Ethnomathematics on Baduy tribe

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Abstract. This research focuses on the leuit that functioned as a granary of the Baduy tribe. Researchers use ethnographic methods to obtain the data. This research finds that besides it is functioned as a place to store, Leuit can also be viewed as a symbol of food security for the Baduy community. After being analyzed mathematically, one leuit is able to support one person of Baduy for approximately 19 years. Moreover, geometric types and shapes of leuit are very interesting to study because of its uniqueness, and also its high Philosophical values.

1. Introduction
This study takes a place in Banten province with the main focus is the Baduy community. The reason of this study is that the Baduy community has a hereditary culture that still exists today. Prohibition of going to school makes researchers are interested in how they think and get knowledge to support their daily activities. Besides, the knowledge’s they have and use are always supported by the values of local wisdom in which nature should be the way it is.

Although, research in the local wisdom of the Baduy community has been widely carried out [1-3], but research in ethnomathematics of the Baduy community itself has not been much explored and has only been carried out by several local researchers [4,5]. Meanwhile, research in ethnomathematics itself has been conducted by many researchers in the world [6-9].

The aims of this study is to examine on how their mathematical thinking process based on their leuit as a granary. This research also models the way of thinking of the Baduy community mathematically using the pre-existing formal concepts.

1.1. Ethnomathematics
Today, there are many studies that connect mathematics and culture. According to Hadi mathematics is a form of human activity that is developed through exploration of various problems in the real world [10]. In which, the real world here is defined as everything beyond the theoretical of mathematics, such as daily activities, the surrounding environment, even its connectivity to other subjects as a starting point in the learning process.

Scientists have collected empirical data about mathematical ideas and other ideas from cultural groups both literally and non-literally [11]. Of course it has course has a widely impact on the philosophy of mathematics education, especially in the learning process. While NASGEM in their web (nasgem.rpi.edu), the North American Study Group of Ethnomathematics, defines broadly that ethnomathematics studies are not only limited to small group scales, but the prefix “ethno” can refer to any group of nations, trade unions, religious traditions, professional classes, and so on.
Ethnomathematics in the picture above is an intersection between cultural anthropology, mathematical modeling and mathematics itself [12]. In other words, ethnomathematics is a concept of non-formal thinking from cultural group which is studied through cultural anthropology (ethnography) and then followed by conceptualizing the non-formal way of thinking using the researcher's perspective based on the concept of formal mathematical concepts.

2. Research methodology
The method we used in this research are ethnographic and analytical descriptive method with a type of case study. Descriptive methods are generally chosen because they can systematically describe the facts and characteristics of objects and subjects that are examined appropriately. In addition, descriptive analytical method is also a research method that emphasizes to the efforts to obtain information about the status or symptoms at the time of research, provides an overview of a phenomena, also further explains the relationship, and give a meaning from a desired problem. Our research methods can be described in the simple flowchart below

![Flowchart diagram](image)

3. Results and discussions

3.1. The philosophy of shape and design of the Leuit
Generally, the philosophical value in the local wisdom of the Baduy community is not only in the shape of *leuit*. However, all aspects of their lives are closely related to the noble values that need to be
conserved. The noble values of the Baduy community can be referred to the book written by Kurnia, A and Sihabudin [13].

There are two types of leuit in Baduy, cuboid and truncated Pyramid which is smaller in the bottom. The first types are only in outer Baduy, but the second types can be observed when we are in the inner Baduy. Generally, the leuit more various in outer Baduy, but at inner Baduy almost similar to its shape and size.

The leuit at inner Baduy which has a type of truncated pyramid is made by design. It aims to reduce the amount of paddy that is stored in the bottom. In other word, it makes the storage volume of the leuit in the bottom smaller than on the top. In many cases, Baduy people almost never use those paddy in the bottom position because the window of leuit is on the top. Therefore, they must go up to the top when they take or they store their paddy. This is actually a ‘security system’ to keep their paddy from the thief besides to maximize the storage volume.

3.2. Ethnomathematics of Leuit Baduy

3.2.1. Mathematically modeling of Leuit Baduy volume. This following is a modeling on how to count the rice capacity that can be stored in one leuit. Because the Baduy leuit has two types, the cuboid and the truncated pyramid, the modeling is splitted into two types of differentiation formula.

3.2.2. Cuboid Leuit type.

Suppose that leuit is considered as a cuboid at the bottom and prism at the top. the volume of cuboid and prisms respectively are

\[ V_b = p \times l \times t_b \]
\[ V_p = \frac{1}{2} p \times l \times t_p \]

With \( p = \text{length}, \ l = \text{width}, \ t_b = \text{height of cuboid} \) and \( t_p = \text{height of prism} \). We assume that the base area of the prism is equals to the top area of cuboid. Thus, the total leuit volume is:

\[ V_{leuit} = (p \times l \times t_b) + \left( \frac{1}{2} p \times l \times t_p \right) \]
3.2.3. *Truncated Pyramid Leuit type*. Observe this following figure 4:

![Figure 4. Truncated pyramid type.](image)

Considering that *leuit* is a truncated pyramid at the bottom and a prism at the top. Based on that above model, we need to find the formula of truncated pyramid volume, but in this article, the proof left for the reader. We have the total volume of *leuit* which has a truncated pyramid type is

\[
V_{total} = \frac{1}{3}t ((L1^2 + L1L2 + L2^2) + V_{prism})
\]

3.3. **Predicting the amount of rice that can be stored in a Leuit**

Now we try to simulate the amount of rice can be stored from a *leuit* with an assumption that *leuit* is full. The *leuit* model we used is the first type (cuboid). If the length, width, height of cuboid and average of prism height are 2 m, 2 m, 1.5 m and 1.2 m, then the total volume of *leuit* is \(8.4\ m^3\). For the second type of *leuit*, it can be calculated using the same principle.

Because the Baduy community in storing their rice into the *leuit* is still in the form of *pocongan* where one *pocong* is equivalent to 3.5 kg of paddy or 2.5 kg of rice. Thus, we need to convert from kilograms’ unit. In the real market, especially sub urban people, they often use liters’ unit when buying rice. It is known that 1 kg of rice is equivalent to 1.25 liters of rice. While 1 liter is equivalent to 1 dm3. So that one kilogram of rice equals to 0.00125 m3. From the calculating before, we have the total volume of *leuit* is \(8.4\ m^3\). Thus, the rice that can be stored in a *leuit* is 6.720 kg or 6.72 tons of rice. If we simulate one Baduy person has one *leuit* and each person eats about 1 kilogram of rice per day, then 1 *leuit* can be used as food stockiest for 18.66 years, almost 19 years. This is a fantastic amount of rice from a single *leuit* when the Baduy person is unable to work or when facing famine time.

4. **Conclusion**

Although the type and size of the *leuit* is various (outer Baduy), but it is similar in inner Baduy. Generally, *leuit* is an effort of Baduy tribe for food security that can be imitated by modern civilization. Paddy which is stored in a *leuit* is similar to money deposits in modern society. Paddy in a *leuit* will only be used for emergency condition such as famine time, wedding celebration that requires a lot of money, and “Savings” for the future or to be passed on to their children. The difference in the way of saving the property of Baduy people with modern people lies on the security system. If Modern society keeps money generally in the Bank by using electronic security systems, then the Baduy community still highly believes in the honesty between the members of the community. It is a culture that increasingly has faded away from among the urban community.

**Acknowledgement**

Special thanks to Institute of Research and Community Service, Indonesia University of Education for Its funding, and also anonymous referees, so that we can publish our research in time.
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