co-owners for 33 (5.6%). Since these categories encompass both land-access arrangements and operational roles, they are interpreted as positions or roles of the respondents rather than as a strict land-tenure classification.

Table 2. Sociodemographic characteristics, respondent classification, and salt-making experience of salt makers (n = 590).

Characteristic	Category	Frequency	Percent
Sex	Male	410	69.5
	Female	180	30.5
Civil status	Married	477	80.8
	Single	78	13.2
	Widowed	35	5.9
Age group	18–30	25	4.2
	31–45	159	26.9
	46–59	245	41.5
	>60	161	27.3
Educational attainment	Elementary level	60	10.2
	Elementary graduate	149	25.3
	High school level	80	13.6
	High school graduate	193	32.7
	College level	60	10.2
	College graduate	45	7.6
	Postgraduate	1	0.2
	Vocational	2	0.3
Respondent classification	Owner	193	32.7
	Renter	178	30.2
	Laborer	115	19.5
	Caretaker	71	12.0
	Co-owner	33	5.6
Years of experience	<5 years	72	12.2
	5–10 years	66	11.2
	11–20 years	109	18.5
	>20 years	343	58.1
Farm size	Small	413	70.0
	Medium	160	27.1
	Large	17	2.9
Type of ownership	Owned	407	69.0
	Cooperative	141	23.9
	Tenant	40	6.8
	Government	2	0.3

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The results also revealed that respondents had extensive experience in salt-making. More than half (343 or 58.1%) had more than 20 years of experience in the salt industry, 109 (18.5%) had 11–20 years, 66 (11.2%) had 5–10 years, and 72 (12.2%) had less than five years of experience. This confirms that salt production in the surveyed provinces is largely sustained by experienced producers. The low proportion of younger and newer entrants may also indicate challenges in ensuring the intergenerational continuity of the salt industry.

Furthermore, the farm and ownership characteristics underscore the dominance of small-scale, privately owned production arrangements. Small farms accounted for 413 respondents (70.0%), followed by medium farms (160, 27.1%) and large farms (17, 2.9%). In terms of ownership type, most respondents were associated with privately owned farms (407, 69.0%), followed by cooperative-based operations (141, 23.9%), tenant arrangements (40, 6.8%), and government-owned areas (2, 0.3%). These patterns suggest that the surveyed salt industry remains largely small-scale and locally managed, with cooperative arrangements also playing an important role in selected production areas.

Production Systems and Post-Harvest Practices

The study classified salt production systems into two primary categories: solar evaporation and cooking-based methods (Table 3). Solar evaporation was the dominant system, accounting for 465 respondents (78.8% of the total). Of these, 445 respondents used conventional solar beds or platforms, while 20 used HDPE-lined crystallization beds. The cooking-based production method accounted for 125 respondents (21.2%).

The results showed clear geographic patterns in the use of production systems. The solar evaporation method was reported by all respondents in Western Visayas and Misamis Oriental and by most respondents in Pangasinan and Occidental Mindoro. In contrast, cooking-based production was dominant in Ilocos Norte and Ilocos Sur. La Union showed a distinct pattern, with most respondents using HDPE-lined solar crystallization beds and a smaller proportion using cooking-based production. Differences in salt-making practices across provinces may reflect differences in local production traditions, site conditions, and available production facilities.

Table 4 shows the post-harvest practices of the respondents. Farm-level packaging was predominantly done using sacks (93.1%). Plastic bags were used by 40 respondents (6.8%), while other packaging materials were rarely reported. This suggests that there is minimal variation in packaging materials at the farm level and that most producers continue to depend on basic bulk packaging rather than adopting differentiated or value-enhancing packaging formats. Regarding packaging costs, most respondents reported costs of PHP 10-20 (63.1%), while 5.1% reported costs below PHP 10. Meanwhile, 188 (31.9%) of the respondents reported that the materials were free, because they were provided by buyers or the government. Of these, 27.5% reported that packaging materials were provided by buyers and 4.4% provided by the government.

Storage practices also highlighted key post-harvest constraints among respondents. Although 64.7% of respondents reported having storage facilities, a substantial 35.3% had none. The most commonly used storage materials were plastic sacks (54.4%), burlap sacks (17.8%), woven baskets (14.4%), and other materials (13.4%). In terms of storage duration before marketing, 35.3% of the respondents stored salt for one week or less, 24.4% for one to two weeks, 4.2% for two to three weeks, 22.4% for more than three weeks or months, and 13.7% reported no definite storage duration. Storage duration was recorded as categorical responses rather than exact numbers of days; hence, these values should be interpreted as survey categories rather than precise continuous measurements.

Table 3. Documented salt production systems and crystallization-bed/lining material in selected salt-producing provinces.

Province	Solar Evaporation		Total solar evaporation	Cooking-based production	Total
	Conventional beds/platforms	HDPE-lined beds			
Ilocos Norte	0	0	0	33	33
Ilocos Sur	0	1	1	53	54
La Union	0	15	15	5	20
Pangasinan	105	1	106	26	132
Central Luzon (Zambales, Bulacan)	13	0	13	8	21
Occidental Mindoro	32	3	35	0	35
Western Visayas (Iloilo, Guimaras, Negros Occidental)	248	0	248	0	248
Misamis Oriental	47	0	47	0	47
Total	445	20	465	125	590
Percent	75.4	3.5	78.8	21.2	100.0

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Primary Constraints in Production, Processing, Distribution, and Marketing

Tables 5 and 6 present the primary problems reported by each respondent. The categories are mutually exclusive because each respondent was coded according to the most salient problem within each domain. In this study, climate- and weather-related production risks refer to direct weather hazards such as untimely rainfall, typhoons, and rainfall-induced disruptions to evaporation and crystallization. By contrast, seasonality and operational vulnerability refer to the short production window and operational stoppages associated with seasonal production limits. Location- and site-related constraints include broad site suitability issues such as flood exposure, land-use conflict, or difficult access. In marketing, inconsistent pricing, weak bargaining power, and the absence of a standardized pricing system were kept as separate categories because they refer, respectively, to price fluctuations, the producer's limited negotiating position, and the lack of a formal or commonly accepted pricing reference.

Climate- and weather-related production risks were the most frequently reported primary problems in production and processing, cited by 374 respondents (63.39%). Increased production costs were reported by 99 respondents (16.78%), followed by seasonality and operational vulnerability (55, 9.32%), location- and site-related constraints (39, 6.61%), and the absence of significant production or processing problems (23, 3.90%). Location and site-related constraints included general concerns about physical suitability, exposure, access, or site conditions, as reported by respondents.

In distribution and marketing, inadequate access to large-scale distribution channels was the most frequently reported primary problem (283, 47.97%), followed by inconsistent pricing and

Table 4. Farm-level packaging, packaging source/cost, storage facility, storage material, storage duration, and packaging information reported by respondents (n = 590).

Characteristics	Frequency	Percent
Packaging Material Used		
Sack	549	93.1
Plastic bag	40	6.8
Others	1	0.2
Packaging Cost		
< PHP 10	30	5.1
PHP 10-20	372	63.1
Source of Free Packaging Material		
Provided by buyer	162	27.5
Provided by government	26	4.4
Farm Storage Facility		
With storage	382	64.7
Without storage	208	35.3
Storage Material Used		
Plastic sack	321	54.4
Burlap sack	105	17.8
Woven basket	85	14.4
Others	79	13.4
Storage Duration Before Marketing		
1 week or less	208	35.3
1 to 2 weeks	144	24.4
2 to 3 weeks	25	4.2
More than 3 weeks or months	132	22.4
No definite duration	81	13.7
Information Marked in Farm-Level Packaging		
Yes	165	28.0
No	425	72.0

Table 5. Primary problems reported in salt production and processing.

Primary problem reported: production and processing	Frequency	Percent
Climate- and weather-related production risks	374	63.39
Increased production costs	99	16.78
Seasonality and operational vulnerability	55	9.32
Location and site-related constraints	39	6.61
No significant problem reported	23	3.90
Total	590	100.00

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Table 6. Primary problems reported in salt distribution and marketing.

Primary problem reported: distribution and marketing	Frequency	Percent
Inadequate access to large-scale distribution channels	283	47.97
Inconsistent pricing and unstable profit margins	188	31.86
Weak bargaining power against buyers	33	5.59
No significant problem reported	33	5.59
High transport costs	25	4.24
Absence of standardized pricing system	20	3.39
Vulnerability to local economic conditions and regional oversupply	8	1.36
Total	590	100.00

unstable profit margins (188, 31.86%). Weak bargaining power (33 or 5.59%), the absence of significant marketing problems (33 or 5.59%), high transport costs (25 or 4.24%), absence of a standardized pricing system (20 or 3.39%), and vulnerability to local economic conditions or regional oversupply (8 or 1.36%) were reported less frequently.

DISCUSSION

The study provides a descriptive baseline of salt-making practices and constraints in selected Philippine coastal provinces. The results should be interpreted as documentation of observed and reported patterns rather than evidence of causal relationships, empowerment outcomes, or intervention impacts. Within this scope, the study contributes by linking respondent characteristics, production systems, post-harvest practices, and reported constraints using a common field instrument across multiple producing areas.

The demographic pattern is consistent with recent research findings concerning the Philippine salt industry. Banicod et al. (2024) reported a predominantly male and aging salt-production workforce with substantial family involvement and limited formal education. The present study yielded similar findings: 69.5% of respondents were male, 68.8% were 46 years or older, and 58.1% had more than 20 years of experience. These results suggest that current production depends heavily on experienced, middle-aged, and older producers. However, because the study did not measure youth attitudes, household labor allocation, or succession plans, youth engagement is treated only as a possible policy implication rather than as a directly measured outcome.

The results regarding respondents' classification and farm size also indicate the small-scale and locally managed character of the surveyed salt farms, which may reflect a broader characteristic of the Philippine salt industry. Owners and renters represented the largest respondent groups, while laborers, caretakers, and co-owners were also present. This pattern shows that production involves both land access arrangements and operational roles. Thus, these categories should not be interpreted as a strict land-tenure typology. The dominance of small farms and privately owned or cooperative arrangements suggests that interventions may need to be tailored to smallholder realities, including limited capital, labor constraints, and uneven access to formal markets.

The findings on the dominance of solar evaporation production systems are consistent with Montojo et al. (2024), who identified solar evaporation as a major production system in the country. The provincial pattern of cooking-based production in Ilocos Norte and Ilocos Sur, and of solar evaporation in Western Visayas, Misamis Oriental, Pangasinan, and Occidental Mindoro, also reflects the diversity of salt-making systems in the Philippines. These patterns are documented descriptively. Further analysis would be needed to test whether they are associated with climate type, brine source, land availability, labor, cultural practice, market demand, or access to capital. Cost-and-return comparisons among conventional solar beds, HDPE-lined beds, and cooking-based systems were not conducted; therefore, the study does not draw conclusions about the relative profitability or economic superiority of these systems. This caution is important because site-specific profitability may vary with input costs, scale, production season, labor requirements, and market prices (Barba and Delos Reyes 2024).

Post-harvest results indicate limited farm-level packaging differentiation and substantial storage gaps. The dominance of sacks as packaging material and the absence of farm-level packaging information among 72.0% of respondents may constrain producer-level traceability, although consumer perception cannot be inferred because retail labeling may be handled later by traders, processors, or distributors. The result is nevertheless relevant to value-chain upgrading because food traceability systems support product identification, quality management, and information flow across supply chains (Aung and Chang 2014). For salt moved in bulk or non-retail containers, appropriate container-level information is also consistent with the purpose of Codex guidance on non-retail container labeling, which seeks to facilitate harmonized information for food moving through

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supply chains (Codex Alimentarius Commission 2021).

The lack of storage facilities among 35.3% of respondents is a practical constraint that may affect the ability of salt farmers to protect product quality and time their sales decisions to obtain better prices. Similar issues of market access and value-chain constraints have been observed in agricultural and salt value chains, where limited storage, weak organization, dependence on buyers, and limited value-adding capacity can reduce producers' bargaining power (Ton 2008; Reardon et al. 2019; Tan et al. 2022; Lat et al. 2024). However, the present study did not measure selling price, margins, or income. Thus, economic implications are discussed only as plausible pathways for future research and intervention design rather than as measured impacts.

Moreover, climate- and weather-related risks emerged as the most frequent production constraints. This pattern is consistent with the dependence of solar salt production on predictable dry conditions for evaporation and crystallization and with constraints reported in salt-farming areas such as Occidental Mindoro (Muyot and Asuncion 2022). Weather disruptions, such as unexpected rainfall, prolonged cloudiness, high humidity, and storms, can reduce brine concentration, dissolve crystallized salt, delay harvesting, damage pond structures, and shorten the effective production season. The results therefore reinforce the need to examine climate-resilient infrastructure, improved drainage, protected or covered crystallization systems, flexible production scheduling, and localized weather advisories. These are feasible intervention areas, but their cost-effectiveness, technical suitability, and adoption by different farm-size groups should be evaluated separately.

Findings on marketing constraints highlight the dominance of limited access to large-scale distribution channels and unstable pricing. While these findings do not constitute a full market opportunity assessment, they identify priority areas for further value chain and feasibility studies. Potential areas for further study include cooperative aggregation, improved quality consistency, producer-level recordkeeping, storage improvements, traceability systems, and stronger linkages with institutional buyers. Collective action can help smallholders address coordination problems, reduce transaction costs, and improve market access, especially when they are supported by appropriate institutional arrangements and external facilitation (Markelova et al. 2009). For salt producers, this suggests that strengthening cooperation should be studied not simply as an organizational goal but as a potential mechanism for aggregation, quality control, negotiation, and access to formal buyers.

Overall, the findings showed that selected Philippine salt-producing communities retain strong experiential knowledge and diverse production practices. Yet they face various practical constraints related to climate-sensitive production, post-harvest handling, storage, and market linkages. The study provides baseline evidence for prioritizing climate-resilient infrastructure, storage support, appropriate technology transfer, improved packaging and traceability, tenure-related assistance, and market-linkage interventions. These priorities should be pursued through targeted and evidence-based programs rather than uniform interventions across all provinces. Future research should move beyond descriptive profiling by measuring income contribution, employment generation, production volume and value, youth participation, gender roles, youth participation, cost-and-return performance, willingness to adopt improved technologies, and the effectiveness of specific storage, traceability, and market-linkage interventions. Such evidence will help determine which interventions can most effectively strengthen the sustainability, productivity, and market participation of small-scale salt producers.

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GENERATIVE AI STATEMENT

Generative AI (ChatGPT) was used to improve the clarity and concision of the manuscript. The authors reviewed and edited the suggested wording and take full responsibility for the final content.

ETHICAL CONSIDERATIONS

The study used a pretested survey instrument and field observation protocol. Informed consent was obtained from respondents before the interviews. Participation was voluntary, confidentiality was maintained, and results were reported in aggregated form. The study was reviewed by the University Research Ethics Review Board of Mariano Marcos State University, and an Ethical Clearance Certificate was secured for the period from 21 February 2024 to 21 February 2025.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no competing interests.

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b. English terminologies should be italicized when paper is written in Filipino language
b. Scientific names and taxonomy authority must be cited for all organisms at first mention (e.g., *Stiphodon palawanensis* Maeda & Palla, 2015). Subsequently, only the initial of the genus should be written except when starting a sentence with a scientific name. All scientific names should be italicized. Example: *Epinephelus fuscoguttatus*; *Anadara* sp. *Musa* spp. Do not italicize the higher levels of taxonomic classification (example: family Echinometridae).
c. Local names should be in double quotes (example: locally called "saging" not 'saging'; "palay" not 'palay').
d. Research articles dealing on species list should provide the authorities for each species (example: *Conus magus* Linnaeus, 1758; *Enosteoides philippinensis* Dolorosa & Werding, 2014).

12. Punctuations, Equations, Symbols and Unit of measures

a. Unfamiliar terms, abbreviations, and symbols must be defined/spelled out at first mention even in the abstract. Acronym should only be spelled-out as it is introduced in the text, it should be written in acronym in succeeding parts of the paper.

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b. Mathematical equations should be clearly presented so that they can be interpreted properly. Equations must be numbered sequentially in Arabic numerals in parentheses on the rightmost hand side of the equations.
c. International System of Units of measurements must be used but separated from the value and the unit of measure (e.g. 5 mm, 3 mL, 5 L, 25 g, 30 m^3, 100 μm, 9 ind ha^{-1}, 10 sacks ha^{-1}, 2 kg h^{-1}, 2 kg h^{-1} day^{-1}) and probability (*P*) is in upper cased and italicized (e.g. $P > 0.05$; $P < 0.05$; $P = 0.01$). To fix a single space between the value and its unit of measure, use the MS word command "CTR+SHIFT+SPACE BAR" to provide a space between the value and its unit of measure.
d. There is a single space between numbers and the following mathematical signs: ±, =, ×, -, +, ÷, (e.g. 92 ± 0.092; 5 × 6).
e. Numbers less than 10 should be spelled out (for example: eight trees, 10 fish) except when followed by a unit of measure (for example: 9 cm, not nine cm). Number mentioned at the start of the statement should be spelled-out (e.g. Nine fishermen not 9 fishermen or Six degrees Celsius not 6˚C).
f. The symbol for Degree (˚) should be inserted using the insert symbol option and not zero (0) or alphabet (o) superscript.
g. Do not separate a percent sign and degree of temperature with the number (example: 5% and 8˚C).
h. Write dates in this manner: day-month-year (example: 20 October 2012).
i. Use a 24-h system for time (example: 1300 instead of 1:00 pm). To express a measured length of time, abbreviations for hour (h), minutes (min) and seconds (sec) should be used (example: 2 h and 30 min; or 2.5 h).
j. Include apostrophes in years (example: 2014's).
k. No periods in acronyms (example: UNESCO not U.N.E.S.C.O.; CITES not (C.I.T.E.S.)
l. Use a single capital letter when writing latitude and longitude (example: 9°44'27.80"N and 118°41'2.01"E). Compass points (north, south, east, west) and their derivations (northern, southern, eastern, western) are lowercase (example: north of Palawan) except when they form part of the place name (example: South Cotabato; Eastern Samar).

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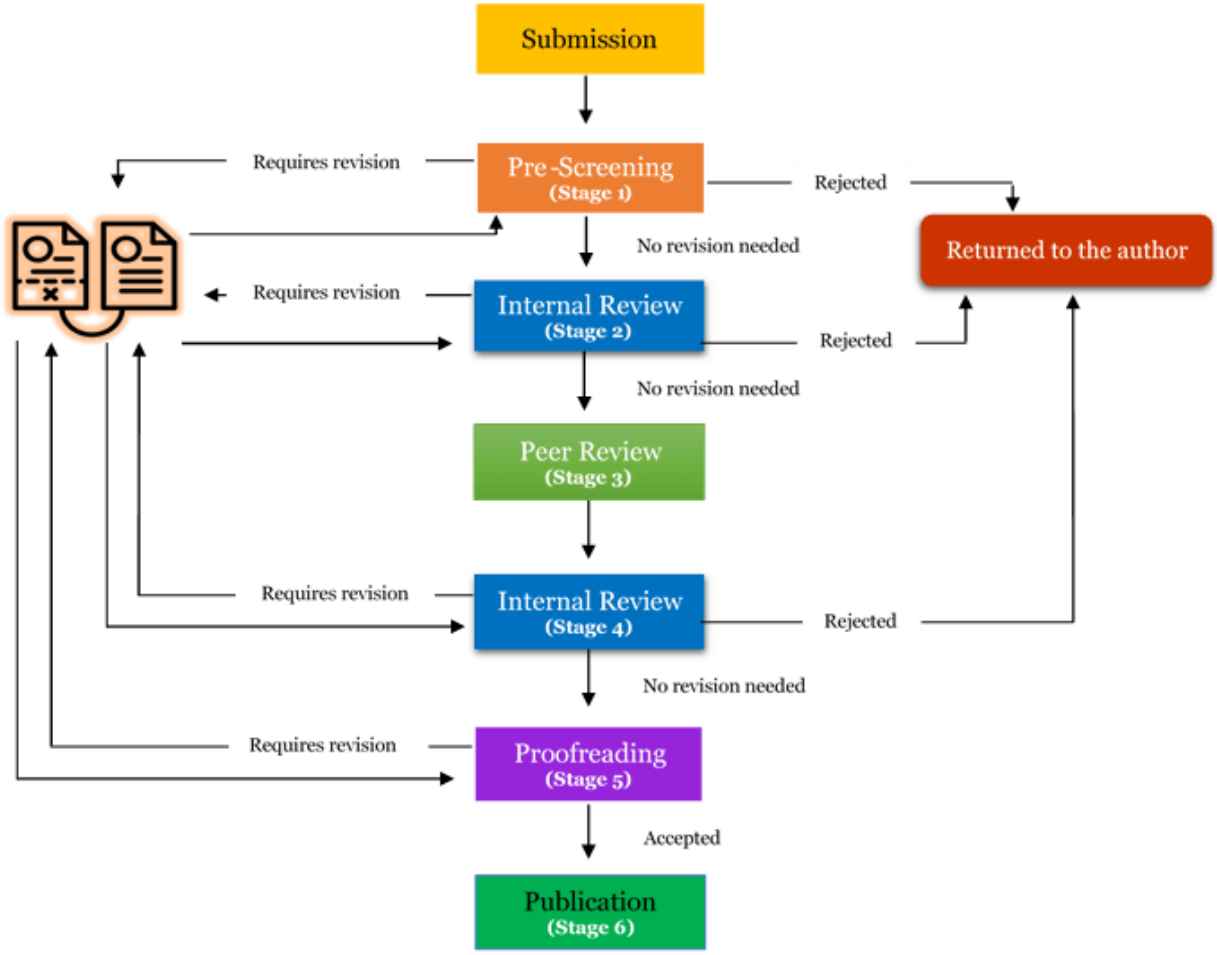

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