*LOGARITHMA: Journal of Research in Mathematics Education*
Vol. 1, No. 1, June 2026, pp. 14–23
DOI: 10.58740/logarithma.v1i1.782
p-ISSN:, e-ISSN:

# Geometric Concepts and Non-Standard Measurement in Dayak Sawe Indigenous Farming Tools: An Ethnomathematical Study

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**ARTICLE INFO**

**Received:**
23 April 2026
**Revised:**
02 June 2026
**Accepted:**
08 June 2026
**Published:**
15 June 2026

**KEYWORDS:**
Ethnographic, Ethnomathematics, Indigenous Farming Non-Standard, Tools Geometric.

**ABSTRACT**

This study aims to explore geometric concepts and non-standard measurement systems in the traditional farming tools of the Dayak Sawe community in Odong Hamlet, Sekadau Regency, West Kalimantan. A qualitative approach with an ethnographic type was used in this study. The research subjects were traditional leaders, farming tool craftsmen, and the general public of the Dayak Sawe community. Data were collected through observation, semi-structured interviews, and documentation, then analyzed using the Miles and Huberman model. The results of the study found 13 types of farming tools containing geometric concepts of both two-dimensional and three-dimensional shapes, as well as body-based non-standard measurement systems such as depa (the distance from the right hand to the left hand when stretched out), seta, and jengkal (distance from the tip of the thumb to the tip of the little finger). There is a close relationship between the geometric shape of the tools and the type of measurement used in the manufacturing process. This study contributes to the study of ethnomathematics and can serve as a contextual learning resource based on local wisdom.

**How to Cite:** Genesius, R., Sandie, S., Hodiyanto, H., & Tejera, M. (2026). Geometric concepts and non-standard measurement in Dayak Sawe indigenous farming tools: An ethnomathematical study. LOGARITHMA: Journal of Research in Mathematics Education, 1(1), 14–23. https://doi.org/10.58740/logarithma.vXiX.pxx-xx



## 1. INTRODUCTION

Mathematics plays an important role in human life and is closely related to everyday activities (Ly et al., 2024). Although often seen as an abstract discipline, mathematics is also embedded in culture and social life, developing not only through formal education but also through community practices (Firdaus & Hodiyanto, 2019). As an applied science, it has long been used in daily life (Suriati & Firdaus, 2019), opening opportunities to understand mathematics as part of cultural knowledge. Therefore, mathematics is not only understood as a formal science, but is also closely related to culture and community activities. Ethnomathematics provides a framework to examine the relationship between mathematics and culture. (Putri, 2017), defines it as the ways cultural groups engage in mathematical activities through learning about, with, and through culture. Similarly, (Harding-DeKam, 2007) and (D'Ambrosio, 2020), emphasize that mathematics is closely connected to sociocultural contexts. (Rosa & Orey, 2011) and (Ummaroh et al., 2023) further describe ethnomathematics as an interdisciplinary field that integrates cultural elements into learning to enhance students' understanding. Thus, ethnomathematics helps connect school mathematics with real-life experiences, making learning more meaningful.

Mathematical concepts in culture can be found in traditional activities such as agriculture. Furthermore, wedding traditions also contain mathematical concepts, (Hodiyanto et al., 2022). (d'Ambrósio, 2006) views ethnomathematics as a bridge between tradition and modern learning, while (Dominikus, 2018) highlights its roots in specific cultural groups. Culture itself is a shared system of knowledge and habits (Devianty, 2017). One example is the Dayak Sawe community in Sekadau Regency, which continues to preserve its traditions (Dionisia, 2023). Their farming activities reflect natural mathematical practices, offering strong potential for ethnomathematical study.

Initial findings show that traditional farming tools of the Dayak Sawe contain geometric concepts and non-standard measurement systems. These tools not only serve practical purposes but also reflect inherited cultural and mathematical knowledge (Lestari et al., 2019). For instance, the making of beriuk uses traditional units such as depa, and its shape resembles a truncated cone, indicating geometric understanding. This demonstrates that mathematical knowledge develops through experience and is applied in daily life, even without formal recognition.

Previous studies have identified mathematical concepts in traditional tools ((Suriati & Firdaus, 2019); ((Akbar & Irajuana, 2021), but they have not specifically examined the relationship between geometric forms and non-standard measurements in the Dayak Sawe community. Therefore, this study focuses on analyzing both aspects together. It aims to explore geometric concepts, describe non-standard measurement systems, and analyze their relationship. The findings are expected to support contextual mathematics learning, promote local culture, and provide references for developing meaningful, culturally based teaching materials (Mahmudah & Arif, 2022).

The research questions in this study are as follows:

(1) What geometric concepts are found in the traditional farming tools of the Dayak Sawe community?
(2) How does the Dayak Sawe community carry out measurement without using standard units?
(3) What is the relationship between the geometric shape of the tools and the non-standard measurement system used?

These questions provide direction for the research and guide the processes of data collection and analysis. More broadly, they reflect the relationship between mathematics and local culture and are intended to produce a systematic and in-depth description of mathematical concepts embedded in the cultural practices of the Dayak Sawe community. Therefore, this study contributes not only to the development of knowledge in ethnomathematics but also to the preservation and appreciation of local cultural wisdom.

## 2. METHODS

### 2.1 Research Design

This study employed a qualitative approach with an ethnographic design. Qualitative research is used to examine phenomena in their natural settings and to understand them based on the meanings individuals or groups assign to them (Sugiyono, 2017). The ethnographic approach aims to provide a detailed description and analysis of a culture through intensive fieldwork (Widhianningrum & Amah, 2014). In this study, the ethnographic design was used to explore the cultural practices of the Dayak Sawe community related to traditional farming tools, particularly the geometric concepts and non-standard measurement practices embedded in those tools.

### 2.2 Participants and Setting

This research was conducted in Odong Hamlet, Nanga Biaban Village, Sekadau, Hulu Regency, Sekadau Regency, West Kalimantan Province. This research took place from February 19 to 25, 2026. Participants consisted of traditional leaders and traditional agricultural tool craftsmen from the Dayak Sawe community as the primary data sources. They were selected because of their knowledge of traditional agricultural tools and Dayak Sawe cultural practices. Meanwhile, the Dayak Sawe community in general served as a secondary data source, because they have knowledge and experience related to traditional agricultural practices and the use of traditional agricultural tools. All interviews were audio recorded, transcribed, and analyzed thematically.

### 2.3 Data Collection and Analysis

#### 2.3.1 Instruments

Data were collected through direct observation, semi-structured interviews, and documentation. Observation was conducted using an observation sheet to identify the forms of traditional farming tools and the mathematical concepts embedded in them. Semi-structured interviews were conducted with traditional leaders and farming tool craftsmen to gather information on the names, functions, forms, and measurement practices associated with the tools. Documentation consisted of photographs and field notes that supported and verified the data obtained through observation and interviews.

#### 2.3.2 Analysis Procedures

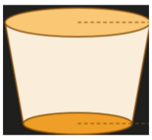
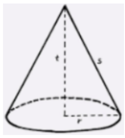
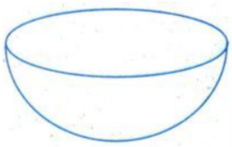
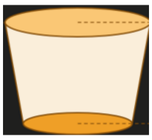
The data were analyzed using the (Miles et al., 2014), which includes data reduction, data display, and conclusion drawing or verification. In the data reduction stage, the researchers selected and organized the data according to the focus of the study. In the data display stage, the findings were presented descriptively and in tabular form to facilitate interpretation. In the final stage, conclusions were drawn and verified based on patterns found across the data. The validity of the data was strengthened through method triangulation by comparing the results of interviews, observations, and documentation.

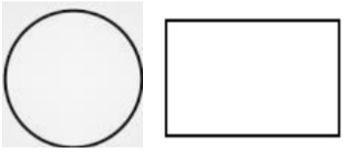
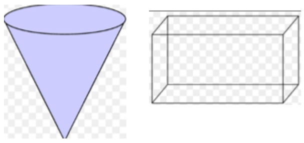
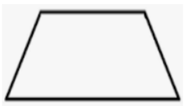
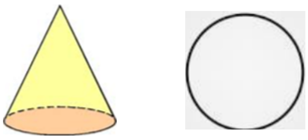
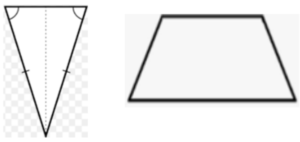
## 3. RESULTS AND DISCUSSION

### 3.1 Geometric Concepts Contained in the Form of Tools

Based on field observations and documentation, 13 traditional agricultural tools are often used by the Dayak Sawe people in farming activities which contain geometric concepts regarding shape. These tools reflect a variety of geometric forms, ranging from two-dimensional figures to three-dimensional shapes. This finding is consistent with previous studies by (Suriati & Firdaus, 2019), (Akbar & Irajuana, 2021), and (Zulfah et al., 2023), which found that traditional farming tools contain ethnomathematical concepts, particularly geometric forms such as circles, squares, rectangles, kites, and trapezoids. In addition, agricultural practices may also reflect other mathematical ideas, such as counting techniques. The geometric concepts identified in each tool are summarized in **Table 1.**

**Table 1.** Geometric Concepts Contained in the Shape

| Tool Name | Illustration | Geometric Concept |
|---|---|---|
|  **Beriuk** |  Truncated Cone | The shape of the *beriuk* resembles a truncated cone. The geometric concepts contained are radius, diameter, height, and volume. |
|  **Seraung** |  Cone | The shape of the *seraung* resembles a cone. The geometric concepts contained are radius, base diameter, height, and slant height of the cone. |
|  **Capan** |  Rectangle | The shape of the *capan* resembles a rectangle. The geometric concepts contained are length, width, right angles, and surface area. |
|  **Len** |  cylinder | The shape of the *len* resembles a cylinder. The geometric concepts contained are circle, radius, diameter, height, and volume of a cylinder. |
|  **Gantang** |  Hemisphere | The shape of the *gantang* resembles a hemisphere. The geometric concepts contained are radius, diameter, height, and volume. |
|  **Pemasok** |  Truncated Cone | The shape of the *pemasok* resembles a truncated cone. The geometric concepts contained are radius, diameter, height, and volume. |

| Tool Name | Illustration | Geometric Concept |
|---|---|---|
|  **Atong** |  Circle And Rectangle | The top of the atong resembles a circle, and the bottom is rectangular. The geometric concepts it encompasses include circle, diameter, radius, length, width, and surface area. |
|  **lonsung** |  Inverted Cone and cuboid | The shape of a cylinder resembles an inverted cone and a cuboid. The geometric concepts it encompasses are length, width, height, and the volume of a concave space. |
|  **Tikar** |  Rectangle | The shape of the *tikar* resembles a rectangle. The geometric concepts contained are parallel lines, right angles, length, width, and area. |
|  **Kapak** |  Trapezoid | The shape of the *mata kapak* resembles a trapezoid. The geometric concepts contained are parallel sides, height of the trapezoid, and area of the trapezoid. |
|  **Alu** |  cone and circle | The pestle's shape resembles a cone at the bottom and a circle at the top. The geometric concepts it embodies are circle, diameter, radius, and height. |
|  **Beliung** |  trapezoid and triangle | The shape of the adze resembles a trapezoid and a triangle. The geometric concepts it embodies include straight lines, length, width, and angles. |
|  Iso |  Trapezoid | The iso-shape resembles a trapezoid. The geometric concepts it encompasses are straight lines, length, and angles. |

The findings in **Table 1** indicate that traditional agricultural tools of the Sawe Dayak people embody various geometric ideas that emerge from practical cultural activities. Some tools are associated with two-dimensional shapes, such as rectangles, trapezoids, and triangles, while others are associated with three-dimensional shapes, such as cones, cylinders, hemispheres, and truncated cones. This suggests that geometric reasoning is embedded in the design and use of traditional tools, even though this knowledge is not formally expressed in mathematical language. These findings support the view that cultural artifacts can serve as meaningful contexts for understanding mathematical concepts in everyday life.

The researchers also drew conclusions from agricultural tools such as the beriuk. The beriuk is a traditional tool of the Sawe Dayak people used to store rice after the harvest. Based on findings and observations, its shape resembles a truncated cone because it has two parallel circular surfaces with a base that is larger than the top and a curved side as a cover. The beriuk has a base diameter of approximately 40 cm, a top diameter of 58 cm, and a height of approximately 70 cm. This shape exhibits the properties of a truncated cone, namely having two different radii, a height, a painter's line, and a curved cover. Therefore, in the pot there are geometric concepts in the form of circles, radii, diameters, heights, painter lines, surface areas, and volumes of truncated cones.

### 3.2 Non-Standard Measurement System of the Dayak Sawe Community

Based on interviews with traditional leaders and agricultural tool craftsmen, findings indicate that the Sawe Dayak people use a non-standard measurement system that has been passed down from generation to generation (J07). This system relies on human body parts and local units meaningful in the community's cultural practices.

This finding is consistent with research (Bude et al., 2025), which found that the people of Nuabosi Village also use traditional measurement systems based on body parts, such as the jengkal (span), hasta (cubit), and fathom (depa), in various cultural activities. The non-standard measurement system used by the Sawe Dayak people is presented in **Table 2**.

**Table 2.** Non-Standard Measurement System of the Dayak Sawe Community

| Unit | Description | Application |
|---|---|---|
| Depa | The length from the tip of the left fingers to the right fingers when outstretched. | Used in making *beriuk*, *atong*, and *tikar*. The length of the material used is approximately two *depa* for a large size. |
| Seta | The length from the elbow to the tip of the middle finger. | Used in making *capan*, the basic material of bamboo where the length of the material is approximately two bamboo segments or 2 seta. |
| Jengkal atau Kilan | The length from the tip of the thumb to the little finger when spread apart. | Used in making *pemasok* to determine the width and height using *jengkal* or *kilan*. |
| Gantang | A local unit of weight. | One *gantang* is equivalent to one kilogram of rice or paddy. |
| Len | A local unit of weight. | Four *len* is equivalent to one kilogram of rice. |

Based on **Table 2**, knowledge of this non-standard measurement system is not taught formally, but is transmitted through direct observation, listening, and repeated practice. As one traditional leader explained, “Usually we learn by seeing, listening, and directly practicing what the elders do (J07).” This indicates that the measurement system is part of the community's lived cultural knowledge rather than a formally standardized system.

An example of the application of *depa* in the making of traditional farming tools can be seen in the production of *beriuk*, as shown in **Figure 1**.

**Figure 1.** The Process of Making *Beriuk*

**Figure 1** illustrates the process of making *beriuk*, a traditional farming tool used by the Dayak Sawe community to store harvested rice. In this process, the community does not use standard units such as meters but instead relies on traditional units considered appropriate for local needs. According to interviews with farming tool craftsmen, making a large-sized *beriuk* requires thorny pandanus leaves measuring approximately two *depa* in length (J04), which is roughly equivalent to 2 meters. This shows that traditional units such as *depa* continue to function effectively in practice and may also be related to standard units through approximate comparison. Thus, although the Dayak Sawe community does not rely on formal measurement systems in the manufacture of traditional tools, their measurement practices reflect a culturally established sense of precision that supports everyday activities.

### 3.3 The Relationship Between Geometric Shapes and Non-Standard Measurements

The results of the analysis of observations and interviews indicate a close relationship between the geometric forms of traditional farming tools and the types of non-standard measurements used in their manufacture. The geometric form of a tool determines which dimensions to consider, while the non-standard measurement system provides the practical means of estimating and constructing those dimensions in everyday practice.

Tools like beriuk (pots) and pengrajin (suppliers), which resemble truncated cones, involve geometric elements such as diameter, height, and overall capacity. In the manufacturing process, craftsmen determine the diameter, height, and volume using body measurements such as fathoms and to measure the length of the woven material that will form the tool's body. In this way, traditional units serve as practical references for determining tool size. For example, a large beriuk requires a thorny pandan leaf approximately two fathoms long (J04). Conical tools like the seraung use the approximate size of the user's head as a practical reference for determining the base diameter, even without using formal units of measurement. Meanwhile, rectangular tools like capan (capan) and karpet (mat) use units such as seta (seta) and fathom (depa) to determine length and width.

## 4. CONCLUSION

This study shows that the traditional farming tools of the Dayak Sawe community embody both geometric concepts and culturally grounded non-standard measurement practices. The findings identified 13 traditional farming tools that reflect a range of two-dimensional and three-dimensional geometric forms, including rectangles, trapezoids, cones, cylinders, hemispheres, and truncated cones. In addition, the study found that the Dayak Sawe community uses non-standard units such as *depa*, *seta*, and *jengkal*, as well as local units such as *gantang* and *len*, in the making and use of traditional tools. The findings further indicate that the geometric form of each tool is closely related to the type of measurement used in its manufacture.

More importantly, this study highlights that mathematical knowledge in the Dayak Sawe community is not separate from everyday life, but is embedded in cultural practices that have been developed and transmitted across generations. The relationship between geometric form and non-standard measurement shows that traditional farming tools are not only practical objects, but also cultural artifacts that reflect meaningful mathematical reasoning. In this way, the study contributes to ethnomathematics by showing how geometry and measurement are functionally interconnected in a local cultural context.

The study also has implications for mathematics education. The findings suggest that local cultural practices can serve as meaningful resources for contextual and culturally responsive mathematics learning. Integrating cultural knowledge into mathematics instruction may help students understand mathematical concepts in ways that are more concrete, relevant, and meaningful, while also supporting the preservation and appreciation of local wisdom.

Future research may build on this study by exploring how the ethnomathematical knowledge found in Dayak Sawe culture can be integrated into classroom practice, teaching materials, or learning activities. Further studies may also examine similar relationships between culture and mathematics in other communities and across different mathematical concepts in order to expand the contribution of ethnomathematics to education and cultural preservation, as previously conducted research in developing ethnomathematics-based media in Pontianak culture (Hodiyanto, Setyaningsih, et al., 2026; Hodiyanto, Kyeremeh, et al., 2026). This study is limited by its location in only one hamlet of Odong, and by the limited time of the research subjects due to the daily activities of the informants, who are farmers.

## ACKNOWLEDGMENTS

The authors would like to express their gratitude to the Dayak Sawe community in Odong Hamlet, Nanga Biaban Village, Sekadau Hulu District, Sekadau Regency, who were willing to be research subjects and provided very valuable information during the data collection process. The authors also extend their thanks to the traditional leaders and traditional farming tool craftsmen who took the time to share their knowledge throughout the research. Furthermore, the authors express their appreciation to the academic supervisors and the staff of PGRI Pontianak

University who provided support, guidance, and facilities during the research process.

## DECLARATIONS

**Author Contributions:** RG: Writing-Review & Editing, Investigation, Visualisation, Resources, and Validation; S: Validation, Investigation and Formal Analysis; H: Conceptualisation, Writing-Original Draft, Visualisation, Data Curation, and Methodology; MT: Conceptualisation, Investigation, Methodology, and Supervision.

**Conflict of Interest:** The authors declare that they have no competing interests.

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