Jurnal Pendidikan Matematika Universitas Lampung
Vol. 13, No. 2, 2025, pp. 124 – 140
https://jurnal.pbs.fkip.unila.ac.id/index.php/jpm/
ISSN: 2715-856X

Binongko Multiplication: An Ethnomathematics Method to Adress Mathematical Challenges Among the Butonese Ethnic Group in Masohi City

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ARTICLE INFO

Article history
Received: 23 March, 2025
Revised: 28 June, 2025
Accepted: 8 August, 2025
Published: 11 August, 2025

Keywords
binongko rivers;
buton tribe in masohi city;
ethnomathematics;

ABSTRACT

Ethnomathematics is defined as the specific methods used by a particular cultural group or society in mathematical activities. This study aims to explain the elements of ethnomathematics found in the term kali-kali binongko and how it can be applied in mathematics learning. The method used in this article is an ethnographic approach, with a qualitative research design. Data were collected through semi-structured interviews, observation, and documentation. The data analysis process in this study consisted of three stages: data reduction, data presentation, and drawing conclusions. The results of this study reveal the presence of ethnomathematics in the application of kali-kali binongko among the Buton tribe in Masohi City. The ethnomathematical aspects of kali-kali binongko practiced by the Buton tribe in Masohi can be explained through three main findings: (1) The history and culture of the Buton tribe, (2) Ethnomathematical elements found in kali-kali binongko, including: a. Number systems, b. Determining marriage dates, c. Mathematical knowledge in agricultural practices, d. Mathematical knowledge in fishing activities, and e. The application of kali-kali binongko in trading activities, (3) The discovery of a mathematical concept referred to as “hidden mathematics” or “frozen mathematics” among the Buton tribe, which includes naming counting activities based on the number of days in a new month, following the traditional practice of counting the moon’s phases in the sky.

How to Cite: Aspin, L., Lessy, D., & Sopamena, P. (2025). Binongko multiplication: an ethnomathematics method to adress mathematical challenges among the butonese ethnic group in masohi city. *Jurnal Pendidikan Matematika Universitas Lampung*, 13(2). http://dx.doi.org/10.23960/mtk/v13i2.pp124-140

INTRODUCTION

Mathematics has grown and developed rapidly in various regions—not just in one location or area, but across the globe. It has emerged and evolved in places such as Brazil, India, the United States, the Arab world, China, Europe, Indonesia, and many others. The growth and development of mathematics occur as a response to the challenges of life faced by people in different regions with diverse cultural backgrounds. Each culture and subculture develops mathematics in its own way. As a result, mathematics can be seen as a product of human intellect shaped through daily societal activities (Wa Ode Nining, 2019:3). This implies that mathematics is a cultural product, the result of human

abstraction, and a tool for problem-solving. As Prabowo (2010:89) stated, mathematics is a construction of human culture.

Mathematics is a science of certainty that cannot be separated from everyday life, as it is highly useful and widely applied in various aspects of human activity. This aligns with the definition of mathematics proposed by Unodiaku (2013), who describes it as the science of space and numbers, as well as a discipline that supports daily human practices. In daily life, we often, and sometimes unconsciously, use mathematics as an integral part of our activities—particularly within the Butonese community in the city of Masohi.

The Butonese community in the city of Masohi possesses a variety of cultural practices that are closely related to mathematics. The connection between mathematics and culture is known as ethnomathematics. Both mathematics and culture are inseparable parts of daily life—culture represents a comprehensive and integrated system that applies within a society, while mathematics is the knowledge used by humans to solve everyday problems (Pandu & Suwarsono, 2020).

Ethnomathematics is not only about mathematics; it also encompasses the cultural values embedded within it. Ethnomathematics is defined as the specific ways used by a cultural group or particular community in engaging with mathematical activities. These mathematical activities involve the process of abstraction from real-life experiences into mathematical concepts or vice versa, and include actions such as classifying, counting, measuring, designing structures or tools, creating patterns, enumerating, determining locations, playing, explaining, and more (Sidi, et al., 2021). The close relationship between mathematics and culture—referred to as ethnomathematics—has inspired a range of innovations in mathematics learning by integrating cultural elements and vice versa. The study of mathematics within cultural contexts is then incorporated into mathematics education as a systematic effort to preserve and transmit cultural heritage (Nuryadi, 2020). Conversely, mathematics learning in schools can become more meaningful when it is aligned with students' cognitive development and utilizes their surrounding environmental context (Putra, et al., 2020).

Ethnomathematics plays an important role in the concept of *"kali-kali Binongko"*, which can be used as a multiplication method to address mathematical challenges among the Butonese ethnic group in Masohi, Central Maluku Regency. *Kali-kali Binongko* is a traditional multiplication method practiced by the local Butonese community that remains preserved and is still used in everyday calculations. However, the mathematical concepts embedded in *kali-kali Binongko* have not yet been integrated into school curricula. Moreover, no prior research has been conducted on this method. Therefore, this study aims to explore the *kali-kali Binongko* approach more deeply, as it is closely related to mathematical topics taught in schools. In line with this objective, the ethnomathematical

calculations of *kali-kali Binongko* among the Butonese in Masohi will be examined in the context of weather forecasting, determining auspicious days for weddings, agriculture and fishing activities, principles of frugal living, and quick calculation methods used in trade. Research on the ethnomathematical concept of *kali-kali Binongko* has never been conducted before. On the other hand, this information is highly valuable and needs to be studied so that it can be preserved and incorporated into mathematics education—particularly in topics such as number bases, addition, multiplication, and measurement.

According to Bishop (Sukandar, 2009), mathematical content considered to have strong potential for development in schools includes: counting, locating, measuring and measurement, designing, playing, and explaining. Based on Bishop's theory, *kali-kali Binongko*, which is a unique feature of the Butonese community, can certainly be studied in greater depth within its cultural context. This aligns with Hartoyo's (2012:107) view that the term ethnomathematics refers to mathematics found within a community, related to the social, economic, and cultural background of that society. It can thus be concluded that ethnomathematics is mathematics that emerges and develops within a community in accordance with its local culture. In this sense, ethnomathematics involves an assimilation between culture and mathematics—a process that the Butonese people in Masohi, Central Maluku Regency, have unknowingly practiced in their daily lives.

The assimilation between mathematics and the daily life of the Butonese community can only occur if it takes into account their local environment and cultural background. The first step that must be taken is to explore elements of the community's culture that contain mathematical concepts. The results of this exploration will serve as the foundation for developing instructional materials. These teaching materials are expected to bridge school mathematics with mathematics in everyday life. Therefore, local cultural contexts should be utilized by teachers in developing such materials. This highlights the need to conduct a study on ethnomathematics within the Butonese community in Masohi, Central Maluku Regency—specifically, a study that investigates how this group understands, expresses, and applies mathematical concepts and practices through their cultural tradition of *kali-kali Binongko*, which contains inherent mathematical elements.

Bishop stated that mathematics is a pan-cultural phenomenon (Bishop, 1988). This assertion is supported by the existence of Chinese mathematics, Greek mathematics, Roman mathematics, African mathematics, Islamic mathematics, Indian mathematics, and even Stone Age mathematics. Based on this, it can be concluded that different cultures give rise to different forms of mathematics. In other words, each culture develops its own mathematical systems according to the needs of its environment and the goals of

its society. It is evident that mathematics exists within every culture because it is needed by the people within that culture.

In relation to human activity, the variations in mathematical forms exist within a shared scope of human practices (D'Ambrosio, 2001; Bishop, 1988). The characteristics of mathematics within a culture depend on factors such as environment, context, focus of interest, motivation, forms of communication, priorities, and goals of each group. While there are many differences in the ways mathematics is expressed across these areas, there are also notable similarities among various cultures. Consequently, each cultural group produces its own distinct form of ethnomathematics.

Bishop concluded that there are six universal mathematical activities that can be found in every cultural group: Counting, Locating, Measuring, Designing, Playing, and Explaining—abbreviated as CLMDPE (Bishop, 1988). These six activities serve as the foundation for the development of mathematics, which later came to be recognized as the characteristics of ethnomathematics (Barton, 1996; Shirley, 2006; Mukhopadhyay & Greer, 2011). The following is a description of the characteristics of ethnomathematics.

1) Counting

Counting practices and tools—both physical and mental—have existed for thousands of years in various forms. These activities are often expressed through local languages used by cultural groups. Similarly, the tools used for counting vary from one cultural group to another. As a result, the number systems employed also differ accordingly.

2) Locating

Locating refers to finding a path, placing an object, determining direction, and identifying the spatial relationship between objects. This is closely related to spatial abilities—how spatial concepts are understood and how objects are positioned within a spatial environment. Activities such as mapping, navigation, and spatial arrangement of objects exist in all cultures, and each contributes to the development of important mathematical knowledge.

3) Measuring

Measuring activities commonly involve the use of non-standard units, such as body parts to measure length. To measure time, liquids, or weight, different tools and methods are used across various cultures. Measuring is also closely related to the use of numbers, and thus includes activities such as comparing, ordering, and quantifying the characteristics of an object.

4) Designing

Designing activities involve the creation of patterns used to construct objects or cultural artifacts for purposes such as household use, trade, decoration, warfare, games,

and religious practices. Designing also extends to larger-scale structures such as houses, settlements, roads, gardens, fields, villages, and cities. All of these serve as sources and components in the development of mathematical knowledge within a cultural group.

5) Playing

Playing refers to various traditional games within a community that involve forms of mathematical reasoning, probability, and strategic thinking. These games typically include established rules, procedures, materials used, and standardized criteria.

6) Explaining

Explaining refers to various cognitive aspects involved in questioning and conceptualizing the environment. Explanation creates meaningful connections between different phenomena in response to the question "why." To explain more complex and dynamic phenomena—such as life processes, tides, and the flow of events—every culture possesses its own stories, folklore, and storytellers. Storytelling is a universal phenomenon, and in the context of mathematical knowledge within culture, what matters most is the storyteller's linguistic ability to relate discourse in multiple ways. In the context of research, attention is focused on the logical connectivity in language that enables propositions to be combined, contrasted, expanded, restricted, elaborated, and more. Through these processes, a form of proof-based knowledge has been developed—knowledge that meets the criteria of consistency and persuasiveness.

The characteristics of ethnomathematics described above are highly useful in guiding researchers' focus and assisting them in identifying and describing mathematical knowledge within the cultural group being studied. In identifying and describing the mathematical knowledge embedded in the *kali-kali Binongko* tradition, the researcher applies Bishop's ethnomathematical framework, while also remaining open to the possibility of discovering other relevant elements based on the researcher's own judgment.

In relation to the above explanation, this study seeks to uncover the mathematical concepts embedded in the term *kali-kali Binongko* among the Butonese community in Masohi, Central Maluku Regency. The aim is for the findings of this research to inspire and increase students' interest and motivation in learning mathematics. Based on this context, the researcher is interested in clearly revealing the mathematical concepts contained within the *kali-kali Binongko* tradition of the Butonese people in Masohi, Central Maluku. The objectives of this study are as follows: 1) To explore the mathematical aspects found in the *kali-kali Binongko* tradition of the Butonese community in Masohi, Central Maluku Regency. 2)To identify the mathematical aspects contained in *kali-kali Binongko* that can be integrated into mathematics learning in schools. As a result, ethnomathematics can be incorporated into the curriculum, as it is

closely linked to how communities perceive and think about mathematics in relation to their culture. Ethnomathematics integrates mathematical ideas with local culture to enhance classroom instruction (Wulandari, et al., 2024). Moreover, to achieve specific learning goals or to master certain mathematical skills, ethnomathematics becomes a valuable strategy in mathematics education when combined with local wisdom (Muhammad et al., 2023).

METHOD

This research is a qualitative study employing an ethnographic approach. Ethnographic design is a qualitative research procedure used to describe, analyze, and interpret patterns of behavior, beliefs, and language shared by a cultural group that develops over time (Creswell, 2012). Ethnography was chosen for this study because it provides an in-depth understanding of culture and human behavior within everyday contexts. Compared to other qualitative approaches, its strength lies in the researcher's ability to be directly involved in the community, offering insights into the meanings, values, and social norms that shape the society, and allowing for more authentic observations of the *kali-kali Binongko* practice. This study was conducted in July 2024 in the city of Masohi, Central Maluku Regency. The research subjects were members of the Butonese community in Masohi, including farmers, traders, traditional leaders, community leaders, and fishermen. The research began with the formulation of a research problem. At this stage, the researcher identified the research object, namely *kali-kali Binongko*. Once the object was determined, the next step was to select informants. The chosen informants were individuals who possessed knowledge related to the research problem or object, such as community leaders, village officials, and residents who understand the *kali-kali Binongko* tradition.

The majority of the Butonese community in Masohi work as farmers and fishermen. They cultivate land to grow staple crops such as cassava, sweet potatoes, corn, and tubers, as well as various vegetables. A smaller portion of the population works as street vendors and basic goods merchants. Economic interactions primarily take place through buying and selling activities at the Binaya Market. Some members of the Butonese community are also engaged in small-scale businesses, such as running food stalls or culinary ventures. In addition to being farmers, fishermen, and vendors, a small number of Butonese people in Masohi also serve as civil servants (ASN), working as teachers and office staff. In terms of education, the Butonese community in Masohi has varying educational backgrounds, ranging from elementary school to higher education. Many pursue their studies in the city of Ambon, while a smaller number continue their education in Makassar or on the island of Java. In daily communication, older generations tend to

use the Butonese dialect, while the younger generation and children generally speak in Ambonese Malay. The daily activities of the Butonese community are closely aligned with their respective professions and adapted to their way of life.

The data collection techniques used in this study include semi-structured interviews, observation, and documentation. Observation focused on the practice of *kali-kali Binongko* in daily life, while documentation consisted of photographs taken during interviews and audio recordings of conversations. The data sources for this research were five informants, representing fishermen, farmers, basic goods traders, street vendors, and traditional leaders of the Butonese community. Informants were selected using purposive sampling, considering their knowledge and understanding of the *kali-kali Binongko* practice (Sugiyono, 2022). The data analysis technique employed in this study refers to the interactive model proposed by Miles & Huberman (2005:20), which classifies data analysis into three stages: 1) Data Reduction, 2) Data Display, and 3) Conclusion Drawing/Verification.

RESULTS AND DISCUSSION

This section presents the research findings on the ethnomathematics of the Butonese community in Masohi City, specifically related to *kali-kali Binongko*. The description of the findings begins with an overview of the history and culture of the Butonese people, followed by an analysis of ethnomathematical elements found within the Butonese community in Masohi, Central Maluku Regency. These two aspects of the research findings are described as follows:

1. The Butonese People: History and Culture

The name *Buton* requires clarification due to the existence of several different interpretations. Rudyansjah (2009) identified at least four meanings associated with the term. First, *Buton* refers to the name of an island — Buton Island. Second, it is used to refer to the *Butonese* people, meaning the inhabitants of Buton Island and the surrounding islands. In the past, the term *Butonese* served as an identifier for people living in the territory of the Buton Sultanate. Third, as the name of an autonomous region (regency), it refers to a regency located in the southern part of the region, situated below the equator. Fourth, *Buton* refers to a sultanate, which before the arrival of Islam was a kingdom, and is estimated to have existed prior to the 14th century. The territory of this sultanate included major islands such as Buton, Mjuna, Kabaena, the Tukang Besi archipelago (now Wakatobi), and two regions in the southeastern part of Sulawesi Island — Poleang and Rumbia — as well as surrounding small islands (Munafi et al., 2015).

The Butonese are one of the ethnic groups that inhabited the territory of the Buton Sultanate, which was located in the Bau-Bau archipelago in Southeast Sulawesi Province.

The Butonese are indigenous to the Southeast Sulawesi region, particularly on Buton Island. They are also spread across several other areas in Southeast Sulawesi, such as Kendari City, Bombana Regency, and surrounding regions. Some accounts suggest that the ancestors of the Butonese people were immigrants from the Johor region who arrived around the 15th century AD and later founded the Buton Kingdom. In 1960, following the death of the last sultan, the Buton Sultanate was reportedly "dissolved," yet many of its royal traditions have remained deeply ingrained among the local population.

The Buton region occupies a strategic position along major maritime routes, both North-South (from the Pacific Ocean in the north to the Indian Ocean in the south) and East-West. The Butonese society is considered heterogeneous. This social diversity is reflected in a saying in the Wolio language: *Wolio siy o lipuna mia mopokawa-kawa*, which means, "Wolio or Buton is a land where newcomers gather."

Although the people within the territory of the Buton Sultanate were quite heterogeneous, they lived under a unified political system governed by the Kingdom and later the Sultanate of Buton. The diversity of the population's origins, which eventually merged into a single political entity, is what led to the heterogeneity of society within the sultanate. This heterogeneity is also reflected in the languages spoken; rather than using a single language, they used several different languages. This reality forms the basis of the multiethnic and multicultural concept as a social and cultural phenomenon in Buton. Nevertheless, due to a strong adherence to a shared ideology and philosophy of life, each ethnic group within the society identifies themselves as Butonese (Munafi, et al., 2015).

The Butonese ethnic group has gradually spread throughout the Indonesian archipelago, including to Maluku, specifically in the city of Masohi. The Butonese people who have settled in Masohi primarily make their living through farming, fishing, and trading. These three aspects of life have long been practiced by their ancestors. Therefore, it is not surprising that the Butonese are also known as a community engaged in agriculture, seafaring, and commerce. These three livelihood aspects are deeply embedded in the Butonese community in Masohi. Furthermore, these aspects of Butonese life are closely related to the study of ethnomathematics, which has yet to be widely explored by researchers. The ethnomathematical study related to *Kali-kali Binongko* among the Butonese people in Masohi can be elaborated through the following explanation.

2. An Ethnomathematics Study of the Butonese People in Masohi City, Central Maluku Regency

The ethnomathematical study of the Butonese ethnic group in the city of Masohi, Central Maluku Regency, consists of five key aspects: (1) number systems, (2)

determination of wedding dates, (3) agricultural practices, (4) fishing traditions, and (5) trading activities. In addition to these, the study also uncovered various mathematical concepts embedded within the culture, which can be referred to as hidden mathematics or frozen mathematics. These six findings can be described in detail as follows:

a) Number Bases

Counting activities are generally carried out to determine the quantity or number of items owned, as well as various aspects found in nature. When the Buton people are about to engage in certain tasks or journeys, they usually observe the weather conditions and choose an auspicious day. The act of counting is performed using *kali-kali binongko*, a traditional method inherited from their ancestors.

The determination of an auspicious day to carry out a task must align with the position of the moon and stars in the sky. This is supported by data from the interview transcript between the researcher and an informant named La Sinane. He is a mathematics teacher from the Buton tribe who teaches at SMP Negeri 2 Masohi. The following is the data from Informant 1:

> "Let's say today is Monday. If we want to do something 30 days from now, what day will it fall on? Let's count together. Ten days from now, it will be Wednesday. Then, another ten days will land on Friday. So, if the 20th day falls on a Saturday, then the 30th day will be on a Tuesday. The proof lies in the Hijri calendar. Just check the calendar—see if the calculation is correct or not, right?"

Based on the interview data from Informant 1 above, let us assume that someone plans to take a journey or carry out a task 30 days from now. The Buton people do not rely on calendar dates to plan such activities; instead, they count the number of days ahead. Their calculations are based on multiples of 10 rather than other numbers. They believe that using the base-10 system brings good fortune. Therefore, the numerical system used by the Buton community is a base-10 (decimal) number system. This supports the accuracy and appropriateness of the *kali-kali binongko* method. The calculations are consistently performed using the number 10. When connected to school mathematics, the *kali-kali binongko* method falls under the topic of number bases.

b) Determining the Wedding Date

When the Buton community in Masohi City, Central Maluku Regency, is about to hold a wedding ceremony, they usually take into careful consideration the selection of an auspicious day for the event. The calculation of this auspicious day is closely related to determining the wedding date. This calculation follows the lunar cycle, specifically observing the phases of the moon and selecting days with odd-numbered dates. This traditional method begins with identifying favorable conditions based on lunar and calendar patterns. This practice is supported by interview findings with Informant 2, Mr. La Ane. Mr. La Ane is a traditional elder of the Buton tribe who resides in the Sugiarto

neighborhood, Namaelo subdistrict. The interview findings with Informant 2 are presented below:

> For us Butonese, when there is a wedding ceremony, we usually calculate the auspicious day by referring to the position of the moon in the sky. The Buton people often observe the moon and match it with the right day. The method of calculation does not follow the moon used in the Hijri calendar directly. The calculation of the auspicious day begins from the month of Muharram. For example, we first determine on which day and date the 1st of Muharram falls. If, for instance, the 1st of Muharram falls on July 7, then the calculation begins from that date and continues for 27 or 30 days. The calculation generally follows odd numbers and odd-numbered months. The number of days calculated by the Buton people is only 27 or 30. This has long been a traditional way of calculating among the Buton tribe. Furthermore, the reason for choosing odd numbers and months is the belief that it brings blessings: the couple will have a long life, bear children quickly, live a blessed life, and have a smooth livelihood."

Based on the interview data from the second informant, it was found that the determination of wedding dates among the Buton community follows the selection of auspicious days, which are aligned with the positions of the moon and stars in the sky, using odd-numbered dates and months within a period of 27 or 30 days. This practice represents a form of local wisdom that has been passed down from generation to generation among the Buton people in Masohi City, Central Maluku Regency.

c) Mathematical Knowledge in the Farming Culture of the Buton Tribe

Farming activities carried out by the Buton tribe begin with the preparation of the land or garden to be cultivated, which includes preparing the soil and plant seeds. The crops typically planted by the Buton people include chili peppers, tomatoes, and various vegetables such as mustard greens, long beans, green beans, spinach, and water spinach. However, it is also common for them to plant cassava and sweet potatoes.

The Buton people usually begin planting or farming based on the selection of auspicious days. These favorable days for planting are limited to Wednesdays, Fridays, and Saturdays. Planting activities on Fridays are only carried out between 08:00 and 10:00 Eastern Indonesia Time (WIT). The planting process in the Buton community does not refer to the Hijri calendar months but strictly follows the chosen days—Wednesday, Friday, and Saturday. However, planting on Fridays is restricted to the specific time window between 08:00 and 10:00 WIT. In contrast, on Wednesdays and Saturdays, Buton farmers do not pay attention to the specific time of day—whether morning, noon, or evening. The reason Buton farmers avoid planting on Mondays, Tuesdays, Thursdays, and Sundays is due to the belief that crops planted on those days will not grow well and may result in crop failure. In addition to crop failure, it is also believed that plants grown on inappropriate days will be eaten by evil spirits, which ultimately causes the plants to die—even if they initially appear healthy. This belief was confirmed in an interview with Informant 3, Mrs. Wa Beti. She is a vegetable farmer from the Buton tribe who lives in

the Sugiarto neighborhood, Namaelo subdistrict. The interview findings with Informant 3 are presented below:

> "We only plant on Wednesdays and Saturdays. If we plant on a Monday, the crops won't grow. Even during the rainy season, the plants will die and we'll have a failed harvest. Planting on a Tuesday is wrong too. Even if it rains, the plants will die and the harvest will fail. If we plant on Thursday, the crops might grow well at first, but then they'll die. On Fridays, we have to be mindful of the exact time. If we want to plant on Friday, it must be between 08:00 and 10:00 WIT. If we plant on a Sunday, people will steal the crops. But those who steal them are not really people—they're spirits. The spirits appear in the form of caterpillars on the plants. So when we plant, we don't look at the calendar month, but only at the day. Besides the day, we also avoid planting during the dry season."

Based on the information provided by Informant 3, it was found that the Buton community in Masohi City begins their farming activities only on Wednesdays and Saturdays. An exception is made for Fridays, but planting is allowed only in the morning between 08:00 and 09:00 WIT. Planting on Wednesdays and Saturdays is believed to result in abundant harvests and bring profit to the farmers. This practice indicates that the *kali-kali binongko* calculation used by the Buton people involves identifying auspicious days, specifically Wednesday, Friday, and Saturday. The total number of planting days is limited to three, with only a two-hour time window available on Fridays.

d) Mathematical Knowledge in Fishing Activities among the Butonese People

The Butonese people plan their fishing activities according to the position of the moon in the sky and the condition of the waves. Rough sea conditions typically occur on the 15th, 25th, and 30th days of the lunar month. There is usually a 4-day difference between the moon phases observed in the sky and the dates on the Hijri (Islamic) calendar. For example, if today is June 29 on the calendar, then the moon phase in the sky corresponds to the 25th lunar day. Butonese fishermen in Masohi City avoid going out to sea on the 15th, 25th, and 30th days of the lunar month because fish are believed to be inactive or will not be caught by line or net during these times.

In addition, fishing activities are also influenced by weather conditions. In Buton Cia-Cia (Buton Toowa) culture, it is believed that the moon shines brightest on the 14th day of the lunar month. This 14th day is closely related to the position of the moon in the sky. If the sky is clear on this day, Butonese fishermen will refrain from going to sea. Therefore, fishermen avoid fishing on the 14th lunar day. This avoidance stems from their fear, which is rooted in the belief that mystical or supernatural events may occur at sea on that day. These beliefs include fears of fishermen disappearing, being covered or blocked by stingrays, or being disturbed by supernatural beings. These occurrences were confirmed through interviews with Informant 4, Mr. La Ali, a resident of Masohi City who lives in the Apui area near the shoreline. The results of the interview with Informant 4 are described below:

> Usually, we Butonese people have certain days that we fear when we want to go fishing. It's the same as when people want to plant crops. If we want to go fishing, we must avoid the 15th, 25th, and 30th days of the lunar month. The calculation of the moon in the sky is not the same as the date on the calendar. To observe the moon in the sky, it's similar to how we count the appearance of the crescent moon during Ramadan. Normally, when we want to count the 1st day of the lunar month, we look at the moon's position in the sky at sunset. So, calculating the moon in the sky is usually four days earlier than the calendar. The moon in the sky is younger. Usually, we Butonese consider the month transition to occur on the 28th, 29th, or 30th lunar days. We also avoid going fishing on the 14th day of the lunar month. On that day, the moon is very bright, and people are afraid of it. The sea is no different from the land. At sea, fishermen often lose their way when they encounter stingrays. If they don't lose their way, they may be disturbed by unseen beings in the sea. Especially after 2 a.m., we often hear strange sounds. If we're lucky, we make it back home safely.

Based on the interview with Mr. La Ali, an ethnomathematical study was found related to the specific periods during which fishing is prohibited. For the Butonese people in the city of Masohi, fishing is forbidden on the 14th, 15th, 25th, and 30th days of the lunar calendar as observed in the sky. When these numbers are compared with the Hijri calendar, the 14th lunar day corresponds to the 18th day of the Hijri calendar. Accordingly, the 15th becomes the 19th, the 25th becomes the 29th, and the 30th corresponds to the 4th of the following Hijri month. This reveals a unique feature in the Butonese method of lunar calculation in Masohi.

e) Mathematical Knowledge in Trading Activities of the Butonese People in Masohi City

The Application of *Kali-kali Binongko* in Trading Activities among the Butonese People in Masohi City is Specifically Found in the Trading of Daily Necessities This is because the application of *kali-kali binongko* among staple goods traders is more detailed in calculating the profit of each item sold. The research found such practices in the trading of shallots and eggs at the Binaya market in Masohi City. The data collected by the researcher is based on an interview with Informant 5, Mr. La Darmin, who is a staple goods trader at the Binaya Market in Masohi City. The findings from the researcher are presented as follows:

> Data 1
> The application of *kali-kali binongko* that I practice focuses on the speed of sales time. The sales process I implement is based on the time frame of selling in Binaya Market. If the goods are not selling well, I will lower the price. For example:
> The capital for shallots is Rp 20,000, and the selling price in the market is Rp 35,000 per kilogram.One sack contains 25 kilograms. The profit obtained by a staple goods trader is: 25 kg × Rp 15,000 = Rp 375,000. However, in the *kali-kali binongko* multiplication system, I use a daily target in the sales process. The daily target is 4 sacks per day. Four sacks equal 100 kg of shallots. So, the way I apply *kali-kali binongko* is by accelerating the sales duration of shallots through lowering prices and reducing profits.

> Data 2

For example, if in one day I can only sell one sack, that means I only earn a profit of Rp 375,000 per day. So, the *kali-kali binongko* that I apply is by reducing the profit and lowering the price of shallots. Because if the multiplication only results in Rp 375,000 profit per day, that is too little. Therefore, the solution is that I have to accelerate the sales process of shallots so that I can sell at least 4 or 5 sacks of shallots per day. The breakdown is as follows:
1 ton = 1000 kg
1000 kg: 25 = 40 sack
375 x 40 sack = 15.000.000

Data 3
To reach this target, I have to sell the shallots below the market price (let's say the market price is Rp 35,000 per kg), so I sell them for Rp 30,000 per kg. I still make a profit of Rp 10,000 per kg, since the purchase price is Rp 20,000 per kg. Therefore, selling 1 ton of shallots over 10 days results in a total profit of Rp 10,000,000. If this is multiplied over 30 days, the total profit from selling shallots becomes Rp 30,000,000. That profit comes from just one item of basic goods sold. This method is applied by Butonese traders to prevent the shallots from rotting and being left unsold. This is the practice of *kali-kali binongko* that is commonly used by Butonese basic goods traders at Binaya Market in Masohi City.

Data 4
Unlike the egg-selling item. The eggs I sell are priced at IDR 350,000, while other traders sell them at IDR 380,000 per bundle. So, the price difference is IDR 30,000. The cost price I pay for eggs is IDR 310,000, which means I earn a profit of IDR 40,000 per bundle. I usually sell around 100 bundles of eggs per day. So, the income from just the egg item alone is 100 bundles × IDR 40,000 = IDR 4,000,000 per day. If calculated for 30 days, the profit from selling eggs reaches IDR 120,000,000. The sales system for eggs using *kali-kali binongko* involves selling them at a lower price than other traders due to market competition. This is done so the eggs sell faster, the capital returns quickly, and the profit remains the same as other traders. The profit remains the same with this calculation: for instance, other traders may only be able to sell 30 bundles of eggs per day, while I can sell 100 bundles or even more, which results in equivalent or greater profit. The daily egg profit continues to be secured because the grocery store I manage is already well-known to many people. In fact, the grocery store I run has become part of the food security monitoring by the Trade Office. The Trade Office regularly checks the price comparisons between my store and other traders' grocery stores.

Data 5
To achieve profit from each sales item, I also consider the market situation and dynamics. For example, I open my shop at 5 a.m. and close at 9 p.m. At 5 a.m., I sell red onions at the same price as other traders. Then, after 10 a.m., I lower the price. This is because the market is usually very crowded between 5 a.m. and 10 a.m. However, if by 10 a.m. the market is still busy but there is no movement in onion sales, I apply the *kali-kali binongko* strategy by estimating that other traders may be selling onions at different prices than mine. Without conducting surveys or going around to check other grocery shops, I simply apply *kali-kali binongko* in that situation by lowering my price to ensure my onion sales target remains on track.
This calculation is important because if onions shrink in size, the weight decreases. Moreover, if onions take too long to sell, they will rot, causing me to suffer a loss from that one sales item.

Based on interview data 1, 2, 3, 4, and 5 above, it can be concluded that the implementation of *kali-kali binongko* is characterized by a process of reducing prices and minimizing profits. For example, 1 ton (1000 kg) of red onions divided into 25 kg sacks results in 40 sacks, with a total potential profit of IDR 15 million per ton. However, La Darmin did not pursue this IDR 15 million profit. Why? Because La Darmin intentionally reduced the profit and price of red onions in order to meet the target sales time and specific

days. The sales target for 1 ton is within 10 days, which means selling an average of 4 sacks per day. Over a 30-day period, La Darmin earned a total profit of IDR 30 million from red onions, while his profit from selling eggs during the same period reached IDR 120 million. What La Darmin prioritizes is not the amount of profit but the speed of sales. In other words, the duration of the sales process must be shortened, rather than chasing maximum profit. The results are not viewed in terms of detailed profit breakdowns, but rather the final outcome—*quick profit*. Thus, the implementation of *kali-kali binongko* in onion and egg sales emphasizes the timing of sales, even if the profit margin is lower, as long as the sales run smoothly and consistently yield results. In conclusion, the *kali-kali binongko* approach applied by the trader La Darmin focuses on sales timing, market conditions, selling price, and the daily sales speed of each item. The cheaper the goods, the more people buy them. This practice relates directly to mathematical concepts of multiplication, division, and addition. Based on the five data findings above, the exploration of ethnomathematics in *kali-kali binongko* among the Butonese people in the city of Masohi can be summarized according to the characteristics of ethnomathematics as proposed by Bishop, as outlined in the following Table 1.

Table 1. Summary of Ethnomathematics Characteristics of Kali-kali Binongko

No	Ethnomathematics of the Buton Tribe	Description of the Buton Tribe's Culture	School Mathematics Concepts	Scope of Mathematics
1	Number Base	The Process of Carrying Out a Task and Undertaking a Journey	Comparing Numbers, Number Bases	Number Base
2	Counting	Farming, Trading, and Determining Wedding Dates	Arithmetic Operations atau Basic Number Operations	Numbers
3	Time Naming	Farming and fishing are carried out based on calculations of the days and lunar phases in the sky.	Time Measurement	Measurement
4	Measuring Context	Farming, trading, and fishing activities	Measurement and units of measurement	Measurement
5	Explaining	Farming, trading, setting wedding dates, and fishing	Logic, reasoning, and drawing conclusions	Logic
6	Evaluating and Deciding	Farming, trading, setting wedding dates, and fishing	Logic, reasoning, and drawing conclusions	Logic

As observed in the five cultural practices of the Buton tribe in Masohi City, the researcher also obtained data on how the Buton people engage with mathematics in their daily lives. The researcher identified a mathematical concept that can be categorized as hidden mathematics or frozen mathematics within the Buton community in Masohi. For example, one traditional practice inherited from the ancestors states that the philosophy behind *kali-kali binongko* is to live frugally and to be highly calculative in spending money. According to their belief, no money should be spent on Saturdays (based on interview data from Informant 2, Mr. La Ane). If this principle is followed, it is believed that one's life will be prosperous and fortunate. In addition to this, hidden mathematics is also found in the calculation of the moon's phases in the sky—a theory that is difficult to comprehend for the general public. As a result, the interpretations remain somewhat ambiguous, as only traditional elders truly understand how to perform and explain these lunar calculations.

CONCLUSION

The ethnomathematical study of *kali-kali binongko* as practiced by the Buton people in Masohi City can be outlined in three key findings: (1) the history and culture of the Buton tribe; (2) ethnomathematical elements found in *kali-kali binongko*, including: (a) number bases, (b) the determination of wedding dates, (c) the Buton people's mathematical knowledge in planting processes, (d) ethnomathematical knowledge in farming activities, (e) ethnomathematical knowledge in fishing activities, and (f) the application of *kali-kali binongko* in trading activities.

The researcher also identified a mathematical concept that can be referred to as hidden mathematics or frozen mathematics within the Buton community in Masohi. This refers to the act of naming counting activities based on the number of days, following the lunar cycle and naming new months according to the counting of the moon in the sky.

It is recommended that future researchers make use of these ethnomathematical findings on *kali-kali binongko* and further explore other mathematical concepts embedded in the cultural practices of the Buton people, such as marriage customs, the *bakurung* tradition, and *aqiqah* rituals practiced by the Buton community in Masohi, Central Maluku Regency.

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