Exploring ethnomathematics activities to tobacco farmers’ community at Jember, East Java, Indonesia

Suwarno¹, N D S Lestari², and W Murtafiah³

¹Institut Agama Islam Negeri (IAIN) Jember, Jl. Jalan Mataram No1 Mangli Jember, Indonesia
²Universitas Jember, Jl. Kalimantan No 37 Sumbersari, Jember, Indonesia
³Universitas PGRI Madiun, Jl. Setiabudi No 85 Kartoharjo, Madiun, Indonesia

Email: s_warno@iain-jember.ac.id

Abstract. This research aims to explore and describe the ethnomathematics on activities of the tobacco farmers’ community at Jember. The discourse that explained ethnomathematics could be related to tobacco’s farmer activities at Jember East Java, Indonesia. Jember was one of the largest tobacco-producing districts in East Java, Indonesia. These plants were grown for generations by some residents at Jember, East Java, Indonesia. The tobacco farming heritages had caused this district is known as the city of tobacco so that the government of Jember made tobacco motifs as batik of Jember. Besides, the dance Jember named Lambaco also be created as an appreciation for the existence of tobacco. This research uses qualitative research, while the approach used is Ethnographic. The data collected by observation and interview involved several farmers. Based on result and discussion, we can conclude that on tobacco farmer community in Jember, there are many activities; giving a unit of land, seeding, transplanting and cultivating, harvesting, curing, and trading involved ethnomathematics activities such as: using of non-standard units, arithmetic concept (computing, addition, multiplication, subtraction), geometrical concept, especially of rectangular shape, triangular shape, perpendicular line, 3-D shape, proportional and relational concept, statistics (estimating)

1. Introduction

Daily human life indeed cannot be separated by their culture. Culture is a universal phenomenon, every society in the world has a culture even though the shape and the pattern are various from one society to another society [1,2]. Culture is manifest in common human nature from various tribes, nations, and races [3]. In daily life, local culture is a system of values that guide the attitudes, behavior, and lifestyle of the tribe's identity. Culture is the characteristics and knowledge of a particular group of people, defined by everything from language, religion, cuisine, social habits, music, and arts [4,5]. Furthermore, a culture defined as shared patterns of behaviors and interactions, cognitive constructs, and understanding that are learned by socialization [6]. Thus, it can be seen as the growth of a group identity fostered by social patterns unique to the group. The word "culture" derives from a French term, which in turn derives from the Latin "colored," which means to tend to the earth and grow, or cultivation and nurture. "It shares its etymology with several other words related to actively fostering growth," Cristina De Rossi, an anthropologist at Barnet and Southgate College in London, told Live Science

Discourse about society and its culture, Mathematics has a proper role in a variety of cultures, on the habit of a tribe or community and in terms of customs, in daily life either directly or indirectly. But unfortunately, society often unaware that most of their life can be related by Mathematics. Even inadvertently, when people were trying to solve their practical problems in daily life, mathematical
activity also participates in it. Instead, they sometimes still confused in applying mathematical concepts learned in school to be applied in everyday life. This process needs decision making from teachers to integrate ethnomathematics in mathematics teaching [7].

The linkage between Mathematic and culture is known as ethnomathematics. A knowledge that is already known through a custom that is developed in a society. But the human just already realized after some scientists introduced ethnomathematics as a part of the Mathematical sciences. Ethnomathematics is a field of study that examines how people from other cultures understand, articulate, and use concepts and practices from their culture, and the researcher describes it is mathematical [8]. Ethnomathematics emerged as a new conceptual category from the discourse on the interplay among Mathematics, education, culture, and politics [9].

Furthermore, The term of ethnomathematics is used to express the relationship between culture and Mathematics [8,10]. Moreover, the condition requires a dynamic interpretation because it describes the concept neither rigid nor singular-namely, ethnic, and Mathematics [11]. The term ethno describes all of the ingredients that make up the cultural identity of a group: language, codes, values, jargon, beliefs, food and dress, habits, and physical traits. Mathematics expresses a broad view of Mathematics, including Arithmetic, classifying, ordering, inferring, and modeling. Ethnomathematics is the Mathematics practiced by cultural groups, such as urban and rural communities, groups of workers, children in a given age group, indigenous societies, and so many other groups. Ethnomathematics is defined as the cultural or everyday practices of Mathematics in a particular cultural group and a program that looks into the generation, transmission, institutionalization, and diffusion of knowledge with an emphasis on the sociocultural environment. Ethnomathematics has a role to play in the context of the teaching-learning process in the formal classroom.

The ethno refers to members of a group within a cultural environment, mathema means to explain the world to manage the reality so that they can survive, and tics refers to techniques such as counting, measuring, weighing, ciphering, classifying, inferring, and modeling [1]. According to the statement of Mesquita, we can conclude that ethnomathematics is a social act [12]. Ethnomathematics is an answer, in practices, to the decline of the idea of Mathematics as a pure thing. It is designed to reveal the social and cultural roots that explain mathematical practices.

Jember is one of the districts in East Java, consisting of 31 districts and 244 villages, whereas people composed of Java and Madura ethnic. Jember has an area of 3293.34 km2 with an altitude between 0-3330 meters above sea level. In terms of agriculture, Jember is one of the largest tobacco producer districts in East Java. The plant is a plant grown for generations by some residents in Jember. Tobacco farming heritage hereditary causes this district is well known as the city of tobacco. No wonder also if the local government made tobacco motifs as batik motif of Jember. Besides, the typical dance Jember named Lambaco is also created as an appreciation of the existence of tobacco.

In carrying out tobacco farming, the tobacco farmer got their knowledge inherited from their ancestors. It is not realized that their activities from seeding, planting, harvesting, and even curing have been typically applied by using Mathematical concepts called ethnomathematics. So that it becomes interesting to be activities being done by the tobacco farmers community in Jember.

Research on ethnomathematics in Indonesia has been carried out by several researchers [13–18]. Ki Ageng Wonolelo’s traditional ceremonies are used as a medium of learning geometry for junior high school students [18]. Ethnomathematics exploration in several Yogyakarta batik motifs contains philosophies, deep cultural values, and mathematical concepts, especially subjects of geometry transformation [13]. The design activities of Kebaya Kartini have mathematical concepts, such as angles, sizes, and integer operations [19]. Sundanese ethnomathematics has three activities, namely estimating, measuring, and making patterns that emerge in activities in terms of kibik (a unit to measure volume), brick (a unit to measure surface area), and the lead path (a model of sugar cane work) [15]. Ethnomatic exploration in several motifs of woven bamboo which contains mathematical concepts, especially subjects of geometric transformation [16]. Numerical values such as numbers, residual theorems, modulo, and congruent modulus in formal mathematics, which are associated with matchmaking using Javanese Primbon [17].

According to these studies, there is no research that reveals ethnomathematics in the tobacco farmer community, especially in Jember. Thus the need for ethnomathematics to be revealed in the tobacco
farmer community in Jember enriches the context that uses mathematical concepts and can be used to teach mathematics. Mathematics learning emphasizes the relevance of mathematical concepts taught to the real meaning of student life [20–23].

2. Method
This study used a qualitative approach. Research subjects were tobacco farmers who did tobacco farming activities traditionally consisted of eight tobacco farmers distributed in the south, east, and west Jember region. The main instrument of the study was the researchers themselves. The methods used to collect the data in this study were the observation, interviews, and documentation; thus, the data collection instruments were observation sheets and interview guidelines. In this study, the researcher used a semistructured interview. This study used descriptive qualitative data analysis techniques. The stages in the data analysis techniques in this research are as follows: a) Data Reduction, b. Data Display and Conclusions Drawing/Verification. Testing the validity of the data used sources and methods triangulation.

3. Result and Discussion
Ethnomathematics activities that can be explored on the tobacco farmer community is described as following.

3.1 Giving the name of unit area
The tobacco farmers in South Jember are measuring the area of an object using non-standard units of area. The non-standard area in a unit area that has not been standardized. Non-standard measurements are measurements whose results vary because they use non-standard or non-standard measuring instruments. The units used in the measuring area are bohu, ru, kedok, wolon, lagguh. The relational of each units are describe as following: Sebahu (bouw) = 500 ru = 4 kedok; ½ bu = 250 ru = seprapat (1/4) bau = sak (1) kedok = 125 ru; Sakwolon = 62.5 ru. In standard area unit, 1 ru = 3.75 m × 3.75 m = 14.07 m². In other cases, the tobacco farmer at East Jember, who are descendants of the Madura, said land area as lagguh = morning. It's meaning that the land needs one worker to finish plowing the land in one morning. It is about 4-hour, start from 7 am until 11 am) that equivalent to ½ hectare. These activities express the concept of proportion and relational two quantity. Proportional reasoning represents the ability to begin to understand multiplication relationships where most arithmetic concepts are usually base on addition [24]. The same thing also expressed that understanding the basic relationships in a proportional situation and at the same time using these relationships is called proportional reasoning [25].

That problem is created in a student worksheet that integrates ethnomathematics. The use of worksheets is essential to explore student activities [26–28]. These activities are appropriate to the geometry field focused on the area of figure involve counting activity. This research relevant to Risdiyanti & Prahma who use culture to teach mathematics [13].

3.2 Seeding
Several non-standard units are involved in the seeding process, such as Corot, bedeng, spoon, and tekem. The farmers planted on their prepared seedbeds with 0.5 m width and 5 m length and called as bedeng. It represents the rectangular concept, and its area, where its area can be found by multiplying the length and the width. Most farmers mixed the one spoon of seeds with water in one corot/gembor/jibor, and then spread/shower them over the beds. If they make two or more beds, they prepare more seeds by multiplying as many as the number of bedeng. These activities express the concept of proportionality. A ratio is a number that connects two quantities or measurements in a particular situation to a multiplication relationship can enhance proportional thinking [24,25,29].

In another way, the farmer can buy the seedlings from other farmers. If farmers buy seedlings from the seller, the seller counts the seedlings by taking a sample in one tekem (handful) of seedlings. Then they multiply one tekem adjusting the seeds needed. For example, if one tekem can consist of 100 seedlings, and the farmers need 6000 seedlings, they only take 60 tekem of seedlings.

The estimating of seedlings needed is appropriate to the proportional concept, and statistics focused on a sample that involves multiplication, addition, or division. These facts are also relevant to previous
studies that mathematics expresses a broad view of mathematics, which includes arithmetic; classifying, ordering, modeling, and mathematical practice is a cultural product [4].

3.3 Planting

The non-standard unit used in this process are deppah, bahu, legguh. The transplanting process is usually called as Tonjo. This process required three steps including (1) make a hole in the furrow with a hand peg, (2) place the seedling in the hole, (3) add water and fertilizer to the plant. The planting process using a rope form a straight line and parallel each other. To locate the hole in a straight line, the worker used the rope (kencho/kencah) signed at a distance of ±30 cm. The farmer called the distance as deppah (the length of the adult arm). It contains a geometric concept, especially the parallelism of the lines. It also contains a non-standard unit in length.

The farmer needed about 3-4 workers to covered ¼ bau area in 3-4 hours of working. The other farmer said that it required about ten workers in transplanting on two legguh of area. The farmer must pay Rp 15000 for each worker. The farmer using a proportional concept intuitively. Furthermore, it also uses an arithmetic concept.

These transplanting activities are appropriate to Geometry and Arithmetic focused on the area of the figure, straight line, involve counting activity (multiplication, addition). This fact is in line with the previous research that integrates the ethnomathematics approach into the teaching of geometry [30].

3.4 Harvesting

As the tobacco plants got closer to harvest time, they would begin to produce a bud near the top that would need to be removed to ensure that the leaves grew to their full potential. The removal of the bud was called "topping" and was done entirely by hand. The laborers walked up and down the rows breaking off the bud. While the topping crew moved through the field, they were also on the lookout for tobacco hornworms, a pest that ate the leaves. Removing the hornworms, which were also called suckers, was called "suckering" and required the workers to pull them off by hand and kill them.

The harvest begins if the stalk is getting a height of 1.5 – 2 meter, which contains 15 leaves for Casturi and 60 for Naoogst or 60-70 days after transplanting. The harvesting leaves are cropped as they ripen, from the bottom to the top of the stalk, and tobacco began to be harvested by pulling individual leaves off the stem as they ripen. The first crop of leaves near the base of the tobacco stalk is called koseran, consisting of 3 sheets. After that, on the next day, the upper leaves are taken 3-4 each. It would be ended by taken 4-6 leaves on the top (prentil). The harvesting is held in the morning starts at 7 am. For ¼ bau area, it needs about four people in 2 hours, and two legguh areas need three people in 4 hours working. After harvesting, the leaves are put in position as Figure 1.

![Figure 1. The position of leaves](image)

These harvesting activities are appropriate to Arithmetic focused on direct and indirect proportion, involve counting activity (multiplication, multiplication, subtraction). This fact is also relevant to [4,17,31], who use culture in many contexts to teach mathematics.

3.5 Curing

There are two types of curing. The drying process starts with the sorting process to select the tasty leaves (see figure 2). After that, the leaves are performed into sujin, stabbing bamboo 25 cm length. One sujin comprises four sheets for koseran and 5-6 for other kinds of leaves alusan or kasaran or prentil). All
sujin are put parallels on the bamboo in ± 2 meters length. It contains the mathematics concept, especially parallelism, non-standard units, number, arithmetic. In making sujin, it uses a commercial system (tebas) for every 100 sujins, the farmer must pay Rp.2000, 00. The farmer can estimate the money should be paid in the collection of leaves.

Figure 2. The curing process under the sun

Tobacco is dried in closed curing barns, and a low-burning fire is built on the floor. This process occurs in a building called as Gudang Mbako (Curing Warehouse). The gudang mbako has a unique geometrical shape, refers to a prism. It consists of 20-30 rooms with 2 meters width and 12 meters in length. One room includes 8 longkang (horizontally space) and 12 galang (vertically space). Based on the figure, we can explore the geometric concept to enhance spatial thinking skills [32]. Figure 3 shows the gudang mbako.

Figure 3. The front side of gudang mbako (curing wirehouse)

The front side is made in pentagon shape or cut isosceles triangle shape. The bamboo buffer pole has a unique name; cagak, tuak, galang, galang tikus with different sizes consecutively 4 m; 6.2 m; 8.3 m; 10.4 m and the highest is 12.5 m in which each pole spacing of 2.5 m length. Figure 3 shows the gudang mbako’s frontside.

Figure 4. The measure of gudang mbako (curing wirehouse) in detail
The leaves of tobacco are put on the *kamaran* with this pattern: one *kamaran* consists of 700 *gelantang*, one *gelantang* consists of 40 *sujjin*. One *sujjin* consists of 40 leaves for *koseran*, 50 leaves for *kasaran/alusan*, and 50 for *cepril*. During the curing process, the heat is produced from the fire on the floor. It contains fuel in the form of firewood or husk, starts from 7 pm until 11 pm. In one *kamaran*, there must be five sources of fire. Based on the figure, we can explore the concept of angle, line, and arithmetic.

![Figure 5. The measure of gudang mbako frontside in detail](image)

These curing activities are appropriate to the Geometry field focused on 3-D figures. They involve drawing a straight line, angle, designing the sketch, making a figure in a fixed measure, and arithmetic field concentrate on series that include counting activity (multiplication, addition). This fact is in line with [30,33,34], who use the exercise model in analyzing and constructing ornaments in a geometry class.

### 3.6 Trading

There are two methods in tobacco trading for traditional farmers. If the tobacco is sold to a businessman (high capital), the price is calculated in the kilogram unit for 2 million rupiahs for 1 quint. If they sell it to the merchant, then the system is by making approximately. The way of approximately is by putting them on *andang*, a bamboo receptacle. After that, the merchant lifts them, and they thought about the weight. In other ways, the trading occurs by counting the number of *sujjin* whereas Rp.50,000 will pay 100 *sujjin*.

These trading activities are appropriate to the statistic field focused on sample technique that involves estimating the weight of things and social arithmetic focused on profit and disadvantages. This fact is in line with [35,36], who use culture to teach arithmetic in mathematics teaching. Learning mathematics that involves the context of everyday life can also train students' mathematical literacy skills. Mathematical literacy problems presented through scientific approaches, discovery learning, and problem-based learning can support students' reasoning and argumentation [37].

### 4. Conclusion

Based on result and discussion, we can conclude that on tobacco farmer community in Jember, there are many activities; giving a unit of land, seeding, transplanting and cultivating, harvesting, curing, and trading involved ethnomathematics activities such as: using of non-standard units, arithmetic concept (computing, addition, multiplication, subtraction), making a pattern using the geometrical concept, especially of rectangular shape, triangular shape, perpendicular line, 3-D shape, proportional and relational concept, statistics (estimating). In this regard, mathematical education must embed or integrate the Ethnomathematics value in the teaching and learning process so that students realize the importance of Mathematics in solving problems in their daily lives. It is because Mathematics is very closed to their life.

### 5. Acknowledgments

The authors wish to thank the Tobacco farmer community of those who contributed so that this research can be finished.
6. References

[1] Rosa M and Orey D C 2011 Ethnomathematics : aspek budaya matematika Etnomatematika : os aspectos culturais da Matematica Rev. Latinoam. Etnoatematica 4 32–54
[2] Maran J P 2019 Etnomatematika dalam Ritus Agama Katolik Larantuka PROSIDING SENDIKA
[3] Dominikus W S, Nusantara T, Subanji and Muksar M 2017 Ethnomathematical Ideas in The Weaving Practice of Adonara Society J. Math. Cult. 11 83–95
[4] Balamurugan M 2015 Etnomathematics; An Approach For Learning Mathematics From Multikultural Perspective Int. J. Mod. Res. Rev. 3 716–20
[5] Oliveras M L 1999 Ethnomathematics and mathematical education ZDM - Int. J. Math. Educ. 31 85–91
[6] Soares A M, Farhangmehr M and Shoham A 2007 Hofstede’s dimensions of culture in international marketing studies J. Bus. Res.
[7] Murtafiah W, Sa’dijah C, Chandra T D and Susiswo S 2019 Decision making of the Winner of the National Student Creativity Program in Designing ICT-based Learning Media TEM J. 8 1039–45
[8] Barton B 1996 Making sense of ethnomathematics: Ethnomathematics is making sense Educ. Stud. Math. 31 201–33
[9] Frankenstein M and Powell A B 2002 Toward liberatory mathematics: Paulo Freire’s epistemology and ethnomathematics (Routledge)
[10] Barton W D 1996 Ethnomathematics : Exploring Cultural Diversity in Mathematics (The University of Auckland.)
[11] D’Ambrosio U 2001 What is Ethnomathematics, and How Can it Help Children in School? (Rotterdam: Sense Publisher)
[12] Mesquita M 2016 The Ethnomathematics Posture as a Political Blow: Unveiling The Mysticism of Five Rhythms Present in Communitarian Mathematics Education Int. J. Res. Math. Educ. 6 92–111
[13] Risdiyanti I and Prahmana R C I 2018 Ethnomathematics: Exploration in Javanese culture J. Phys. Conf. Ser. 943
[14] Maryati and Prahmana R C I 2018 Ethnomathematics: exploring the activities of designing kebaya kartini MaPan J. Mat. dan Pembelajaran 6 11–9
[15] Muhtadi D, Sukirwan, Warsito and Prahmana R C I 2017 Sundanese Ethnomathematics : Mathematical Activities In Estimating, Measuring , And Making Patterns J. Math. Educ. 8 185–98
[16] Maryati and Prahmana R C I 2019 Ethnomathematics: Exploration of the muntuk community Int. J. Sci. Technol. Res. 8 47–9
[17] Utami N W, Sayuti S A and Jailani 2019 Math and mate in javanese primbon: Ethnomathematics study J. Math. Educ. 10 341–56
[18] Irfan M, Slamet Setiana D, Fitria Ningsih E, Kusumaningtyas W and Adi Widodo S 2019 Traditional ceremony ki ageng wonolelo as mathematics learning media J. Phys. Conf. Ser. 1175
[19] Maryati M and Indra Prahmana R C 2018 Ethnomathematics: Exploring the Activities of Designing Kebaya Kartini MaPan 6 11–9
[20] Jelatu S, Sariyasa S and Ardana I M 2018 Effect of GeoGebra-Aided REACT Strategy on Understanding of Geometry Concepts Int. J. Instr. 11 325–36
[21] Turmudi 2017 Kajian Ethnomatematika: Belajar Matematika dengan Melibatkan Unsur Budaya Providing Seminar Nasional Etnomatnesia pp 38–53
[22] Widjaja W 2013 The use of contextual problems to support mathematical learning J. Math. Educ. 4 151–9
[23] Suwarno 2019 How to Make an Ill-Structured Problem to be Well Done ? a study About Decision Making of Prospective Mathematics Int. J. Insight Math. Teaching(IJOIMT) 02 1–10
[24] Walle J V Matematika sekolah dasar dan menengah pengembangan pengajaran (Jakarta: Erlangga)
[25] Kilpatrick J, Swafford J and Findell B Adding it up: Helping children
[26] Krisdiana I, Masfingatin T, Murtafiah W and Widodo S A 2019 Worksheet-Based Learning
Research to Improve Creative Thinking Skills. J. Phys. Conf. Ser. 1254 012054

27. Krisdiana I, Masfingatin T, Murtafiah W and Widodo S A 2019 Research-based learning to increase creative thinking skill in mathematical Statistic J. Phys. Conf. Ser. 1188 012042

28. Lestari N D S, Juniati D and Suwarsono 2018 Exploring The Knowledge Of Content And Teaching Of Prospective Math Teacher In Planning Mathematical Literacy Teaching IOP Conf. Ser. J. Phys. Conf. Ser. 1097 012150

29. Ekawati R, Lin F L and Yang K L 2015 Developing An Instrument For Measuring Teachers’ Mathematics Content Knowledge On Ratio And Proportion: A Case Of Indonesian Primary Teachers Int. J. Sci. Math. Educ.

30. Sunzuma G and Maharaj A 2019 Teacher-related Challenges Affecting the Integration of Ethnomathematics Approaches into the Teaching of Geometry Eurasia J. Math. Sci. Technol. Educ. 15

31. Matang R 1998 The Role of Ethnomathematics in Mathematics Education in Papua New Guinea: Implication for Mathematics Curriculum Educ. J. Stud. 20 22–9

32. Bednarz R and Lee J 2019 What improves spatial thinking? Evidence from the Spatial Thinking Abilities Test Int. Res. Geogr. Environ. Educ. 28 262–80

33. Massarwe K, Verner I, Bshouty D and Verner I 2010 An ethnomathematics exercise in analyzing and constructing ornaments in a geometry class J. Math. Cult. 5 1–20

34. Zhang W and Zhang Q 2010 Ethnomathematics and its integration within the mathematics curriculum J. Math. Educ. 3 151–7

35. Powell A B and Temple O L 2001 Seeding ethnomathematics with oware: Sankofa Teach. Child. Math. 7 369–75

36. Cimen O A 2014 Discussing ethnomathematics: Is mathematics culturally dependent? Procedia-Social and Behavioral Sciences pp 523–8

37. Hermawan L I, Lestari N D S, Rahmawati A F and Suwarno 2019 Supporting Students’ Reasoning and Argumentation Skills Through Mathematical Literacy Problem on Relation and Function Topic IOP Conf. Ser. Earth Environ. Sci. 243 1–8