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Fishing Practices of Freshwater Prawn Collectors at Ligawasan Marsh, Southern Philippines

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ABSTRACT

Ligawasan Marsh, the largest wetland in Southern Philippines, serves as a critical resource for local communities, providing water for agriculture, fishing, and other livelihood activities. Spanning Maguindanao del Sur, Maguindanao del Norte, and parts of Cotabato and Sultan Kudarat, the marsh plays a vital role in both the local economy and ecosystem. Freshwater prawns are among the key aquatic resources harvested, yet scientific data on fishing practices and the socio-demographic characteristics of prawn collectors remain limited. This study, conducted from January to December 2023, aimed to address this knowledge gap by assessing prawn collection methods and fisher demographics. A mixed-methods approach was employed, comprising structured questionnaires, participant observation, and key informant interviews (KIIs) with a total of 126 respondents, ensuring a minimum of 30 participants from each of the three marsh areas to achieve balanced geographic representation. Results revealed that the majority of prawn collectors were between 31 and 40 years old, possessed primary-level education, and supported large households with an average monthly income of PhP 9,183.13 to PhP 12,427.73. The most commonly employed fishing gear included fish traps (62.46%), followed by harvesting nets (15.94%), cast nets (11.57%), and fish pots (10.03%). Grated coconut was the preferred bait among respondents, used by 88.05% of fishers to enhance the efficiency of their traps. Seasonal and lunar cycles significantly influenced fishing activity, with higher prawn abundance reported during the rainy season (87.45%) and peak harvesting during the new moon phase (56.31%). These findings provide valuable insights into the prawn fishing practices in Ligawasan Marsh, informing future resource management and sustainability initiatives.

INTRODUCTION

Freshwater prawns, particularly species from the genus *Macrobrachium*, are among the Philippines' most commercially important aquatic species. They are widely distributed in the country's river systems, lakes, and other freshwater habitats, valued for their high market price and culinary appeal **(Cavallo *et al.*, 2001)**. Historically, freshwater prawn fisheries thrived in major rivers and lake systems, providing a significant source of livelihood for local communities **(Santos *et al.*, 2024)**. However, overfishing, habitat destruction, pollution, and other environmental stressors have contributed to a notable decline in natural prawn populations, placing pressure on capture fisheries and aquaculture production **(FAO, 2020)**.

Despite the recognized commercial value of *Macrobrachium* species and the ecological importance of Ligawasan Marsh, empirical research on site-specific fishing practices, socio-demographic drivers, and seasonal trends in freshwater prawn collection within this ecosystem remains limited. Existing studies on aquaculture and inland fisheries in the Philippines often lack localized, data-driven analyses of community-based harvesting practices, particularly within the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM). This study addressed this critical gap by presenting the first comprehensive assessment of freshwater prawn fishing activities in Ligawasan Marsh. The findings offer vital baseline information to support evidence-based policymaking and the development of sustainable fisheries management strategies in this ecologically sensitive and socioeconomically important region.

Economically, freshwater prawn fisheries are notable for their high market value. According to the Bureau of Fisheries and Aquatic Resources **(BFAR, 2023)**, prawn farming offers better profit margins than traditional aquaculture species, making it one of the top commodities in inland municipal production. However, freshwater prawn production has declined in recent years, decreasing from 70,303.71 metric tons in 2022 to 64,280.74 metric tons in 2023, representing a reduction of 6,022.97 metric tons.

The Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) remains a stronghold for natural freshwater prawn populations. Since 2021, BARMM has been the leading fish-producing region in the Philippines, contributing 30.41% of the national fisheries production, with a record of 1.319 million metric tons in 2022. Ligawasan Marsh is a vital habitat for the freshwater prawns and other aquatic species in this region.

Ligawasan Marsh, spanning approximately 288,000 hectares within the Cotabato Basin, is one of the country's largest and most ecologically significant wetland ecosystems. It comprises interconnected river channels, extensive marshlands, and flood-prone arable lands. The marsh experiences seasonal hydrological changes, with approximately 140,000 hectares becoming cultivable during drier months. The system comprises three distinct marshes: Ebpanan, Liguasan, and Libungan. Each marsh has unique hydrological characteristics, with Ebpanan Marsh affecting municipalities in Maguindanao del Norte and Maguindanao del Sur, Liguasan Marsh sustained by the

Pulangi, Maganoy, Buluan, and Allah Rivers, and Libungan Marsh receiving water from the Libungan and Mindanao Rivers. These ecosystems support diverse aquatic species, including *Macrobrachium* spp., tilapia, eels, mudfish (*Channa striata*), catfish (*Clarias* spp.), carp (*Cyprinus carpio*), gourami (*Osphronemus goramy*), climbing perch (*Anabas testudineus*), and sirang (*Barbodes sirang*) **(Sinolinding *et al*., 2012; Donia *et al*., 2023)**.

Ligawasan Marsh supports over 112,000 households that depend on fishing during high water levels and agricultural activities during low water levels. Traditional rice farming and fishing remain central to local livelihoods **(Buisan & Roxas, 2021)**. As a designated priority inland water body by the Department of Environment and Natural Resources (DENR), Ligawasan is a focus for research and conservation efforts. However, historical armed conflicts in the region have impeded conservation efforts and limited research opportunities **(Tanalgo *et al*., 2023)**.

Given its ecological importance and abundant natural resources, Ligawasan Marsh offers sustainable freshwater prawn fisheries and opportunities for aquaculture development. Development projects aim to strike a balance between environmental protection and economic growth **(Limbaro *et al*., 2024)**. Understanding fishers' fishing methods and socio-demographic characteristics is essential for formulating effective policies that promote sustainability and community resilience. Implementing regulated fishing seasons, promoting eco-friendly gear, and protecting critical habitats are vital steps toward sustainable management.

This study was guided by the central research question: What are the prevailing fishing practices, socio-demographic characteristics of fishers, and seasonal patterns associated with freshwater prawn collection in Ligawasan Marsh? It was hypothesized that fishing practices and gear preferences are significantly influenced by socio-demographic variables, including age, gender, and educational attainment, and that seasonal variations shape the patterns of fishing activity.

This study examined the fishing practices of freshwater prawn collectors in Ligawasan Marsh, focusing on the types of fishing gear used, the socio-demographic factors influencing these practices (such as age, gender, and education), and the seasonal patterns of prawn catch. The findings aimed to contribute to informed decision-making for the sustainable management of freshwater prawn fisheries in the region.

MATERIALS AND METHODS

Study area

The research was conducted across three distinct marshes within Ligawasan Marsh: Ebpanan, Liguasan, and Libungan (Fig. 1). These marshes serve as critical resources for local communities, contributing directly and indirectly to livelihoods through fishing activities.

To ensure a detailed understanding of freshwater prawn fisheries in Ligawasan Marsh, the study involved on-site visits conducted between January and December 2023. These visits were strategically planned in collaboration with the Ministry of Agriculture,

Fisheries, and Agrarian Reform of the Bangsamoro Autonomous Region in Muslim Mindanao (MAFAR-BARMM). Sampling locations were selected to represent the socio-demographic and fishing practices across the marsh's diverse areas: Liguasan Marsh: Covered key fishing sites in Datu Salibo, General S.K. Pendatun, and Datu Piang in Maguindanao Del Sur, as well as Midsayap in Cotabato Province; Libungan Marsh: Focused on areas within the Mega Market of Cotabato City and the Special Geographic Area, including Pikit and Pigcawayan in Cotabato; Ebpanan Marsh: Included fishing grounds in Lower Kabuntalan and Datu Odin Sinsuat in Maguindanao Del Norte, as well as Kalanganan in Cotabato City. These sites were selected to systematically assess the ecological, socio-demographic, and operational fishing practices influencing freshwater prawn fisheries.

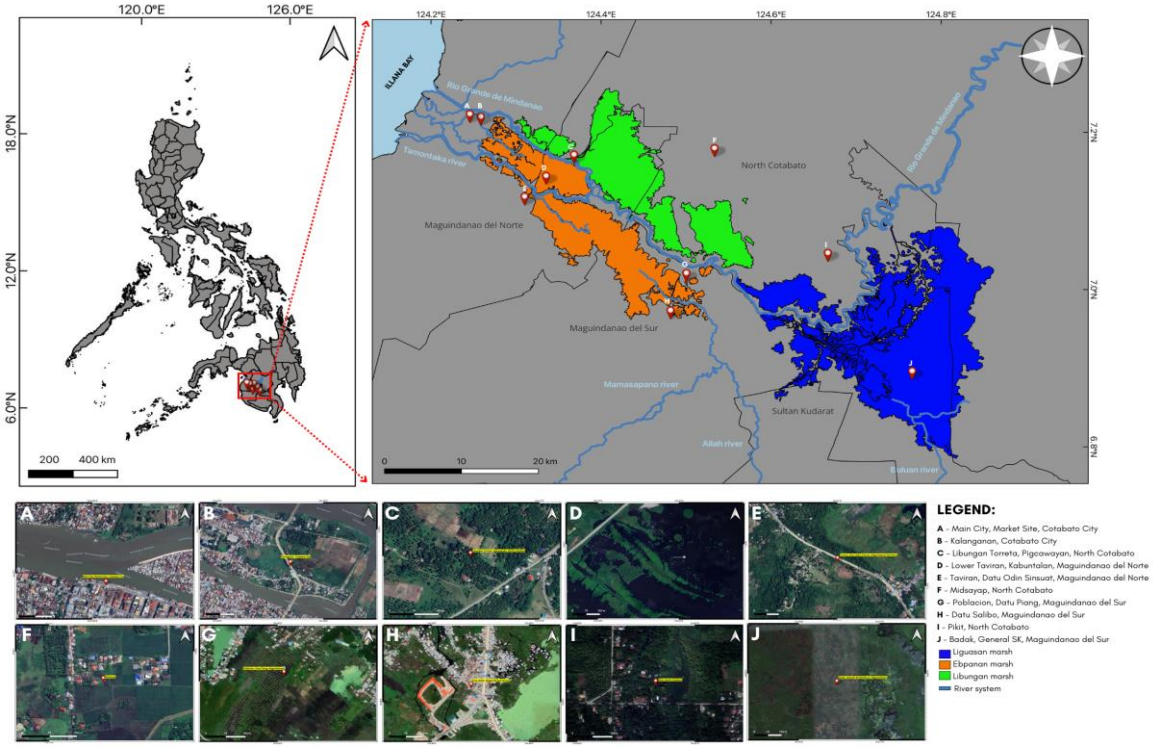

Fig. 1. Geographical map of the research areas in Ligawasan Marsh, Southern Philippines.

The map presents the geographical distribution of the three major marsh zones within Ligawasan Marsh: Ebpanan (Ebpn), Liguasan (Lgsn), and Libungan (Lbgn). Each marsh zone is distinctly color-coded: Ebpanan in orange, Liguasan in blue, and Libungan in green to facilitate clear visualization of their respective locations. Blue line represents river system within the marsh, highlighting the ecological context of the research sites

These marshes extend across key areas in Maguindanao del Norte, Maguindanao del Sur, and Cotabato Province (Table 1), critical habitats for freshwater prawn fisheries.

Table 1. List of prawn fishing municipalities surveyed along the different sampling sites within Ligawasan Marsh (2023)

Sampling area	Barangay/Municipality/City	Province
Ebpanan Marsh	Lower Taviran, Kabuntalan	Maguindanao Del Norte
	Taviran, Datu Odin Sinsuat	Maguindanao Del Norte
	Kalanganan	Maguindanao Del Norte
Liguasan Marsh	Poblacion, Datu Piang	Maguindanao Del Sur
	Datu Salibo	Maguindanao Del Sur
	Badak, General Salipada K. Pendatun	Maguindanao Del Sur
	Pikit	North Cotabato
Libungan Marsh	Midsayap	North Cotabato
	Libungan Torreta, Pigcawayan	North Cotabato
	Mother Barangay Poblacion,Cotabato City	Maguindanao Del Norte

The study areas are strategically located to examine the socio-demographic characteristics and fishing practices of freshwater prawn collectors.

Data collections

The study involved a diverse group of fishers actively engaged in freshwater prawn fisheries within Ligawasan Marsh in the Southern Philippines. A total of 126 respondents participated, with a minimum of 30 individuals selected from each of the three marsh areas. All respondents were directly involved in the collection of freshwater prawns. Data were collected using structured questionnaires translated into Maguindanaon, the local dialect, to ensure clarity and comprehension. Information gathered included socio-demographic characteristics, commonly used fishing gear, and preferred bait or lures.

A mixed-methods approach was employed, integrating structured questionnaires, participant observation, and key informant interviews (KIIs) conducted between January and December 2023. Key informants were purposively selected based on their expertise and active involvement in prawn fishing within the study sites. Data from questionnaires, participant observations, and key informant interviews (KIIs) were cross-validated to ensure the accuracy and consistency of the findings. The questionnaire was pilot-tested on a small group of fishers before deployment to improve question clarity and relevance. The study documented important practices, such as feeding techniques to enhance fishing efficiency, and recorded fishers' perceptions of catch abundance relative to lunar phases, seasonal fluctuations, and monthly periods.

Data analysis

In this study, the collected data underwent analysis using descriptive statistics in Microsoft Excel 2016 to calculate the percentage. This analysis aimed to determine the prevalent fishing practices employed by fishers in the research area and to evaluate the

perspectives of small-scale fishers concerning different variables. Percentages were utilized to summarize the descriptive results.

Ethical considerations

In this study, informed consent was obtained from all participants before their inclusion. Participants were informed about the study's purpose, procedures, potential risks, and benefits, and they voluntarily agreed to participate. Additionally, separate informed consent was obtained from individuals whose identifying information is included in this article to ensure their privacy and confidentiality. The study adhered to ethical guidelines and was conducted following approval from the research ethics committee of MSU-Naawan, Naawan, Misamis Oriental.

The study involved obtaining informed consent from participants, who were assured of confidentiality and protection of their privacy. The research team adhered to ethical standards throughout the study.

RESULTS

Socio-demographic characteristics

The socio-demographic characteristics of freshwater prawn fishers in Ligawasan Marsh, Southern Philippines, were analyzed to understand their involvement in prawn gathering activities. The respondents, including key informants, ranged in age from 21 to 80 years (Table 2A & Fig. 2B). The highest proportion of fishers (33.33%) belonged to the 31–40 age group, followed by 26.19% in the 21–30 years category and 19.84% in the 41–50 years bracket. Fishers aged 51–60 accounted for 15.08%, while those aged 61–70 represented 4.76% of the sample. The least represented age group comprised individuals over 70 (0.79%), indicating a decline in fishing participation among older individuals.

Table 2. Age range and educational attainment percentage (%) frequency distribution of the respondents in each sampling site (Table 2A) and pooled percentage composition of the age range of the freshwater prawn fishers (Fig. 2B) in the selected sampling sites, respectively (N=126)

A

Parameter	Sampling Sites			Percentage (%)
	Ebpanan Marsh	Liguasan Marsh	Libungan Marsh	
	Frequency			
Age Range				
21 - 30	11	10	12	26.19
31 – 40	16	15	11	33.33
41 – 50	12	6	7	19.84
51 – 60	10	3	6	15.08

61 – 70	2	3	1	4.76
> 80	1	0	0	0.79
Education				
Tertiary	0	2	2	3.17
Secondary	6	6	5	13.49
Primary	28	19	27	58.73
Arabic	1	1	0	1.59
Kindergarten	0	0	1	0.79
None	17	9	2	22.22

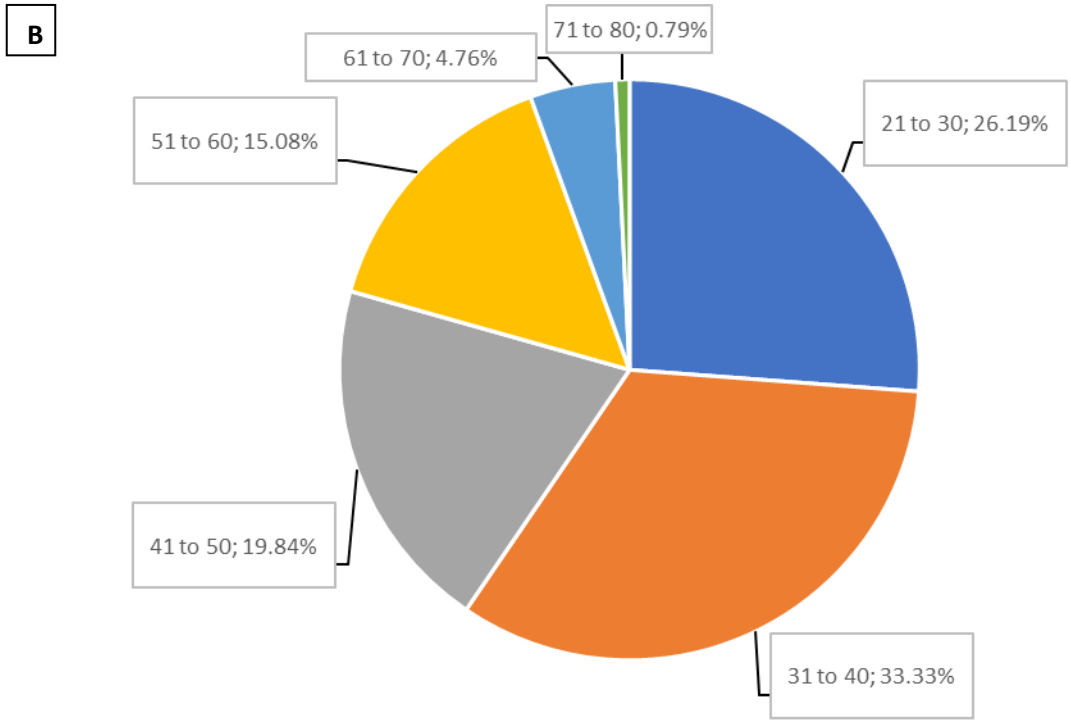

Table 3. Distribution of freshwater prawn fishers by sex, marital status, household members, and fishing experience (in years) in Ligawasan Marsh, Southern Philippines (N=126)

Parameter	Sampling Sites			Percentage (%)
	Ebpanan Marsh (52)	Liguasan Marsh (37)	Libungan Marsh (37)	
	Frequency			
a. Sex				
Male	52	30	32	90.48
Female	0	7	5	9.52
b. Marital status				
Married	44	32	30	84.13
Single	6	4	5	11.90

Widowed	2	1	2	3.97
c. Household member/s				
≤ 2	5	2	2	7.14
3-5	17	14	13	34.92
6-8	27	18	17	49.21
8 >	3	3	5	8.73
d. Fishing experience (in years)				
≤ 2	1	3	2	4.76
3-5	26	22	21	54.76
6-8	22	9	13	34.92
8 >	3	3	1	5.55

Educational attainment among respondents showed that the majority (58.73%) had completed primary education. The gender distribution revealed that prawn fishing is a male-dominated activity, with 90.48% of participants being men (Table 3a). Moreover, most fishers were married (84.13%) (Table 3b). Household size analysis indicated that 49.21% of the respondents had families of six to eight members, although variations in household composition were observed across different marshes (Table 3c).

Fishing experience varied among respondents, with 54.76% reporting 3–5 years of involvement in freshwater prawn gathering, suggesting a moderate experience level among fishers (Table 3d). These socio-demographic findings highlight the diverse backgrounds and expertise of prawn fishers in Ligawasan Marsh. The results emphasize the need for targeted strategies to promote sustainable fishing practices and to improve the socio-economic conditions of local fishing communities.

The income of freshwater prawn fishers in Ligawasan Marsh exhibits considerable variation, likely influenced by differences in fishing practices, gear efficiency, and access to resources. Fishers with greater skills, more effective fishing gear, and better access to resources tend to earn higher incomes, whereas those lacking these advantages may face financial difficulties.

The average monthly income (Table 4) differs among the three areas studied. Fishers in Ebpanan reported the highest average income of Php 12,427.73, followed by those in Liguasan with Php 11,736.36, while Libungan had the lowest average income at Php 9,183.13. Notably, Liguasan exhibited the highest recorded maximum monthly income at Php18,000.00, indicating that some fishers in this area generate substantially higher earnings than others. Conversely, Libungan recorded the lowest minimum monthly income of PHP 1,000.00, highlighting the economic difficulties many fishers faced in these marsh areas. These findings highlight the differences in income levels among freshwater prawn fishers and emphasize the need for equitable access to resources and capacity-building initiatives to enhance their livelihoods.

Table 4. Monthly income of the freshwater prawn fishers in Ligawasan Marsh, Southern Philippines (N=126)

Sampling Sites	Pesos (Php)		
	Max	Min	Ave
Ebpanan (52)	15,000.00	3,000.00	12,427.73
Liguasan (37)	18,000.00	2,000.00	11,736.36
Libungan (37)	15,000.00	1,000.00	9,183.13

Max (Maximum), Min (Minimum), and Ave (Average). 1 US Dollar = Php 55.6304 (Average in 2023 from BSP).

Fishing gear and practices

The utilization of various fishing gears among freshwater prawn fishers in Ligawasan Marsh (Table 5). Fish traps emerged as the most commonly used gear, surpassing other fishing equipment, such as fishnets, pots, and cast nets. The prevalence of fish traps was particularly notable across the three marshes studied, with Ebpanan recording the highest usage rate at 71.15%, followed by Libungan at 67.57% and Liguasan at 48.65%.

The dominance of fish traps among fishers suggests their effectiveness and widespread acceptance, likely due to their efficiency in capturing freshwater prawns and their adaptability to local fishing conditions. The preference for fish traps over other gear types highlights their role as a primary tool in sustaining freshwater prawn fisheries in Ligawasan Marsh. These findings underscore the importance of understanding fishing gear preferences in informing sustainable management practices and enhancing the productivity of local fisheries.

Table 5. Preferred fishing gear used by the fishers to catch freshwater prawn (N=126)

Sampling sites (Respondents)	% Responses on the preferred fishing gear							
	Fish trap		Harvesting fishnet		Fish pots		Cast nets	
	No.	%	No.	%	No.	%	No.	%
Ebpanan Marsh (52)	37	71.15	8	15.38	3	5.77	4	7.69
Liguasan Marsh (37)	18	48.65	6	16.22	7	18.92	6	16.22
Libungan Marsh (37)	25	67.57	6	16.22	2	5.41	4	10.81
Total (126)	**80**	**62.46**	**20**	**15.94**	**12**	**10.03**	**14**	**11.57**

Description of fishing gears

Fish trap

The fish trap, locally known as "Bubo," is a carefully designed and highly efficient tool used in freshwater prawn fishing (Fig. 3). The trap is constructed in a rectangular shape and consists of netting material stretched over a sturdy frame. This design enhances its effectiveness in capturing aquatic species while maintaining structural simplicity. The trap features a funnel-shaped entrance that guides prawns

inside, where their chances of escape are significantly reduced due to the inward-bent funnel and side panels, creating a one-way entry system.

The structural components of the fish trap are reinforced by a shafting bar frame, measuring 21 inches in length, 12.5 inches in width, and 13 inches in height. The mesh size is precisely 10cm, allowing the capture of target-sized prawns while permitting smaller, non-target species to pass through, thus contributing to sustainable fishing practices.

Fish traps are typically deployed in waters ranging from 2 to 3 meters. Depending on the season, traps can be left submerged for extended periods, allowing for passive fishing while enabling fishers to engage in other livelihood activities. This method is particularly advantageous for small-scale fishers who rely on freshwater prawn harvesting as a primary source of income. The efficiency, simplicity, and sustainability of fish traps highlight their critical role in freshwater prawn fisheries within Ligawasan Marsh.

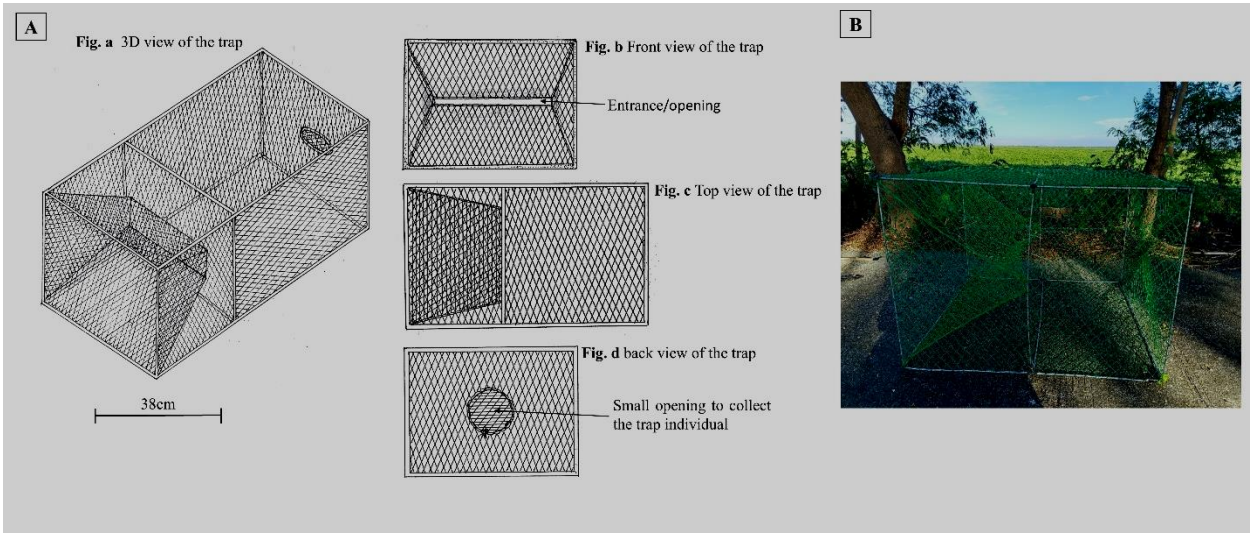

Fig. 3. (A) Design and illustration of fish trap and **(B)** actual photo of fish trap

Harvesting fish net

The harvesting fish net is another widely used fishing gear among fishers in Ligawasan Marsh (Fig. 4). This practical and efficient tool is constructed from bamboo poles and netting, forming an enclosure that passively traps various aquatic species, including fish, prawns, and other invertebrates. The gear is deployed in calm waters, where it remains in place to capture species without requiring continuous human intervention.

The leader net of the harvesting fish net extends approximately 8–10 meters in length. Bamboo posts, driven approximately 1 meter into the substrate, are strategically positioned at intervals of 1 meter in width and 7 meters in length. The mesh size of the

netting is 10cm, ensuring the effective capture of target species while allowing smaller, non-target organisms to pass through, thus promoting selective fishing practices.

Fishers typically position the netting near vegetative areas, as these locations are believed to attract aquatic species into the enclosure. Once captured, the fish and prawns can be collected using a scoop net or retrieved by hand, minimizing damage to the catch and preserving its quality. The passive nature of this fishing method allows small-scale fishers to optimize their efforts while maintaining sustainable harvesting practices in Ligawasan Marsh.

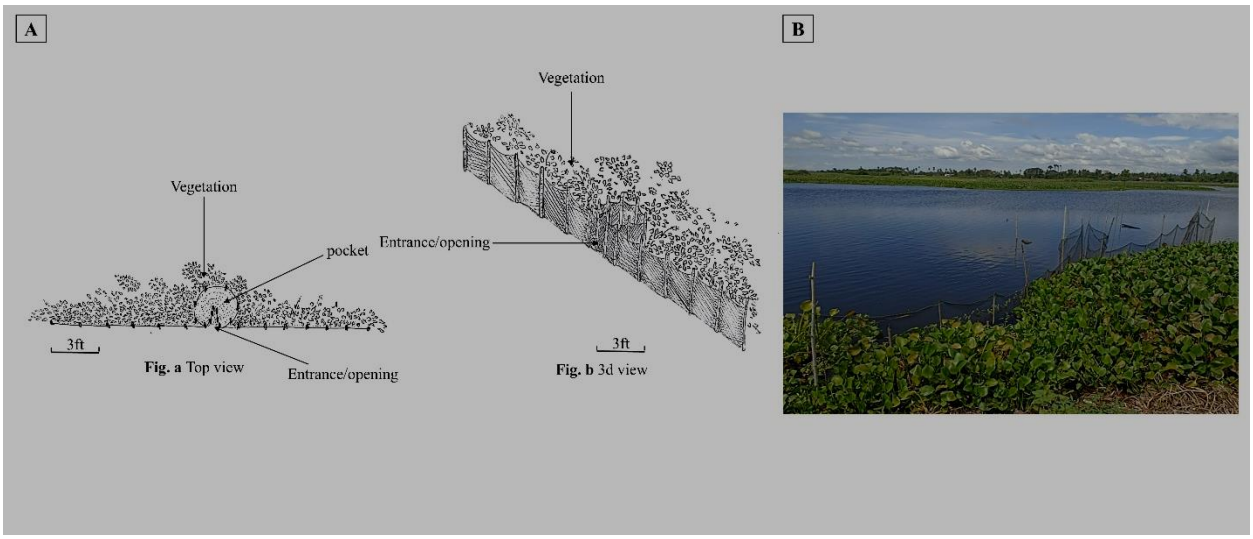

Fig. 4. (A) Design and illustration of harvesting fish net and **(B)** actual photo of harvesting fish net

Fish pot

The fish pot (Fig. 5), locally known as "balyat" or "buyo," is a traditional and highly effective fishing gear widely utilized across the three sampling sites. This conical-shaped trap, constructed from bamboo and netting, is designed to capture fish, shrimp, and prawns passively. Once deployed, the trap remains in place, allowing aquatic species to enter while preventing them from escaping.

The fish pot features a mesh size ranging from 10 to 13cm, enabling the selective capture of larger species while allowing smaller organisms to pass through. The netting is tightly wrapped around a sturdy bamboo framework, giving it its distinctive conical shape. At the top of the pot, a non-returning valve, typically made from bamboo strips or a plastic tube, functions as a one-way entry system. This valve is sufficiently large to permit freshwater prawns to enter but effectively prevents their escape **(Petetta *et al.*, 2021)**.

The fish pot, measuring approximately 2.5 feet in diameter and height, provides ample space for captured species. This gear is designed for passive fishing, enabling fishers to leave the trap submerged while capturing target species with minimal supervision. The fish pot exemplifies the integration of traditional fishing knowledge and

sustainable resource management, underscoring its significance in the livelihoods of local fishing communities within Ligawasan Marsh.

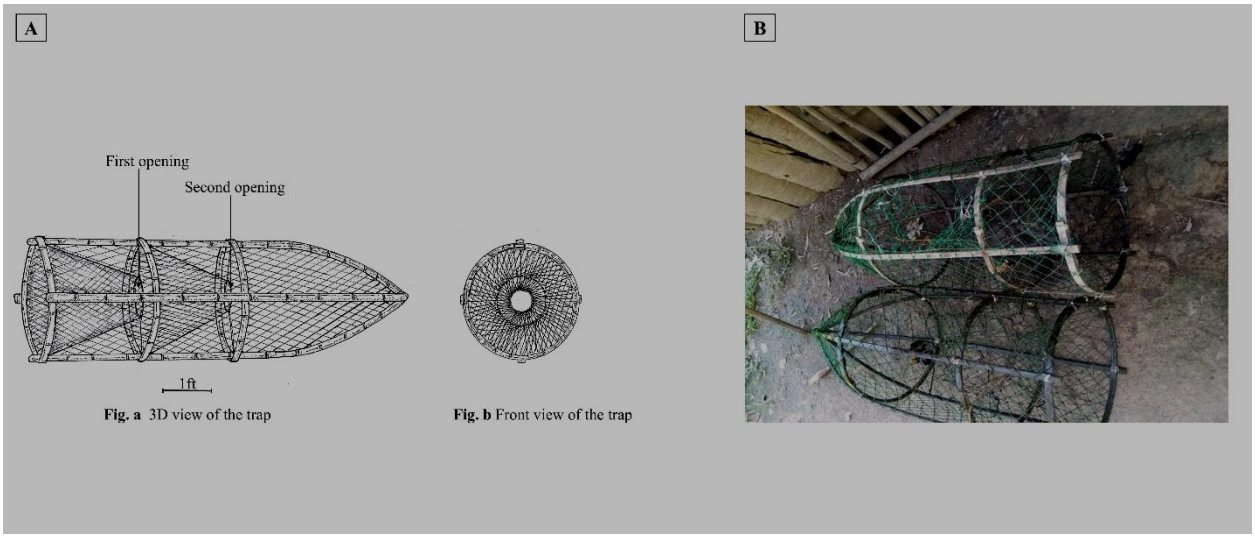

Fig. 5. (A) Design and illustration of the fish pot and **(B)** actual photo of the fish pot

Cast net

The cast net (Fig. 6), locally called "laya" or "byala," is an active fishing gear widely used in Ligawasan Marsh. Unlike passive fishing methods, the cast net requires skill and physical effort from the fishers. The typical cast net measures 6 to 8 feet long and has a mesh size of approximately 15cm. The net is equipped with weights, typically 1 to 1.5 lbs per foot, allowing it to sink rapidly and spread out upon entering the water.

Fishers deploy the cast net using a circular throwing motion, maximizing the area covered. The weights facilitate quick sinking, trapping fish and prawns beneath as the net settles. This gear is particularly effective for bait fishing and is commonly used near areas with vegetation where target species are likely to congregate.

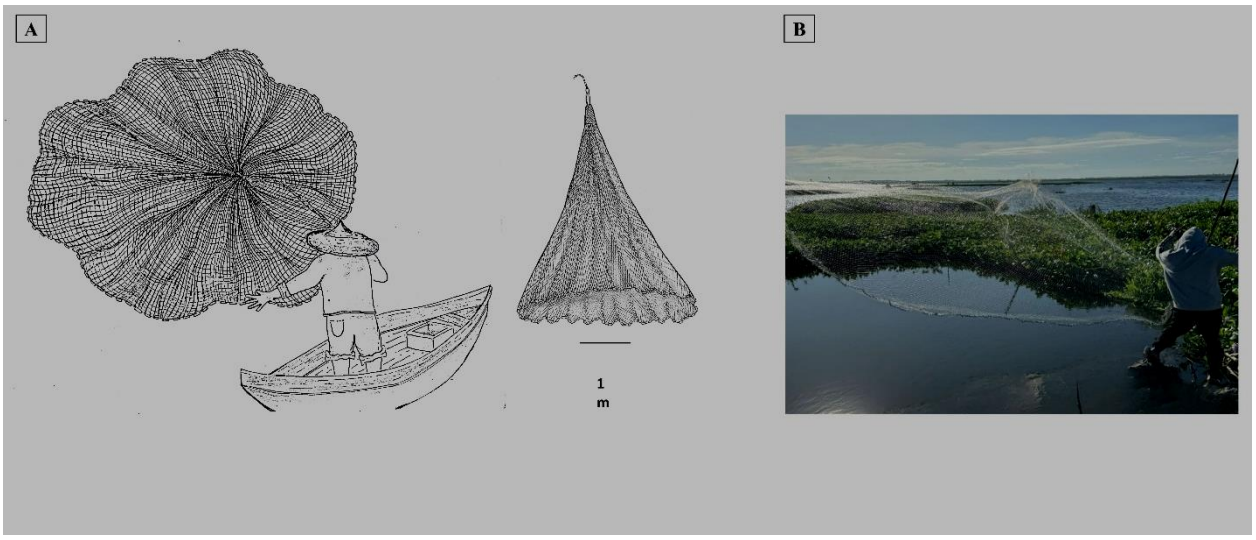

Fig. 6. (A) Design and illustration of cast net and **(B)** actual photo of cast net

Role of grated coconut in freshwater prawn fishing

An innovative fishing technique utilized in Ligawasan Marsh involves using grated coconut as bait for freshwater prawns. In this method, grated coconut is placed in fishing nets before collection, serving as an attractant due to its scent and taste. This approach influences the natural feeding behavior of prawns, potentially enhancing catch efficiency. Additionally, using grated coconut is both cost-effective and environmentally sustainable, making it a promising strategy for promoting sustainable fishing practices (Table 6).

Survey results indicate a high adoption rate of this technique among prawn collectors across different locations. In Ebpanan, 88.46% of prawn collectors reported using grated coconut as bait, while 11.54% employed alternative methods. Similarly, in Liguasan, 89.19% of collectors utilized grated coconut, whereas 10.81% opted for other baiting techniques. In Libungan, 86.49% of prawn collectors adopted this method, while 13.51% did not. These findings suggest that most prawn collectors in the Ligawasan Marsh recognize the advantages of grated coconut as bait, particularly in improving catch efficiency and supporting sustainable fisheries management.

Table 6. Responses on the utilization of grated coconut as a lure for catching prawns (N=126)

Sampling sites (Respondents)	**(Response)**			
	Respondents who use a lure		**Respondents who do not use lure**	
	No.	%	No.	%
Ebpanan Marsh (n= 52)	46	88.46	6	11.54
Liguasan Marsh (n= 37)	33	89.19	4	10.81
Libungan Marsh (n= 37)	32	86.49	5	13.51
Total (n=126)	111	88.05	15	11.95

Influence of lunar phases and seasonal variations on fishing activity

Table (7) presents fishers' perceptions regarding the effects of lunar phases and seasonal variations on fishing activities across three marshes in Ligawasan Marsh. The results indicated that the new moon phase was the most favorable period for prawn collection, with the highest fishing activity recorded in Libungan (64.86%), followed by Liguasan (54.06%) and Ebpanan (50.00%). Conversely, fishing activity declined during the quarter moon and full moon phases across all sites, suggesting a potential influence of lunar illumination on prawn behavior and fisher success rates.

Seasonal variations also significantly impact fishing patterns. Most fishers (85.49%–90.38%) fish during the wet or rainy season. Fishing activity during the dry or summer season was recorded only in Libungan (10.81%), while no activity was reported in Ebpanan and Liguasan. A small proportion of respondents reported year-round fishing, with the highest percentage observed in Liguasan (13.51%). These findings suggested that fishers strategically adjust their fishing efforts in response to lunar and seasonal cycles to maximize catch efficiency.

Table 7. Responses on the lunar periodicity and seasonality of the catch abundance of freshwater prawn in Ligawasan Marsh in Ligawasan Marsh. N=126

Fishing Condition (Response)	**Sampling sites**					
	Ebpanan n=52		**Liguasan n=37**		**Libungan n=37**	
	No. of respondents	%	No. of respondents	%	No. of respondents	%
Lunar phase						
New moon	26	50.00	20	54.06	24	64.86
Quarter moon	17	32.69	11	29.73	9	24.32
Full moon	9	17.31	6	16.22	4	10.81
Seasonal variation						
Dry or summer season	0	0.00	0	0.00	4	10.81
Wet or rainy season	47	90.38	32	85.49	32	86.49
Any season	5	9.62	5	13.51	1	2.70

Fishing frequency across sampling sites

Table (8) summarizes the fishing frequency across the study sites, revealing that daily fishing was the most prevalent practice. Overall, 93.59% of fishers reported daily fishing, with Liguasan and Libungan exhibiting a 100% daily fishing rate. In contrast, in Ebpanan, 80.77% of fishers engaged in daily fishing, while 9.62% fished every other day or every two days. These results highlighted the economic and subsistence significance of the freshwater prawn collection in the region, demonstrating its role as a vital and consistent livelihood activity for local fishers.

Table 8. Responses of fishermen on fishing frequencies for catching freshwater prawn in Ligawasan Marsh

Sampling site (Respondents)	Fishing trip (Response)					
	Everyday		Every other day		Every other two days	
	No.	%	No.	%	No.	%
Ebpanan Marsh (52)	42	80.77	5	9.62	5	9.62
Liguasan Marsh (37)	37	100.00	0	0.00	0	0.00
Libungan Marsh (37)	37	100.00	0	0.00	0	0.00
Total (126)	**116**	**93.59**	**5**	**3.21**	**5**	**3.20**

Highest and lowest catch per quarter

Understanding seasonal variations in freshwater prawn catch abundance is essential for effective fisheries management and promoting sustainable fishing practices. Table (9) presents the quarterly distribution of prawn catches across the three marshes, revealing significant seasonal trends.

The highest prawn catch abundance was recorded during the July–September period across all sites, with Ebpanan (30.77%), Liguasan (40.54%), and Libungan (32.43%), indicating a peak in prawn availability during this quarter. In contrast, the lowest prawn catch abundance occurred between January and March, with the highest proportion of minimal catches observed in Ebpanan (38.46%), Liguasan (40.54%), and Libungan (43.24%). These findings suggest that seasonal factors strongly influence prawn populations and fisher success rates.

Additionally, year-round fishing activity was evident, as prawn catches recorded from January to December accounted for 19.23% in Ebpanan and 21.62% in both Liguasan and Libungan. It indicates that while prawn fishing remained a continuous practice, seasonal fluctuations had a significant impact on catch rates. These insights can inform fisheries management strategies to optimize prawn harvests while ensuring long-term sustainability.

Table 9. Quarterly variation in freshwater prawn catch based on respondent responses (N=126)

Quarterly Catch (Response)	Sampling sites (Respondents)											
	Highest catch						Lowest catch					
	Ebpanan n=52		Liguasan n=37		Libungan n=37		Ebpanan n=52		Liguasan n=37		Libungan n=37	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Jan-Mar	6	11.54	6	16.22	3	8.11	20	38.46	15	40.54	16	43.24
Apr-Jun	14	26.92	9	24.32	9	24.32	17	32.69	16	43.24	15	40.54
Jul-Sep	16	30.77	11	29.73	13	35.14	6	11.54	2	5.41	0	0.00
Oct-Dec	6	11.54	3	8.11	4	10.81	4	7.69	2	5.41	3	8.11
Jan-Dec	10	19.23	8	21.62	8	21.62	5	9.62	2	5.41	3	8.11

Influence of lunar phases and seasonal cycles on daily landed catch

Understanding the relationship between daily freshwater prawn catch volumes, lunar phases, and seasonal cycles is essential for effective fisheries management. The interaction between the wet season, the new moon, the dry season, and the full moon plays a significant role in shaping prawn behavior and influencing catch success. These natural cycles affect prawn aggregation and dispersal patterns, which, in turn, impact fishing efficiency.

Table (10) presents the estimated daily catch volumes of freshwater prawns across three marshes in Ligawasan Marsh, highlighting variations driven by seasonal and lunar influences. During the wet or rainy season, the proportion of fishers reporting catch volumes exceeding 10 kg per day was notably high, with 84.62% in Ebpanan, 100.00% in Liguasan, and 94.59% in Libungan. In contrast, during the dry or summer season, the percentage of fishers achieving similar catch volumes was significantly lower (25.00% in Ebpanan, 18.92% in Liguasan, and 5.41% in Libungan). These findings suggest that the wet season provides optimal conditions for prawn collection, facilitating higher catch yields.

Lunar cycles also influenced the availability and catch success of prawns. The new moon phase increased catch volumes, as prawns tend to cluster in darker conditions. Consequently, the proportion of fishers reporting catches exceeding 10kg per day was 82.69% in Ebpanan, 100.00% in Liguasan, and 97.30% in Libungan. In contrast, during the full moon phase, when prawns are more dispersed, catch volumes exceeding 10kg per day were significantly lower, at 23.08% in Ebpanan, 16.22% in Liguasan, and 2.70% in Libungan.

These findings indicate that fishers strategically align their fishing activities with lunar and seasonal patterns to maximize catch efficiency. The dominance of catches exceeding 10kg per day during the wet season and new moon highlights the importance of environmental conditions in sustaining high prawn yields. Liguasan consistently

recorded the highest proportion of large prawn catches, while Ebpanan exhibited slightly lower percentages, suggesting a more diverse prawn size distribution in this marsh.

Table 10. Fisher's perception of the daily landed catch influences the lunar and seasonal cycle. N=126

Estimated catch per kilo (Response)	Sampling sites (Respondents)					
	Ebpanan n=52		Liguasan n=37		Libungan n=37	
	No.	%	No.	%	No.	%
Wet						
>10	44	84.62	37	100.00	35	94.59
<10	8	15.38	0	0.00	2	5.41
Dry						
>10	13	25.00	7	18.92	2	5.41
<10	39	75.00	30	81.08	35	94.59
New Moon						
>10	43	82.69	37	100.00	36	97.30
<10	9	17.31	0	0.00	1	2.70
Full Moon						
>10	12	23.08	6	16.22	1	2.70
<10	40	76.92	31	83.78	36	97.30

DISCUSSION

Socio-demographic trends

The socio-demographic characteristics of freshwater prawn fishers in Ligawasan Marsh, Southern Philippines, exhibit different patterns across different groups and locations. Most fishers were men aged 31 to 40 years, with primary education as their highest level of formal schooling. Most were married, though a higher proportion of single fishers was observed in Liguasan and Libungan. Family sizes typically ranged from six to eight members, and most fishers had three to five years of fishing experience. These findings underscore the importance of adopting sustainable fishing practices to promote community livelihoods and to ensure the long-term availability of resources.

Several socio-demographic factors, including age, education, and income, have a significant influence on fishing practices. Fishers with higher educational attainment demonstrated greater awareness of environmental issues and sustainable fishing methods, aligning with findings from **Cinner *et al.* (2009)**. Income levels also varied among the study sites, with Ebpanan reporting the highest average monthly income (₱12,427.73). It suggests that better financial resources may facilitate access to improved fishing equipment, such as fish traps and advanced harvesting techniques.

Investing in education and promoting sustainable fishing practices can enhance fishers' economic well-being while ensuring the long-term viability of fisheries. **Jenkins and Garrison (2012)** emphasized the importance of understanding the types of fishing

gear and their ecological impacts. A comprehensive assessment of various fishing methods and their effects on aquatic ecosystems can inform the development of management strategies that balance fishing activities with conservation efforts. Such an approach is crucial in preventing resource depletion, minimizing habitat degradation, and preserving the biodiversity of marsh ecosystems.

Fishing gear and practices

Fishing in Ligawasan Marsh requires striking a balance between resource extraction and environmental conservation to ensure long-term sustainability. This ecosystem, which includes the Ebpanan, Liguasan, and Libungan marshes, presents distinct ecological and socio-economic challenges. Fishers aim to maximize their catch while minimizing the ecological impact on the marsh's biodiversity. The selection of fishing gear plays a crucial role in achieving this balance, with fish traps being the most commonly used gear across all sites, 71.15% in Ebpanan, 48.65% in Liguasan, and 67.75% in Libungan. Cast nets are also utilized; however, they pose a risk of unintentional bycatch, including non-target species such as carp and tilapia **(Okoh *et al.*, 2007)**.

The sustainability of freshwater prawn fishing is significantly influenced by gear selection, as different fishing methods vary in efficiency and ecological impact **(Bonjoru *et al.*, 2019)**. The diversity of fishing techniques employed across the marshes reflects the area's ecological richness and the adaptability of local fishers. Understanding these gear choices provides valuable insights into local fishing practices and their implications for sustainability.

Local environmental conditions and seasonal variations significantly impact the success of prawn fishing and the gear used. For instance, harvesting nets are more commonly used during the dry season when prawn populations are more concentrated. Each marsh has developed site-specific fishing practices tailored to local ecological and hydrological conditions, contributing to the region's overall resilience and sustainability of prawn fishing. A comprehensive understanding of fishing gear use and its ecological effects is essential for developing management strategies that align fishing practices with conservation efforts, ensuring the long-term health of the Ligawasan Marsh ecosystem.

Role of grated coconut bait in Ligawasan

Using grated coconut as bait is a well-established and highly effective technique for enhancing freshwater prawn capture. The strong aroma of coconut attracts prawns toward the nets and significantly improves catch efficiency **(Pacho *et al.*, 2021)**. This method is widely practiced across Ligawasan Marsh, with a substantial majority of prawn collectors in Ebpanan, Liguasan, and Libungan incorporating it into their fishing strategies. The widespread adoption of this baiting technique emphasizes its effectiveness and reflects the deep-rooted traditional ecological knowledge within fishing communities.

Although the use of grated coconut is prevalent, variations in adoption rates exist among fishers. These differences may be attributed to factors such as local fishing preferences, the availability of coconut as a resource, and individual adaptations of fishing methods. Such variability highlights the adaptability and resourcefulness of prawn collectors, who modify their techniques to align with local environmental conditions and fishing practices.

Beyond its role in improving catch efficiency, grated coconut bait also holds cultural and ecological significance. This practice reflects the traditional fishing heritage of Ligawasan Marsh communities and demonstrates an environmentally sustainable approach, as coconut is a biodegradable and locally available resource. Understanding the role of traditional baiting methods in prawn fishing can provide valuable insights for developing sustainable fisheries management strategies, ensuring both economic benefits for local fishers and the long-term conservation of freshwater ecosystems.

Catch trends in response to seasonal changes and lunar phases

The seasonal patterns and daily catch volumes of freshwater prawns in Ligawasan Marsh provide critical insights for effective fisheries management. During the dry season, significant reductions in water levels alter fishing dynamics, prompting many fishers to temporarily shift their focus to inland agriculture. While some marsh areas experience severe water scarcity, others retain sufficient water to support continued fishing activities. This adaptive strategy enables fishers to sustain their livelihoods and food security within their communities. The transition between fishing and agricultural activities during periods of low water availability highlights the resilience and resourcefulness of fishers in responding to environmental fluctuations.

In contrast, the wet season provides optimal conditions for freshwater prawn populations, resulting in a marked increase in fishing activities. Elevated water levels enhance habitat suitability and food availability, increasing prawn abundance and catch rates. Fishers in Ebpanan, Liguasan, and Libungan capitalize on this seasonal abundance by employing various harvesting techniques to maximize yields. Furthermore, fishing during the wet season is associated with a lower environmental impact, as increased water availability reduces habitat disturbance and stress on aquatic populations **(Ihsan *et al*., 2023)**.

Lunar phases also play a significant role in influencing prawn catch rates. During the new moon, when nights are darkest, fishers report the highest catch volumes, as prawns tend to aggregate rather than disperse without moonlight. This behavioral response facilitates more efficient harvesting. However, excessive rainfall during this period can increase water turbidity and disrupt prawn habitats, negatively affecting survival and catch rates. To mitigate these potential challenges, site-specific environmental conditions, including flood risks and sedimentation levels, must be taken into account in fisheries management strategies.

Data from the three marshes indicate that daily fishing is the most common and sustainable harvesting method, regardless of seasonal variations. Catch volumes are notably influenced by lunar cycles, with more enormous prawns (exceeding 10kg) dominating harvests during peak conditions. Frequent harvesting of prawns may contribute to population replenishment by preventing the overexploitation of specific cohorts while distributing fishing pressure more evenly across the ecosystem. However, sustainable management strategies must be adapted to account for prawn species composition, environmental factors, and ecosystem dynamics to ensure the long-term viability of fisheries **(Edmondson & Fanning, 2022)**.

These findings highlight the importance of integrating ecological knowledge into fisheries management to promote sustainability. Adopting adaptive fishing strategies and resource management frameworks can help safeguard prawn populations while supporting the economic stability of local fishing communities.

Comparative insights from Southeast Asia

The fishing practices and socio-ecological patterns observed in Ligawasan Marsh parallel broader trends in Southeast Asia's inland fisheries. In the Philippines, **Agtong *et al.* (2022)** reported that community knowledge of fish behavior and sustainable practices in Lake Mainit was strongly influenced by household income and education. Similarly, in Thailand's Pak Phanang River Basin, fishers, many of whom live below the poverty line, have responded to declining fish stocks and water quality degradation by adopting selective conservation practices that align with their livelihood needs **(Sakset *et al.*, 2013)**.

In the Pak Peung wetlands of Lao PDR, **Millar *et al*. (2019)** reported that most fishers engage in part-time, seasonal fishing. Women target a wider range of species closer to villages, while fish populations decline due to habitat loss, irrigation, population growth, and illegal fishing. The installation of a fishway, which enables the migration of Mekong River species, has led to the return of previously absent, endangered, and vulnerable fish, underscoring the need for enhanced regulation, enforcement, and gender-inclusive fisheries governance.

Seasonality is a recurring theme across the Southeast Asian region. In Sarawak, Malaysia, **Mustafa *et al*. (2021)** observed distinct seasonal fluctuations in fish landings, with stable catches from March to August and declines during the wet season, attributed to variations in species availability. Similarly, in Myanmar's Sunye Lake, **Winn *et al*. (2021)** recorded 25 species showing seasonal changes in abundance and composition, though diversity indices showed no significant variation.

Hydrological adaptation is common in the Mekong Basin, where communities alternate between farming and fishing, relying on traditional gear and ecological knowledge **(Morton *et al*., 2013)**. In Indonesia, **Setiadi (2015)** documented the use of

beje traps in peatland wetlands to retain fish during breeding periods, compensating for seasonal catch reductions.

Institutional challenges persist in efforts to introduce alternative livelihoods. In Vietnam's Tam Giang Lagoon, attempts often failed due to the weak integration of local needs, limited institutional capacity, and a lack of government support **(Hanh, 2021)**. These examples stress the importance of participatory, locally informed governance for small-scale fisheries.

In Ligawasan Marsh, where seasonal and lunar cues significantly influence freshwater prawn collection, these regional insights underscore the importance of integrating traditional knowledge with ecological science. Lessons from Southeast Asia offer valuable guidance for designing context-appropriate fisheries management policies in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM).

Policy recommendations

Findings from the study on freshwater prawn fisheries in Ligawasan Marsh, Southern Philippines, highlight the need for targeted policy interventions to enhance local fisheries management. Several key strategies should be implemented to ensure the long-term sustainability of prawn populations and the livelihoods of fishers.

Promoting sustainable fishing practices by enforcing regulations aligned with seasonal cycles, size restrictions, and catch limits is essential for preventing overexploitation and ensuring population replenishment. Seasonal fishing moratoriums during peak breeding periods should be considered to protect juvenile and breeding stock. Additionally, establishing education and skill development programs can enhance fishers' knowledge and technical capabilities, particularly in sustainable aquaculture techniques and resource conservation. Training initiatives should focus on responsible fishing practices, habitat protection, and adaptive strategies to mitigate the impacts of environmental changes.

Developing comprehensive guidelines and protocols for the responsible collection of prawn breeders will help maintain population stability while maximizing economic benefits. These regulations should emphasize selective harvesting techniques that minimize ecological disruption. Moreover, engaging local fishing communities in decision-making ensures that management strategies align with their needs and priorities. Collaborative governance approaches, including co-management models, can enhance compliance and promote locally adapted solutions for fisheries management.

Integrating traditional ecological knowledge with scientific research will provide a robust foundation for evidence-based policy development. Collaborative studies and data-sharing initiatives can support adaptive management strategies that balance conservation goals with socio-economic needs. Implementing these policy recommendations will contribute to the long-term sustainability of freshwater prawn

fisheries in Ligawasan Marsh, ensuring ecological resilience while supporting the economic well-being of local fishers.

Study limitations and future directions

This study provides valuable insights into the socio-demographics and fishing practices of freshwater prawn collectors in Ligawasan Marsh, primarily based on self-reported data that reflect fishers' perspectives on catch volumes and seasonal trends. Conducted over a period of one year, it provides a comprehensive overview while acknowledging the need for future studies to capture interannual variations in environmental conditions and prawn populations. Although direct catch quantification and biomass assessments were not conducted, the findings establish a foundation for understanding fishing pressure and the status of the resource. Logistical and security constraints limited ecological surveys in certain areas, emphasizing the necessity for broader spatial coverage.

Future research should incorporate direct sampling, standardized biomass measurements, and multi-year monitoring to enhance ecological understanding and support sustainable fisheries management in Ligawasan Marsh. Additionally, investigating socio-economic factors influencing fishing techniques is essential for promoting sustainable livelihoods alongside aquatic resource conservation **(Tolentino-Zondervan & Zondervan, 2022)**. Integrating scientific training programs and innovative technologies into local fishing practices can significantly improve conservation efforts by equipping communities, stakeholders, and entrepreneurs with advanced knowledge and tools. It will help mitigate conflicts, strengthen community resilience, and encourage the adoption of sustainable fishing methods.

Furthermore, future interventions should prioritize systematic data collection on actual daily catch volumes and gear utilization. Such data are crucial for assessing fishing pressure, detecting trends in resource utilization, and developing targeted strategies for effective fisheries management. A data-driven approach will enable policymakers and resource managers to develop adaptive regulations that balance ecological sustainability with the economic well-being of fishing communities.

By addressing these research gaps and implementing evidence-based interventions, future efforts can contribute to the long-term sustainability of freshwater prawn fisheries in Ligawasan Marsh. Strengthening collaboration among researchers, policymakers, and local fishers will ensure that management strategies are both ecologically sound and socially inclusive, fostering a sustainable and resilient fishery sector.

CONCLUSION

This study demonstrated that fish traps are the predominant fishing gear used by freshwater prawn collectors in Ligawasan Marsh, followed by harvesting nets, fish pots, and cast nets. The widespread use of grated coconut as bait also emerged as a highly

effective and culturally embedded fishing practice. Socio-demographic analysis revealed that most fishers were male, aged 31 to 40, with primary-level education and large household responsibilities, factors that shape fishing strategies and economic resilience within Ligawasan Marsh communities.

Seasonal and lunar cycles had a significant influence on catch volumes, with higher yields recorded during the rainy season and the new moon phase. These patterns emphasize the role of traditional ecological knowledge in shaping adaptive fishing practices. The integration of such indigenous insights with empirical data strengthens the basis for effective and context-specific fisheries management.

To ensure the sustainability of freshwater prawn fisheries in Ligawasan Marsh, a multifaceted management approach is essential, one that considers both ecological variability and the socio-economic realities of local communities. These findings can inform regional fisheries policies and support the development of community-based resource management frameworks. Furthermore, the insights gained may serve as a foundation for scaling up sustainable fishing practices in other wetland systems across Southeast Asia, contributing to broader conservation goals and improved rural livelihoods.

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