Measuring Culture: Ethnomathematical Practices in Brackish Water Fishpond Construction and Management in Barangay Lanas, Barotac Nuevo, Iloilo

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Abstract: This qualitative ethnomathematics study investigates the traditional measurement and estimation practices employed in the construction and management of brackish water fishponds in Barangay Lanas, Barotac Nuevo, Iloilo. Rooted in the framework of ethnomathematics, the research explores how indigenous knowledge systems—expressed through body-referenced units (such as dipa, dangaw, and tuhod) and ecological observations—are utilized by local fisher-farmers in daily fishpond operations. Through interviews, field documentation, and site visits, the study reveals how concepts of geometry, measurement, ratio, proportion, and time estimation are naturally embedded in fishpond preparation, soil treatment, water management, and fish rearing. Findings show that these practices are not only mathematically rich but are also environmentally sustainable, cost-effective, and culturally relevant. The study highlights the pedagogical value of integrating such indigenous mathematical knowledge into the Philippine mathematics curriculum to support contextualized and culturally responsive education. Ultimately, it advocates for the recognition, documentation, and inclusion of local ethnomathematical systems in formal education as a means of preserving heritage and promoting inclusive learning.

Keywords: Ethnomathematics, indigenous measurement, brackish water fishponds

Introduction

Ethnomathematics, a term introduced by Brazilian scholar Ubiratan D'Ambrosio, refers to the study of mathematical practices embedded in the cultural traditions of different groups (D'Ambrosio, 2001). This perspective challenges the conventional view of mathematics as a purely abstract and universal discipline by recognizing that mathematical ideas are often developed and expressed through culturally specific ways of knowing and doing. Ethnomathematics highlights the presence of mathematical thinking in real-life contexts such as architecture, weaving, agriculture, and navigation (Ascher, 2002; Gerdes, 1999). By grounding mathematical concepts in the lived experiences of diverse communities, ethnomathematics fosters more inclusive education and promotes respect for multiple cultural perspectives in mathematical learning (Powell & Frankenstein, 1997).

For Indigenous and coastal communities, aquatic resources form the backbone of their livelihoods, encompassing fishing, seaweed gathering, fish farming, and marine navigation. These practices are underpinned by highly developed and context-specific mathematical knowledge systems. Fishers and fish farmers often employ spatial reasoning to assess fishing areas, apply counting and timing methods to manage routines, and rely on ecological patterns, such as tidal behavior and lunar cycles, for critical decision-making (Nakashima & Roué, 2002).

Moreover, traditional gear construction, including nets, fish traps, and pond layouts, involves geometric reasoning and estimation based on body-referenced measurements such as *dangkal* (handspan), *dipa* (armspan), and *tuhod* (knee height). Navigation practices among Pacific Island cultures, such as those in Polynesia and Micronesia, further demonstrate mathematical precision through oral mapping, star positions, and wave dynamics (Lewis, 1994).

In the Philippine context, several studies have begun to document the rich ethnomathematical practices of various Indigenous communities. For instance, research on the *Pambubo* squid fishing method in Gigantes Island revealed the use of mathematical concepts such as basic counting, measurement and estimation, ratio and proportion, and geometric reasoning in the construction and deployment of fishing traps (Sulatra, 2023). Similarly, a study conducted in two fishing villages on Panay Island identified ethnomodels derived from local fishing practices, emphasizing the potential of integrating these models into mathematics instruction to enhance contextual learning (Madrigal, 2021). Additionally, the Eskaya tribe in Bohol has been documented to employ unique counting systems, measurement techniques, and pattern recognition in their daily activities, underscoring the diversity of mathematical practices across Indigenous groups (Janiola & De Los Santos, 2021).

Despite these practices' enduring relevance, Indigenous measurement and estimation systems are often underrecognized in mainstream science and mathematics education, which tend to prioritize standardized, instrument-based approaches (Barton, 2008; McKinley, 2001). In the Philippine educational system, while the Department of Education's K to 12 curriculum advocates for contextualization and localization, there remains a lack of structured content, teaching guides, and instructional materials that reflect ethnomathematical knowledge, particularly in topics such as measurement, geometry, and problem-solving. This gap not only marginalizes local knowledge systems but also represents a missed opportunity to contextualize mathematics for learners in Indigenous and rural communities. Mathematics instruction often remains abstract, failing to connect with students lived realities or cultural backgrounds.

Furthermore, the estimation of quantities, volumes, distances, time, and tidal behavior remains essential in various occupations, especially among fisherfolk. Traditional methods developed through practical experience and intergenerational knowledge enable communities to navigate and manage their environments effectively. These methods often rely on body-based measurements and environmental indicators rather than modern tools. However, the extent to which such traditional systems are still understood, preserved, and practiced today remains unclear. Without thorough documentation and critical analysis, their pedagogical value and relevance to mathematics education risk being overlooked or lost entirely.

This qualitative study aims to document and analyze Indigenous measurement and estimation systems as used in traditional fishpond management. It addresses the central question of how fish farmers estimate and measure aspects of fishpond operations using culturally rooted and non-instrumental methods. Through interviews, field visits, and visual documentation, the study seeks to uncover how body-based units, natural signs, and orally transmitted knowledge are applied in daily fish farming practices. In doing so, it contributes to the ethnomathematics discourse, fills a gap in local literature, and supports ongoing efforts to elevate Indigenous knowledge in academic and educational spaces, particularly through the development of instructional resources and teaching strategies aligned with the principles of culturally responsive pedagogy.

Methodology

This study adopted a qualitative ethnomathematics research design to explore the traditional systems of measurement and estimation used by a fisher-farmer in the management of a brackish water fishpond in Barangay Lanas, Barotac Nuevo, Iloilo. Ethnomathematics, as a research approach, examines mathematical ideas and practices embedded in the everyday cultural routines of specific communities. It does not regard mathematics as a fixed, universal discipline, but rather as a form of knowledge that is shaped by the lived experiences and socio-cultural contexts of people in diverse settings (Rosa & Orey, 2010). This study was further informed by the broader perspective of ethnomathematics, which emphasizes how communities develop localized systems of reasoning, measurement, and problem-solving in response to environmental conditions and practical needs (Knijnik, 2002).

The research was conducted in Barangay Lanas, a coastal village located about eight kilometers from the town center and two kilometers from the shoreline, locally referred to as baybay. The area is known for its traditional brackish water fishponds and long-standing community-based aquaculture practices. The participant's fishpond is situated in a secluded location, surrounded by trees and other ponds, and can only be accessed by foot or motorcycle. Before the data collection began, the researcher sought and obtained formal permission from the university, municipal government, and barangay authorities. A letter of request and informed consent, signed by the researcher, the course facilitator, and the university president, was submitted to the Barangay Captain of Brgy. Lanas. After approval was granted, the researcher purposively selected a participant, an experienced and respected fisher-farmer known in the community for his extensive knowledge of traditional fish farming practices.

Data gathering involved multiple visits to the research site and employed a combination of interviews, participant observation, and field documentation. The research followed the ethnographic data collection procedures outlined by Esterberg (2006), which included immersion in the field, both formal and informal interviews, direct observation, systematic note-taking, and reflective analysis. An in-depth, semi-structured interview was conducted at the participant's home using the local language, Hiligaynon, to ensure comfort and cultural appropriateness. The open-ended interview explored how the participant estimates pond dimensions, water volume, timing, and tidal behavior using traditional, non-instrumental methods. This flexible format allowed the researcher to pose follow-up questions and seek clarifications based on the participant's responses (Kallio et al., 2016). The interview was audio-recorded with the participant's consent, and detailed field notes were taken to capture key points, contextual observations, and non-verbal cues. The recording was later transcribed and prepared for analysis.

To supplement and triangulate the interview data, the researcher conducted site visits to the participant's fishpond. While the researcher did not directly observe the participant performing traditional measurement and estimation practices, the participant vividly described these techniques. He explained the use of body-based units such as dipa (armspan) and tuhod (knee height) to estimate distance, depth, and spatial layout in managing the fishpond. He also elaborated on his interpretation of environmental indicators, such as tidal changes, water currents, and weather patterns, to guide decisions related to fishpond operations. During the site visits, photographs of the fishpond layout, tools, and surroundings were taken with the participant's consent. These visual materials served to enrich and contextualize the verbal data, providing a clearer understanding of the traditional practices discussed during the interview.

The data analysis followed the thematic analysis approach proposed by Clarke and Braun (2013). This method involved six recursive phases: familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Transcripts, field notes, and visual documentation were read repeatedly to identify meaningful patterns. Codes were developed around recurring concepts such as body-based measurement, environmental observation, estimation strategies, and intergenerational knowledge transmission. These codes were then clustered into broader themes that reflected the participant's culturally embedded mathematical knowledge. The analysis was guided by the ethnomathematical framework of D'Ambrosio (2001), which enabled the researcher to situate the participant's knowledge within a culturally grounded view of mathematics as practical, adaptive, and contextually meaningful.

Ethical considerations were integral throughout the study. The researcher ensured that informed consent was obtained, and the participant's rights to privacy, anonymity, and voluntary participation were upheld at all times. Cultural sensitivity and respect for local customs were observed during interviews and site visits. Beyond these standard protocols, the research embraced a commitment to reciprocity. After the data were analyzed, the findings were compiled into a summary report written in both English and Hiligaynon. This report was returned to the participant and shared with local barangay officials to ensure transparency and to honor the participant's role not only as a subject but as a co-contributor to the research. This act of giving back to the community reinforced the ethical imperative of mutual respect and validated the community's traditional knowledge as a valuable form of mathematical understanding.

RESULTS AND DISCUSSION

The traditional fishpond management practices in Barangay Lanas, Barotac Nuevo, Iloilo, exemplify a rich integration of indigenous knowledge and mathematical reasoning, particularly in the areas of measurement and estimation. These culturally rooted practices reflect the community's deep understanding of their environment and sustainable resource management. This section explores ethnomathematical aspects of traditional fishpond management in Barangay Lanas, focusing on three key themes: (1) Estimation and measurement in preparation for layout and construction; (2) Measurement and estimation in soil treatment and water introduction; and (3)

Measurement and estimation in fish rearing. Through this exploration, we highlight the practical applications of mathematical concepts in indigenous practices, underscoring their significance in sustainable aquaculture and cultural heritage.

Theme 1. Estimation and measurement in preparation for lay-outing and constructing the pond.

This theme explores the mathematical concepts applied in the initial stages of traditional fishpond construction in Barangay Lanas, Barotac Nuevo, Iloilo. The focus is on how indigenous measurement and estimation practices guide land layout, boundary marking, and excavation processes. Local fish farmers utilize body-based units and simple tools such as bamboo sticks, rope, and the traditional digging tool tagad to measure depth, area, and spatial dimensions of the pond. These culturally embedded practices reflect mathematical ideas related to geometry, counting, and proportion, all performed without the use of modern measuring instruments. The community's approach to fishpond preparation demonstrates a practical and sustainable application of mathematical thinking rooted in local knowledge and shared labor systems.

The construction of a traditional *punong* (fishpond) begins with identifying and measuring the land area based on the land title. A licensed surveyor is responsible for determining the exact size and boundaries of the property.

"Gin base sa titulo sang duta ang kalapadun, ginpatakos sa surveyor"

Several traditional tools and materials are used in preparing and constructing the pond:

Figure 1. "Tagad" – a traditional digging tool used for excavation.

Bamboo stick (1 meter) – used to measure the pond's depth. Its length is based on a local body reference: the distance from the extended fingertips of one arm to the hand placed on the chest using the other arm.

Figure 2. Isa ka metros nga stick **Figure 3. Pagtakos ka kadalumon sang punong**

Bamboo stick (1 armspan or "isa ka dupa") – used in the "baydanay" or land payment system. One square dupa costs 100 pesos.

Figure 4. Isa ka dupa

Rope – used to mark the boundaries of the pond based on the land title.

The layout of the pond is prepared by placing the rope along the borders of the area covered in the land title. If the boundaries are already identified, the rope may no longer be necessary. However, if adjustments or extensions are needed within the limits of the title, the rope is used to maximize and clearly mark the area.

Once the layout is finalized, excavation begins. Four bamboo sticks, each about one meter in length (to serve as a visual indicator of the intended pond depth), are placed vertically to form a square with sides measuring one armspan (*dupa*). This helps in identifying the number of square *dupa* dug, making it easier to calculate the total cost for labor based on the *baydanay* system.

The excavation follows a method called "tableya", which involves squaring or sectioning the land. Workers dig the soil in square or rectangular sections using the *tagad*, and the removed soil is placed along the edges of the pond to raise the "kahon" (the embankments or sides of the pond). The digging starts from the kahon (edge of the pond), going 8 armspans (dupa) toward the center — this is the area that is excavated. This process continues around the entire perimeter of the pond.

> *"Gin tableya (kwadrado nga pagbuol kalupa) ka tawo gamit ang tagad. Isa ka metros and kadalumon sang pag tableya, gintakos ini gamit ang stick nga gintakos man sang tawo gamit ang mga kamot. Ang sa baydanay gintakos gamit ang stick nga gintakos man isa ka dupa. Ang isa ka dupa kwadrado ang bayad 100 pesos"*

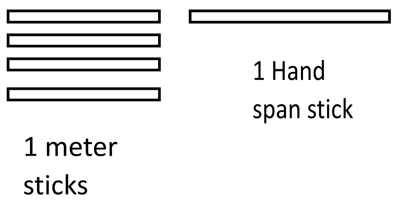
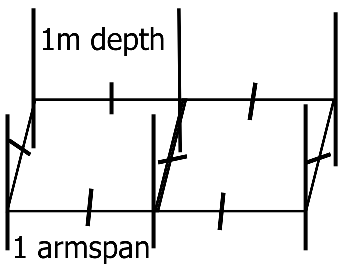
This system of layout and excavation reflects the community's practical knowledge, use of indigenous measurement, and labor coordination rooted in their local context:

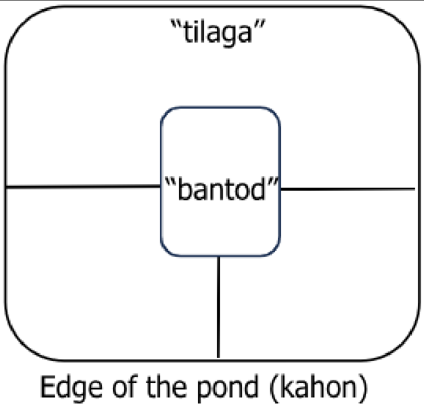
Figure 5: Proseso sang Pag-tableya

The preparation for lay-outing and constructing a traditional fishpond in Barangay Lanas involves various ethnomathematical concepts rooted in indigenous knowledge and daily practice. Ethnomathematical concepts applied were measurement and estimation, basic counting, ratio and proportion, square, rectangle, lines, and distance. The preparation process reflects a strong integration of mathematical reasoning in land management, demonstrating how traditional communities apply geometry, arithmetic, and estimation in contextually meaningful ways. The ethnomathematical concepts were reflected in the table below

Table 1: Ethnomathematical Concepts in the Preparation for Lay-outing and Constructing the Pond

Theme 2: Measurement and Estimation as Central Practices in Brackish Water Pond Management

Activities	Ethnomathematical Concepts	
Preparation of materials to be used in lay-outing and constructing of the pond.	-Measurement and estimation	
Land Measurement and Lay-outing	- Basic counting (number of dupa, sticks) - Measurement and estimation (armspan, handspan, square dupa, depth using bamboo stick) - Ratio and proportion (number of square dupa to payment system) - Geometry: square and rectangle (layout and dug sections), lines (marking boundaries with rope)	

Digging and Construction of the Pond (Punong)	- Measurement and estimation (dupa, dangaw) - Basic Counting (number of square dupa) - Geometry: area (square dupa), elevation (depth), - Ratio and proportion (Number of square dupa to payment) - distance (8 armspan away from the edge of the pond (kahon)	

This theme consolidates how measurement and estimation practices guide major phases of brackish water fishpond management—namely soil treatment, water preparation, and fish rearing—in Barangay Lanas, Barotac Nuevo, Iloilo. These mathematical practices are applied using indigenous units of measure and practical tools, and play a vital role in ecological preparation, safety assurance, and sustainability of the pond environment. The discussion highlights how fish farmers naturally integrate length, depth, time, volume, and ratio estimation into their traditional systems—grounding these in cultural knowledge and observable references.

Soil Treatment and Water Introduction into the Pond

After the pond layout and excavation have been completed, the next crucial phase is soil treatment and the gradual introduction of water. This process ensures the pond environment is safe and suitable for fingerling stocking, integrating both indigenous knowledge and practical safety practices.
Materials Used

Figure 6: Hilo nga gamit - 1 liter of insecticide per hectare.

Fertilizer ("abono") – 2 sacks per hectare (1 sack of Urea and 1 sack of 16-20)

Figure 7: Ang pag abono – Fertilizer used to produce "lablab" and other fish foods.

Figure 8: Sprayer – used to spray the insecticide.

Figure 9: Motor sap ag pa sulod tubig - used to pump seawater into the pond Initial Watering and Insecticide Application

"mapasulod gamay nga tubig para ka treat ang lupa, makapangabuno kag mka spray ka insecticide. Gapasulod kmi katubig mga 6 inches and kadalumon ukon mga isa ka dangaw."

A small amount of water, about 6 inches deep or one handspan (isa ka dangaw), is first introduced into the pond. This shallow water serves multiple purposes: it prepares the soil for treatment, facilitates the effective spraying of insecticide, and most importantly, creates the necessary environment for the growth of natural fish food such as "lablab" and "lumot".

Without this initial layer of water, lablab and other edible aquatic plants, which are essential for the healthy growth of fingerlings, cannot grow. Thus, this step is crucial in setting the foundation for a productive and balanced ecosystem in the fishpond.

Once the shallow water is in place, an insecticide is sprayed to eliminate unwanted aquatic organisms that may be carried by seawater. For the treatment, 1 liter of insecticide is mixed with 1 gallon of water, and the mixture is sprayed across the entire pond using a sprayer. The unwanted organisms include; tilapia fingerlings, eels, and other small fish or aquatic creatures.
These organisms are not intentionally introduced but are often carried into the pond by seawater. They can become predators or competitors to the milkfish fingerlings (bangros), affecting their growth, survival, and overall yield. The application of insecticide ensures that the pond is free from these threats before stocking.

Five-Day Waiting Period Before Fertilization

> *"Mga 5 days pagtapos ka hilo, amu naman na ang paghaboy sang abono. Kinanglan gid palipason anay mga lima ka adlaw nga mag tahaw ya hilo kai ka delikado kung may pilas ang manug abono nga maubog sa may hilo"*

Fertilizer is not applied immediately after insecticide treatment. A five-day waiting period is strictly observed to protect the health and safety of the workers. This is because if the presence of insecticide in the water is still strong, it becomes risky for workers to enter the pond. During fertilization workers must step into the pond (locally known as "ubog") to distribute fertilizer. If they accidentally get cuts or wounds (mapilas) from rough soil, sharp shells, or debris, and the insecticide has not yet subsided (wala pa nagtahaw), these wounds may result in skin irritation, infection, or even poisoning.

Allowing time for the insecticide to subside (magtahaw anay) is crucial for ensuring the safety of those working in the pond. This five-day interval reduces the risk of exposure to harmful chemicals and makes the pond safe for the next stage of fishpond management
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Fertilizer Application (Pangabuno)

> *"Sa isa ka hectare 2 ka sako nga abono (1 ka urea kag 1 16-20) tapos sa insecticide 1 ka litro sa isa ka hectare. Sa pag pang abono naman, gina abonohan para nga ang lupa maka produce sang mga pagkaun sang mga semilya pareho sang lablab, lumot kag iban pa nga tanom nga pwede makaun sang fingerlings."*

After the waiting period, 2 sacks of fertilizer per hectare (1 Urea and 1 16-20) are applied. This promotes the growth of natural food for the fingerlings such as; lablab (a type of aquatic plant), lumot (moss or algae), and other edible aquatic vegetation.

Figure 10: Lablab – fish food.

These organisms enrich the pond ecosystem and reduce the need for artificial feed.

Water Introduction

> *"Mga 15 days tapos sang pag pang abono mapasulod na liwat sang tubig sa punong gamit ang motor. ginabanta namun nga ang tubig makalab ot na sa tuhod, mga 2 days ukon 50 hours ang pagpaandar ka motor(continuously)."*

Once fertilization is complete, seawater is gradually introduced using a motorized pump. Pumping continues for approximately 50 hours, or about 2 days, until the water level reaches knee-deep. This depth is important because it helps protect fingerlings from predatory birds like the dugwak, which can easily catch fish in shallow waters and also ensures a stable environment for fingerlings to adapt and feed properly.

This process is done 15 days after fertilization and usually takes place in the month of May, which marks the start of the rainy season. Rainwater naturally mixes with seawater, helping to balance salinity levels and maintain proper water volume for the pond.

Readiness for Stocking

"Pagtapos pasulod tubug, mga 15 days man bag o mag buya ka isda"

About 15 days after introducing seawater, the pond is ready to be stocked with fingerlings. By this time, the environment has become biologically rich, safe from predators and toxins, and properly conditioned to support healthy fish growth.

Figure 11: Knee-level Depth

During the soil treatment and water introduction phase of traditional fishpond preparation, various ethnomathematical concepts are applied such as ratio and proportion, measurement and estimation, time estimation, and volume estimation. These practices show how local fish farmers incorporate mathematical thinking in managing time, quantity, and environmental risks effectively. The ethnomathematical concepts were reflected in the table below

Table 2: Ethnomathematical Concepts in the Soil Treatment and Water Introduction into the Pond (Pag-treat kag Pagpasulod ka Tubig sa Punong)

Activities	Ethnomathematical Concepts
Soil Treatment (Paghilo)	- Ratio and proportion (1 liter of insecticide per hectare) - Measurement (6 inches water, 5-day waiting period) - Time Estimation (duration of pesticide breakdown for safe entry)
Fertilization (Pag-abono)	- Ratio and proportion (2 sacks per hectare; 1 urea, 1 16-20) - Basic counting - Time measurement and estimation (every 15 days)
Water Introduction	- Time measurement (pumping for ~50 hours) - Estimation (knee-level water depth, bird threat control) - Volume

Theme 3.Measurement and Estimation as Applied in Fish Rearing in the Pond (Pagpadako sang Isda sa Punong)

Fish rearing in traditional fishpond management involves different practices that rely on indigenous knowledge and practical estimation. Farmers apply measurement techniques and observe environmental cues to make informed decisions throughout the rearing cycle. These include estimating fish population density, monitoring water levels, timing fertilization, and assessing fish growth. Such practices are deeply rooted in local experience and are essential for maintaining a healthy and productive pond environment. This theme explores how measurement and estimation are naturally embedded in the day-to-day routines of fish rearing and how they reflect the community's ethnomathematical knowledge.

"Sa isa ka hectare gabuhi kmi 2500-3000 nga fingerlings. Wala naman kmi ga ubog, naga ubog lang kmi kung mangabono liwat. Mga every 15 days gapangabono kmi. Gina sige lang monitor ang tubig kay gataas pagid da depende sa panahon, gala bot da tana asta sa dughan, wla kmi ga buhin tubig pa kay para sa lukon, kinahanglan bi sang lukon (prawn) dalum nga tubig. Kung maubog namun ang punong kag kung asta na sa liog, kay may tendency pagid nga ga magtaas kung magulan, malapaw ang tubig sa punong amu nan ga ginabuhinan namun ang tubig sa punong. Kay kung mag awas may tendency nga mabuhang kag ang iban nga isda masaylo sa iba nga punong"

After the fingerlings are released into the pond, the fish rearing stage begins. The number of fingerlings per hectare is equal to 2500-3000. No additional water is added after stocking, as the depth already reaches about knee level. Water levels naturally rise during the rainy season, reaching up to the waist or even the chest. This natural increase in water volume is important, especially when prawns (lukon) are also being raised alongside milkfish (bangros), since prawns require deeper water to thrive.

Throughout the rearing process, farmers do not stir or disturb the pond (called "ubog") unless it's time to fertilize again. An important part of fish rearing is regular fertilization. This process begins three months after stocking, as the fingerlings would have grown significantly by this time and would require more natural food sources in the pond. Starting from the third month of fish rearing, fertilization is carried out every 15 days. For a 1-hectare pond, 1 sack of fertilizer is applied each time. This regular fertilization promotes the continuous production of natural food sources such as lablab, lumot (algae), and other edible aquatic plants. These natural feeds are essential for the healthy growth of milkfish, allowing them to thrive without immediate dependence on commercial feeds. This practice reflects an indigenous, cost-effective approach that supports sustainable aquaculture.

The water level is regularly monitored. If it reaches the neck level or begins to overflow, water is drained to avoid spillage into adjacent ponds, which could cause fish to transfer or escape. One of the visible indicators that the pond is too full is when the water is only one handspan (dangaw) away from the top edge of the pond or the "kahon."

"Houd gina samplingan namun gamit ang laya(fishing tool), every 15 days gina laya kag gina sampling sa kilohan(weighing scale). Gakuha lang kmi 5 ka bilog kag gina kilo. Sa pag sampling dira mo mabal an kung naga dalagko na ang isda kag kung kinahanglan pa mag feeding. Kung mga 1 month before mag haw as, kag makita mo nga medyo gagmay ang isda, kinahanglan mag feeding ikaw gamit ang feeds."

Fish growth is monitored through regular sampling. After three months of stocking, fish are sampled every 15 days using a traditional fishing tool called *laya*. Typically, five fish are caught and weighed on a scale to determine their average size. This sampling helps farmers decide whether to begin supplemental feeding. If they find that three fish weigh about one kilogram, feeding is unnecessary. However, if five fish weigh significantly less—such as five fish per kilogram—farmers begin to feed them with commercial pellets, especially one month before harvest, to ensure marketable size.

Harvesting usually takes place after five to six months of rearing. If water is still deep (up to the navel or beyond), harvesting is done using *pukot* (a type of seine net). However, if the water is shallow due to dry conditions or planned draining, they use *sahid*—another traditional fishing tool suited for shallower water. These practices reflect a blend of traditional knowledge, practical experience, and careful estimation to ensure the health and growth of fish in the pond.

Fish rearing practices in traditional fishpond management involve the consistent use of ethnomathematical concepts. These include basic counting, time awareness, and ratio and proportion, periodic sampling, estimation and measurement, time These highlight the integration of mathematics in decision-making processes throughout the fish rearing cycle. The ethnomathematical concepts were reflected in the table below

3: Ethnomathematical Concepts in Fish rearing

Activities	Ethnomathematical Concepts
Stocking Fingerlings	- basic counting - ratio and proportion - Time
Fish Rearing (Pagpadako sang Isda)	- Periodic sampling (every 15 days) - Basic counting and operations (number of fish per kilogram) - Estimation and measurement (water depth: knee, waist, chest level) - ratio and proportion
Harvesting	- basic counting - Measurement and estimation (water level to choose *pukot* or *sahid*) - time

Figure 12: Laya

Figure 13: Pukot

Figure 14: Ang pag Sahid

Conclusions

The traditional practices involved in fishpond (punong) construction and management illustrate a well-developed system of indigenous knowledge that is deeply rooted in local culture. Techniques such as body-based measurements (e.g., *dupa*, *dangaw*), the use of visual markers, and reliance on natural indicators showcase the community's ingenuity and experiential approach to estimation and planning. These methods are not only practical but also cost-effective and sustainable, as evidenced by the use of traditional tools like *tagad*, *laya*, *pukot*, and *sahid*, along with the cultivation of naturally occurring fish food such as *lablab* and *lumot*. This reduces dependence on commercial aquaculture inputs while preserving ecological balance. Furthermore, practices like observing a five-day waiting period after insecticide application and carefully timing the introduction of fertilizer and water reflect a strong awareness of environmental health and worker safety. The community's culturally embedded understanding of risk management contributes significantly to responsible farming. Additionally, the *baydanay* system—where labor costs are calculated based on the square *dupa* excavated—demonstrates a precise, fair, and easily understood local method of labor quantification and compensation, reinforcing transparency and efficiency. Finally, the adaptive management of water levels based on rainfall and environmental cues, along with the use of traditional fishing methods tailored to current pond conditions, highlights the farmers' ability to respond effectively to natural cycles and environmental changes without relying on advanced technology.

The ethnomathematical concepts found in traditional fishpond management are mathematically rich, culturally embedded, and environmentally responsive. Integrating these practices into the Department of Education's (DepEd) curriculum enhances mathematics instruction by providing authentic and contextual learning experiences that are rooted in the lived realities of Filipino communities. This approach aligns with DepEd's advocacy for localization and contextualization, ensuring that learners can relate abstract mathematical concepts to meaningful cultural practices such as measurement, estimation, ratio, proportion, and geometry observed in everyday activities like fishpond construction and maintenance. Moreover, it serves as a vital means of preserving and honoring Indigenous mathematical knowledge systems, which are often overlooked in mainstream education. Through this integration, learners not only develop a deeper understanding of mathematical ideas but also cultivate a sense of cultural identity, pride, and environmental consciousness. Ultimately, incorporating ethnomathematical knowledge into the curriculum promotes inclusive education and empowers learners to see the relevance of mathematics in sustaining local traditions and addressing real-world challenges.

Recommendations

To preserve and promote the rich indigenous knowledge embedded in traditional fishpond construction and management, several actions are recommended. First, the local government, in collaboration with academic institutions, should prioritize the documentation and preservation of these practices to safeguard cultural heritage and facilitate knowledge transfer to younger generations. Integrating ethnomathematical content—such as body-based measurements and estimation techniques—into local mathematics and science curricula can contextualize learning while fostering cultural pride. Policymakers and agricultural agencies should support sustainable aquaculture by offering training, technical assistance, and access to organic alternatives for insecticides and fertilizers, ensuring that interventions respect and enhance indigenous methods. Community-based participatory research should also be encouraged to refine traditional approaches, possibly blending them with low-cost innovations, such as developing locally available organic treatments or culturally respectful improvements to traditional tools. Recognizing experienced local fishpond managers as indigenous knowledge holders and providing them with incentives—such as financial support, training roles, or community awards—can further ensure the continuity and vitality of these practices. Finally, given the realities of climate change, localized climate information services should be made available to help traditional farmers adapt their practices, such as stocking, fertilization, and harvesting, to shifting weather conditions.

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