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Punongan: Indigenous Measurement and Estimation Systems in Bangus Growth at Barangay Guintas Barotac Nuevo, Iloilo Philippines

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***Abstract*—** This study examines the Punongan system indigenous measurement and estimation practices used by Bangus (milkfish) farmers in Barangay Guintas, Barotac Nuevo, Iloilo, Philippines through an ethnomathematical lens. Although the Philippines officially uses the metric system, farmers blend metric and English units alongside embodied, body-based measures to quantify pond size, stocking densities, and fish growth. Data were gathered via semi structured interviews in Hiligaynon. Following Braun and Clarke's thematic analysis framework, two major themes emerged: the seamless integration of formal and vernacular measurement systems and the use of body based units like finger-widths (dangkal) as reliable mnemonic tools for sizing fingerlings and estimating quantities.

Farmers described how surveyors' boundary markers and gridlines in hectares create mental maps that guide decisions on stocking and harvesting. Simultaneously, caretakers rely on their own finger spans to identify when fingerlings reach ideal sizes, ensuring consistent stocking densities without rulers or tapes. These embodied practices simplify daily routines in muddy, fast-paced environments and foster shared standards across workers. By blending formal metrics with local ecological knowledge, farmers improve planning accuracy, reduce errors, and communicate clearly with government agencies, while keeping cultural traditions intact.

Documenting the Punongan system highlights how hybrid measurement practices support sustainable aquaculture. This research underscores the cultural significance of vernacular measures and suggests that integrating local knowledge into fisheries management can empower communities, especially in data-poor contexts. Recognizing these practices bridges formal science and traditional know-how, offering practical insights for inclusive, contextually grounded fish farm.

***Keywords*—** Ethnomathematics, Vernacular Measurement, Bangus Farming, Aquaculture, Sustainable Fisheries, Local Eclogical Knowledge, Body-based Units, Fish Farming Practices, Iloilo Philippines.

I. INTRODUCTION

Bangus (milkfish) farming is a cornerstone of coastal agriculture in the Philippines, and Barangay Guintas a brackishwater aquaculture community in Barotac Nuevo, Iloilo is no exception. Ethnomathematics teaches that everyday cultural practices often encode systematic mathematical ideas (D'Ambrosio, 1985). For example, recent work in nearby Western Visayas fishing communities reveals that tasks like setting squid traps embed concepts of counting, measurement, and estimation in coherent. In this view, studying Guintas fishponds and fishers' habits through an ethnomathematical lens can illuminate how Bangus farmers quantify growth and yield. While Bangus is popularly regarded as the Philippine "national fish," the specific measurement and estimation traditions of Guintas farmers (the Punongan system) have not been documented. Examining these local practices is thus highly relevant: it connects concrete aquaculture practices (pond sizing, stocking, harvest) to the community's cultural knowledge.

A striking feature of Filipino measurement is the seamless mix of English and metric units. Even though the Philippines officially uses the metric system, people commonly switch between unit systems depending on context. As one observer notes, Filipinos "normally use a mixture of the English and metric systems" for instance, giving height in feet/inches. In aquaculture, pond areas and stocking densities likewise straddle conventions: farmers quote hectares or square meters for pond size and kilograms for biomass, yet may mentally convert these to familiar local units when planning. Indeed, Herrera and Palomo (2022) recorded local conversion rules such as 1 tapak (= 12 inches) and 1 dupa (= 1.5 meters). Such hybrid usage shows that Bangus farmers fluidly mix imperial and metric measures. When a farmer says a pond is "three rolling basins" (pail-sized containers) or "half dap," these translate into standardized areas (square meters) and volumes (kilograms) by convention. Documenting this mélange of units is crucial for understanding how farmers reason about space, density, and weight in both formal and vernacular terms.

Alongside formal units, Guintas farmers also use embodied, finger-span measures. In Philippine vernacular, a dangkal (the span from outstretched thumb to middle finger, roughly 7–8 inches) is a familiar "hand ruler". In fact, Herrera and Palomo found that local fishermen routinely used their bodies to measure nets and gear: one fisher measured net float spacing by his dangaw (thumb-to-finger span), and another noted a sikuan (elbow length) marking spacing between. By analogy, Bangus farmers often estimate fish length and counts with their hands or arms for example, measuring a fish by how many finger-widths long it is, or scooping a "handful" of fingerlings. These gestures are not random: they reflect internalized units (the dangkal, talampakan, kudlit, etc.) that vary from person to person but are well understood in context. Recognizing finger-span estimation is essential to ethnomathematics: it highlights how embodied knowledge (like knowing one's own hand-width) supplements formal measures when farmers make daily growth assessments.

Importantly, these hybrid and embodied systems have practical and cultural significance for sustainable aquaculture. Local measurement practices are not mere curiosities; they drive decision-making. Studies of fisheries science show that fishers' own records and perceptions often align closely with formal data, making their local ecological knowledge (LEK) invaluable. For example, in Bangladesh small-scale fishers' catch reports tracked official trends so well that analysts concluded "fishers have a good understanding of their fishing system," and that their knowledge could be "invaluable, especially in data-poor areas". Likewise, integrating vernacular measures into management empowers communities and improves outcomes. Petriki et al. (2024) note that explicitly using fishers' LEK in decision processes can "empower stakeholders" and foster more inclusive, effective management in inland. In Guintas, the Punongan system likely plays a similar role by enabling farmers to gauge pond productivity, feeding rates, or harvest timing in familiar terms, it supports both individual judgment and collective knowledge. These measures are also tied to identity and tradition – echoing the fact that cultures worldwide have long used body parts for measurement (from Egyptian cubits to indigenous dangan spans). Thus, documenting Bangus farmers' measurement and estimation systems reveals how practical aquaculture know-how and local heritage intertwine to guide sustainable fish farming in Barangay Guintas.

II. PROCEDURE

Use of metric and English System of measurement for pond measurement

Although manug-punong (fishpond caretakers) follow traditional fish farming practices, they have begun incorporating state standard units such as hectares, square meters, and kilograms to measure pond areas and determine fish stocking densities. This integration of formal metric measurements with local knowledge creates a shared reference point that allows them to better plan their operations, manage resources more effectively, and communicate clearly with external actors like land surveyors or government agencies. One manong Manug-punong explained that they now measure pond area in square meters and use a general ratio such as 3,000 fish per hectare to guide stocking decisions. This is what he stated

"Ang pag gamit namon parti sa punong is per square meter kung pira ang squire meter amo man daa ang nabuhi namon halimbawa sa isa ka hectar mabuhi lang kami three thousand kaisda per hectar" (We use square meters to measure the pond. For example in one hectar we release three thousand fishes per hectar.)

This allows for more precise planning and helps avoid issues like overcrowding. He added that their land had been formally measured by surveyors, confirming a total of 25 hectares, he stated this

"Gin takos dun ni nila sang mga land surveyer ang mga gapang takos sa mga punong bali 25 hectars ni tanan" (Since they already measured it with the help of a land surveyer he also added that it is a total of 25 hectars).

This collaboration with state actors not only formalizes land use but also strengthens their ability to access support or comply with regulations.

Overall, this blending of traditional and formal systems reflects the manug-punong's adaptability and practical decision-making, allowing them to maintain cultural practices while aligning with broader institutional frameworks.

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Table 1: *Mathematical Concepts in using of Metric and English System of measurement for pond measurement.*

Activities	Illustrations	Mathematical Concepts	Descriptions
Measuring the total area of the fish pond.		• Area • Irregular shapes • Perimeter	This is the image of the 25 hectares of the total land area of the Fish Pond (Punongan).

The use of standardized measurements in fishpond management doesn't stop at paperwork; it actively reshapes how farmers understand and engage with their environment on a daily basis.

When a surveyor measures a pond and marks it with boundary posts or gridlines in hectares or square meters, these markers go beyond their bureaucratic function.

They become everyday tools and physical reference points that farmers rely on to orient themselves and make practical decisions.

Over time, these stakes and corners embed themselves in the farmers' spatial awareness.

Instead of needing to measure with a tape each time, a farmer begins to "see" the pond in terms of its measured segments.

A certain stretch of bank or a cluster of posts might come to represent a quarter hectare or a known stocking area.

This creates a kind of mental map, allowing for faster, more confident decisions about where and how many fish to release or when to harvest.

What began as an abstract conversion of land into numbers now grounds real, hands-on judgments in the field.

This shift from formal measurement to lived spatial familiarity—marks an important transformation: it turns metric units from static data into dynamic, visual guides that shape daily routines and long-term management.

The ability of manug-punong to visually estimate pond size and shape is deeply rooted in the physical landmarks that have been established through formal surveying.

When professional surveyors measure and mark out the ponds—dividing them into hectares or smaller sections—these measured boundaries don't just serve legal or administrative functions.

They become part of the farmers' working knowledge, forming a mental map that guides their daily decisions.

Landmarks like corner posts, embankments, and natural divisions turn into quick reference points that help farmers judge pond area at a glance, without needing to remember each time.

As one manong manug-punong explained, their pond has a stretched shape and is divided into known sections: one part measures 6 hectares, another wider section is 10 hectares, and another is 5 hectares, he stated

"Ang shape ka punong namon palaba ni mo te kada kwadro ni natakos na ni, Halimbawa amo ni six hectar ni isa ka pond tapos aning malapad is ten hectar kag amo ni 5 hectars ni te mabal an mo ni kung pila ka hectars isa ka pond" (Our pond shape is stretched then every quartile of it is already measured, Example this pond is 6 hectares, this bigger one is 10 hectares).

These figures are not abstract; they become part of how farmers read the land. Over time, this leads to informal categories of "big" or "small" ponds, which are based not on rough impressions but on accurate, previously measured data.

These mental shortcuts, grounded in concrete measurements, allow for quick and confident decisions when it comes to stocking fish, estimating feed, or planning harvests.

In effect, the formal act of surveying transforms into a practical tool for spatial reasoning in the field.

Table 2: *Mathematical Concepts in using of Metric and English System of measurement for pond measurement.*

Activities	Illustrations	Mathematical Concepts	Descriptions
Measuring the total area of the Nursery Pond/Similyahan of the fish pond.		• Area • Irregular shapes • Perimeter	This is the image of the 4 hectares of the total land area of the Fish Pond (Punongan).
Measuring the total area of the harvesting/Palargohan of the fish pond.		• Area • Quadrilateral • Perimeter	This is the image of the 6 hectares of the total land area of the Fish Pond (Punongan).
Measuring the total area of the harvesting/Palargohan of the fish pond.		• Area • Quadrilateral • Perimeter	This is the image of the 10 hectares of the total land area of the Fish Pond (Punongan).
Measuring the total area of the harvesting/Palargohan of the fish pond.		• Area • Irregular shapes • Perimeter	This is the image of the 5 hectares of the total land area of the Fish Pond (Punongan).

When farmers have a clear mental map of a pond's size and layout, it doesn't just help them decide how many fish to stock it also guides how they plan and execute the harvest. Knowing exactly where the shallower corners, deeper channels, and narrower passages lie means they can choose the right nets and traps to move fish gently yet efficiently toward the harvesting area. For example, a wide, rectangular pond might call for seine nets along the long edge to herd fish into a corner, while a smaller, irregularly shaped pond might need a push net used in tighter turns so fish aren't injured. By visualizing each measured section of the pond, caretakers can estimate how many fish will be caught in each sweep and adjust net size or mesh spacing to prevent smaller fish from escaping or larger ones from being overcrowded. This attention to spatial detail helps protect fish quality by reducing stress and physical damage, and it also produces more accurate head counts so that expected harvest volumes match reality. In other words, the same landmarks that once helped set stocking rates now become the reference points for gentle, precise harvesting, ensuring both the wellbeing of the fish and the reliability of harvest estimates.

The choice of capture tool (cast net vs. pukot) reflects concerns over accuracy and fish well-being. Cast nets with finer mesh are preferred to minimize scale damage and stress, indirectly linking gear selection to reliable weight-based measurement at harvest. Manong said that

"Waay kami pukot kundi Laya, man an mo mastress ang isda kung pukuton mo kag ang himbis ya mahukas" (We don't use 'Pukot' but rather we use cast net for the reason that the fish has a tendency to be stressed and damage the scales [with pukot]).

Since every fish needs to arrive at the weighing station in good condition unbroken scales and minimal injury, cast nets' gentler action ensures that harvested fish more closely match the expected weight calculations. Moreover, because fewer fish slip through the tight mesh, farmers can trust that their head counts and subsequent weight-based projections are reliable. In short, the finer mesh of a cast net safeguards fish health, making it the preferred tool for a harvest that values precision as much as animal welfare. He also explained the difference between a cast net and a pukot and stated that:

"Ang cast net gagmay na iya mata, Ang pukot tana my sizes na iya mata my seven or six kag malusot ulo ka isda sa mata mapatay pa na gani" (Cast net has smaller holes while the Pukot have hole sizes ranging from 6 to 7 inches and the fish can fit its head on it and can cause death to them [if using pukot]).

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Table 3: *Mathematical Concepts in using of Metric and English System of measurement for pond measurement.*

Activities	Illustrations	Mathematical Concepts	Descriptions
Measurement of the net ring/support structure of frame.		• Circumference • Diameter • Radius	This is the Cast Net that they use during Palargo or Harvesting.
Measurement of the cast net meshes.		• Measurement • Quadrilateral	This is the image of the cast net mesh with 3.5 inches size.
Measurement of the fish net (Pukot) mesh.		• Measurement • Quadrilateral	This is the image of the cast net mesh with 6 to 7 inches size.

Beyond selecting the right gear, pond caretakers rely heavily on hands on, embodied methods to ensure both precision and the well-being of their fish at every stage.

Just as they choose a cast net over a pukot to prevent scale loss and stress during harvest, they use "finger gauges" when stocking fingerlings placing a fish alongside their fingers to estimate its length rather than breaking out a ruler.

This intuitive measurement technique is rooted in years of daily practice: a caretaker knows that when a fingerling reaches the width of two fingers, it's at the ideal size for moving into the nursery pond.

By trusting their own sense of touch and visual familiarity, they maintain consistent stocking densities without needing expensive or delicate tools.

This same body based expertise extends to other tasks feeling the pulse of water temperature by dipping a hand in the pond or judging feed portions by the weight they can feel in their palms so that every decision balances fish care with operational accuracy.

By blending tactile knowledge with thoughtful gear choices, these farmers create a seamless system where care and precision go hand in hand.

Part of the Hands as a tool for measurement

In the absence of formal measuring rods during fingerling counting, caretakers rely on their own body parts particularly finger spans to estimate fish length (~4 inches) and to ensure consistency in stocking ("Palargo"). This embodied technique is both practical and mnemonic. Manong stated that

"Ang kamot namon ga counting kami nagamit namon daad sa pag isip kung mag palargo na kami"(In terms of using body parts we use our fingers in counting, for counting fishes).

He also gave an example and added that "Halimbawa Ten Hectars mapabuhi kami thirty thousand nga similya nga mga duwa ka tudlo kadaragko or mga 4 inches para kapalargo kami" (We count thirty thousands of fingerlings with a size of two fingers or 4 inches for us to 'Palargo').In this way, the embodied technique does more than save time it creates a shared standard among workers. Since everyone's finger width is fairly consistent, it becomes a mnemonic device that aligns stocking practices across different ponds and seasons. By relying on their hands, caretakers weave precision into everyday routines, ensuring that thousands of tiny fish are counted and stocked at the right stage of growth without ever needing to measure out each one with cumbersome tools.

Table 4: *Mathematical Concepts in using Part of the Hands as a tool for measurement.*

Activities	Illustrations	Mathematical Concepts	Descriptions
Measuring Milkfish (Bangus) fingerlings using finger.		• Unit conversion • Estimation • Ratios	In this image the use of partition of fingers is being used as method to measure fingerlings.
Measuring Milkfish (Bangus) fingerlings using finger.		• Unit conversion • Estimation Ratios	In this Image the fingerling is being measure using the fingers partition for us to see that it's accurate.

When caretakers measure milkfish fingerlings by comparing them to their own finger spans, they tap into a method that's as intuitive as it is reliable. By knowing that a healthy fingerling should stretch across roughly two to three fingers about 2.5 to 4 inches they don't need a tape measure or ruler each time; their hands become a living benchmark. This approach works well in the busy, muddy environment of a nursery pond, where fumbling with tools can slow things down. Because everyone on the team shares a similar sense of finger width, it also creates a built in check against variation: if a fish fits the "two finger rule," it's ready for stocking, and workers don't need to ask, "How big is this one?" over and over. The mnemonic side of it comes from repetition—each time a caretaker "Palargo" (sizes up) a fingerling against their fingertips, that action cements the size standard in their mind. Over time, the sight of a fish that doesn't span two fingers immediately signals that it's too small or too large, ensuring that stocking densities remain consistent without written charts or digital tools. In short, the body-based measurement is a simple shortcut that makes daily tasks faster, keeps everyone on the same page, and anchors care routines to a shared, tangible standard.

III. CONCLUSION

The community of manug-punong have been accustomed to employing symbolic mathematical calculations daily activities in Guintas Barotac Nuevo's culture, such as the basic counting, measurement and estimation, distance, time, average, calculating pond dimensions, volume, and surface area, modeling parameters, growth rates, or feed calculations, analyzing water quality data, fish growth rate, or mortality rates. Furthermore, existing mathematical computations are used to simulate and predict specific natural events. Ethnomathematics, for example, is still frequently employed, particularly among rural communities. This demonstrates that the community has strong Ethnomathematical abilities, which must be institutionalized, utilized, and maintained in particular by formal educators. Apart from providing an overview of the community, which is rich in Ethnomathematics, it must be preserved. This study is expected to inspire and motivate government officials, particularly those in charge of education, to preserve culture through Ethnomathematics on realistic mathematics education program.

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