Volume 8, Nomor 1, Juli 2026, pp. 59-79

RANGE : Jurnal Pendidikan Matematika
e-ISSN :2685-2373

Investigating Ethnomathematics in Traditional Farming in Bitefa Village, North Central Timor District

Yohanis Ndapa Deda [1]*, Stanislaus Amsikan[2], Otaget Daniel[3], Maya Purwaningsi Lasfeto[4]
[1,2,4]Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Timor, NTT, Indonesia
[3]Department of Mathematics and Statistics, Kyambogo University, Kampala, Uganda

Received: February 1st 2026. Accepted: June 30st 2026. Published: July 30th 2026

ABSTRACT

The community of Bitefa Village in North Central Timor Regency (TTU) keeps farming corn on dry land as they have done for generations, but they are not aware of the mathematical activities that could be used as a source of mathematics education. The purpose of this study is to explore ethnomathematical activities in the dryland farming culture of corn cultivation in Bitefa Village. The research method is qualitative with an ethnographic approach. The Spradley ethnographic approach research sequence is used to identify, classify, and interpret ethnomathematical activities embedded locally in traditional dry farming. Data collection is through participatory observation, interviews, and recording of agricultural artefacts. Analysis was conducted using Spradley's research sequence approach, domain analysis, taxonomic analysis, component analysis, and cross-domain theme analysis. The results show that spatial planting patterns aim to facilitate weeding and root competition; informal cultural units of measurement are used with functional adequacy and selective metric verification; seasonal decision-making based on local phenological indicators; a hierarchical aggregation system for crop yields (*Pulir-Ikat-Kuda*) that facilitates calculation, exchange, and estimation; and ritual-social mechanisms that legitimize and coordinate collective agricultural efforts. This study suggests that applying mathematical exercises to traditional corn farming methods, such as comparing or converting local units to standard units and forecasting corn seeds based on farm size, could be a source of learning in mathematics education in the classroom.

Keywords: Anthropometric units; Dryland farming; Ethnomathematics; Spradley ethnography

How to Cite: Deda, Y. N., Amsikan, S., Daniel, O., & Lasfeto, M. M. (2026). Investigating Ethnomathematics in Traditional Farming in Bitefa Village, North Central Timor. *Range: Jurnal Pendidikan Matematika*, 7(1), pp-pp.

Introduction

Ethnomathematics presents mathematics as a cultural practice that is deeply rooted in how local groups measure, compare, organize space, and make decisions. Ethnomathematics links abstract mathematics to real-world situations by examining how and why mathematical ideas are created, shared, and developed within local communities (D'Ambrosio, 1985, 2020). The ethnomathematics perspective is linked to contextual learning in mathematics education, where students create meaning through familiar cultural practices and local knowledge. This approach has been shown to improve problem-solving skills and the applicability of mathematics in the classroom (Amsikan & Deda, 2018; Irawan et al., 2018; Umbara et al., 2021).

Since 2010, ethnomathematics study has expanded quickly, with studies typically recording mathematical components in traditional meals, games, crafts, rituals, architecture, and cultural artefacts (Hidayati & Prahmana, 2022). The majority of ethnomathematics research still concentrate on identifying "mathematical content" such as geometry in motifs or buildings-while focusing less on (a) the cultural logic that establishes sufficient precision, (b) how measurement standards are collectively established in shared work, and (c) how local spatial arrangement and quantification systems function throughout the production cycle (Hidayati & Prahmana, 2022; Rosa & Orey, 2024). Even though Bishop's (1998) six universal activities-counting, locating, measuring, designing, playing, and explaining-frame mathematics as a cross-cultural practice, a lot of exploratory work still lists these activities as static concepts instead of analysing the situated reasoning that underpins them (D'Ambrosio, 2020). The decision logic of routine mathematical activity is under-theorized as a result of this propensity to enumerate ideas without examining their philosophical or cultural justification.

These limitations are most obvious in traditional dryland agriculture, where farmers use mathematical reasoning to manage crop competition, calculate planting distances, aggregate harvests, and time planting based on environmental cues. However, it is rare to capture or theorize this decision reasoning. Dryland farming depends on adaptation strategies, soil-moisture management, water conservation, and locally appropriate crop selection to maintain production without irrigation.(Stewart & Thapa, 2017; Todd et al., 2024), making it highly relevant to ecology and food security. Because such knowledge in border and rural areas is increasingly eroded by modernization and shifting labour patterns, documenting it is urgent for both mathematics education and cultural transmission to the next generation.

Dry farming of corn has been passed down from generation to generation in the community of Bitefa Village, TTU District, located on the island of Timor. Farmers use local phenological indicators to predict seasonal changes, local units for aggregation, and local measurement units for spacing and the use of dryland farming tools. These traditional agricultural practices demonstrate operational local mathematics and have become part of the farming culture of the community in Bitefa Village. Indicators, units of measurement, and rainy season predictions involve shared conventions, coordination of roles in collective work, and accuracy and efficiency in all dry land conditions (e.g., sloping terrain, time constraints, and division of labour).

This study examines ethnomathematics practices in traditional dryland agriculture in Bitefa Village, TTU, focusing on local measurement and dryland agricultural management. This study focuses on three research questions: (1) What forms of traditional dryland farming practices in TTU contain ethnomathematical elements? 2) What local units, spatial patterns, and numerical systems are used, and how do they function across farming activities? (3) What are the implications of these locally embedded mathematical practices for culturally contextualized mathematics education and local knowledge preservation?

Methodologically, we employ Spradley's Developmental Research Sequence (DRS) to move from domain identification (what counts as relevant "cultural math" in the field), to taxonomic structuring (how categories relate), to componential analysis (what dimensions differentiate practices), and finally to cross-domain cultural themes (what coherent logics organize multiple domains). This approach supports an analytic pathway from situated practices, such as bodily measurement and spacing choices, toward interpretable themes that can be mapped to formal mathematical ideas and classroom tasks while preserving cultural meaning (Deda et al., 2024; Deda & Disnawati, 2024; Lee et al., 2011).

In theory, agricultural practice is a rich site for ethnomathematics because production cycles compress measurement, optimization, aggregation, and prediction into a single, recurring, socially coordinated workflow-as opposed to artefact studies, which capture mathematics as a finished result. Farming studies allow us to study how accuracy is negotiated and why certain standards stabilize. This work advances the discipline by moving the focus from documenting cultural "mathematical content" to describing the situational decision logic that organizes it throughout the production cycle. This study provides two contributions. First, it provides the first in-depth ethnomathematical description of an agrarian production cycle in TTU, which is dominated by artefacts and architectural culture in Indonesian ethnomathematics. Second, it goes beyond identifying concepts by proposing three cross-domain logics: functional sufficiency and adaptive precision, the body as a shared standard with collaborative ergonomics, and spatial optimization in the context of resource competition. Together, these represent the cultural thinking that fundamentally supports farmers' mathematical practice.

Methods

Research Design

This study uses a qualitative method with Spradley's ethnographic approach to identify, classify, and interpret locally embedded mathematical practices in traditional dry farming in Bitefa Village. The analytical sequence is from domain analysis to taxonomic analysis, component analysis, and finally theme analysis (Lee et al., 2011; Nowell et al., 2017).

The research was conducted in Bitefa Village, North Central Timor (TTU), East Nusa Tenggara, Indonesia. Data was collected from July to October 2025. The dryland farming context includes garden preparation, intercropping corn with secondary crops, and relying on local units of measurement for planting distance and local units for calculating crop yields, accompanied by local seasonal indicators

Participants and Sampling

To provide rich in data cases, informants were chosen by criterion-based purposive sampling (age ≥ 40 years; farming experience ≥ 10 years; active participation in traditional dryland maize farming). Snowball sampling was then used, in which the original informants suggested other farmers who were well-known in the area for their proficiency in farming and familiarity with traditions. Five main informants (A–E) made up the final sample, which was significant for a thorough ethnographic investigation due to frequent themes in the observations and interviews (Guest et al., 2020; Hennink et al., 2017).

Data Sources and Collection Procedures

Researchers used three complementary data sources, namely (1) participatory observation supported by field notes and visual documentation, focusing on planting patterns and spacing, tools and techniques, seasonal markers, and ritual or coordination practices; (2) sequential interviews following Spradley's approach, using descriptive questions to reveal local terms, category relationships, and distinguishing dimensions of practices; and (3) documentation of artefacts, including measuring and planting tools, and materials for binding the harvest. The research instruments used were observation sheets (unit, row spacing, pattern, tools, rituals, seasonal markers) and semi-structured interview guides aligned with Spradley's interview sequence as shown in Table 1 below.

Table 1. *Instruments Grid*

Instrument	Domain	Indicators	Observation targets	Data source
Participatory observation sheet	Spatial planting patterns and spacing practices	Grid vs zig-zag; row or column alignment; spacing decisions; tolerance or quick checks; division of labour	Observe how rows are aligned; How spacing is marked; when body-based units versus rope or meter are used; Roles during marking/planting	Field sites; work sequences
Visual documentation protocol	Artefacts and embodied action	Measuring rope (tali ukur); suan/patok; stakes or markers; gestures or positioning	Photograph/describe tools and their use; Record when tools are used for calibration or straightness	Tools/artefacts in situ
Semi-structured interview guide (Spradley sequence)	Local units & meanings; decision rules	Meanings of Jengkal/Langkah/ RTD; conversion logic; when verification occurs; reasons for grid or zig-zag choice	How do you decide spacing? What does RTD mean in practice? When do you check with meter/rope?	Informants A-E

Interview yield aggregation system	Numerical system for harvest units	Definitions and conversions Pulir-Ikat-Kuda; bundling rules; market/transaction uses	How many pulir in one ikat? When do you calculate per kuda? Can it be converted to kg?	Informants A-E; post-harvest contexts
Interview seasonal knowledge	Phenological indicator and timing decisions	Kol Ulan clue; preparation triggers; reliability notions; timing window	What does Kol Ulan indicate? What actions follow when it appears?	Informants A-E; seasonal narratives

Data Analysis

Four DRS phases were used to analyse the data. Significant phrases and consistent semantic linkages were first found through domain analysis. The included terms were then compiled, each of which was backed up by quotes from interviews and verified by observational data. Second, to depict category relationships (types and subtypes), taxonomic analysis creates a hierarchical structure for every domain. Third, component analysis creates a component matrix that makes category separation easier by identifying parameters including accuracy level, metric conversion, agricultural stage, and practical aims. Fourth, thematic analysis synthesizes cross-domain patterns into cohesive cultural themes that explain the underlying logic of behaviours that include coordination, measurement, spatial organization, aggregation, and seasonal knowledge.

By returning summary interpretations to informants for confirmation and preserving the high standard of analytical judgments, data credibility is reinforced through informant verification (Birt et al., 2016). Method and source triangulation across observation, interviews, and artefacts was used to reduce single-source bias and enrich interpretive depth (Noble & Heale, 2019; Tlonaen & Deda, 2021). The study received permission from the Bitefa village leadership; participant anonymity was protected through coding, with participants informed of their right to withdraw. Visual documentation was collected and reported only with community consent and in non-identifiable form.

Observation of Traditional Farming in Bitefa Village

Based on observations of dryland farming activities in Bitefa Village, North Central Timor (TTU), East Nusa Tenggara, Indonesia, the people of Bitefa Village prepared their farmland from July to October by cutting down large trees with axes and clearing bushes with machetes. In early November, they began burning dry shrubs, leaves, and tree branches. From late November to December, they entered the planting season, using a grid planting pattern on flat land. For sloping land, they used a zig-zag spatial planting pattern. Farmers usually use the sound of the *Kol Ulan* bird as a sign that the rainy season or planting season has arrived. After the observation, interviews were conducted with five informants (coded

Informants A-E) in Bitefa Village to confirm data on land preparation, planting patterns, maintenance, harvest period, and post-harvest. The data from observations, documentation, and interviews were analysed based on Spradley's ethnographic approach sequence, namely domain analysis, taxonomic analysis, component analysis, and theme or cross-theme analysis (Amsikan et al., 2023; Deda et al., 2024; Deda & Disnawati, 2024; Uskono et al., 2023).

Domain Analysis

The focus of the analysis domain in dryland agricultural ethnomathematics in Bitefa village is the harvest units, namely *Pulir*, *Ikat*, and *Kuda*; planting distance units, namely *Jengkal*, *Langkah*, and *Rentang Tangan ke Dada* (RTD); spatial planting patterns, namely Grid/zig-zag; and the artefacts used, namely *Suan/Patok*; measuring rope; machete; and axe. Finally, the phenology (seasonal indicator) is the sound of the *Kol Ulan* bird.

Taxonomic Analysis

Table 2. *Taxonomic Analysis*

No	Cover terms	Category	Subcategory	Artefact
1	Unit of harvest	Smallest unit	*Pulir*	*Pulir* (smallest unit)
		Bundel unit	*Ikat* (≈ 12 Pulir)	1 Ikat ≈ 12 *Pulir*
		Agregate unit	*Kuda* (≈ 30 Ikat = 360 Pulir)	1 *Kuda* = 30 *Ikat*
2	Spatial planting patterns	Grid	x-axis and y-axis remain fixed	measuring rope as a reference
		zig-zag	even rows are shifted by ½ step	Zigzag so that the roots don't compete
3	Planting distance unit	Anthropometric	span	Hand-held
			span (~80 cm)	Step-based row spacing estimation
			RTD (arm-to-chest range)	Ergonomic guidelines for pulling ropes
4	Tools and techniques	Marking and measurement	measuring rope	Straighten the line
		Hole creation	*suan/patok*	Make planting holes according to the spacing
		Preparation/clearing of dry land	Machete	Clearing bushes
			Axe	Cutting branches/small wood when clearing land
		Binding/post-harvest	rope/tie/corn husk	Tying *Pulir* into *Ikat*
5	Fenologi	Biotic	the sound of the *Kol Ulan* bird	Pre-rain indicator
6	Work coordination	Deliberation	*Eka Hoek* (Discussion)	Setting schedules and role division
		Legitimation	*Sesaji*	Ritual gateway before work
		Collective workday	Hari kerja bersama	Shared labour allocation

Table 2 illustrates local knowledge in cultivation and post-harvest management, organized by unit, pattern, and natural indicators. Harvest units start from the smallest unit, the *Pulir*, then are bundled into *Ikat* containing approximately ±12 *Pulir*, and then aggregated into *Kuda*, which is ±30 ikat (equivalent to approximately 360 *Pulir*). In the spatial planting pattern, the community applies a grid with fixed x- and y-axes using a measuring tape as a reference for straightness, as well as a zig-zag pattern by shifting even rows by half the distance so that the roots do not compete for space and nutrients. Planting distance is determined using anthropometric units, namely hand spans, steps of approximately ±80 cm to estimate the distance between rows, and RTD (range of hand-to-chest) as an ergonomic reference when pulling the rope. The set of tools and techniques includes measuring tape for marking and straightening rows, stakes for forming planting holes according to the distance, machetes and axes for preparing and clearing dry land (clearing bushes and cutting small branches/wood), and then rope/ties/corn husks for tying the *Pulir* into bundles at the post-harvest stage. Finally, the phenological/biotic aspect is demonstrated through the interpretation of the *Kol Ulan* bird call as a natural indicator of the arrival of the pre-rainy season, which helps to determine the planting time contextually.

Component analysis

Table 3. *Component analysis*

No	Reference components	Precision	Body-based	Metric conversion	Stages	Objective
1	Finger width/step	Low-Medium	Yes	Yes (estimated to cm)	Early signs	Speed and uniformity
2	RTD (arm-chest span)	Medium	Yes	Yes (cm)	Marking/quick check	Ergonomics and efficiency
3	Measuring rope	Medium-High	No	N/A	Determination of sequences	Straightforward and consistent
4	Count the *Pulir-Ikat-Kuda*	High (quantity)	No	Yes (kg)	Harvest-post-harvest	Aggregation and transactions
5	Grid (rows and columns)	Height (positional accuracy)	No	N/A	Planting and maintenance	Ease of weed control and harvesting
6	Phenology (*Kol Ulan*)	Qualitative (indicative)	N/A	No	Pre-planting (timing)	Determining the planting time

Table 3 shows that each comparison component is selected according to the required precision, work stages, and practical objectives in the field. The span/step has low to medium precision because it is body-based, but it can still be converted approximately to cm, making it suitable for initial marking that emphasizes speed and uniformity. RTD (range of hand-chest) provides medium precision, is also body-based, and can be converted to cm, making it effective for marking and quick checks with the main objectives of ergonomics and efficiency during repetitive work. When more consistent straightness is needed, measuring tape is used because of its medium to high precision, is not dependent on the body, and is used in determining rows for straight and consistent results. In the harvesting and post-harvesting phases, the *Pulir-Ikat-Kuda* counting mechanism excels in quantity precision and can be converted to metric units (for example into kg) for aggregation and transactions. For planting space regularity, grids (rows-columns) offer high precision in position neatness and are applied to planting and maintenance, facilitating weed control and smoothing harvesting. Meanwhile, phenology (*Kol Ulan*) is qualitative-indicative, not body-based and not metric-convertible, but is very important in the pre-planting stage as a determinant of planting time based on biotic signs in Bitefa Village.

Thematic analysis

Cross-domain analysis (units of distance and yield, spatial patterns, artefacts, seasonal indicators, and work coordination) produced cultural themes that organize farmers' mathematical reasoning in practice. Rather than treating local units and patterns as isolated mathematics content, the themes show how farmers calibrate precision, share standards socially, and optimize planting layouts under ecological constraints.

Theme 1 Responsive and Operational Efficiency

Anthropometric units (*Jengkal, Langkah, RTD*) are widely used by farmers in Bitefa to effectively indicate planting distances. Precision is treated as *task-dependent*: farmers increase accuracy only when the situation demands it-such as when ensuring straight rows through a measurement rope, or when occasionally validating with metric tools. This logic is well captured by the theme's evidence: "*Kalau barisnya jauh, pakai langkah*…" (If the line is far away, take a few steps…) and "*Sesekali dicek dengan meter*…" (Check it once in a while with a meter…). One informant explained the pragmatic choice of body-based measurement for longer spacing needs: "*Kalau barisnya jauh, pakai langkah saja ukurannya*" (If the row spacing is far, we just measure it using steps).

Figure 1. *Tali ukur to create rows of corn plants*

In componential terms, this practice prioritizes speed and sufficient uniformity over maximal precision, which is rational given fieldwork constraints (time, terrain, and collective workflow). The presence of "*tali ukur*" (Figure 1) as a higher-precision artefact in the same system shows that local practice already contains a built-in mechanism for calibration when straightness and consistency matter: "*Pertama tali ukur ditarik, baru pakai Suan (Figure 2) untuk lubang.*" (First the rope is stretched, then we use the *suan* to make holes).

Figure 2. *Patok (Suan)*

Mathematically, Theme 1 corresponds to measurement with tolerance/error, significant rounding, and unit conversion-where "accuracy" is negotiated against feasibility. "they use *langkah/jengkal*," but they operate a culturally stable rule for when approximation is acceptable and when verification is required, which is a sophisticated form of situated quantitative reasoning.

Theme 2 The Body as a Shared Standard

Beyond being personal estimators, bodily units in Bitefa function as shared social standards that support coordination in team-based work. *RTD (rentang tangan ke dada)* is used as a quick ergonomic reference for marking points and tool-related measurement: "*RTD itu tangan ke dada, biar cepat tandai titik.*" (RTD is hand-to-chest distance so we can quickly mark points).

Farmers emphasized synchronized sequencing and role specialization, including women's involvement in hole-making and spacing: "*Mama-mama yang biasa ketika ukur jarak supaya sama... Ibu-ibu yang biasa buat tiga lubang kecil menggunakan Suan, sedangkan kaum laki-laki bagian tanam.*" (The women often make three tiny holes with wood while the men plant, measuring the spacing to ensure consistency).

Theme 2 shows that "measurement" has become established in workflow design: teams may assign tasks without periodically mediating numerical conversions due to a consistent unit standard (*jengkal/langkah/RTD*). An implicit algorithm for effective, repeated planting activities is suggested by the rope-and-*suan* method, which further demonstrates collaborative ergonomics. One person holds the rope while another marks or drills the locations.

Theme 2 helps students learn about proportional reasoning, anthropometry (size and body-based measurement), and algorithmic thinking (sequencing and coordination) in school mathematics maps. The crucial academic point is that bodily units are culturally standardized tools that are in line with the ergonomics and social organization of labour, not "informal substitutes" for metric measurement.

The importance of the body in measurement is emphasized in Themes 1 and 2. Anthropometric measurements, such as hand spans, steps, and hand-to-chest distance, function not just as individual estimators but also as practical standards that are negotiated and anchored by regular, shared equipment (like ropes) and cooperative workflows. This is in line with more general evidence that body-based units, which use embodied reference points while staying context-adaptive, are historically common and cognitively inexpensive. Cultural evolution research has demonstrated that body-based units persist among societies because they are useful, transferable, and good enough for a variety of purposes, particularly prior to and in conjunction with standardized instruments (Deda et al., 2024; Kaaronen et al., 2023).

These results align with the increasing focus on embodied cognition and the significance of gesture, action, and tangible artefacts in mathematical meaning-making from the standpoint of mathematics education. When instruction is responsive to students' embodied ideas, it has been demonstrated that embodied involvement in formal learning environments supports the development of mathematical perception and abstraction (Deda & Maifa, 2021; Flood et al., 2020).

In the Bitefa village context, the responsive teaching parallel is communal: farmers modify space and alignment repeatedly through collective adaptation, quick checks, and repetitive work. This shows that precision is not an absolute attribute but rather a function of goals including speed, uniformity, soil condition, and permissible error margins.

Theme 3 Spatial Optimization

Optimization under resource limits is reflected in the planting scheme that farmers choose. A straight grid (Figure 3), which is regarded for ease of maintenance, and a zigzag/offset layout, which is valued for lowering below-ground competition, particularly on sloped land, were the two main spatial designs that were noted and described.

Figure 3. *Straight grid*

A grid layout is preferred by farmers due to its effectiveness in weeding and its systematic flow through the rows: "The straight pattern makes it easier to clear weeds." The zigzag design, on the other hand, is thought to be an approach to lessen root competition: "If the pattern is zigzag, the roots do not compete with each other."

This illustrates a trade-off model where farmers choose a configuration that works with the terrain and slope characteristics of the land by balancing (a) operational convenience, such as maintenance access, and (b) ecological performance, such as root competition and planting distance. This arrangement can be represented mathematically as a grid structure, namely a square grid as opposed to an offset grid. Additionally, the choice to strike a balance between ecological performance and access needs to be formalized using density comparisons, distance factors, and qualitative optimization constraints.

Theme 3 highlights how mathematical optimization and modelling are principles found in dryland agricultural ethnomathematics. Resource issues, such as controlling root competition, increasing weeding effectiveness, and adjusting to slope conditions, are reflected in farmers' choices for grid or other layouts. Constraints, objectives, and workable solutions are discussed locally in these activities, which can be seen as a type of informal mathematical modelling. Recent modelling research indicates that modelling can endure marginalization and be maintained provided participants' cultural knowledge and life experiences are valued as legitimate tools for mathematics and action (Deda & Disnawati, 2024; Turner et al., 2024). These findings show that these resources are already available for communal activities like crop management, which are impacted by environmental limitations and the intergenerational work schedules of Bitefa farmers.

Theme 4 System of Yield Aggregation

A hierarchical system known as *Pulir-Ikat-Kuda* is used by farmers in Bitefa to efficiently calculate and package maize harvests both during and after harvest. 1 *kuda* ≈ 360 *pulir* is shown by the stable and socially accepted local conversion, "1 ikat ≈ 12 *pulir*" and "1 *kuda* = 30 *ikat*." For aggregation at different scales, this hierarchy of units provides a useful arithmetic foundation. This enables farmers to transition to community-level production estimates (annual aggregate) from small bundles (for seeds and packing) for everyday requirements. Local units and their numerical conversions are explained in Table 4 below.

Table 4. *Local units and numerical conversions*

Local unit	Local definition	Local numerical conversion
Pulir	Smallest unit (grain/small bundle)	1 *Pulir* = 1 unit (local)
Ikat	Packaging/quantity unit for seeds	1 *Ikat* = 12 *Pulir*
Kuda	Aggregate unit for harvest	1 *Kuda* = 30 *Ikat* = 30 × 12 *Pulir* = 360 *Pulir*

The informant's statement demonstrates economic functions and decision-making: "If the harvest is abundant, we calculate per horse to sell." This demonstrates that the unit system is a culturally appropriate accounting tool that facilitates market interactions and planning rather than just being descriptive.

Theme 4 has to do with ratios and proportions, factorization, multiplication reasoning, and estimate under variable conditions from the standpoint of mathematics education. It is possible to convert local units to metric units; for instance, weighing one bundle of maize using a typical dacing scale results in an average weight of 0.2–0.3 kg. These results make it possible for students to estimate the weight of one *Kuda* or one *Pulir* in class tasks.

Theme 4 presents the hierarchical aggregation method used to quantify agricultural yields. This method combines smaller units, such as the quantity of grains, into bigger, more useful units that make reporting, exchange, and storage easier (Banoet et al., 2022; Basuki et al., 2022). Because it deals with ideas like grouping, multiplication, and equivalency-all of which are essential to comprehending numbers and proportional reasoning-this is significant mathematically. It is crucial to remember that these local systems are not inferior to conventional measurements; rather, they are tailored for local needs, such as rapid estimation and mutual understanding among community groups.

Theme 5 Embedded Seasonal Knowledge

Local phenological signs, especially the sound of a bird called *Kol Ulan*, are used by farmers to determine when to plant. The phrase "The rain bird is called *Kol Ulan*... it means get ready for rain" and

"When *Kol Ulan* sings, prepare the seeds" serve as useful early warning signals for the onset of rain and planting preparedness.

Kol Ulan serves as a categorical predictor (present/absent; beginning/end) in local thinking that initiates preparatory behaviours, such as land preparation and seed readiness. Farmers efficiently use experience, which is based on repeated seasonal observations, as evidenced by their belief in the annual advent of the rainy season, which often occurs in November or December. Theme 5 is not limited to "farmers using bird calls," but rather as contextual forecasting logic: a heuristic managed by the community to reduce uncertainty and support the coordination of labour and resources under conditions of variable rainfall. In formal mathematical terms, this relates to time series reasoning at the beginner level (event recording), categorical data, the concept of accuracy (hit/false alarm/miss), and basic probability interpretation.

Theme 5 situates agricultural timing in a knowledge system that can be read as a qualitative forecasting model. Wildlife noises and phenological clues are examples of environmental signs that farmers utilize as categorical forecasts to help with planting preparation. Recent global work on local rainfall forecast knowledge shows that such community-based indicators are widely used in agricultural decision-making, especially where access to formal forecasts is limited, and that these knowledge systems encode locally relevant predictors and decision rules (Paparrizos et al., 2023).

In climate adaptation research, systematic mapping has also emphasized that indigenous/local knowledge is a substantial evidence domain but unevenly represented geographically and thematically, underlining the value of rigorous documentation of local predictive practices (Basuki et al., 2022; Petzold et al., 2020). Moreover, systematic reviews of Indigenous Knowledge (IK) and climate resilience highlight the importance of bridging IK with scientific knowledge through respectful, context-sensitive approaches (Dorji et al., 2024). These results support that bridging agenda by specifying the mathematizable structure of local prediction: classification of cues, implicit notions of reliability (hit/miss), and decision thresholds ("prepare seed when cue x appears").

Theme 6 Management and Social Recognition

In Bitefa, traditional dryland farming is regulated by social recognition and community management systems in addition to technical procedures. Prior to commencing major farming activities, farmers described a chicken-offering ritual (sesaji) as a social and symbolic "gateway" to action: "*Kita bunuh ayam… minta panen melimpah… jaga dari hama,*" (We butcher chickens to ensure a plentiful harvest and safeguard crops from pests), summarised in the field as "*Sesudah sesaji, baru mulai*…" (After the offering, we begin).

Beyond legitimation, coordination is structured through community deliberation and collective workdays (documented as meeting notes/notulen and "*hari kerja bersama*"), with the manuscript identifying *Eka Hoek* (community discussion) as a mechanism for arranging schedules and role division in communal labour. Even where the paper reports this briefly, it is analytically important: farming operations are executed under constraints (sequence dependencies and shared labour availability), not as isolated individual routines.

Eka Hoek (community discussion) serves as farming's scheduling layer, determining the order of operations and assigning duties before work begins. This reasoning follows a mathematical precedence structure. Let S = offering (*sesaji*), C = land clearing/burning, and T = planting, with the limitations $S \rightarrow C \rightarrow T$ (each must be completed before the next begins). To balance labour hours, the discussion assigns parallelizable subtasks (rope-holding, hole-making, and planting) to available workers. *Eka Hoek*, shown as a dependency graph with precedence constraints and a labour-balancing target, maps directly onto simple scheduling (for example, construct a daily plan that prioritizes *sesaji* and balances team labour), making explicit the link between the social ritual and its underlying mathematical scheduling logic.

The concept of ethnomathematics of measurement is demonstrated in Theme 6, which is incorporated into constraint-based planning through ceremonial preliminaries such as planting, land clearing, offerings, and agreed working days, establishing a priority relationship similar to scheduling issues. This provides a novel and defensible mapping to mathematics education via dependency graphs, precedence constraints, and elementary scheduling/optimization tasks that remain culturally faithful (for example: designing a work plan that satisfies "*sesaji* first" and balances team labour hours).

Theme 6 also foregrounds the social dimension: rituals and collective scheduling operate as coordination mechanisms that reduce uncertainty, align labour availability, and legitimize timing decisions. This extends ethnomathematics from "embedded concepts" to embedded governance of action, decision-making constrained by social rules and shared commitments. In particular, the research findings are consistent with current recommendations for decolonizing mathematics education: curricula might acknowledge community knowledge systems as pedagogically effective and epistemically acceptable instead of importing a limited tradition of what constitutes mathematics (Gadong, 2025). In order to empower students from ethnic groups, it also promotes ethnomodelling ideas that view mathematics education as a collaborative process combining academic mathematics and cultural knowledge (Rosa & Orey, 2024).

When taken as a whole, the six themes immediately address the third study question: every locally entrenched activity retains its cultural significance while mapping onto a distinct curriculum strand. This mapping is made clear in Table 5.

Table 5. *Mapping cultural themes to mathematical ideas, curriculum strands, and classroom tasks*

Theme	Integrated Mathematical Concept	Strand of Curriculum	Classroom Entry Point
Adaptive precision	Measurement with tolerance; rounding; unit conversion	Measurement and estimation	Compare jengkal/langkah with metric; discuss acceptable error
Body as shared standard	Proportional reasoning; anthropometry; sequencing	Ratio and algorithmic thinking	Calibrate RTD in cm; describe the rope-and-suan algorithm
Spatial optimization	Square vs offset grids; distance; density	Geometry and optimization	Compute nearest-neighbour distance in grid versus zig-zag
Yield aggregation	Grouping; multiplication; equivalence	Number and proportion	Convert Pulir–Ikat–Kuda to kg; estimate harvest
Seasonal knowledge	Categorical data; reliability (hit/miss); probability	Data and uncertainty	Tabulate Kol Ulan cue vs rain over years
Social scheduling	Precedence constraints; dependency graphs	Discrete math / modelling	Plan workdays under "sesaji-first" rule

Table 5's mappings demonstrate that the contribution to culturally contextualized mathematics education is a collection of particular, mathematizable activities based on Bitefa practice rather than a general exhortation to use culture. Documenting the units, conversions, and decision rules in a teachable format helps preserve local knowledge by passing them on to a generation that is becoming more and more removed from dryland farming. This preserves cultural continuity while boosting mathematics literacy (Deda & Disnawati, 2024; Rosa & Orey, 2024).

Key Results

The research above explains how Bitefa's traditional dryland farmers apply sophisticated mathematical knowledge to their day-to-day farming activities. Across six themes, farmers' practices demonstrate a coherent system of (i) functional sufficiency and adaptive precision through anthropometric units and tolerance-based measurement; (ii) the body as a shared standard that supports coordination and ergonomic efficiency; (iii) spatial optimization in planting layouts to manage competition for resources; (iv) hierarchical quantification of yield through culturally meaningful aggregation units; (v) embedded seasonal knowledge as a qualitative predictive model for timing decisions; and (vi) social legitimation and collective scheduling that coordinates labour and reduces uncertainty in communal work.

Rather than treating these practices as informal approximations, these findings position them as situated mathematical systems that balance accuracy, efficiency, and social coordination under constraints typical of dryland farming (limited water, uneven terrain, labour availability, and risk). The mathematical character of these systems becomes visible when we interpret practices as involving tolerance, unitizing, optimization, classification, and decision-making under uncertainty, core ideas that align with contemporary views of mathematical activity as culturally and materially mediated.

Research Implications and Limitations

The findings suggest three practical pathways for curriculum development and teacher education. First, using units that are familiar to the culture, measuring instruction might specifically include error and tolerance. Teachers can begin with anthropometric measures and ropes as genuine “first models,” then help students analyse differences, talk about acceptable error margins, and formalize measurement as a trade-off between precision and purpose, rather than presenting measurement only as accurate with standard equipment. The units measurement approach is in line with current research on body-based, culturally situated measuring in schools, where instructional designs use regional measurement traditions to create conceptual connections with formal measurement systems (Deda & Amsikan, 2019; Fyhn et al., 2024).

Second, ethnomathematical modelling tasks can be designed from Theme 3 and Theme 6. For example, students can be asked to propose planting layouts under constraints (slope, water limits, labour time) and justify decisions using representations (grids, tables, simple optimization criteria). Such tasks are not only mathematically rich (geometry, ratio, optimization), but also equity-oriented when they position community practice as a legitimate knowledge base and a site for mathematizing (Rosa & Orey, 2024; Turner et al., 2024).

Third, Theme 5 deals with the ideas of climate literacy, uncertainty, and ethnomathematics data. Teachers can invite students to document events over time, relate local environmental indications as "variables," and compare rainfall data with local projections. This supports calls to integrate local knowledge (IK) with scientific knowledge in climate adaptation and resilience (Dorji et al., 2024; Petzold et al., 2020) and makes it easier to discuss categorical predictions, conditional reasoning, and basic measures of accuracy. It also highlights the importance of local forecasting knowledge documented in global studies (Paparrizos et al., 2023)

Through this ethnomathematics approach, teachers should promote mathematics learning that is both practically and cognitively responsive, namely by utilising community practices as teaching aids in mathematics. Research findings on culturally responsive mathematics learning indicate that equity-oriented learning is further enhanced when everyday knowledge is used as the foundation for mathematics learning (Abdulrahim & Orosco, 2020).

The objective of this initiative promotes the preservation of local knowledge as a local cultural resource by investigating and writing down the units, patterns, values, and coordination mechanisms that regulate them. Through the representation of mathematics education, the integration of dryland farming techniques into the educational system seeks to maintain cultural continuity and improve mathematical literacy (Deda et al., 2026; Deda & Disnawati, 2024).

Regarding abstract mathematics to dryland farming practices and integrating concepts of arithmetic, measurement, geometry, ratios, modular arithmetic, and functions in real-world tasks like land measurement, planting distance, profit sharing, water control, and seasonal forecasting are the pedagogical implications of teaching mathematics in the classroom (Padang & Lubis, 2023; Pathuddin et al., 2023). Moreover, farmers' use of calculation, measurement, and timing practices validates rural and indigenous knowledge systems and strengthens cultural identity (Padang & Lubis, 2023; Pathuddin et al., 2023; Suharna et al., 2024). Finally, seeing mathematics in familiar farming tools and activities can increase interest and perseverance in learning (Padang & Lubis, 2023).

We offer two assignments that are directly derived from the documented procedures in order to make the implications concrete. Task A: Estimating and converting units (Theme 4). Five *Kuda* and ten Ikat of maize are harvested by a farmer. (i) Use *Pulir* to express the total. (ii) Calculate the harvest as a weight range in kilograms, considering that a single *Pulir* weighs between 0.2 and 0.3 kg. (iii) Calculate the income range if corn sells for Rp 5,000 per kilogram. Solution Task A: 5 × 360 + 10 × 12 = 1,800 + 120 = 1,920 *Pulir*; revenue ≈ Rp 1.920.000–2.880.000; weight ≈ 1,920 × 0.2 to 1,920 × 0.3 = 384–576 kg. The exercise teaches estimating under uncertainty and multiplicative reasoning.

Task B: Zigzag pattern geometry (Theme 3) comes next. Both the row and in-row plant spacing are roughly 80 cm. Every second row in the zigzag pattern is moved half a step (40 cm) sideways. Determine the distance between a plant and the closest plant in the shifted neighboring row using the Pythagorean theorem, then compare it to the 80 cm distance in a straight grid. *Task B's solution is distance* $= \sqrt{40^2 + 80^2} = \sqrt{8000} \approx 89.4\ cm > 80\ cm$. Farmers' claims that the roots do not compete are explained quantitatively and culturally by the offset, which raises the nearest-neighbor distance by about 12%.

The research only explored ethnomathematics practices in dryland farming in the village of Bitefa on Timor Island, specifically corn farming. In addition, it did not explore and compare dryland farming ethnomathematics in other regions or islands in NTT. Therefore, further research, such as the development of dryland farming-based teaching materials for students in TTU, is still needed.

Conclusion

Spradley's DRS analysis of this ethnographic study provides answers to its three research questions. First, land preparation, spatial planting layout, anthropometric spacing, hierarchical harvest aggregation, phenological timing, and ritual-based task coordination are the types of dryland corn-farming practices at TTU that contain ethnomathematical features. Second, the local system consists of two spatial patterns (grid and zigzag), a hierarchical yield system (*Pulir–Ikat–Kuda*, where 1 *Kuda* = 30 *Ikat* = 360 *Pulir*), anthropometric distance units (*jengkal*, *langkah*, *RTD*), and a categorical seasonal predictor (*Kol Ulan*). These components work in tandem and are precisely calibrated to each stage of farming. Third, by mapping onto measurement-with-tolerance, proportional reasoning, geometric optimization, probabilistic reasoning, and rudimentary scheduling, these practices offer classroom activities that are culturally appropriate and a record that helps preserve local knowledge.

Acknowledgement

We would like to thank the Institute for Research and Community Service (LPPM), University of Timor for funding this research based on contract number 087/UN60.6/PP/2025. We would also like to thank the Head of Bitefa Village, Mr. Donisius Uskono, for his support as a field contributor, as well as all informants in Bitefa Village.

References

Abdulrahim, N. A., & Orosco, M. J. (2020). Culturally Responsive Mathematics Teaching: A Research Synthesis. *Urban Review*, *52*(1), 1–25. https://doi.org/10.1007/s11256-019-00509-2

Amsikan, S., & Deda, Y. N. (2018). Memanfaatkan Potensi Lokal Kefamenanu dalam Pembelajaran Matematika Untuk Meningkatkan Kreativitas Guru SMP. *Bakti Cendana*, *1*(1), 32–40. https://doi.org/10.32938/bc.v1i1.17

Amsikan, S., Deda, Y. N., & Sintia, A. (2023). Ethnomathematics exploration of Kaneka and Mariam tradional games in Nangapanda, Nusa Tenggara Timur culture. *Journal of Honai Math*, *6*(2), 88–98. https:/doi.org/10.30862/jhm.v6i2.434

Banoet, M. R., Dominikus, W. S., & Nenohai, J. M. H. (2022). Etnomatematika dalam Aktivitas Berladang Masyarakat di Kecamatan Tobu. *Fraktal: Jurnal Matematika Dan Pendidikan Matematika*, *3*(2), 43–51. https://doi.org/10.35508/fractal.v3i2.7297

Basuki, T., Hau, D. K., Nulik, J., Hosang, E. Y., deRosari, B., & Ngongo, Y. (2022). The Existence of Farming Types in Dryland Agriculture in Timor, Indonesia. *Proceedings of the 9th International Seminar on Tropical Animal Production (ISTAP 2021)*, *18*(Istap 2021), 301–307. https://doi.org/10.2991/absr.k.220207.063

Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member Checking: A Tool to Enhance Trustworthiness or Merely a Nod to Validation? In *Qualitative Health Research* (Vol. 26, Issue 13). https://doi.org/10.1177/1049732316654870

Bishop, A. (1998). Mathematical enculturation. A cultural perspective on mathematics education. In *Kluwer Academic Publishers*. Kluwer Academic Publishers. https://doi.org/10.1007/978-94-009-2657-8

D’Ambrosio, U. (1985). Ethnomathematics and Its Place in the History and Pedagogy of Mathematics. *For the Learning of Mathematics*, *5*(February 1985), 44-48 (in 'Classics'). https://doi.org/https://www.jstor.org/stable/40247876

D’Ambrosio, U. (2020). Ethnomathematics: past and future. *Revemop*, *2*.

https://doi.org/10.33532/revemop.e202002

Deda, Y. N., & Amsikan, S. (2019). Geometry Concept on the Motifs of Woven Fabric in Kefamenanu Community. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *4*(1), 23–30. https://doi.org/10.23917/jramathedu.v4i1.6253

Deda, Y. N., Amsikan, S., & Son, A. L. (2026). Integrating traditional games into digital worksheets to enhance numeracy skills of students in border area. *Multidisciplinary Science Journal*, *8*(6), 1–13. https://doi.org/10.31893/multiscience.2026365

Deda, Y. N., & Disnawati, H. (2024). Ethnomathematical investigation of traditional games for cultural preservation in the Indonesia-Timor Leste border region. *Journal of Honai Math*, *7*(1), 19–36. https://doi.org/10.30862/jhm.v7i1.512

Deda, Y. N., & Maifa, T. (2021). Development of Student Worksheets Using the Context of Local Wisdom on Integers and Fractions. *Jurnal Pendidikan Matematika*, *15*(1), 71–82. https://doi.org/10.22342/jpm.15.1.12824.71-82

Deda, Y. N., Rosa, M., Disnawati, H., & Tamur, M. (2024). Ethnomathematical perspectives on Galah Asin: Investigating the mathematical and cultural significance of a traditional game. *Jurnal Elemen*, *10*(3), 516–532. https://doi.org/10.29408/jel.v10i3.25467

Dorji, T., Rinchen, K., Morrison-Saunders, A., Blake, D., Banham, V., & Pelden, S. (2024). Understanding How Indigenous Knowledge Contributes to Climate Change Adaptation and Resilience: A Systematic Literature Review. *Environmental Management*, *74*(6), 1101–1123. https://doi.org/10.1007/s00267-024-02032-x

Flood, V. J., Shvarts, A., & Abrahamson, D. (2020). Teaching with embodied learning technologies for mathematics: responsive teaching for embodied learning. *ZDM*, *52*(7), 1307–1331. https://doi.org/10.1007/s11858-020-01165-7

Fyhn, A. B., Somby, D. N., & Karlsen, A. H. (2024). Sámi Body-Based Measuring in the Mathematics Classroom—The Development of a Model for Teaching. *Education Sciences*, *14*(12). https://doi.org/10.3390/educsci14121398

Gadong, E. S. A. (2025). Decolonizing mathematics education in the Philippines using ethnomathematics for curriculum critique and pedagogical renewal. *Mathematics Education Research Journal*, *13*(1), 104–116. https://doi.org/10.1007/s13394-025-00548-x

Guest, G., Namey, E., & Chen, M. (2020). A simple method to assess and report thematic saturation in qualitative research. *PLoS ONE*, *15*(5), 1–17. https://doi.org/10.1371/journal.pone.0232076

Hennink, M. M., Kaiser, B. N., & Marconi, V. C. (2017). Code Saturation Versus Meaning Saturation: How Many Interviews Are Enough? *Qualitative Health Research*, *27*(4), 591–608. https://doi.org/10.1177/1049732316665344

Hidayati, F. N., & Prahmana, R. C. I. (2022). Ethnomathematics' Research in Indonesia during 2015-2020. *Ethnomathematics' Research in Indonesia*, *1*(1), 29–42. https://doi.org/10.48135/ije.v1i1.29-42

Irawan, A., Kencanawaty, G., & Febriyanti, C. (2018). Realistic mathematics and ethnomathematics in improving problem solving abilities. *Journal of Physics: Conference Series*, *1114*(1). https://doi.org/10.1088/1742-6596/1114/1/012108

Kaaronen, R. O., Manninen, M. A., & Eronen, J. T. (2023). Body-based units of measure in cultural evolution. *Science*, *380*(6648), 948–954. https://doi.org/10.1126/science.adf1936

Lee, J. S., Nargund-Joshi, V., & Dennis, B. (2011). Progressing through the Haze in Science and Mathematics Education Research: Contemporary Use of Spradley's Qualitative Inquiry in Two Case Studies. *International Journal of Qualitative Methods* , *10*(1). https://doi.org/10.1177/160940691101000104

Noble, H., & Heale, R. (2019). Triangulation in research, with examples. *Evidence Based Nursing*, *22*(3), 67–68. https://doi.org/10.1136/ebnurs-2019-103145

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, *16*(1), 1–13. https://doi.org/10.1177/1609406917733847

Padang, D. S., & Lubis, M. S. (2023). Ethnomathematical Exploration of Traditional Agricultural Tools in Hutamanik Village, Sumbul Regency. *Indonesian Journal of Science and Mathematics Education*, *6*(2), 137–151. https://doi.org/10.24042/ijsme.v6i2.17003

Paparrizos, S., Attoh, E. M. N. A. N., Sutanto, S. J., Snoeren, N., & Ludwig, F. (2023). Local rainfall forecast knowledge across the globe used for agricultural decision-making. *Science of the Total Environment*, *899*(November 2022), 165539. https://doi.org/10.1016/j.scitotenv.2023.165539

Pathuddin, H., Kamariah, & Mariani, A. (2023). Ethnomathematics of Pananrang: A guidance of traditional farming system of the Buginese community. *Journal on Mathematics Education*, *14*(2), 205–224. https://doi.org/10.22342/jme.v14i2.pp205-224

Petzold, J., Andrews, N., Ford, J. D., Hedemann, C., & Postigo, J. C. (2020). Indigenous knowledge on climate change adaptation: A global evidence map of academic literature. *Environmental Research Letters*, *15*(11). https://doi.org/10.1088/1748-9326/abb330

Rosa, M., & Orey, D. C. (2024). Exploring cultural dynamism of ethnomodelling as a pedagogical action for students from minority cultural groups. *ZDM – Mathematics Education*, *56*(3), 423–434. https://doi.org/10.1007/s11858-023-01539-7

Stewart, B. A., & Thapa, S. (2017). Dryland farming: Concept, origin and brief history. In *Innovations in Dryland Agriculture*. https://doi.org/10.1007/978-3-319-47928-6_1

Suharna, H., Ishak, H., Waliyanti, I. K., & Hasyim, R. (2024). The Ethnomathematics in Farming Activities on Halmahera Island , Waidamo Village , East Sahu District. *International Journal of Social Science and Education Research Studies*, *04*(10), 1134–1138. https://doi.org/10.55677/ijssers/V04I10Y2024-05

Tlonaen, M. A., & Deda, Y. N. (2021). Exploration Ethnomathematics on Traditional House Ume Kbubu in North Central Timor Districts. *Journal of Physics: Conference Series*, *1776*(1). https://doi.org/10.1088/1742-6596/1776/1/012016

Todd, O. E., Creech, C. F., Kumar, V., Mahood, A., & Peirce, E. (2024). Future Outlook of Dryland Crop Production Systems in the Semi-Arid High Plains Amid Climate Change. *Outlooks on Pest Management*, *35*(1), 4–10. https://doi.org/10.1564/v35_feb_02

Turner, E., Aguirre, J., Carlson, M. A., Suh, J., & Fulton, E. (2024). Resisting marginalization with culturally responsive mathematical modeling in elementary classrooms. *ZDM – Mathematics Education*, *56*(3), 363–377. https://doi.org/10.1007/s11858-023-01542-y

Umbara, U., Wahyudin, & Prabawanto, S. (2021). Symbolic measuring: An exploration of ethnomathematics based on people's daily communication. *Journal of Physics: Conference Series*, *1806*(1). https://doi.org/10.1088/1742-6596/1806/1/012075

Uskono, D., Deda, Y. N., & Amsikan, S. (2023). Exploration of ethnomathematics in the traditional game of kaneker in Bitefa Village [In Bahasa]. *Primatika : Jurnal Pendidikan Matematika*, *12*(1), 19–30. https://doi.org/10.30872/primatika.v12i1.1312