The Ethnomathematical Study about the *Trampahan* (Water Gates) of Brackish Water Fish Culture in Banate, Iloilo

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Abstract: As we see Mathematics as part of our everyday life and culture, it becomes important to study ethnomathematics. This helps us understand how different communities use and express Mathematics in ways that are meaningful to them. This study aims to identify the ethnomathematical concepts in constructing the water gates (Trampahan) and its impact in fish growth and farm productivity of Brackish Water Fish Culture in Banate, Iloilo. This research looks at the math ideas in these cultural practices of constructing the Trampahan to help improve math education and support fish farming. This qualitative ethnographic study as researchers as the main instrument, gathered data through interviews, observation, and photographic and video documentation. The results, data presentation, discussions and conclusions were carried out for each analysis. The results show that there are mathematical concepts rooted in constructing every part of the Trampahan (water gates). There are mathematical concepts, including symmetry, ratio and proportion, quadrilaterals, angles and length measurements with non-standardized units. These results showed that in constructing the Trampahan and its impact in fish growth and farm productivity had a geometric sense through the local measurement of pond areas, control water levels, and time their operations based on natural patterns reflects how math is used in everyday life outside the classroom. These math concepts embedded in constructing a Trampahan can be used as a contextualized lesson specifically in Geometry. This study, we see the presence of ethnomathematics, a mathematical idea found in their cultural practices in fishing.

Keywords: Ethnomathematics, Brackish Water Fish Culture, Trampahan (Water Gates), Indigenous Knowledge Geometry in Culture, Aquaculture Structures, Mathematical Concepts in Fishing, Local Measurement Practices

INTRODUCTION

In brackish water fish culture, the shape and dimensions of ponds are essential for maintaining optimal water flow and ensuring healthy fish growth. The pond shape, such as rectangular, triangular or circular with appropriate depth, and sloped bottoms are some of the elements that facilitate efficient water circulation. Proper drainage design, particularly the strategic placement, opening of drainage outlets and constructing water gates, are necessary for effective pond management. Proper drainage can help in cleaning processes and upgrade water quality, ultimately impacting fish growth and farm productivity. Therefore, careful consideration of pond geometry and drainage mechanisms are vital for sustainable aquaculture operations (FAO, 2005).

In the Philippines, for instance, the development of brackish water fish ponds has been influenced by various factors, including the need for proper pond design and management practices (Baliao, 1995). According to The Secretariat SEAFDEC 1986, in Brackish water Pond Construction, water control structures such as dikes, canals, and gates must be properly constructed to have an effective water circulation.

Water gateways serve as critical points for managing water flow in a fish ponds, enhancing flood control and irrigation efficiency. They play a vital role in sustainable water management and functions as a controlled passage that helps regulate how and when water moves.

Some studies conducted on Indigenous Fish Trap (Bubo) in the Kijang area, Bintan Regency, Riau Islands (Febrian et al., 2024) and another study describe in detail the ethnomathematics in fishing activities in the

Rembang community which consists of the tools used in catching fish, the process of catching fish, and buying and selling of fishing results. In addition, researchers also want to know the relationship between fishing activities in the Rembang community and mathematics in terms of culture and mathematics (Muna et al.,2016). However, results of these studies only cover certain parts of mathematics and don't fully explore the deeper aspects of mathematical activity needed for a complete understanding. Even so, they have opened up opportunities to study similar topics in different cultural and community settings specifically in Brackish Water Fish Culture.

This study aims to identify the ethnomathematical concepts in constructing the water gates (*Trampahan*) and its impact in fish growth and farm productivity of Brackish Water Fish Culture in Banate, Iloilo. This research looks at the math ideas in these cultural practices of constructing the *Trampahan* to help improve math education and support fish farming.

METHODS

This study employed a qualitative ethnographic research design grounded in the principles of ethnomathematics. Ethnographic research is appropriate for uncovering culturally embedded knowledge and practices (Creswell, 2013), and ethnomathematics, as introduced by D'Ambrosio (1985), provides a lens through which to examine how mathematical thinking is expressed in local, practical, and cultural contexts. This design aligns with the research questions, which seek to identify the ethnomathematical concepts in constructing the water gates (*Trampahan*) and its impact in fish growth and farm productivity of Brackish Water Fish Culture in Banate, Iloilo.

The study was conducted in Banate, Iloilo, a coastal area with a longstanding tradition of brackish water aquaculture. Participants were selected using purposive sampling based on defined inclusion and exclusion criteria. The inclusion criteria required participants to have at least five years of hands-on experience in managing fishponds and direct involvement in constructing or operating *trampahan*. Individuals with less than five years of experience or without practical involvement in fishpond operations were excluded. A total of six participants—comprising experienced fishpond caretakers, elder fish farmers, and community-recognized aquaculture practitioners—were included to provide rich, context-specific insights.

Data were collected using multiple methods to enhance depth and validity. Participant observation allowed the researcher to witness firsthand the operation and design of *trampahan*, especially in relation to tidal timing, water volume control, and spatial measurements. Semi-structured interviews conducted in Hiligaynon enabled participants to share their experiences and explain the reasoning behind gate dimensions, placement, and seasonal adjustments. Focus group discussions (FGDs) provided opportunities for collaborative reflection and cultural validation of the data. These were complemented by photographic and video documentation to visually capture the tools, techniques, and processes involved.

Data from observations, interviews, and FGDs were cross-validated, and member checking was conducted by sharing summaries of findings with participants to confirm the accuracy of interpretations. Thematic analysis was used to identify recurring mathematical concepts such as estimation, measurement, geometric design, and proportional reasoning, grounded in the cultural context of the community (Braun & Clarke, 2006).

The research procedure was designed to be detailed and replicable. It included: identifying eligible participants based on criteria; obtaining informed consent; conducting multiple field visits for observation and interviews; recording and transcribing data; coding and categorizing data thematically; and validating findings through participant feedback. Ethical considerations were observed throughout the study, ensuring informed consent, participant anonymity, and cultural sensitivity, particularly in handling indigenous knowledge systems.

RESULTS AND DISCUSSIONS

Trampahan is the local term for water gates used in brackish water fish culture in Banate, Iloilo. More than just a simple structure that controls the flow of water in and out of the fishpond, the *Trampahan* plays a vital role in the successful production of local fisherfolk. Though it may appear modest in design, the *Trampahan* as shown in Figure 1, carries with it a wealth of ethnomathematical knowledge embedded in every aspect of its construction and function.

Figure 1. Sample *Trampahan* in Banate, Iloilo

Figure 2. *Pwerta Mayor nga Trampahan*

In the past, the fisherfolk of Banate used wooden planks to construct their *Trampahan* as seen in Figure 3. Typically, the major or *"Pwerta Mayor nga Trampahan"* as shown in Figure 2, measured about *"tres metros"* or three meters in length, with an opening approximately *"mga tres pyes"* or three feet wide. It stood *"dose pyes"* or 12 feet tall, with *"mga tres"* or three feet of its height buried underground to serve as a stable foundation.

Figure 3. ***Segunda nga Trampahan***

There are also *"Segunda nga Trampahan"* as shown in Figure 3, which serve as the water gate from *"kanal"* to *"kwadro"* and from *"kwadro"* to *kwadro"* and are a little bit smaller than the major or *"Mayor nga Trampahan"* whose height is *"mga dyes ang kabilogan kag tres pyes ang lubong"* with an opening of *"mga dos pyes ang buka"* or two feet. However, the wooden *Trampahan* as seen in Figure 4, typically lasted only around three years, requiring the fisherfolk to invest additional time, effort, and money for reconstruction. To improve durability and ensure more sustainable production, the fisherfolk, together with the pond owner, decided to build a concrete *Trampahan* as shown in Figure 5.

Figure 4. Wooden Trampahan

Figure 5. Concrete Trampahan

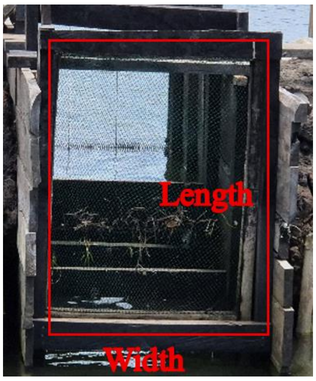
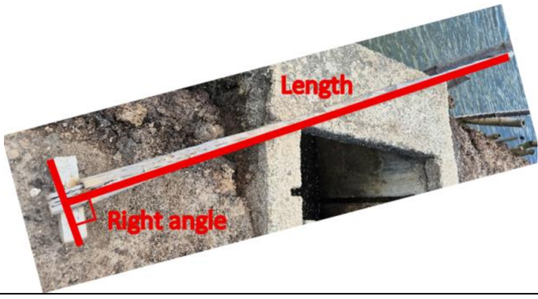
The study identified the local terms and discuss the parts of a *Trampahan* as follows:

(a) *"Salug"* or Floor. The floor which is usually rectangular in shape serves as the foundation of the structure and its elevation for the *"Mayor nga Trampahan"* must be lower than the pond bottom elevation and as low or slightly lower than the lowest tide in the site.
(b) *"Ding-ding"* or Side walls. Side walls define the passage way in addition to their being retaining wall for the dike fill. *"Alangtan"* for *Siradura* and *Bastidor* are built on these walls.
(c) *"Pak-pak"* or Wing walls. Wing walls are typically symmetrical and funnel-shaped, designed to provide a smooth transition from the sluiceway into the main canal.
(d) "*Tapakan"* or Bridges. These are reinforced concrete slabs or thick wooden planks that span the side walls. At least three bridges are provided, two at each end and one at center near the flashboard grooves.

(e) *"Siradura"* or Flashboards. Slabs or flashboards are generally wooden planks, inserted into *"alangtan"* or grooves. They are used to control the amount of water flowing through the gate.
(f) *"Bastidor"* or Screens. Screens are usually made of nets or plastic screen attached to a wooden rectangular frame that fit into the grooves. The screens are used to prevent the exit of the cultured fish and the entry of predators into the ponds.
(g) *"Kaw-it"*. The *Kaw-it* is typically made from a strip of wood attached to a bamboo handle. It is used to attach and remove "*Siradura*" to and from the "*alangtan"* or grooves of the side walls.
(h) *"Haligi"* or Pillars. In wooden gates, these are bamboo or *"dos por dos"*, serves as vertical supports where wooden walls are nailed. They are placed at regular intervals so that they form a framework for the gate itself.
(i) *"Bris"* or Braces. In wooden gates, these wooden members hold or fasten two or more pillars together or in place. They keep the opening of a gate rigid.

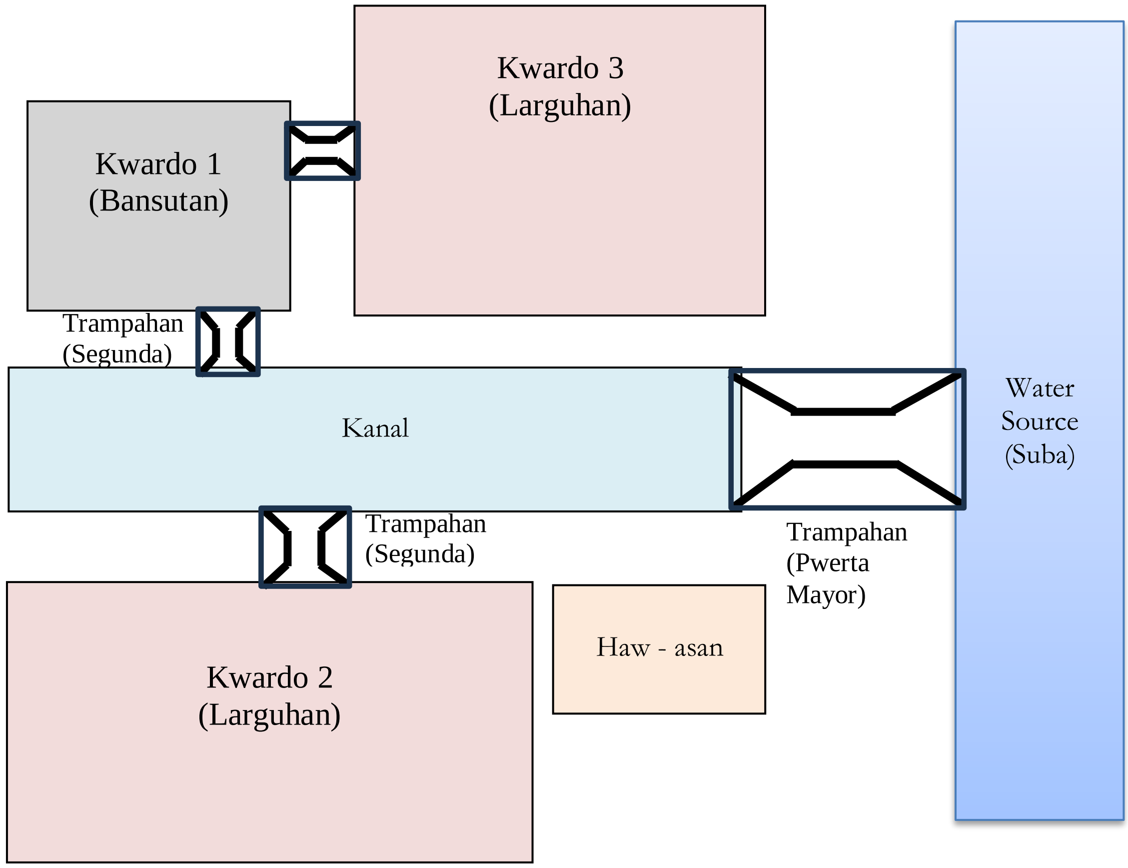
Table 1. Ethnomathematical Concepts in Constructing the *Trampahan*

Parts of *Trampahan*	Sample Picture	Ethnomathematical Concepts
Siradura		Quadrilaterals (Measurement of the length and width of the *siradura* and making sure it is parallel are math concepts involving properties of a rectangle) Measurement and Estimation (Measuring the *siradura* and making sure it will fit in the *alangtan* is applying measurement and estimation) Ratio and Proportion (Wooden *trampahan* uses small sizes *siradura*, while the concrete *trampahan* uses bigger *siradura*. With this, direct proportion is applied, as the greater the *trampahan*, the greater the *siradura*.)
Salug, Ding-ding, tapakan and Pakpak sang Trampahan		Symmetry (In constructing the *Trampahan*, all the parts must be symmetrical to ensure a good flow of water) Angles & Diagonal lines (The *pakpak* sang *trampahan* is obtuse angle to prevent soil from eroding.) Measurement and estimation (Measuring and estimation of the length and width of the *dingding* and *salug* during construction)

Bastidor	 	Quadrilaterals (Cutting the nets or the screens and attaching it to the rectangular frame, making sure it is parallel is applying the concepts of parallelograms.) Measurement and estimation (Measuring and estimation of the length and width of the *bastidor* so that it will fit in the *alangtan* during construction) Ratio and Proportion (Wooden *trampahan* uses small sizes *bastidor*, while the concrete *trampahan* uses bigger *bastidor*. With this, direct proport ion is applied, as the greater the *trampahan*, the larger the *bastidor*.)
Kaw it sang Siradura		Measurement and estimation (Measuring and estimation of the length of the handle of the *kaw-it*.) Angle (In constructing the *kaw-it* for the *siradura*, the angle is perpendicular to its handle.)
Haligi and Bris for Wooden Trampahan		Measurement and estimation (Measuring and estimation of the height of the *haligi* during construction) Angle (In constructing the braces, the angle is perpendicular to its *haligi*.)

The layout of the fishpond in Figure 6, shows how important the *Trampahan* is because it serves as the gateway to the *Kwadro* (fish enclosures). It controls the flow of water in and out of the pond, which is very important for maintaining clean, oxygen-rich water that fish need to grow. By managing water levels and quality, the *Trampahan* helps create a healthy environment for the fish, making it a key part of a successful brackish water fish farm.

Figure 6. Layout of the Pond



The construction of *Trampahan* in brackish water fish culture systems plays a crucial role in enhancing fish growth and overall farm productivity. These structures regulate water exchange, allowing farmers to maintain optimal salinity, oxygen levels, and waste removal, which are essential for healthy fish development. By controlling tidal inflow and outflow, *Trampahan* also helps prevent the entry of predators and harmful substances, thus reducing fish mortality rates. Furthermore, consistent water quality promotes better feed conversion efficiency and faster growth rates, ultimately increasing yield and economic returns for aquaculture operations in brackish water fish culture.

Ethnomathematics is seen in the layout of the fishpond with a *trampahan* through the traditional knowledge and practical use of measurement, geometry, and patterns by local fish farmers. The careful design of the pond—such as the size and shape of the *kwadro* (fish enclosures), the position of the *trampahan* to align with tidal flow, and the calculated water level which all reflect mathematical thinking rooted in cultural practices. These farmers apply spatial reasoning and timing based on moon phases and tides to manage water exchange effectively, showing how indigenous knowledge systems integrate math with daily life in brackish water fish culture.

Table 2. Ethnomathematical Concepts in the Impact of *Trampahan* in fish growth and farm productivity

Activities	Ethnomathematical Concepts
Lay outing the fishpond	Measurement and estimation Geometry
Flow and controlling of water	Measurement and estimation Time (Lunar Calendar)

Fish Production	Business Math

The method in constructing the *Trampahan*, a traditional fishery system rooted in indigenous knowledge, significantly influences fish growth and production, especially when viewed through the lens of ethnomathematics. *Trampahan* involves the use of natural or semi-structured enclosures in rivers, swamps, or rice paddies to trap and rear fish, often guided by generations of local ecological understanding. This system promotes sustainable fish growth by allowing fish to thrive in environments that closely mimic their natural habitats, with careful attention to seasonal water cycles, feeding patterns, and population balance. From an ethnomathematical perspective, local communities apply culturally embedded mathematical principles—such as measuring pond dimensions and every part of the *Trampahan* using local units (e.g., *pyes, metros*), scheduling harvests according to lunar calendars, and estimating fish population using visual and experiential cues. These traditional systems integrate proportion, geometry, measurement and estimation in ways that align with sustainable resource management. However, when *Trampahan* is not maintained properly or is pressured by overuse, it can lead to reduced water quality, overcrowding, and lower fish productivity. Thus, understanding *Trampahan* through ethnomathematics not only highlights the scientific value of indigenous practices but also opens opportunities for blending traditional knowledge with modern aquaculture techniques to enhance both ecological sustainability and fish production outcomes.

CONCLUSION

The ethnomathematical concepts in constructing water gates (*Trampahan*) in Banate, Iloilo reveals the valuable traditional knowledge that fisherfolks apply in brackish water fish culture. From measuring the dimensions of the *kwadro* to calculating the best location and angle for the *Trampahan* based on tidal flow and water levels, and constructing every part of it manually, these practices demonstrate how mathematics is deeply embedded in their cultural techniques. Fisherfolks use estimation in measurement in constructing every part of the *Trampahan*, spatial reasoning for making the purpose of each part effectively, and timing based on lunar cycles to regulate water flow efficiently and ensuring that the pond maintains optimal salinity and oxygen levels necessary for fish survival and growth.

This traditional mathematical knowledge has a direct impact on fish growth and farm productivity. Properly constructed and positioned *Trampahan* allow for better water quality management, reduce the risk of diseases, and improve feed efficiency, all of which contribute to healthier fish and higher yields. By recognizing and valuing these ethnomathematical practices, we not only highlight the scientific wisdom in local culture but also support the sustainability of brackish water fish farming in communities like Banate, Iloilo. Embracing these concepts can strengthen both environmental stewardship and economic success in local aquaculture.

Through this, we see the presence of ethnomathematics, a mathematical idea found in their cultural practices in fishing. The way fisherfolks construct *Trampahan*, measure pond areas, control water levels, and time their operations based on natural patterns reflects how math is used in everyday life outside the classroom. These math concepts embedded in constructing a *Trampahan* can be used as a contextualized lesson specifically in Geometry. Contextualized lesson in teaching the concepts of Quadrilaterals and may apply sample or problems related to parts of the *Trampahan*. Recognizing the value of this traditional knowledge not only preserves cultural heritage but also supports sustainable and efficient aquaculture practices. In essence, constructing the *Trampahan* is more than just a farming method, it is a living example of how culture and mathematics work together to support community livelihoods. However, it is recommended that further researchers may study on the innovation constructing of the *Trampahan* through the years and the perspective of the people behind it.

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