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# Knowledge, Attitude, and Practices Towards Utilization, Conservation, and Marketing of Economically Important Fish Species Among the Local Communities of Lake Mainit Watershed, Philippines

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ABSTRACT

The Lake Mainit community's Knowledge, Attitude, and Practices (KAP) were assessed to determine perspectives on the lake's ecological state in terms of industry and recreation-related utilization, conservation, and the marketing of *Glossogobius giuris* and *Channa striata*—two of its economically important fishery resource. The KAP survey was obtained from 383 respondents within the 25-54 age group within the lake's five fishing communities. Analysis of the solicited responses confirmed the community's utilization of the lake for various purposes. Still, it showed that the respondents have moderate knowledge of basic information on the state of the lake and its resources. The study noted positive responses towards lake utilization and conservation but negative views towards the prohibition of marketing and distribution of the two fish species surveyed. The study shows a positive association between sociodemographic and economic profiles on the community's knowledge of the distribution, biological characteristics, collection, and marketing of *G. giuris* and *C. striata*. The years of residency and those respondents involved in fishing have a positive affinity towards lake utilization; however, as members of the family increase, their attitude towards lake utilization decreases. Also, households with fisher members have a positive relationship towards practices on lake utilization. This study recommends strengthened environmental initiatives enabling broader community participation in the lake's conservation. It provides baseline informational statistics on behaviors and perspectives on exploiting the lake's resources, serving as a reference for future research.

Keywords: *Channa striata, Glossogobius giuris, haluan, lake resource, perception, pijanga*

## 1 Introduction

In the Philippines, Lake Mainit is considered an essential communal resource in the provinces of Surigao del Norte and Agusan del Norte, which covers remarkable diversity of life (Demetillo et al. 2015). The economy of the municipalities surrounding Lake Mainit is highly reliant on agricultural production, providing the communities with fresh aquatic food and livelihood (Apdohan 2021). Nonetheless, Lake Mainit is continuously affected by several anthropogenic activities from its surroundings, such as mining, unsustainable fishing practices, agrochemicals, and the increase of human settlements, which may have aggravated the current situation of the lake (Paylangco et al. 2020).

Residents surrounding the lake have a vital role as allies and stakeholders of any government

or private institution in protecting and conserving the Lake Mainit ecosystem (de Jesus et al. 2015). KAP surveys are commonly used to identify knowledge gaps and behavioral patterns among sociodemographic subgroups in a community. The residents' KAP are significant views to explore how their knowledge affects their attitude and practices towards lake utilization, conservation, distribution, and marketing of fishery resources. It is necessary to understand the KAP of the lake's fishing communities to assess the abundance and utilization of vital fishery resources while gaining the community's perspectives on perceived threats to the lake ecosystem.

One of the dominant fish species with high economic value in Lake Mainit is the tank goby and snakehead murrel (Catoto 2015). Tank goby (*Glossogobius giuris*) is one of the lake's most popular resources and has been an abundant catch for years (Vedra et al. 2019). The fish is commercially developed as a local and international export in the form of "*bulad pijanga*" or dried tank goby. Nonetheless, the population of adult *G. giuris* in the lake has decreased (Battad 2018) due to highly unsustainable fishing practices, particularly the harvest of its "saguyon" or the fingerlings of tank goby. The freshwater snakehead murrel (*Channa striata*) lives in various environments, including rivers, marshes, ponds, canals, lakes, and rice fields (Dumalagan et al. 2017). This carnivorous snakehead murrel is a highly invasive species that can withstand harsh environments (Song et al. 2013). It is an essential food source in Asia-Pacific (Dumalagan et al. 2017) and an economically important fish species to the communities of Lake Mainit (Ebol et al. 2020).

Studies on the assessment of the ecological state of Lake Mainit have been conducted in the past (Demetillo et al. 2015; Ebol et al. 2020; Paylangco et al. 2020). However, studies on the perceived knowledge of communities regarding fish health and lake resource utilization have yet to be conducted. This study focused on filling this gap and evaluating the community KAP based on their response. Results from their KAP responses would help the residents and the local government determine what possible approaches need to be done to monitor and protect the lake and its resources from being exploited and further polluted.

## 2 Materials and Methods

### *Research Locale and Duration of the study*

The study was conducted at Lake Mainit on the border of Surigao del Norte and Agusan del Norte provinces. Based on the 2020 census, the total population surrounding the lake was 90,336 (Philippine Statistics Authority 2021), and among the 31 barangays, five (5) stations were chosen as representative study sites, namely S1-Tagbuyawan, S2-Magtiaco, S3-Jaliobong, S4-Dinarawan, and S5-Kalinawan (Figure 1). Of the

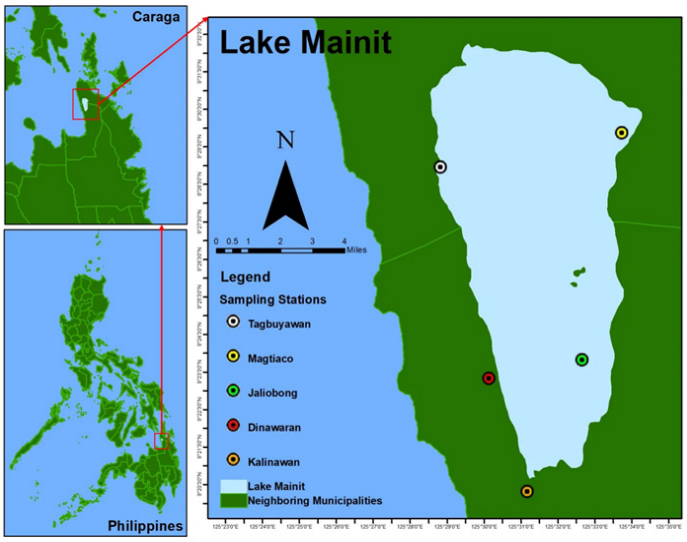


Figure 1. Study stations established in Lake Mainit, Philippines

8,051 residents, accounted for 8.91% of the overall inhabitants of communities, 383 individuals were interviewed randomly. The selection was based on convenience measures—proximity to the lake and direct involvement in lake activities (livelihoods, recreation) along with the population density, ecological factors, and anthropogenic activities (Ebol et al. 2020). The face-to-face survey lasted five months, between November 2021 and April 2022, considering the COVID-19 pandemic during the study.

The overall population of Lake Mainit, based on a 2020 census, was N=90,336 (Philippine Statistics Authority, 2021), and there were 8,051 residents. In the five stations selected in this study (Tagbuyawan = 412; Magtiaco = 2,434; Jaliobong = 2047; Dinarawan = 1299; Kalinawan = 1858). Out of this population, 383 participants were randomly interviewed (20, 116, 97, 62, and 88 in each respective station) following Cochran's (1963:75) formula. The confidence interval was set at p=0.05 for sample variability (Elvira et al. 2021).

$$n_0 = \frac{t^2 pq}{d^2} \qquad (1)$$

***N*** = the total number of the target population and $n_0$ is estimated as shown in the formula below:

$$N_0 = \frac{n_0}{1 + \frac{n_0}{N}} \qquad (2)$$

where: $t^2$ = the abscissa of the normal curve that cuts off an area at the tails (1- equals 95% confidence level); ***p*** = the estimated proportion of an attribute that is present in the population; ***d*** = the desired limits of error, and ***q*** is 1-*p*.

### *Data Collection for the Knowledge, Attitude, and Practices (KAP) on Fish Consumption and Lake Utilization*

#### *Ethical Consideration*

Informed consent was prepared to obtain the approval of each significant participant. Before conducting the survey, each barangay was informed of the study, and a formal agreement was made. For the face-to-face survey, a request letter was submitted and signed to collect primary data on residents' personal experiences (KAP) relevant to the scope of the study. The minimum health protocols were observed in surveying to avoid the risk of contracting the virus.

#### *Knowledge, Attitude, and Practices (KAP) on fish consumption*

This study examined fishing communities' knowledge, attitude, and practices towards Lake Mainit utilization, conservation, management, and distribution and marketing of economically important fish species *G. giuris* and *C. striata*. A KAP survey is a comprehensive survey of a specific population designed to gather information on one topic's general knowledge, attitudes, and practices. KAP responses received significant attention regarding their ability to provide an overall outlook of a particular population. The attitude would typically predict behavior though there are some inconsistencies. Also, attitude and behavior are both affected by external circumstances that impact their consistency (Kraus 1995). On the other note, practices help shape and reveal an individual's attitude and perception in a particular scenario based on personal experiences and societal influence (Kasych and Vochozka 2019).

The quantitative interview includes respondents' general knowledge of the lake, observation, and behavior on utilizing the lake over the years' distribution and marketing of economically important fish species. Key participants were chosen based on the convenience criteria—their availability during the study period and direct involvement in lake activities. The questions were grouped into four sets as follows: (1) Socio-demographic, (2) Knowledge, (3) Attitude, and (4) Practices. The sociodemographic section includes gender, age, civil status, educational attainment, years of residency, occupation, family size, and the number of household members involved in fishing activities. In the knowledge section, the survey tackled the current awareness of the participant on heavy metal contamination, the sources of pollution relating to human endeavors, economic and agricultural activities, and their knowledge of government agencies responsible for maintaining water quality. The attitude section of the survey instrument covered the residents' behavior towards protecting the lake from illegal activities and proper waste handling. The practices section of the survey questionnaire intends to elicit the participants' habit of utilizing the lake (for recreational purposes or convenient living) (Elvira et al. 2021). The conversations and the questionnaire were steered in the local language. During analysis, gathered responses from participants were translated into English to be understood internationally.

***Statistical Analysis***

The KAP responses were descriptively presented through mean value, frequency, and percentages. In determining the significance and the association of the respondent's sociodemographic and economic profile towards KAP responses, multiple regression analysis using STATA version, 13.1 was used (Elvira et al. 2021; Makinano et al. 2022). The method of calculation used the independent variables (sociodemographic and economic profile) whose values are known to predict the value of the single dependent value (KAP responses) (Moore et al. 2006). These equations are shown below:

$$K_i = \beta_0 + \beta_1 DGender_i + \beta_2 Age_i + \beta_3 DCivil\ status_i + \beta_4 Educational\ attainment_i + \beta_5 Years\ of\ residency_i + \beta_6 Occupation_i + \beta_7 Family\ size_i + \beta_8 Involved\ in\ fishing\ activity_i + e_i$$

$$A_i = \beta_0 + \beta_1 DGender_i + \beta_2 Age_i + \beta_3 DCivil\ status_i + \beta_4 Educational\ attainment_i + \beta_5 Years\ of\ residency_i + \beta_6 Occupation_i + \beta_7 Family\ size_i + \beta_8 Involved\ in\ fishing\ activity_i + e_i$$

$$P_i = \beta_0 + \beta_1 DGender_i + \beta_2 Age_i + \beta_3 DCivil\ status_i + \beta_4 Educational\ attainment_i + \beta_5 Years\ of\ residency_i + \beta_6 Occupation_i + \beta_7 Family\ size_i + \beta_8 Involved\ in\ fishing\ activity_i + e_i$$

Where *K* is the dependent variable for Knowledge, *A* is the dependent variable for Attitude, *P* is the dependent variable for Practices, and *i* denotes the $i^{th}$ respondent. The independent variables used in the regression are *DGender* is the dummy variable for gender (where 1= Male, 0= Female), *Age* is the respondent's age, *DCivil status* is the dummy variable for civil status, *Educational attainment* is the respondent's educational attainment, *Years of residency* is the respondent's years of residency, *Occupation* is for the respondent's occupation, *Family size* is for the respondent's family size, and *Involved in fishing activity* is the respondent's number of household members involved in fishing activities, and e is the error term.

## 3 Results and Discussion

***Socio-demographic profile of the respondents***

Sociodemographic surveys provide the backbone of the study. The gathered data offers relevant variables for the subject, guiding the reliance on the dependent variables (KAP response). Most of the respondents who participated in the survey were within the age group of 25-54 (Table 1). According to Smith (2008), men are less likely to respond to surveys than women. Based on the sociodemographic profile results, males are the least encountered respondents from the overall sample population because mostly wedded males are out of the household for work. The result also suggests that married respondents are numerous, meaning their presence during interviews is affected. Most of those who participated in the survey were within the 25-54 age group (Table 1). Our survey noted that educational attainment in each community is moderate, primarily educated at the high school level (36.2%), with only four individuals accounting for no formal education, and most are unemployed (40.7%). Households with fishers in the family surveyed were observed to be fewer (8.4%) because there are career opportunities offered in nearby areas with enough salary compared to income from fishing. Also, considering the massive fish kill in 2015, several fishing communities suffered severe economic and livelihood losses (Catoto 2015).

Most respondents have lived near the lake for more than 30 years, with an average of 32 years of residency. Respondents from Kalinawan, Jaliobong, and Magtiaco primarily live in upland areas (Apdohan et al. 2021) because the coastal residents are prone to flooding and other natural disasters. However, males are the least encountered respondents (32.4%) from the overall sample population. This observation may be due to the time and day of the survey, wherein mostly wedded males are out of the household for work. The data also suggests that married respondents are numerous, meaning their presence during interviews is affected.

***Knowledge of the respondents***

Knowledge is reflected as a collection of appropriate information, experience, and skilled insight, providing a foundation for estimating and incorporating new experiences and information (Mohajan 2016). Respondents from each station were moderately knowledgeable that Lake Mainit is the 4$^{th}$ largest lake in the Philippines and the lake's poor water quality. Nonetheless, respondents were highly knowledgeable of the abundance and presence of *G. giuris* and *C. striata* in Lake Mainit. Although respondents are moderately knowledgeable of the lake's water quality being polluted and the possibility of its quality declining because of household sewage, they are unaware

Table 1. Socio-demographic profile of the respondents from the stations surrounding Lake Mainit, Philippines

| VARIABLE | Tagbuyawan | | | Magtiaco | | | Jaliobong | | | Dinarawan | | | Kalinawan | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | frequency | % | mean | frequency | % | mean | frequency | % | mean | frequency | % | mean | frequency | % | mean |
| **AGE** | | | 46 | | | 46 | | | 42 | | | 40 | | | 47 |
| **15-24** | 1 | 5 | | 11 | 9.5 | | 20 | 20.6 | | 12 | 19.4 | | 6 | 6.8 | |
| **25-54** | 13 | 65 | | 71 | 79.3 | | 50 | 51.5 | | 40 | 64.5 | | 53 | 60.2 | |
| **55-64** | 3 | 15 | | 21 | 18.1 | | 16 | 16.5 | | 6 | 9.7 | | 16 | 18.2 | |
| **≥ 65** | 3 | 15 | | 13 | 11.2 | | 11 | 11.3 | | 4 | 6.5 | | 13 | 14.8 | |
| **SEX** | | | | | | | | | | | | | | | |
| **Male** | 7 | 35 | | 52 | 44.8 | | 41 | 42.3 | | 28 | 45.2 | | 34 | 38.6 | |
| **Female** | 13 | 65 | | 64 | 55.2 | | 56 | 57.7 | | 34 | 54.8 | | 54 | 61.4 | |
| **CIVIL STATUS** | | | | | | | | | | | | | | | |
| **Single** | 0 | 0 | | 12 | 10.3 | | 13 | 13.4 | | 20 | 32.3 | | 12 | 13.6 | |
| **Married** | 17 | 85 | | 92 | 79.3 | | 66 | 68 | | 29 | 46.8 | | 57 | 64.8 | |
| **Widowed** | 2 | 10 | | 9 | 7.8 | | 6 | 6.2 | | 4 | 6.5 | | 11 | 12.5 | |
| **Live-In** | 1 | 5 | | 3 | 2.6 | | 11 | 11.3 | | 8 | 12.9 | | 8 | 9.1 | |
| **Divorced** | 0 | 0 | | 0 | | | 1 | 1 | | 1 | 1.6 | | 0 | 0 | |
| **EDUCATIONAL ATTAINMENT** | | | | | | | | | | | | | | | |
| **No Formal Education** | 0 | 0 | | 0 | 0 | | 3 | 3.1 | | 0 | 0 | | 1 | 1.1 | |
| **Elementary Level** | 11 | 55 | | 45 | 38.8 | | 27 | 27.8 | | 21 | 33.9 | | 17 | 19.3 | |
| **High School Level** | 6 | 30 | | 45 | 38.8 | | 44 | 45.4 | | 36 | 58.1 | | 50 | 56.8 | |
| **College Level** | 3 | 15 | | 24 | 20.7 | | 22 | 22.7 | | 4 | 6.5 | | 20 | 22.7 | |
| **Vocational Graduate** | 0 | 0 | | 2 | 1.7 | | 0 | 0 | | 1 | 1.6 | | 0 | 0 | |
| **ALS** | 0 | 0 | | 0 | 0 | | 1 | 1 | | 0 | 0 | | 0 | 0 | |
| **OCCUPATION** | | | | | | | | | | | | | | | |
| **Government Employee** | 2 | 2 | | 10 | 8.6 | | 4 | 4.1 | | 4 | 6.5 | | 5 | 5.7 | |
| **Private Company Employee** | 0 | 0 | | 4 | 3.4 | | 5 | 5.2 | | 6 | 9.7 | | 3 | 3.4 | |
| **Fisherman** | 4 | 20 | | 4 | 3.4 | | 5 | 5.2 | | 14 | 22.6 | | 5 | 5.7 | |
| **Farmer** | 1 | 2 | | 22 | 19 | | 13 | 13.4 | | 5 | 8.1 | | 14 | 15.9 | |
| **Fish Vendor** | 0 | 0 | | 2 | 1.7 | | 2 | 2.1 | | 0 | 0 | | 0 | 0 | |
| **Self-Employed** | 3 | 15 | | 25 | 21.6 | | 21 | 21.6 | | 9 | 14.5 | | 13 | 14.8 | |
| **Student** | 2 | 40 | | 7 | 6 | | 4 | 44.3 | | 4 | 6.5 | | 5 | 5.7 | |
| **Unemployed** | 8 | 10 | | 42 | 36.2 | | 43 | 4.1 | | 20 | 32.3 | | 43 | 48.9 | |
| **YEARS OF RESIDENCY** | | | 42 | | | 31 | | | 32 | | | 30 | | | 34 |
| **MEMBERS IN HOUSEHOLD** | | | 4 | | | 5 | | | 5 | | | 5 | | | 5 |
| **MEMBERS INVOLVED IN FISHING** | | | 1 | | | 0 | | | 0 | | | 1 | | | 0 |
| **WITH proper TOILET FACILITIES** | 20 | 100 | | 116 | 100 | | 97 | 100 | | 57 | 92 | | 88 | 100 | |
| **WITHOUT proper TOILET** | 0 | 0 | | 0 | 0 | | 0 | 0 | | 5 | 8 | | 0 | 0 | |

if factories or the chemical run-offs from farms contribute further to the lake's deteriorating water quality. From the overall average rating (Table 2), 75% of the respondents were moderately knowledgeable about the distribution, biological characteristics, collection, and marketing of *G. giuris* and *C. striata* from Lake Mainit.

In addition, the respondents were highly knowledgeable about *G. giuris* and *C. striata* having high protein content. However, they are moderately familiar with the health risks posed by possible ingestion of *G. giuris* and *C. striata* contaminated by heavy metals. Moreover, they are highly knowledgeable about *G. giuris* and *C. striata* being sold at local markets. Some ordinances prohibit them from collecting *G. giuris* and *C. striata* if it is still not of marketable size, and regulations keep the lake from being polluted. They also mentioned agencies/institutions that help take care of Lake Mainit, such as Bantay Danao, the Department of Agriculture (DA), the Department of Agrarian Reform (DAR), the Bureau of Fisheries and Aquatic Resources (BFAR), the Department of Environment and Natural Resources (DENR), Lake Mainit Development Alliance (LMDA), Fish Warden, and Marginal Fisherfolks Association (MAFIA). The overall results of the data revealed that every individual has common adherence to the concept of lake conservation and is aware of the legal and illegal activities.

Knowledge is reflected as a collection of appropriate information, experience, and skilled insight, providing a foundation for estimating and incorporating new experiences and information (Mohajan 2016). Ratings on the abundance of *G. giuris* and *C. striata* in the lake and dietary habits as carnivorous from all the domains are significantly high (90.86%, and 90.184,

Table 2. Respondents Knowledge on the distribution, biological characteristics and the collection and marketing of *G. giuris* from Lake Mainit

| Statements | Tagbuyawan | Magtiaco | Jaliobong | Dinarawan | Kalinawan | Overall | Remark |
|---|---|---|---|---|---|---|---|
| 1. 4th largest lake in the Philippines. | 76.00 | 72.93 | 79.79 | 85.16 | 69.55 | **76.686** | **MK** |
| 2. Water quality is poor. | 71.00 | 71.9 | 63.09 | 45.81 | 60.00 | **62.36** | **MK** |
| 3. Degradation of water quality is caused by waste discharge from factories. | 71.00 | 60.7 | 67.22 | 44.516 | 56.591 | **60.005** | **U** |
| 4. Degradation of water quality is caused by waste from houses. | 74.00 | 71.21 | 77.11 | 54.52 | 64.55 | **68.278** | **MK** |
| 5. Degradation of water quality is caused by chemicals from agriculture. | 53.00 | 71.9 | 73.4 | 39.68 | 62.5 | **60.096** | **U** |
| 6. Bottom sediments nearby lake is dirty. | 60.00 | 70 | 64.95 | 38.06 | 54.55 | **57.512** | **U** |
| 7. Many garbage are seen in the shoreline of the lake | 72.00 | 67.24 | 67.01 | 50.32 | 59.77 | **63.268** | **MK** |
| 8. Tank goby are abundant in the lake. | 83.00 | 93.28 | 94.64 | 92.26 | 91.14 | **90.864** | **HK** |
| 9. Tank goby is carnivorous. | 90.00 | 91.9 | 87.42 | 93.87 | 87.73 | **90.184** | **HK** |
| 10. Tank goby is rich in proteins | 80.00 | 80.7 | 82.06 | 97.74 | 85.909 | **85.282** | **HK** |
| 11. Tank goby in Lake Mainit is contaminated. | 58.00 | 72.93 | 63.71 | 45.81 | 57.73 | **59.636** | **U** |
| 12. Consumption of contaminated Tank goby could lead to diarrhea. | 74.00 | 66.55 | 62.89 | 58.39 | 67.27 | **65.82** | **MK** |
| 13. Consumption of contaminated Tank goby is prohibited by RHU. | 67.00 | 64.31 | 56.7 | 54.19 | 73.41 | **63.122** | **MK** |
| 14. Tank goby are sold to the market | 90.00 | 89.31 | 94.64 | 82.26 | 88.64 | **88.97** | **HK** |
| 15. There are ordinances prohibiting direct dumping of trash in Lake Mainit. | 91.00 | 86.9 | 91.13 | 99.68 | 91.818 | **92.106** | **HK** |
| 16. The LGU manages and monitor the water quality of the lake | 91.00 | 83.97 | 93.81 | 97.74 | 91.364 | **91.577** | **HK** |
| 17. The LGU enforces local ordinances in the lake | 90.00 | 83.97 | 90.72 | 97.42 | 89.545 | **90.331** | **HK** |
| 18. There are institutions maintaining the quality of the lake. | 68.00 | 77.76 | 74.02 | 78.71 | 75.91 | **74.88** | **MK** |
| **Rating per domain** | **75.5** | **76.53** | **76.91** | **69.78** | **73.78** | **74.5** | **MK** |
| **Overall remark** | **MK** | **MK** | **MK** | **MK** | **MK** | | |

Rating: 81-100 = Highly Knowledgeable (HK); 61-80 = Moderately Knowledgeable (MK); 60-20 = Uninformed (U)

respectively). Most of the rating falls into the percentage of 61-80 (MK) (Table 2). However, most respondents agreed that ordinances are imposed prohibiting the direct disposal of trash into the lake. These results revealed that every individual has common adherence to the concept of lake conservation and is aware of the legal and illegal activities. Nevertheless, they are unaware of what is happening with the lake and the general state of aquatic life, whether it is contaminated with surrounding sources of pollution or not.

***Attitudes of the respondents***

Attitude is an essential aspect of calculating the attributes of communities (Wolf et al. 2020). Lack of consideration of the proper attitudes toward protection and maintenance could result in a cascade of risks. Attitudes of the respondents toward the lake's utilization and management are positive. Also, communities jointly do not approve of fishing or marketing prohibition of *G. giuris* and *C. striata* to the public (Table 3). The respondents remain opposed to the ban on harvesting and marketing of snakehead murrel and tank goby because it is one of their sources of income and food alongside other fish species. Other respondents claim that it is only illegal if "saguyon" (*G. giuris* fingerlings) are caught instead. Despite the locally imposed prohibitions, many fishermen continue to engage in illegal fishing practices and commercializing fingerlings of *G. giuris.* This unlawful practice is most likely the cause of the fish species' abrupt population decline due to constant utilization. In the past, local fishers could capture 25 kg or more of tank goby in a day but now could only manage to catch 5-10kg, which is extremely few" (Battad 2018).

Mindanao Development Authority (MinDA) has started building an inclusive program that guarantees the sustainability of "Tank goby" fishing in Lake Mainit. Part of the program's design was to toughen the neighboring towns' union so that environmental programs could warrant a sustainable income for families who rely on the lake's resources. Also, the program's crafted "Tank goby" hatchery has been constantly enriched so that there will still be loads of fingerlings to be seeded in the lake every year (Trozo 2020). Institutional and public participation is necessary to maintain the lake's ecological integrity. The role of LGU in the improvement, waste management, and maintenance of water quality is essential, specifically the Bantay Danao, LMDA, DENR, and DA sectors which are the prominent mentioned private and public agencies taking part in the protection of the lake. Residents have a considerable positive response towards the capacity of these organizations. An inter-local cooperative that was established in 1999 (de Jesus et al. 2014) known as Lake Mainit Development Alliance (LMDA) was organized to maintain and provide environmental management plans as imperative services to the Lake Mainit adjoining areas and its communities (Natad 2018).

Table 3. Attitude of respondents on the conservation, protection and utilization of lake resources

| Statements | Tagbuyawan | Magtiaco | Jaliobong | Dinarawan | Kalinawan | Overall | Remark |
|---|---|---|---|---|---|---|---|
| 1. Pays attention to the water quality of the lake | 86 | 83.62 | 92.99 | 96.45 | 93.41 | **90.49** | **P** |
| 2. Throwing garbage is prohibited | 98 | 90.86 | 96.70 | 96.13 | 94.55 | **95.25** | **P** |
| 3. Catching of Tank goby should be banned. | 32 | 29.48 | 31.34 | 31.94 | 31.14 | **31.18** | **N** |
| 4. Marketing of Tank goby should be banned | 26 | 28.62 | 37.11 | 27.74 | 26.59 | **29.21** | **N** |
| 5. Water quality must be made public | 98 | 93.28 | 98.35 | 100 | 92.73 | **96.47** | **P** |
| 6. Residents should be involved on protecting the lake | 99 | 94.48 | 97.53 | 100 | 93.64 | **96.93** | **P** |
| 7. There is no apparent problem observed in the lake. | 91 | 88.10 | 91.34 | 91.94 | 90.68 | **90.61** | **P** |
| 8. Maintenance of water quality is a responsibility of the LGU. | 99 | 93.79 | 98.35 | 98.71 | 97.27 | **97.43** | **P** |
| 9. Lake waste management needs to be improved. | 99 | 95.17 | 97.53 | 100 | 98.41 | **98.02** | **P** |
| 10. The LGU are taking their part to improve lakes water quality. | 100 | 84.66 | 72.37 | 98.39 | 92.73 | **89.63** | **P** |
| **Rating per domain** | **82.80** | **78.21** | **81.36** | **84.13** | **81.11** | **81.52** | **P** |
| **Overall remark** | **P** | **P** | **P** | **P** | **P** | | |

Rating 61-100 = Positive (P); 41-60 = Undecided (U); 20-40 = Negative (N)

The main actors in the LMDA are the Provincial Governments of Surigao del Norte and Agusan del Norte and their member municipalities (de Jesus et al. 2014) plus selected government line agencies: Local government units (LGUs), government line agencies (GLAs) and civil society organizations (CSOs) which has common grounds of maintaining sustainable development by cooperating towards the safeguard and upright improvement of Lake Mainit to eliminate potential destructive contributors (Natad 2018).

Moreover, the establishment of Lake Mainit as a Key Biodiversity Area (KBA) through the DENR-Caraga aims to establish the lake and its terrestrial as a protected zone housing rich flora and fauna and indigenous communities. Although the participatory method was not the main focus of the current survey, it explored the community's involvement in the planning and implementing of community policies. The attitude of the respondents is rooted in their actual experiences as residents of the lake. According to Asena (2014), people's attitudes toward resource management are influenced by land-use patterns and where they reside. Hence, economic factors, as well as educational background, is vital for conservation.

***Practices of respondents***

From the five lakeshore communities surveyed, most of the population from Magtiaco and Jaliobong has little direct involvement and daily interactions with the lake. Most residents reside upland and are distant from the lake. Considering the area's susceptibility to flooding, inhabitants of Magtiaco, Jaliobong, and Kalinawan prefer to settle upland to evade frequent flood problems that often damage homes and livelihoods. Residents from these sampling areas do not have the privilege to go for a swim, fishing, picnic, or for any recreational purposes to enjoy the scenic view of the lake. However, they are still consumers of *G. giuris* and *C. striata.* Only those involved in fishing are likely to have a definite interaction with the lake, including its family members. Respondents of Tagbuyawan, Dinarawan, and Kalinawan had a closer relationship and daily interactions with the lake. The setting provided much more reliable information about lake utilization, the population of *G. giuris* and *C. striata*, and endeavors contributing to pollution with what they experienced daily. These are reasons why the Magtiaco and Jaliobong domains' overall remarks fall into the VR rating—20.34% and 20.65%, respectively (Table 4).

***Relationship between KAP, socio-demographic and economic profile***

Analysis showed that as the respondent gets older, their knowledge of the distribution, biological characteristics, collection, and marketing of *G. giuris* and *C. striata* also increases. This affinity exhibited a significant relationship among the variables (Table 5). According to Brod and Shing (2022), it has long been assumed that increases in the amount of knowledge improve with age—that knowledge grows during maturation and is often well preserved in old age. Moreover, if the respondent is a fisherman and is self-employed, the probability of having positive knowledge of distribution, biological characteristics, collection, and marketing of *G. giuris* and *C. striata,* and this relationship suggested significance (Table 5). This could indicate that fishermen better understand the lake's resources and are most aware of the nature of the disturbance since they are mostly

Table 4. Practices of respondents on lake utilization, preservation and marketing of *G. giuris* and *C. striata*

| Statements | Tagbuyawan | Magtiaco | Jaliobong | Dinarawan | Kalinawan | Overall | Remark |
|---|---|---|---|---|---|---|---|
| 1. Getting water from the lake for various purposes. | 25 | 20 | 20 | 27.10 | 21.82 | **22.78** | **R** |
| 2. Bathing in the lake. | 26 | 20.69 | 20 | 43.23 | 22.73 | **26.53** | **R** |
| 3. Throwing garbage in the lake | 20 | 20 | 20 | 20 | 20.91 | **20.18** | **VR** |
| 4. There is a weekly income from the lake. | 42 | 20.69 | 22.68 | 41.29 | 23.86 | **30.10** | **R** |
| 5. Used for recreational activities | 25 | 20.52 | 20 | 37.10 | 21.59 | **24.84** | **R** |
| 6. Participates in activities related to Lake Mainit care. | 32 | 20.17 | 21.24 | 46.77 | 23.41 | **28.72** | **R** |
| **Rating per domain** | **28.33** | **20.34** | **20.65** | **35.91** | **22.39** | **25.53** | **R** |
| **Overall remark** | **R** | **VR** | **VR** | **R** | **R** | | |

Rating: 0.81-1= Always (A); 0.61-0.80 = Very frequently (VF); 0.41-0.60 = Occasionally (O); 0.21-0.40 = Rarely (R); 0.0-0.20 = Very Rarely (VR)

affected by any environmental pressure. As part of the respondents' indigenous knowledge, their perception and understanding of anthropogenic activities involving freshwater fish biodiversity are critical for making and implementing decisions and policies related to mitigating these threats and managing freshwater fish biodiversity (Amoutchi et al. 2021).

The same observation goes for the number of family members within the household. Their knowledge also increases as the number in the family grows, indicating a significant relationship (Table 5). The number of family members within a home could affect the household's knowledge since knowledge among members is shared within the family. However, family size tends to affect ability within families. Smaller family sizes tend to produce higher IQ, academic achievement, and occupational performance than larger family sizes, producing lower academic performance (generally low level of knowledge) (Wagner et al. 1985). The survey also shows no significant relationship between education and respondents' knowledge (p-value= 0.27).

Evaluating attitude is very important since it is interconnected with an individual's general evaluations on issue awareness, values, beliefs, and testimonies (Lavrakas 2008), reflecting whether persons like or dislike (Wolf et al. 2020). An individual's attitude is often interrelated with the duration to which they are exposed, for instance, with the culture in the area (Petty 1996). More extended periods of exposure to residents with specific characteristics greatly influence an individual's perception of lake utilization. In this study, as the respondent's years of residency increase, their attitude toward lake utilization also increases (Table 6). Implying that the longer a person resides in a particular community, the more they consider their attitude toward community involvement. According to Chih-Yao (2010), the length of residency is directly related to community attachment. Thus, their attitude toward participation in community activities indicates how strong community members feel interconnected and how much responsibility they feel to take actions aimed at solving problems that arise in their surrounding environment (Toruczyk-Ruiz and Martinovi 2020). The respondents' behavior is reflected in their responses and is significantly related to the years of residency and the family members involved in fishing. Nonetheless, more than the gathered information from the respondents may be needed to grasp the expected attitude of the entire station, similar to the study of Elvira et al. (2021) on the Laguna de Bay, Philippines, residents.

Moreover, a positive correlation is also observed in members involved in fishing (Table 6). Suppose the number of members engaged in fishing increases. In that case, the attitude toward lake utilization also increases since households with family members involved in fishing rely on it as their source of income. According to Apdohan et al. (2021), this is relevant to the community since Lake Mainit offers livelihood opportunities (e.g., fishing and farming) and food security to the surrounding communities.

The relationship between sociodemographic profile and practices measured the communities' actual involvement in the lake. Respondents commonly have rare activities towards using the lake for recreational purposes, water for bathing or income in fishing, and activities that focus on the care of lakes. This observation is probably associated with the respondent's distance to the lake since most of the respondents surveyed are settlers from the upland. This explains why their practices highly limit their regular involvement in the lake.

Practices are significantly related to the number of fishing families (Table 7). This suggests that if the number of members engaged in fishing increases, the attitude toward lake utilization also increases. According to Apdohan et al. (2021), this is relevant to the community since Lake Mainit offers livelihood opportunities (e.g., fishing and farming) and food security to the surrounding communities. Fishermen would likely participate in activities related to caring for Lake Mainit because their primary revenue is coming from the lake. The number of family members could also significantly affect the respondents' responses (p-value=0.03; Table 7) since attributes or behavior within the household is habitually shared and attained through daily interactions between parents to children (Kim et al. 2011). However, it had a negative correlation, signifying that as the family member increases, it would result in harmful practices on lake utilization. According to Ng'onga et al. (2019), large household sizes negatively impact resource utilization since every family member must be fed, which might lead to resource

Table 5. Association of knowledge on the distribution, biological characteristics, collection, and marketing of *G. giuris* and *C. striata* against the socio-demographic profile of the respondents from Lake Mainit, Philippines

| Variables | Coefficient | p-value |
|---|---|---|
| Sex | -.06 | 0.37 |
| **Age** | **.01** | **0.00** |
| Years of Residency | -.00 | 0.06 |
| Widowed | .06 | 0.60 |
| Live-in | .08 | 0.40 |
| Divorced | .02 | 0.95 |
| Educational Attainment | -.01 | 0.27 |
| Government Employee | -.09 | 0.38 |
| Private Company Employee | .64 | 0.67 |
| **Fisherman** | **.28** | **0.02** |
| Farmer | -.15 | 0.08 |
| Fish Vendor | -.30 | 0.30 |
| Student | .12 | 0.39 |
| **Self-employed** | **.19** | **0.01** |
| **# of family members** | **.04** | **0.00** |
| # of members involved in fishing | -.09 | 0.11 |

Table 6. Association of attitude towards lake utilization and the prohibition of harvesting and selling of *G. giuris* and *C. striata* against the socio-demographic profile of the respondents from Lake Mainit, Philippines

| Variables | Coefficient | p-value |
|---|---|---|
| Sex | -.02 | 0.71 |
| Age | -.00 | 0.48 |
| **Years of Residency** | **.00** | **0.01** |
| Widowed | -.03 | 0.72 |
| Live-in | .01 | 0.84 |
| Divorced | .12 | 0.65 |
| Educational Attainment | -.00 | 0.93 |
| Government Employee | .05 | 0.55 |
| Private Company Employee | .02 | 0.85 |
| Fisherman | .06 | 0.49 |
| Farmer | -.02 | 0.78 |
| Fish Vendor | .12 | 0.56 |
| Student | -.02 | 0.84 |
| Self-employed | .02 | 0.71 |
| # of family members | -.02 | 0.08 |
| **# of members involved in fishing** | **.10** | **0.02** |

Table 7. Association of practices on lake utilization against the sociodemographic profile of the respondents from Lake Mainit, Philippines

| Variables | Coefficient | p-value |
|---|---|---|
| Sex | -.00 | 0.94 |
| Age | -.00 | 0.29 |
| Years of Residency | .00 | 0.49 |
| Widowed | .04 | 0.57 |
| Live-in | -.04 | 0.52 |
| Divorced | .31 | 0.19 |
| Educational Attainment | .00 | 0.65 |
| Government Employee | .17 | 0.02 |
| Private Company Employee | .00 | 0.10 |
| **Fisherman** | **.40** | **0.00** |
| Farmer | .02 | 0.79 |
| Fish Vendor | .15 | 0.45 |
| Student | .01 | 0.94 |
| Self-employed | .05 | 0.30 |
| # of family members | -.02 | 0.03 |
| # of members involved in fishing | .34 | 0.00 |

exploitation. As also observed, survey participants who are also government employees have a more in-depth understanding of the importance of practices, especially in the conservation of Lake Mainit (p-value= 0.02; Table 7). This finding entails that those individuals who belong to this occupation Furthermore, as the number of household members involved in fishing increases, their practices toward lake utilization also increase, probably because they rely on fishing as their source of income (Apdohan et al. 2021; Table 7). Fishermen also play a critical part in promoting sustainable fishing practices to avoid exploiting the lake's fishery resources.

## 4 Conclusion and Recommendations

This study aimed to assess the Knowledge, Attitude, and Practices (KAP) of residents within Lake Mainit and determine the factors that drive the elicited information dynamics. The results indicate that critical dependent variables like age, years of residency, nature of work with the study of interest, and family members are among the many factors that could impact the respondents' responses in the survey. Despite governmental authorities' ongoing attempts to adopt environmental management programs, communities experience various environmental and institutional difficulties. The result presented in this study will assist all institutions in developing programs for lake monitoring, preservation, and evaluating water pollution and help provide information to all

institutions that aim to build programs on the monitoring and protection of lakes and the assessment of water pollution.

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## Statement of Conflict of Interest

Joycelyn C. Jumawan, the Editor-in-Chief of JESEG, abstained from the reviewing process of the article in the journal.

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