

Practices and challenges in Pijanga (*Glossogobius giuris* H.) fishing across Lake Mainit, Philippines

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ABSTRACT

Lake Mainit is the fourth-largest Lake in the Philippines, playing a crucial role in the lives of local fishermen who rely on Pijanga fishing as their primary source of income. This study examines the livelihood practices and challenges of fishermen, using semi-structured questionnaires administered to 90 respondents. The data collected were tabulated in frequency and percentages. Point-biserial and Spearman's rho correlation tests were utilized to determine the significant relationship between practices and socio-demographic variables using Jamovi, an open statistical software. The findings showed that their primary way of catching fish is by using a modified cast net at 65.56% followed by Gillnets and spears at 36.67% and 12.22%, respectively. Most of the challenges they encountered were related to natural disasters (83.33%), adverse weather conditions (57.78%), and problems with boat or fishing equipment (35.56%). Moreover, there was no significant correlation between age of the respondents and the variables of full-time fishermen ($p=0.210$), catch per kilo per fishing ($p=0.904$), percentage sold of Pijanga ($p=0.559$), and percentage of consumed Pijanga ($p=0.651$). Fishermen believed that pijanga fishing is a sustainable practice at 77.78% and they are aware of the prohibition of catching small fish (91.11%), prohibition of using small nets (71.11%), and banning of dynamite fishing (10%). Despite this, 51% of the respondents also believed the possibility of pijanga fishing ban in the lake. Pijanga fishing faces a range of challenges, including adverse weather, pollution, and regulatory constraints. Fishermen view pijanga fishing vital to their livelihood and community well-being. Addressing these challenges requires strong cooperation between local authorities, environmental groups, and other stakeholders to ensure the long-term health and sustainability of the Lake.

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1. INTRODUCTION

Lake Mainit, the fourth largest in the Philippines, is geographically located between the provinces of Surigao del Norte and Agusan del Norte, in the island of Mindanao (90 20.32"-9 0 31.98" N Latitude and 1250 28.50" E Longitude). It is also the deepest, with a maximum depth of about 223 meters and a mean depth of about 128 meters. It is one of the most productive lakes in the country, ranking only third to Laguna de Bay (Balayut, 1983). As it stretches across several municipalities like Tubay, Santiago, Jabonga, Kitcharao, Mainit, Alegria, Tubod, and Sison, the magnificent Lake Mainit serves as a lifeline for countless communities. Its rich waters provide vital food and livelihood, fostering a deep connection between people and nature (Apdohan et al., 2021). A study conducted by Galicia & Lopez (2000) showed that Lake Mainit

supports a high diversity of aquatic fauna and a thriving freshwater fishery.

One of the dominant and economically important fish species found in Lake Mainit is the tank goby, also known locally as "Pijanga" (Pauly et al., 1990; Galicia & Lopez, 2000; Catoto, 2015). It holds great significance in Lake Mainit as a primary fishery resource (Gorospe et al., 2013). Pijanga (*Glossogobius giuris* H.) accounts for 48.4% of catch from a report in the year 2007–2008 by de Guzman et al. (2008). It is a small, freshwater fish that serves as a popular commercial food source, developed in the form of "bulad Pijanga" or dried tank goby, for local and international export (Agtong et al., 2022). The fish is a crucial source of income for impoverished fishing families residing along the 64-kilometer stretch of the coast. The towns around Lake Mainit have embraced dried Pijanga as a well-loved product, establishing it as the iconic

symbol of the Lake. However, the population of *G. giuris* in the Lake has apparently decreased over the years due to unsustainable fishing practices, particularly the harvesting of its fingerlings (Battad, 2018).

Environmental perturbations such as prevalent and irresponsible mining, poor agricultural practices, human-induced activities, soil erosion, and fishing malpractices have contributed to ecological risks and pollution (Ebol et al. 2020). Past reports have detected lead, cadmium, and mercury in the Lake Mainit waters, but the levels were not alarming (Ebol et al. 2020). While the levels of these metals may not yet pose immediate health risks to humans, the potential for long-term exposure and bioaccumulation remains a significant concern. The presence of heavy metals in Lake Mainit's ecosystem can have far-reaching consequences. These metals can disrupt the delicate balance of the lake's food chain, affecting the health and reproduction of various aquatic organisms. Additionally, heavy metals can accumulate in the tissues of fish, posing a potential health risk to those who consume them. The primary sources of heavy metal contamination in Lake Mainit are small-scale gold mining activities, agricultural runoff, and untreated wastewater discharges from nearby towns. These activities release heavy metals, such as lead, mercury, cadmium, into the environment, where they eventually find their way into the lake's water and sediments.

Fishing is the primary livelihood for many people in the municipalities nearby. However, the Lake is facing increasing pressure from anthropogenic activities, such as unsustainable fishing practices, the use of agrochemicals, and mining, which result in the accumulation of heavy metals in its waters and sediments. The risk of heavy metal accumulation in the human body's tissues is a matter of great concern, depending on the frequency of fish consumption and the level of exposure (Elvira et al., 2021). These heavy metals pose a significant threat to the health of the Pijanga and the communities that rely on them for food and livelihood. In recent years, there has been a decline in the Pijanga population in the Lake. This has hurt the livelihoods of many people in the affected municipalities. A study conducted by the International Labour Organization found a 20% decline in the average income of local fishermen in the Municipality of Jabonga from 2010 to 2013. Several factors contribute to the decline of the pijanga population. This includes overfishing, habitat loss, and pollution. Moreover, previous studies have assessed the ecological state of Lake Mainit and the perceived knowledge of communities regarding fish health and lake resource utilization (Demetillo et al., 2015; Ebol et al., 2020; Paylangco et al., 2020; Agtong et al., 2022). They recommended several measures to address the decline in the Pijanga population, including restoring fish habitats and

reducing lake pollution. Thus, the present study evaluated the different practices, challenges, and perceptions of local fishermen towards pijanga fishing.

2. MATERIALS AND METHODS

2.1. Research locale

The study focuses on the selected respondents in the municipalities of Kitcharao, Alegria, and Jabonga (Figure 1). Lake Mainit spans the southern part of Surigao del Norte and the northern part of Agusan del Norte, encompassing a total of eight municipalities. The Lake Mainit area, along with its watershed, is situated on a small peninsula that extends north from the eastern side of Mindanao. Lake Mainit has a total watershed area of 87,072 hectares, of which about 75% is classified as forestlands, and the remaining 25% is Alienable and Disposable land. Patches of remaining old-growth forests at present are found in Alegria, Jabonga, and Santiago, while large areas of the forestlands are presently converted for agriculture.

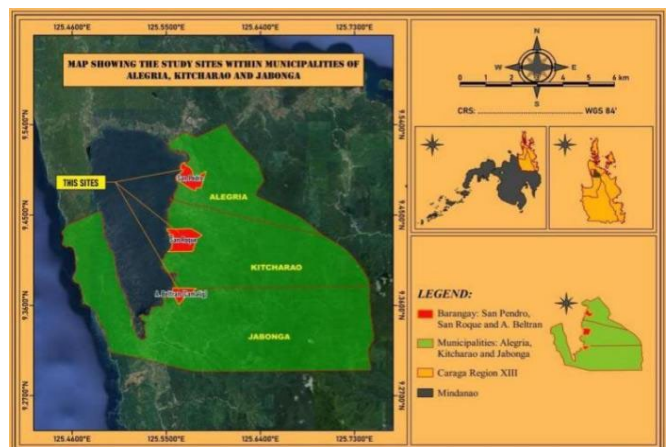


Figure 1: Map showing the three municipalities, namely: Jabonga, Kitcharao, and Alegria

2.2. Selection of Respondents

The respondents were selected through a purposive sampling via the snowball technique. Snowball sampling involves asking initial respondents to refer others who meet the study's criteria, allowing researchers to expand their sample through social networks (Hair et al., 2020). The advantages of the snowball sampling include access to hard-to-reach respondents, cost-effectiveness and time efficiency and higher response rates (Ting et al., 2025). In this study, a total of 90 respondents, 30 respondents from three different municipalities- Jabonga, Kitcharao (Province of Agusan del Norte), and Alegria (Province of Surigao del Norte).

2.3. Research Instrument

The researchers used a semi-structured questionnaire that had been pre-validated by a university-based statistician. This process included a field survey with

the selected respondents. The questionnaire included questions specifically designed to elicit detailed or typed responses. Verbal consultations and planning with concerned authorities were conducted prior to the survey to ensure the safety of the researchers and the respondents.

2.4. Data Analysis

The data was summarized, tabulated, and trends were identified. Thematic and narrative analyses were applied to the qualitative data. A correlation test was also conducted to determine the significant relationship between practices and the socio-demographic profile of the respondents. Point-biserial and Spearman's rho correlation tests were conducted using a free and open-source statistical package- Jamovi 2.4. <https://www.jamovi.org/download.html>

2.5. Ethical Consideration

To safeguard the rights of the participants, the researchers carefully handled various ethical considerations throughout the research. Before conducting the study, the researchers communicated with the municipal mayor, explaining the study's purpose, and assured the respondents of complete confidentiality and anonymity throughout and after data collection. The researchers are the sole individuals aware of the participants' identities and their responses to the questionnaire.

3. RESULT AND DISCUSSION

3.1 Socio-demographic Profile of the Respondents

Table 1 shows the demographic profile of the respondents. Out of 90 respondents, only one was Female, and the remaining 89 were male. This is because, traditionally, fishing has been viewed as a masculine activity that requires physical strength and risk-taking, often associated with venturing out to sea. This aligns with historical gender norms that placed men in the role of providers and protectors (WorldFish, 2016). As for the Marital Status of the respondent, 56.67% were married, 25.56% were common-law/lived-in, 12.22% were Single, and only 5.56% were divorced/separated. For the Educational Attainment of the respondents, both Elementary Level and Elementary Graduates garnered 30%, while High School was 25.56%, 11.11% were High School Graduates, and 2.22% Were at the College Level, while 1.11% had no educational attainment at all. Elementary education has the highest attendance rate among all levels of education. This could be attributed to fishing communities, which may have traditions of starting work at a young age, potentially leading to early school leavers helping to support their families (Iversen, 2002). For the Civil Society/Organizational Membership category, the majority of respondents were members of the Association of

Farmers/Fisherfolk, accounting for 63.33%. Cooperative of Farmers/Fisherfolks accounted for 6.67%, PWD and Kitcharao Mafia Fisherfolks (KIMAFI) for 2.22%, and BAGRAS for 1.11%. The average number of years of residency for the respondents was 34.77 ± 15.99 . This means that they have a long history of making a living near the Lake, and the practices have been passed from generation to generation.

Table 1: Distribution of demographic profile of the respondents.

Variables	Category	Frequency	Percentage (%)
Sex	Male	89	98.89
	Female	1	
Marital Status	Married	51	56.67
	Common-law/ lived-in	23	25.56
	Single	11	12.22
	Divorce/Separated	5	5.56
	Widowed	0	-
No. of Children (Mean ± SD)	3.53±2.07		
Educational Attainment	Elementary level	27	30
	Elementary Graduate's	27	30
	High School Level	23	25.56
	High School Graduate	10	11.11
	College Graduate	2	2.22
	None	1	1.11
Civil Society Organizational Membership	Association of Farmers/Fisher folks	57	63.33
	Cooperative of Farmers/Fisher folks	6	6.67
	PWD	2	6.67
	Kitcharao Mafia Fisher folks	1	1.11
	BAGRAS	1	1.11
	Years of Residency (Mean ± SD)	34.77 ± 15.99	

3.2 Pijanga Fishing Practices

Table 2 presents the various practices and methods employed in Pijanga fishing. Fishing methods, using Modified Cast Nets or Laya/Laja, accounted for 65.56%, while Gillnets or Pukot were used at 36.67%, and the usage of Spears or Pana was at 12.22%. According to the respondents, they prefer using Modified Cast Nets or Laya over other fishing tools because the design of Laya enables a broader spread compared to traditional cast nets. This wider spread potentially increases their catch of fish. Moreover, for the Work as Fisherfolk, 71.11% were on a Full-Time Basis, while the remaining 28.89% were on a Part-Time Basis. The number of hours when they usually go fishing had a total mean of 11.73 ± 0.96 with a range of 10.77 to 12.96. While Pijanga fishing serves as their primary source of income, 81.11% answered 'Yes', and only 18.89% answered 'No'. Accordingly, Lake Mainit is a vital resource for the local community, providing essential benefits through its significant fishery, which serves as a primary source of livelihood for the people living in the surrounding areas. The community surrounding Lake Mainit

derives significant economic benefits from the Lake's robust fishery, which substantially contributes to the financial well-being of its residents. Lake Mainit's role in sustaining a thriving fishing industry not only supports the local population's livelihoods but also has significant socioeconomic implications, fostering community resilience and prosperity.

Table 2: Practices and methods in Pijanga fishing

Variable	Category	Frequency	Percentage (%)
Fishing methods	Modified cast net/Laya	59	65.56
	Gillnet	33	36.67
	Spears	11	12.22
Work as a Fisherfolk	Full-time basis	64	71.11
	Part-time basis	26	28.89
No. of hours fishing (Mean ± SD)	11.73±0.96		
Pijanga fishing is the primary source of income	Yes	73	81.11
	No	17	18.89

3.3 Pijanga Selling Practices

Table 3 presents the Pijanga Selling Practices of the respondents, showing the average catch per kilogram of Pijanga across different fishing ranges, ranging from 25.54 to 92.9. The average percentage of Pijanga sold ranges from approximately 79.7% to 103.96%. The average percentage of Pijanga consumed by the respondents ranges from 0.7 to 26.28, and the average percentage of Pijanga used to make dried fish was about 10.00. The respondents mostly sold their caught fish in San Roque Fish Landing, Kitcharao, with 33.33%, and in both Beltran Fish Landing, Jabonga, and Direct to Market, Alegria, at 32.22%. Some respondents preferred selling the fish they caught at fish landings or directly to markets because these fish are guaranteed to be bought by fixed buyers. The average selling price of Pijanga was around 53.8- 87.98 pesos.

Regarding the practices or actions taken with their unsold Pijanga, 47.78% of respondents stated that they would sell all of it, 42.22% would process it into dried fish, and 20% would keep it for their own consumption. This result indicates that the majority of the fish caught by the respondents are intended for sale, and unsold fish are dried to maximize their profit. Dried pijanga fish is a popular product from Lake Mainit, not only marketed within the Caraga region but also promoted in Metro Manila. The local government units, regional development authorities, and cooperatives are fully supportive of efforts to market pijanga beyond Mindanao and promote sustainable livelihood initiatives. However, a study conducted by the International Labour Organization in 2013 found that the decline in the Pijanga population in Lake Mainit hurt the

livelihoods of many people in Jabonga. The study found that the average income of fishermen in Jabonga had declined by 20% between 2010 and 2013. The study also found that many fishermen had been forced to find alternative livelihoods, such as farming or construction work. Another study conducted by the Southeast Asian Regional Center for Agriculture (SEARCA) in 2015 found that the decline in the Pijanga population in Lake Mainit is due to several factors, including overfishing, habitat loss, and pollution. The study recommended several measures to address the decline in the Pijanga population, including the development and implementation of sustainable fishing practices, restoration of fish habitats, and reduction of pollution in the Lake.

Table 3: Pijanga Selling Practices of the Respondents

Variable	Category	Frequency	Percentage
Average catch per kilo of Pijanga (kg) per fishing		59.22 ± 33.68	
Average percentage of pijanga (%) sold		91.83 ± 12.13	
Average percentage of pijanga (%) consumed		13.49 ± 12.79	
Average percentage of pijanga (%) used to make dried fish		10.00 ± 0	
Location usually has pijanga fish being sold	San Roque Fish Landing	30	33.33
	Direct Palengke	29	32.22
	Beltran Fish Landing	29	32.22
	Palengke/ Talipapa	1	1.11
	Santiago Fish landing	1	1.11
Average Actual Selling Price of Pijanga (Php) per kilo (Mean ± SD)	70.89 ± 17.09		
Practices for unsold Pijanga Fishes	Everything will be sold	43	47.78
	For consumption	38	42.22
	Make dried fish	18	20

3.4 Challenges Facing Pijanga Fishing

Figure 2 shows the challenges facing Pijanga fishing require a methodical approach that gathers insights from various quarters, pinpointing recurring issues and obstacles encountered by fishermen. Bad weather conditions (57.58%) pose significant hurdles, with storms, heavy rains, strong winds, and rough seas significantly impacting fishing endeavors. Macusi et al., (2021) reported that typhoons and heavy rains are principal factors interrupting fishing and damaging gear, forcing livelihood shifts on bad weather days. These adverse conditions not only jeopardize safety but also diminish catch potential. Issues with boats or fishing gear (35.56%), such as engine malfunctions, equipment failures, or damage to nets and lines, disrupt fishing operations and

reduce efficiency. Additionally, fishermen may incur extra expenses for repairs or replacements. Stringent fishing policies (5.56%) set by governing bodies or fisheries management authorities may impede fishing activities through regulations such as restricted seasons, catch quotas, or designated zones, requiring fishermen to adapt to these compliance measures. Natural disasters (83.33%), such as floods or earthquakes, wreak havoc on coastal communities, damaging infrastructure, vessels, and habitats. This result is strongly supported with regional and global evidence indicating that extreme weather conditions significantly reduce fishing effort, damage gears and vessels, and force fishers to suspend fishing operation and seek other alternative livelihoods (Pfeiffer et al., 2020; Macusi et al., 2021; Okeke-Ogbuafor et al., 2022). These events have long-lasting effects on both livelihoods and marine ecosystems.

Environmental pollution (23.33%) from sources such as industrial waste and plastic contamination harms marine life, diminishes fish stocks, and makes navigation challenging, thereby endangering the health of fishermen. It is evident that pollutants have a drastic effect on aquatic ecosystems, often causing mortality of fish and aquatic invertebrates and affecting community for years (Shaika et al., 2025).

Mining activities (17.78%) near coastal regions contribute to habitat degradation and water pollution, disrupting fishing grounds and jeopardizing the sustainability of Pijanga fishing. Azevedo-Santos et al., (2021) showed that mining activities generate several disturbances such as input of crude oil, heavy metals, erosion and siltation, deforestation and road construction.

Health problems (7.78%) among fishermen, exacerbated by harsh working conditions and limited access to healthcare, impair productivity and lead to income loss. Illegal fishing practices (20.00%), including overfishing and the use of banned gear, deplete fish populations, undermine conservation efforts, and threaten marine ecosystems' health. Low fish prices (1.11%) resulting from market fluctuations and oversupply deter investment in fishing operations, exacerbating economic hardships within the industry. Occasional instances of no fish caught (6.67%) due to environmental factors or poor strategies highlight the unpredictability and risks inherent in fishing, directly impacting income and livelihoods.

3.5 Perceptions of Fishermen towards Pijanga fishing regulations

Table 4 below shows that most fishermen believe pijanga fishing is a sustainable practice, with percentages of 77.78% and 16.67% for those who do not. On the other hand, there are four categories that the Fishermen knew about the policies or regulations regarding Pijanga fishing in the

municipality, those are: Prohibition of catching small fish or Saguyon 91.11%, Prohibition of using small nets 71.11%, No to compressor 16.67%, Banning of Dynamite fishing 10.00%, and Illegal Boso 7.76%. In addition, the majority of fishermen are unaware of any contamination in Lake Mainit that might harm marine resources, with 100% accuracy. Three categories of impacts of pijanga fishing on local fish populations are: Pijanga as the primary source of income (38.89%), a greater pijanga population than other fish species (10.00%), and no increase in pijanga over time (3.33%).

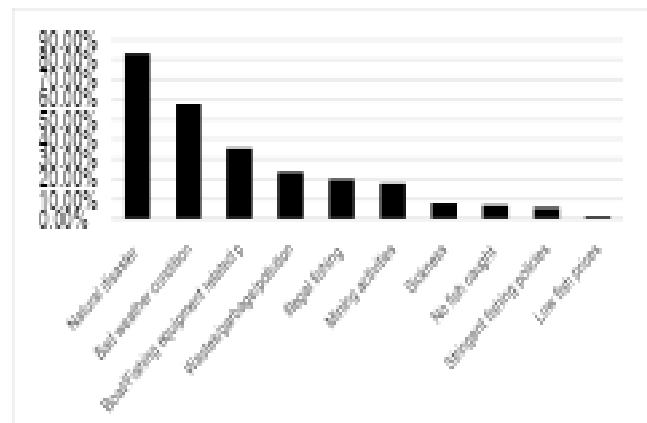


Figure 2: Challenges encountered in Pijanga fishing by the respondents

Furthermore, most fishermen have been aware of the ecological impact of Pijanga Fishing, with 64.44% participating and 35.56% not participating. Among those who did not participate, 35.56% stated that they are not members of a fisherfolk association, while the remaining 35.56% reported being unaware of any training. For the banning of Pijanga fishing, 51.11% are aware of any possibility of banning Pijanga fishing, while 37.78% do not have any expectations of banning Pijanga fishing. Lastly, they provided four pieces of feedback on conserving aquatic resources and protecting the ecosystem as fishermen, which are: following the rules/policies (67.78%), no to illegal fishing (18.89%), taking care of the Lake (11.11%), and no to dumping waste in the Lake (2.22%). Accordingly, Lake Mainit Development Alliance (LMDA), established in 1999 (de Jesus et al., 2014), provides environmental management plans and services to the adjoining areas and their communities. Some of the actors of LMDA include the provincial government of Agusan del Norte and Surigao del Norte, local government units (LGUs), Civil Society Organizations (CSOs), and government line agencies (GLAs). They promote sustainable development and safeguard the Lake and its communities from potential destructive contributors (Natad, 2018). Moreover, the Mindanao Development Authority (MinDA) has initiated a program to promote the sustainability of Pijanga fishing under the Mindanao Fisheries and Aquaculture Development

(MINFAD). The program includes the improvement of the existing "Pijanga" hatchery to ensure the availability of fingerlings for seeding in the Lake every year, as well as the

establishment of post-harvest facilities (Trozo, 2020; Agtong et al., 2022).

Table 4: Perception of Fishermen towards Pijanga fishing regulations

Variable	Category	Frequency	Percentage (%)
Believed that pijanga fishing is a sustainable practice	Yes	70	77.78
	No	15	16.67
	No response	5	5.56
Aware of any regulations or policies regarding pijanga fishing in your municipality	Prohibition of catching small fish or "sayugon"	82	91.11
	Prohibition on using small nets	64	71.11
	No to the compressor	15	16.67
	Banning of dynamite fishing	9	10
	Illegal Boso	7	7.78
Aware of any contamination in the Lake that can harm marine resources	None	90	100
Impact of Pijanga fishing on local fish populations	Pijanga as the primary source of income ¹	35	38.89
	There are more pijanga populations than other fishes	9	10
	No increase in pijanga over time	3	3.33
	No impact/None	14	15.56
	No response	29	32.22
Participated in any training or information regarding the ecological impact of pijanga fishing	Yes	58	64.44
	No	32	35.56
Pijanga fishing will be banned	Yes	46	51.11
	No	34	37.78
	Maybe/ Not sure	10	11.11
The role of a fisherman in conserving aquatic resources and protecting the ecosystem	Follow the rules/policies	61	67.78
	No to illegal fishing	17	18.89
	Take care of the Lake	10	11.11
	No to dumping of wastes in the Lake	2	2.22

3.6 Correlation Analysis

Table 5 presents the practices of Pijanga fishing in terms of work as a full-time fisherman, catch per kilogram per fishing, percentage of Pijanga sold, and percentage of Pijanga consumed, in relation to the socio-demographic profile of the respondents. As observed, working as a full-time fisherman, catch per kilo per fishing, percentage sold of Pijanga, and percentage of consumed Pijanga among the respondents were not significantly related at $p = 0.05$ with age, number of children, and educational attainment. This result suggests that socio-demographic factors, such as age, educational attainment, and household size, do not significantly influence the manner in which Pijanga fishing was conducted. Fishing activities may be shaped more by ecological, cultural, or market-related factors rather than the individual characteristics of the fisherfolk (Kittinger et al., 2015). Similarly, a recent study conducted by Idrus et al., (2025) showed that fishing practices of Barrang Lompo Island fishermen are shaped by their ecological understanding, which is rooted in prolonged interaction with the marine

environment and reinforced through generational transmission.

Table 5: Relationship of practices on Pijanga fishing in terms of work as a full-time fisherman, catch per kilo per fishing, percentage sold of Pijanga, and percentage of consumed Pijanga towards the socio-demographic profile of the respondents.

Variable 1	Variable 2	Correlation Coefficient	P-value	Significance
Fulltime fisherman	Age	0.133	0.210	Not significant
	No. of children	-0.017	0.875	Not significant
	Educational attainment	0.040	0.709	Not significant
Catch per kilo per fishing	Age	-0.013	0.904	Not significant
	No. of children	0.048	0.653	Not significant
	Educational attainment	0.061	0.570	Not significant
Percentage sold of pijanga	Age	-0.062	0.559	Not significant
	No. of children	-0.122	0.251	Not significant
	Educational attainment	0.108	0.311	Not significant
Percentage consumed of pijanga	Age	0.048	0.651	Not significant
	No. of children	0.112	0.294	Not significant
	Educational attainment	-0.073	0.494	Not significant

4. CONCLUSION

This study employed a semi-structured survey questionnaire to assess the fishing practices and challenges encountered by local fishermen across Lake Mainit. The findings showed that their primary way of catching fish was a modified cast net, or locally known as "Laya or Laja". The study also found that the challenges faced by fishermen include natural disasters, adverse weather conditions, problems with boats and fishing equipment, as well as environmental issues. The community's perceptions towards banning Pijanga fishing varied, reflecting both economic concerns and environmental awareness. They perceived economic consequences of the ban on their livelihood. Overall, no significant correlations were found between fishing practices and socio-demographic characteristics. Moreover, there remains a notable lack of awareness about potential contamination in the Lake. Despite this, they firmly believe in the sustainability of fishing through collaborative efforts, promoting sustainable practices and improved environmental monitoring.

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