American Journal of Environment and Climate (AJEC)

ISSN: 2832-403X (ONLINE)

VOLUME 4 ISSUE 2 (2025)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

American Journal of Environment and Climate (AJEC)

Volume 4 Issue 2, Year 2025
ISSN: 2832-403X (Online)
DOI: https://doi.org/10.54536/ajec.v4i2.4681
https://journals.e-palli.com/home/index.php/ajec

Farmers' Perception of the Current Farming Practices on Agricultural Ecological Risk in Loes Watershed, Timor-Leste

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Article Information

Received: March 05, 2025
Accepted: April 11, 2025
Published: June 25, 2025

Keywords

Conservation, Ecological-Risk, Farmer Perception, Local Customary, Policy

ABSTRACT

Timor-Leste has been experiencing a decline in suitable land for agriculture over the years. Yet, slash-and-burn, shifting cultivation, and farmers steadily practice open grazing in the country. In the Loes watershed, slash and burn, shifting cultivation, and open grazing are expanded, although there have been stated in various studies that the practices seem to the stressors of the agricultural ecological risk to crop and livestock production failure. However, none of these studies explored the perception of farmers on agroecological risk that related to their farming practices. Therefore, the study aimed to determine farmers' perception of the agricultural ecological risk related to farming practices in Loes watershed. A questionnaire survey was used to interview 243 household farmers out of 2,878 households in 10 villages. Three focus group discussions (FGD) were conducted in the municipalities of Bobonaro, Ermera, and Liquiça on the perception related to soil fertility, erosion, crop, and grassland production, conservation policies and laws awareness include its advantages to their life. The result of the study illustrated that 75% of interviewed farmers stated no risk to crop and livestock production related to soil fertility, erosion, and crop production failure. In addition, 82% mentioned not being aware of the conservation and agriculture-related policies and laws, however, 80% of them perceived customary law "Tara-Bandu" has a strong influence on their farming practices. Moreover, 36% were willing to be advised on conservation but 17% insisted to continue using their current practices. Only 20% acknowledged the advantages of agriculture and conservation-related policies and laws. Furthermore, adopting introduced conservation practices was very low ranging from 0.4% to 21.8% for various innovations and technologies. It concluded farmers perceived crop and livestock production decline are not caused by their poor practices, but instead considered as a natural process. In addition, policies and laws are considered new colonization by them due to their formulations ignoring their customary laws and traditional beliefs, thus perceiving low agroecological risk in the Loes watershed. Thus, this study recommends to promote the Sloping Agricultural Land Technology (SALT), Conservation Agriculture (CA) with no burn, minimum tillage, and integrating cover crops in farm management. In addition, integrating local wisdom into innovation promotion and agriculture-related policy formulations by promoting Customary Law (Tara-Bandu) which is the local community is the initiator of having rules and regulations to farm.

INTRODUCTION

According to Timor-Leste's National Action Program to combat land degradation (NAP, 2008), poor farming practices in Timor-Leste have been causing food insecurity, declining food production and productivity, significant grassland degradation, and other environmental problems such as erosion, landslide, and flooding. As a consequence, decline number of households engaged in agriculture was 90% in 2015 decreased to 66% in 2019 (Census, 2015; TLAC, 2019).

Poor land utilization such as slash and burn, shifting cultivation, and open grazing are predominantly practiced in Timor-Leste. These farming practices seem to contribute to soil degradation, indicated by having low soil nutrients for crops, high runoff, and on-farm erosion. This in turn leads to low crop production and productivity, a high potential for a failed harvest, and food insecurity. The Census data in 2015 indicated that crop production by households with less than 1 hectare is 56.3 % and increased to 65.4% in 2019.

Loes watershed is one of the critical watersheds due to the following conditions: the decline of river water flow, high erosion, landslide, a decrease of land cover, and high deforestation as declared by the Ministry of Agriculture and Fisheries Timor-Leste (MAF, 2007; Soares *et al.*, 2011). Although the watershed has been declared to be in critical condition, there are protected areas and important bird areas inside the watershed. The protected areas found in the watershed are Guguleur Mountain (≈ 13,159 ha), Loelaku Mountain (≈ 4700 ha), and Tapo Saburai Mountain (≈ 5000 ha). The watershed is also well known as the dwelling of important biodiversity. About 28 hectares is defined as the Important Birds' Area (IBA) at Lake Bemalae. Yet the farming practices, such as slash-and-burn, shifting cultivation, open grazing, and uncontrolled forest and grass fire, are predominant in the area including the entire country (NBSAP, 2011; NAP, 2008; MITLTW, 2020).

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Due to the increase in population growth and demand for land, nowadays the shifting cultivation period becomes short with only a 2 to 3-year period before, until a 10 to 12 year-period (Jeus *et al.*, 2012). The effect is that the available communal land in Timor-Leste used by the community for farming and raising livestock decreased from 9.7 % in 2015 to 2 % in 2019. With the decrease in land availability, only 29 % of households have 2 to 3 parcels of farmland, while 66 % have 1 parcel of farmland (Census, 2015; TLAC, 2019).

Raising livestock increased over time in Timor-Leste with 87.2 % of households raising livestock in 2015 and increased to 95 % in 2019. (Census, 2015; TLAC, 2019). Farmers are mostly using open grazing and herders are using fire in grassland areas. In the dry season, when grasses dry up, herdsmen tend to use fire to allow new grass to grow to feed their livestock. In addition, herders leave livestock on grassland for unlimited time; the monitoring and controlling will only be done once or twice a month. The shifting grazing is only applied when the grassland has no more grass for livestock.

The practices mentioned here are highlighted by many scholars that the practices are causing poor soil health which is damaging essential roles of soil for crop production, grassland conservation, and food security (Fachin & Thomaz, 2023; Sandi *et al.*, 2023; Dacosta *et al.*, 2022). Thus, the current farming practices are considered as the stressors of risk to agriculture ecology. However, the perceptions of farmers on the agricultural ecological risk due to their farming practices in Loes watershed have not been studied yet. Therefore, this study aims to investigate socioeconomic factors and the perception of farmers to the ecological risk of agriculture.

Conceptual Framework

The conceptual framework used in this study was based on the principles of agricultural practices that are influenced by the socioeconomic, political, and cultural of farmers which determine perceptions of agroecological risks (Figure 1).

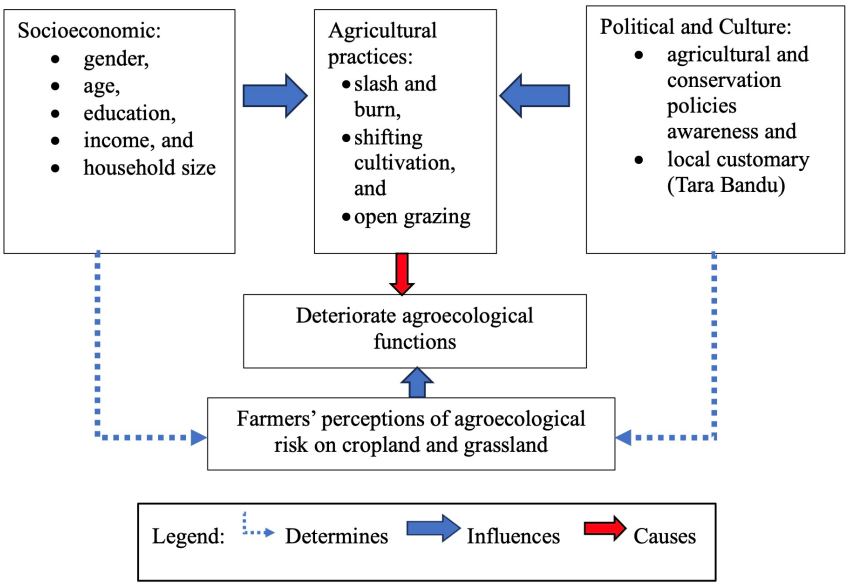


Figure 1: The conceptual framework of the study
Source: By the author

The concept of agroecology as defined by FAO is an integrated approach that applies ecological and social concepts and principles to the design and management of food and agricultural systems (FAO, 2018). The principles refer to the influences of the knowledge, age, gender, income, and household size of farmers to what type of agricultural practices are to be done. The agricultural practices are also influenced by political and cultural factors such as policy awareness, and the existence of local customs. Both socioeconomic and political factors determine how a farmer views the importance of agroecology. Lack of knowledge and low income might less awareness of the agroecosystem services and lead to more deterioration rather than conservation. Other influences are policy and law awareness, farmers with low or no awareness might not be interested in the what are the consequences of deteriorating the agroecosystem. Nevertheless, policy and law awareness are also influenced by the contexts of policy and law formulation. Considering local customs in policy or law might have a positive influence on farmers.

MATERIALS AND METHODS

Study Area

The study was conducted in the municipalities of Bobonaro, Ermera, and Liquiça within Loes watershed area, Timor-Leste. Loes watershed is a cross-boundary watershed of Timor-Leste and Indonesia. It lies between 9° 12' 49.78" to the 8° 44' 5.09" South latitude to 125° 1' 42.50" to the 125° 6' 19.82" East longitude. It covers

180,634 hectares which is equivalent to 72 % of the watershed size and 28 % of the watershed area (Talau) which is part of Indonesian's jurisdiction. Loes watershed is sustained by three tributaries, or river flows, namely, Lauveli River, Marobo River, and Nunura River (MITLTW, 2020; ADB, 2011). The elevation is approximately 2000 meters above sea level (masl) with a slightly steep to steep slope. It covers three protected areas: Guguleur Mountain (≈ 13,159 ha) Loelaku Mountain (≈ 4700 ha), and Tapo Saburai Mountain (≈ 5000 ha). The area is also well known as the dwelling of important biodiversity; about 28 ha is defined as the Important Birds Area at Lake of Bemalae (NBSAP 2011; NAP, 2008; MITLTW, 2020). In terms of a climeta, the area has two seasons: dry and rainy seasons. The dry season starts from June until November, while the rainy season starts from November until May. The average annual rainfall is 1600 mm. per year with the high annual evaporation at approximately 1800 mm. per year (NAP, 2008). The average temperature is 23 °C with the minimum temperature at approximately 20 °C and maximum temperature reaching 30 °C (World Bank, Climate Change Knowledge Portal).

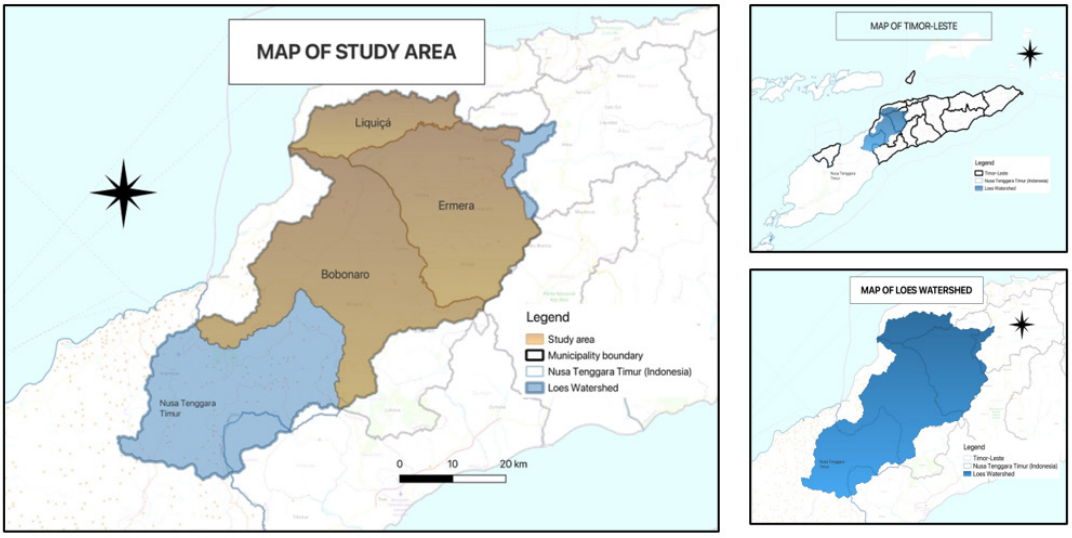


Figure 2: Map of study area

Sampling, data collection, and analysis

The study used a quantitative approach through interviews and using simple random sampling techniques. Two hundred forty-three farmers' households out of two thousand eight hundred and eighty-seven of total farmers' households from 10 villages in three municipalities: Ermera, Liquiça, and Bobonaro were interviewed. Data were collected by visiting farmers' households and asking questions on socioeconomic characteristics, main crop and livestock production, and their perception of agricultural ecological risk that refers to the relationships of soil health and grassland conditions to their farming practices. In addition, the questionnaire also included the awareness of conservation and agriculture-related policies and laws in Timor-Leste. In addition, three focus group discussions (FGD) were moreover in the municipalities of Bobonaro, Ermera, and Liquiça with the farmers who reside in the watershed area and have been experiencing farming for a long time. The thematic analysis was used to analyze the FGD data. To ensure the validity and reliability of the FDG, the participants were consisting of farmer, agriculture extension officers, local leader, farmer group representatives.

The interviewers were trained on how to interview the farmers before being deployed to the field. In addition, the interviewers must fluent in the local language to smooth the communications. The questionnaires were prepared in the national language (Tetum) but the interviewees delivered them in local languages (Mambae in Emrera municipality, Bunak and Kemak in Bobonaro municipality, and Tokodede and Mambae in Liquiça municipality).

Data obtained from the interview was analyzed by using descriptive statistics. The statistical package for the social sciences (SPSS) application was used to perform the analysis.

RESULTS AND DISCUSSION

The result and discussion of the study are presented in two sections. Section one is about the socioeconomic and demography of the farmers and section two on the farmer's perception of the agricultural ecological risk.

Socioeconomic and demographic of farmers

The interview was done with 243 farmers from three municipalities such as Bobonaro, Ermera, and Liquica who have been practicing a different type of farming within Loes watershed. All of the interviewed farmers are household heads.

Table 1: Socioeconomic and demographic

Variable	Municipality					
	Bobonaro	Ermera	Liquiça			
	n	%	n	%	n	%
Gender						
Male	73	94.8	22	28.9	21	28
Female	4	5.2	54	71.1	54	72
Total	77	100	76	100	75	100
Age						
20-39	53	43.5	34	44.8	21	46.7
40-59	40	32.8	35	46.1	20	44.4
>60	29	23.8	7	9.2	4	8.9
Total	122	100	76	100	45	100
Education attainment						
No Schooling	67	54.9	43	56.6	5	11.1
Elementary School	18	14.8	8	10.5	10	22.2
Junior high school	14	11.5	9	11.8	15	33.3
Senior high school	20	16.4	13	17.1	13	28.9
College	3	2.5	3	3.9	2	4.4
Total	122	100	76	100	45	100
Source of income						
Crops (%)						
<50	26	21.31	24	32.4	9	20
50 - 74.9	77	63.11	30	40.5	17	37.8
75-100	19	15.57	20	27	19	42.2
Total	122	100	74	100	45	100
Livestock (%)						
<50	42	34.43	22	28.95	24	53.33
50 - 74.9	72	59.02	38	50	18	40
75-100	8	6.56	16	21.05	3	6.67
Total	122	100	76	100	45	100
Other (%)						
<50	113	92.62	76	100	42	93.33
50 - 74.9	5	4.1	0	0	1	2.22
75-100	4	3.28	0	0	2	4.44
Total	122	100	76	100	45	100
Monthly income (USD)						
10 - 100	99	81.15	52	68.42	30	66.67
101 - 200	17	13.93	23	30.26	14	31.11
201- 300	5	4.1	1	1.32	0	0
> 300	1	0.82	0	0	1	2.22
Total	122	100	76	100	45	100
Household size						
2- 4	38	31.1	33	43.4	6	13.3
5 - 7	59	48.4	26	34.2	22	48.9
8 - 10	21	17.2	17	22.4	14	31.1
> 10	4	3.3	0	0	3	6.7
Total	122	100	76	100	45	100

Respondents in Bobonaro municipality are 94.8 % males and 5.2 % females, in Ermera and Liquiça municipalities 28.9 % males, 71.1 % females and 28 % males and 72 % females respectively. The gender distribution in these three municipalities as household agricultural holding is somewhat similar to the national data of gender household agricultural holding which is 15 % female and 85 % male in the entire country (TLAC, 2019) which is influenced by patriarchal culture.

Respondents age was grouped into three: 20-39, 40-59, and above 60. In Bobonaro municipality, respondents aged 20-39 years old were the biggest group (43.5 %), followed by the age of 40-49 years old (32.8 %), and above 60 years old (23.8 %). However, Ermera municipality has a different dominant age group. The age group of 40-59 years old is the dominant group (46.1 %) followed by a group of 20-39 years old (44.8 %), and lastly the group of age above 60 years old was 9.2 %. In Liquiça, the group of 20-39 is dominant (46.7 %) followed by the group aged 40-59 years old (44.4 %), and the group above 60 years old was only 8.9 %. The age group of farmers in Loes watershed indicates the declining interest of youth to be a farmer. This situation is close to a report from Thu (2022) stated in Timor-Leste, about 92 % of farmers do not want their generation to be a farmer. Moreover, most of the heads of agriculture are above 40 years old (Oxfam Australia, 2022).

Education group was made based on the education level established in Timor-Leste; No schooling group is referred to never attending formal or informal school, elementary school is referred to 1-6 years schooling, Junior high school is referred to 7-9 years schooling, senior high school is referred to 10-12 years schooling, college is referred to graduate of Bachelor degree from institutions or universities. Data indicates no schooling group is dominant in Bobonaro and Ermera municipalities (54.9 % and 56.6 %) respectively, but in Liquiça municipality, farmers mostly graduated from Junior high school (33.3 %). In Bobonaro municipality, elementary school is 14.8 %, junior high school is 11.5 %, senior high school is 16.4 %, and college is 2.5 %. In Ermera municipality, elementary school is 10.5 %, junior high school is 11.8 %, senior high school is 17.1 %, and college is 3.9 %. In Liquica municipality, no schooling at 11.1 %, elementary school is 22.2 %, senior high school is 28.9 %, and college is 4.4 %. The education attainment of farmers has been an issue in the country when the concept of modernizing farming toward food security is promoted. Lack of education tackles the technology and knowledge transfer process to enhance the agriculture sector that was initiated by the government and other agencies (Lundah & Sjöholm, 2019).

The source of income of crop farmers and livestock farmers was asked separately. For crop farmers; in Bobonaro and Ermera, 63.1 % and 40.5 % respectively of farmers mentioned their source of income from crops up to 75 % while 25 % comes from other sources like livestock and incidental income (cash for works in the village to earn money). However, in Liquica 42.2 % of farmers depend totally on crops, while the rest of farmers have sources of income vary: livestock, poultry, and selling traditional handmade products. For the livestock farmers; farmers in all municipalities Bobobnaro (72 %), Ermera (50 %), and Liquica (40 %) confirmed their source of income up to 75 % come from livestock, while the rest 25 % come from different sources such as horticulture from backyard garden and poultry. A less diverse source of income for farmers occurred because of the barrier to entrepreneur attitude and lack of capability to diversify the income. Tomak (2022) has identified the causes of low sources of income among farmers in Timor-Leste; technical knowledge, structural issues such as infrastructures and access to improved crop and livestock variety, and access to technologies to enhance income.

The monthly income of farmers was obtained from the monthly expenditure of each household. This is due to most farmers having no regular income on a monthly base, therefore the expenditure for a farmer's household is assumed as the income of the farmer. Data indicates the majority of farmers (81.15 % in Bobonaro, 68. 42 % in Ermera, and 66.67 % in Liquica) have monthly incomes of less than USD 100 which is very low. In addition, less than 5 % of the total interviewed farmers have a monthly income above USD 200. The low income from mostly all farmers is due to a lack of knowledge or many of them are illiterate and slow to access agricultural information from other sources, but other factors, for instance, the capability to diversify the income are also low. Lundahl and Fredrik (2013) have described the income and challenges of farmers in Timor-Leste; Low technologies, lack of education, and lack of government support on extension and subsidies are the most influential factors. Moreover, Akter *et al.*, (2021) added adoption of technologies has a big impact on farmers' income especially on market linkages and value added to their farm products.

Average household size in the municipality of Bobonaro: 2 to 4 people (38 %), 5 to 7 people (59 %), 8 to 10 people (21 %), and above 10 people (4 %). In Ermera municipality: 2 to 4 people (43.4 %), 5 to 7 people (34.2 %), and 8 to 10 people (22.4 %). In Liquica: 2 to 4 people (13.3 %), 5 to 7 people (48.9 %), 8 to 10 people (31.1 %), and above 10 people (6.7 %). The household size of farmers in Loes watershed reflects the household size of the entire population of Timor-Leste which is an average of 5.4 persons (Ministry of Finance-Timor-Leste, 2022).

Types of farming, cropping system, and main crop planted in Loes watershed.

The type of farming practices here is limited to what they do for crop growing and livestock raising in farmers' daily lives. The percentage of each type of practice accounted for the total number of farmers who used these methods; thus, some farmers might be counted twice or third according to their farming activities. Some of them do two or more practices at the same time; for instance, slash and burn and open grazing are practiced routinely at the same time in their life.

Table 2: Types of farming, cropping system, and main crop planted in Loes watershed

Farming type	n	%	Cropping system	n	%	Main crop planted	n	%
Slash & Burn	227	93.4	Monoculture	19	7.8	Maize	227	93
Shifting cultivation	33	13.6	Multiple cropping	194	79.8	Rice	7	3
Open Grazing	107	44.0	Contour strip	0	0.0	Tubers	9	4
Traditional conservation	18	7.4	Cropp rotation	30	12.3			
Adopted conservation	2	0.8						
Total farmers interviewed	243	100	Total	243	100	Total	243	100

Five types of farming practices are found in Loes watershed. The slash-and-burn practice is dominant (93.4 %) followed by open grazing by livestock farmers (44 %) and shifting cultivation (13.6 %), while traditional conservation and adopted conservation practices are very low. Although slash and burn has been considered a poor practice and a risk to agroecology, the practices keep going on and being the most dominant. It can be assumed that the slash-and-burn practice is being culturized by local people and is being transmitted to young farmers in their local area. Basdew *et al*., (2017) found that indigenous knowledge transferred orally to its generation in South Africa is considered faster in adoption compared to written knowledge which uses many technical words. Furthermore, Alemu (2016) found that indigenous knowledge (IK) used in Ethiopia for agroforestry development is considered as an option, however due to socio-economic problems raised among them the IK is predicted to be less effective in the future. Multiple cropping is practiced by 79.8 % of farmers, 12.3 % do crop rotation, and only 7.8 adopt monoculture. The multiple cropping systems generally planted maize mixed with cassava, sweet potato, beans, and pumpkin. The previous report stated the main crops planted by farmers in the entire country are maize, cassava, sweet potato, vegetables, beans, and rice (MAF, 2019; Da Cruz, 2003). However, none of the farmers do contour trip farming, although mostly use slope areas as mentioned in Table 4.6. In terms of main crops planted by farmers in Loes watershed, 93% of the total interviewed farmers cultivated maize as the main crop, 4 % of farmers planted tuber crops, and 3 % of them cultivated rice. There are no significant changes compared to a previous study in Timor-Leste, the northern and southern slopes were cultivated with maize, cassava, sweet potato, and rice (Molyneux, 2012). Moreover, a study conducted in Sapele-Nigeria stated that not all recommended farming practices adopted by farmers due to various socioeconomic reasons.

Five years of crop productivity in different farming practices

Crop productivity over five years according to the interviewed farmers illustrated declined from 2008 until 2022. (Figure 2). In the slash-and-burn area, the productivity decreased for all crops through the years but adopted conservation indicated maize increased in 2008 and decreased in 2009 but remained constant through the years, while cassava productivity increased from 2008 until 2022. In addition, sweet potatoes and beans have not yet been cultivated in adopted conservation farmland.

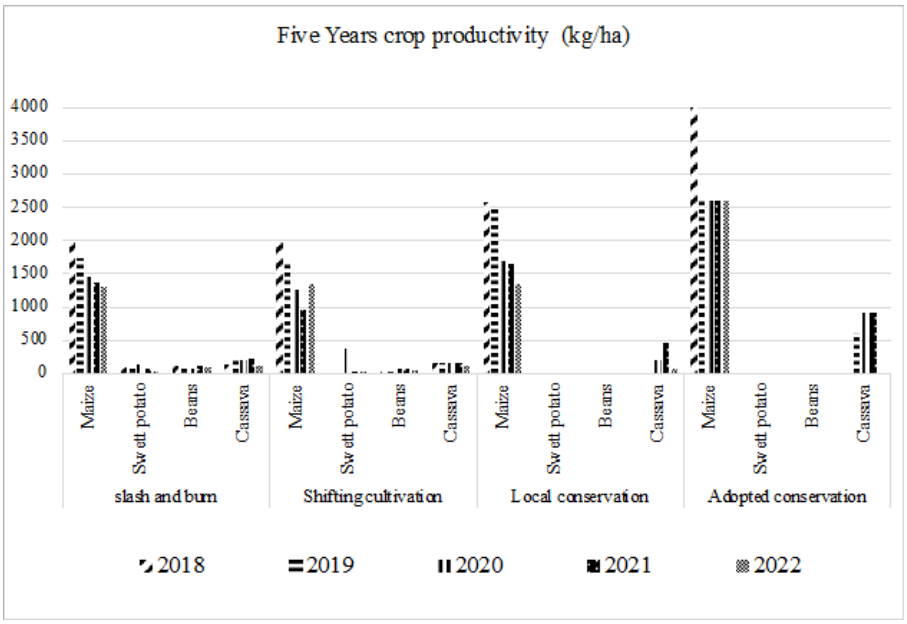
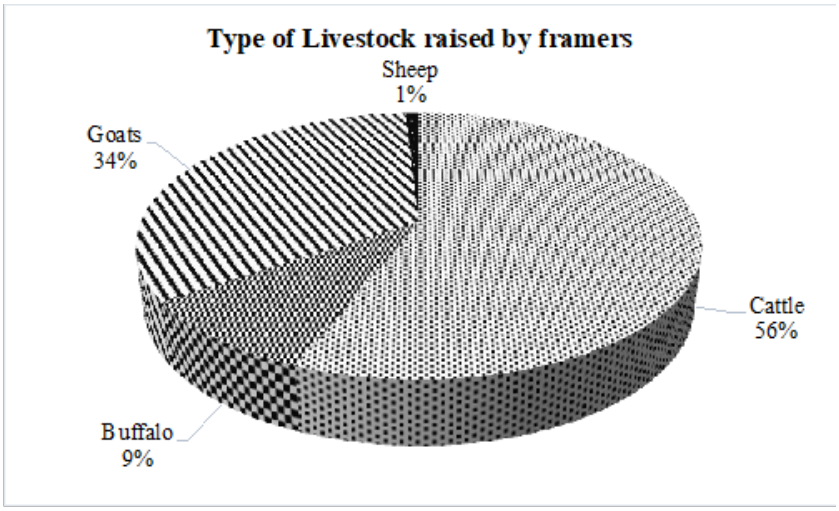


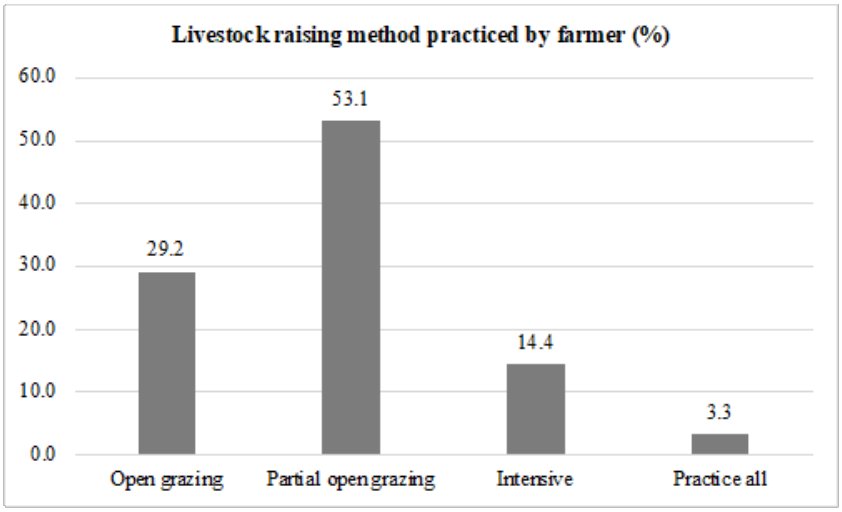
Figure 3: Five years productivity of main crops

The decline of crop productivity in watershed areas has been influenced by soil health conditions. The practices have deteriorating soil quality to support crops for its production. The shifting cultivation method sounds sustainable; the infertile land is left to regenerate before being reused for agricultural purposes. However, the short period of rotation makes the farmland degraded. For instance, the study by Dasgupta *et al.* (2021) in India mentioned shifting cultivation being practiced for one to two consecutive years and then left for 30 years. But today the practices are conducted in less than 5 years, a period which does not allow for the proper regeneration of forests. In addition, Mishra *et al.* (2019), shifting cultivation decreases soil organic carbon when return-period is short. Essential factors of lower shifting cultivation return- period are linked to availability of land, increase of population growth, and land ownership that limit shifting cultivation to wait for the regeneration process of cultivated land for full recovery.

Integration of local knowledge with technologies was perceived as the proper combination to address food security, climate change, and disaster risk reduction issues. For example, Nelson *et al.* (2019) revealed that the combination of traditional knowledge and agriculture technologies ensures farming sustainability and more resilience to climate change impacts in Iloilo, Philippines. In Timor-Leste, traditional environmental practices are not only based on morality (spiritual relations to nature) but also on the ability to cope with the changes to survive (local coping mechanisms) amid climate change and water scarcity (Burns, 2013). A few limitations of local knowledge in farming in Timor-Leste have been raised in an assessment conducted in Timor-Leste. These consist of commercial aspects that are accessed and involved, uptake of new knowledge and technology, and human resource quality towards opportunities and challenges for economic diversification (OXFAM-Timor-Leste, 2019). A mixed cropping system is the common practice in the home garden. Maize, upland rice, beans, vegetables, potato, pumpkin, sweet potato, taro, chili, and some seasoning crops are found in the land and planted with fruit trees. Paudel *et al.* (2022) stated that although agroforestry practices have been implemented traditionally by the local people, knowledge, institutional capacity, and funds are the challenges that prompt the farmers to address environmental degradation and food security in Timor-Leste.

Type of livestock raised by farmers in Loes watershed





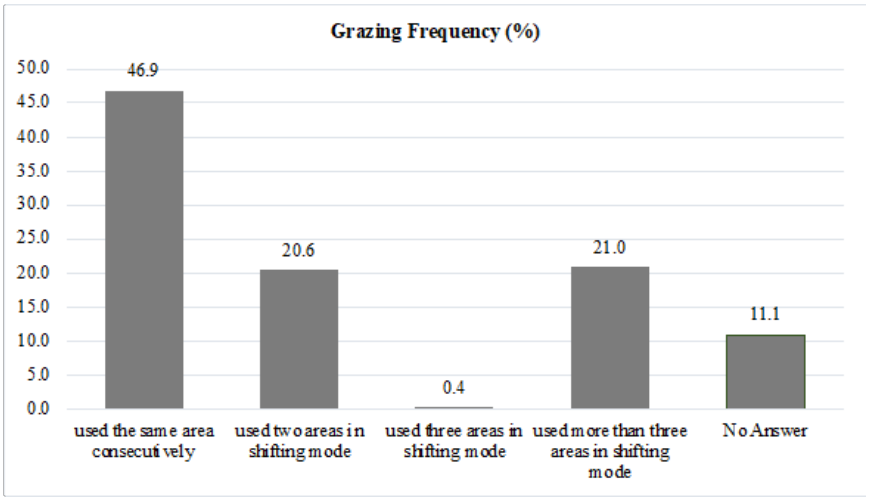


Figure 3: Type of livestock raised by farmers in Loes watershed

The interviewed livestock farmers consist of 56 % raised cattle, 34 % raised goats, 9 % raised Buffalo, and 1 % raised sheep. Farmers' Preference for raising cattle compare to buffalo due to its economic value and feeding methods. The cattle have higher reproductivity than buffalo it is because the cattle get puberty earlier than buffalo, thus the reproduction cycle much faster than buffalo. According to Jainudeen & Hafez (2016), the age of puberty of cattle ranges from 10 – 25 months, while buffalo ranges from 15-36 months.

In terms of the grazing method, 53.1 % of the interviewed farmers practiced the partial grazing method, 29.2 % are fully open grazing, and 14.4 % adopted the intensive livestock raising method. However, 3.3 % of them practiced all (fully open grazing, partial grazing, and intensive method). Farmers do fully open grazing for their cattle, partially for their buffalo, and do intensive only for selected cattle that plan to sell in next coming months.

The grazing frequency practices in Loes watershed are dominated by using one area only for consecutive grazing (46.9 %), while several farmers manage to use two grazing areas in shifting mode to allow grass to recover before being reoccupied with the livestock (20.6 %). Only 0.4 % of the interviewed farmers stated using tree areas for their shifting grazing for livestock. In addition, farmers who live away from the village residences mostly practice shifting grazing in more than three areas because of less competition among farmers and sufficient grassland availability around their areas. The consequences of high-intensity grazing in one area consecutively are lowering grass diversity and leading to grass degradation in the long run (Rakosy *et al.*, 2022).

Risk Perception

Table 3: Risk perception of farmers

Perceptions question	**Total participants = 243**					
	Yes					**No**
Do you think your soil fertility is decreased?	Significantly	Moderately	Slightly	No category	**Total Yes**	
	4	10	45	2	61	182
Percentage (%)					**25.1**	**74.9**
Do you think your crop productivity is decreased?	4	9	42	2	56	187
Percentage (%)					**23.1**	**76.9**
Do you think grassland area is declining?	4	14	43	2	63	180
Percentage (%)					**25.9**	**74.1**
Do you think your farmland is at risk?	5	23	53	2	83	160
Percentage (%)					**34.2**	**65.8**
Do you think your grazing area is at risk?	2	14	45	2	63	180
Percentage (%)					**25.9**	**74.1**
Do you note the erosion in your farmland or grassland?	0	14	30	0	48	195
Percentage (%)					**19.8**	**80.2**

The risk perception of interviewed farmers was limited to their views on crop and grassland production and productivity concerning soil health conditions to crop and grassland production and productivity as the consequences of their farming practices. The perceptions on soil fertility, erosion, crop production, grassland production and productivity in farmers' view revealed no risk. In terms of soil fertility, 75 % of farmers mentioned soil fertility in healthy condition, while 25 % stated there are problems with soil fertility, but only slight risk to their crop and livestock production (Table 3).

Most of the interviewed farmers (77 % and 74 %) perceived no decline in their crop yield and grassland productivity but assumed their farmland and grassland conditions remained stable. They also confirmed their grassland and farmland are not at risk (66 % and 74 %) of a decline its productivity over time. On the other hand, more than 80 % of interviewed farmers argued no erosion has been noted in their farmland and grassland areas, although some eroded paths do exist in their areas, farmers perceived it as a natural process and confirmed that the existent erosion is not related to their farming practices. The risk perception of farmers in Loes watershed is similar to a study by Rahman *et al.* (2022) in Bangladesh, various risk perceptions among farmers on infertile topsoil, deeper water level, soil erosion, water logging, land conversion and high precipitation were the major effects of environmental degradation. In contrast, Tesfahunegn *et al.* (2021) found that in Ghana, the majority of farmers perceived the risk as the cause of over-cultivation and deforestation as the consequences farmers faced risk to decline of productivity, soil erosion, and soil loss from farmland.

The influence of the local customary (Tara Bandu) on farming practice

To understand how farming practices; especially farming planning on the expansion of farmland and land preparation, consider the Tara Bandu as a rule and guideline for land use in their villages. Thus, the influences were categorized into four such no influence at all, light influence, moderate influence, strong influence, and extreme influence.

Table 4: Influence of Tara-Bandu to farming practices

Category	Number of farmers	%
No influence at all	49	20
Light influence	73	30
Moderate influence	36	15
Strong influence	22	9
Extremely strong influence	63	26
Total	243	100

The Tara Bandu is a traditional law recognized by the government of Timor-Leste and used for addressing cultural rules of natural resource uses and protections, social conflict resolutions, and human relationships. Tara Bandu plays an important role in conservation, natural resource management, and regulating the relationship of human to nature, and human to human (Fodalgo-Castro, 2023; Tobias *et al.*, 2021; Ajroud *et al.*, 2015). The Tara Bandu influences on farming practice choices vary among farmers. Twenty percent of farmers stated no influence at all. However, 30 % recognized the Tara Bandu as one of the considerations as slightly influenced their planning to choice on what type of farming practices, especially, to open new farmland in forest area. In addition, the Tara Bandu plays its role as local law and takes place in farmers' planning processes as 9 % to 15 % or moderate to strong influence in their decision respectively. Furthermore, 26 % of farmers very strongly believe that Tara Bandu is the local rule which is very strong and used by farmers to make farming plans in their villages. This is consistent with to study of Casquilho and Martins (2022) revealed that Tara Bandu is the bottom-up approach to land use, boundary management, and social rules that are efficient in managing natural resources and land use planning.

Farmer awareness of conservation-related policies and their benefits

The policy awareness of farmers was assessed by using top-five conservation laws in Timor-Leste by asking them do they are familiar with these laws. Most of the farmers have no awareness of conservation laws. In addition, how farmers rated the benefits of the laws and policies on conservation and agriculture to their lives.

The percentage of no awareness of farmers indicated in respective laws; The laws are Timor-Leste National Forest Policy 2017 (3rd Objective is on watershed conservation (84 %); Law No. 13/2017 Special Regime for the Definition of the Ownership of Property (88 %); Decree/ Law No 26/2012 of 4 July 2012 on Environment Basic Law (77,8 %); Law N.º 5 / 2016 National System of Protected Areas 74,5 %); Decree/ Law No 6/2020 establishing the Legal Regime for the protection and conservation of biodiversity (88 %).

The existence of law awareness by farmers and the local community is mostly low due to several factors. Law enforcement by local authorities and its effectiveness in addressing the conservation problems. In addition, the dissemination of laws might affect law awareness by local people. According to Budiman *et al.* (2020), Institutional conflict impeded the dissemination of existing laws and their uses in the community, in some way affecting the traditional knowledge and rules used to manage non-timber products, grazing management, and prevent forest fires.

The perceptions of farmers on the benefits of conservation policies to their lives. Farmers' views on the benefits of conservation policies in their lives are expressed in different categories: some of them mentioned not all conservation policies give benefits to them, on the other hand, some farmers acknowledged the benefits of some conservation policies produced by the

Table 5: Farmer awareness on the conservation and the benefits of policies.

Variables	Timor-Leste National Forest Policy 2017 (3rd Objective is on watershed conservation)		Law No. 13/2017 Special Regime for The Definition of The Ownership of Property.		Decree/ Law No 26/2012 Of 4 July 2012 on Environment Basic Law		Decree/ Law N.º 5 / 2016 National System of Protected Areas		Decree/ Law No 6/2020 establishing the Legal Regime for the protection and conservation of biodiversity	
	n	%	n	%	n	%	n	%	n	%
Laws & policies awareness										
Aware	38	15.64	29	11.93	54	22.22	62	25.51	28	11.52
Not aware	205	84.36	214	88,07	189	77.78	181	74.49	215	88.48
Standard Deviation	0.36		0.32		0.42		0.44		0.32	
Total	243	100	243	100	243	100	243	100	243	100
Laws & policies benefits' perception										
Benefited	43	17.7	19	7.8	41	16.9	43	17.7	22	9.1
Not benefited	200	82.3	224	92.2	202	83.1	200	82.3	221	90.9
Standard Deviation	0.72		0.27		0.38		0.38		0.29	
Total	243		243		243		243		243	

government. Thus, their perception of getting benefits is separated into two categories; have been benefitted or have not. The percentage of farmers who acknowledge the benefits of conservation policies is less than 20 % as stated by each policy category: The laws are Timor-Leste National Forest Policy 2017 (3rd Objective is on watershed conservation (17,7 %); Law No. 13/2017 Special Regime for the Definition of the Ownership of Property (7,8 %); Decree/ Law No 26/2012 of 4 July 2012 on Environment Basic Law (16,9 %); Law N.º 5 / 2016 National System of Protected Areas 17,7 %); Decree/ Law No 6/2020 establishing the Legal Regime for the protection and conservation of biodiversity (9,1 %). In addition, most farmers confirmed they have not benefitted from these policies yet.

Acceptance and willingness of farmers to be advised on conservation farming

Two dominant farming practices, such as slash-and-burn and open grazing, were further explored to determine whether farmers agreed to change their actual farming practices to conservation farming.

There are 52 % of slash-and-burn farmers have shown their willingness to implement conservation farming and eventually leave their actual practices, however, 48 % remain to keep their own experience as farmers for various reasons. The general reasons for rejecting other advice than slash and burn are the practice has been implemented since their ancestor's time, they have not been trained yet on conservation and lack of information from extension workers. In addition, farmers assumed that slash and burn is the only easy and cheaper method that can be done by poor farmers, while other methods require capital to invest and must be managed by educated people. In contrast, those who agreed to leave their actual practices stated that slash-and-burn damages soil and declining soil quality affects crop yield and loss of grasses. Farmers have experienced soil erosion in farmland and landslides in some areas due to these practices, so they believe that adopting conservation farming would help them to avoid soil erosion, and increase soil fertility, and grassland productivity. However, some farmers confessed, that they agreed to the advice because of expected to receive some incentives and subsidies from the government.

The open-grazing farmers showed slightly different percentages when compared to the slash-and-burn farmers in terms of accepting to be advised and willingness to do conservation farming. 36 % of livestock farmers do not agree to leave open grazing practice due to establishing paddocks for livestock requires high cost and we don't have enough resources to do this. Some of them mentioned, that adopting open grazing is better than paddock because in open areas livestock can easily find grass for themselves, while putting in the paddock we have to invest additional cost to build paddock, grow green fodder and hire people to feed and control. Some of them stated due to a lack of ability to manage their livestock, they prefer to leave the natural grow in an open area and take it to sell for urgent demand of money in the family. However, there are 64 % of livestock farmers who have been practicing open grazing welcome the

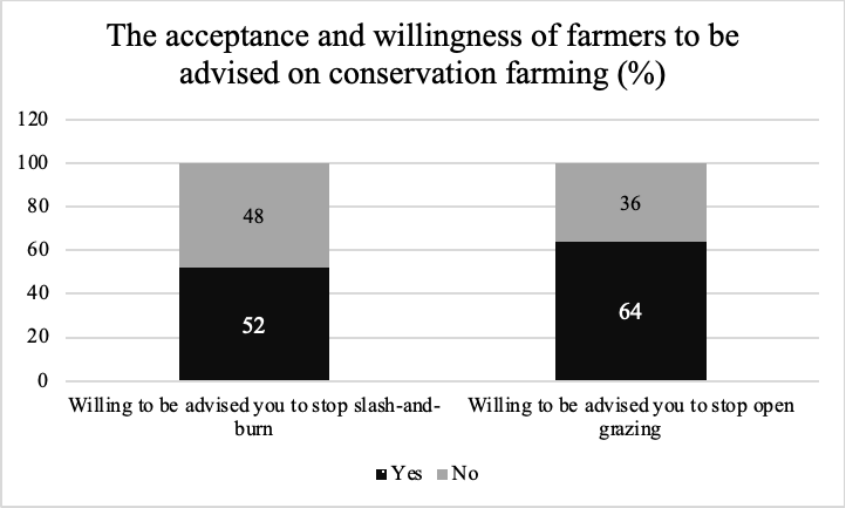


Figure 4: The acceptance and willingness of farmers to be advised on conservation farming

semi-intensive livestock raising method or fully intensive livestock raising method. The fundamental reason area: the livestock is easy to control and manage so that the productivity and quality of livestock increase, which elevates household income. Some of them mentioned, that the advantages of intensive care of livestock to them are reducing social conflicts among farmers, in which livestock will not damage crops and farmland of other farmers, it also helps farmers to address any diseases that could attack their livestock.

CONCLUSION

The study concluded that farmers' perception of agroecological risk was classified as low risk on grassland and crop production. In addition, farmers weighing the risks were not based on the changes of any biophysical components of agroecology (soil, water, and topography) and perceived their actual farming practices have no relationship to the soil health and uncertainty of crop and livestock production in their area. However, farmers blamed policy formulators ignored their local rules to engage them in conservation and natural resource management. Moreover, the lack of village extension assistance was acknowledged by farmers as one of the factors causing them to adopt fewer conservation practices. The socioeconomic factors: low education level of farmers and lack of information access might influence farmers' perceptions. This shall be considered a risk and must be addressed in an integrated way. Thus, it recommends delivering conservations and natural resource management based on economic and adult education approaches such as Sloping Agricultural Land Technology (SALT), Conservation Agriculture (CA) with no burn, minimum tillage, and integrating cover crops in farm management. Integrating local wisdom into innovation promotion and agriculture-related policy formulations by promoting Customary Law (Tara-Bandu) which is the local community is the initiator of having rules and regulations to farm.

ACKNOWLEDGMENTS

I would like to acknowledge the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) for funding this study as part of the PhD fully funded scholarship to Delfim da Costa as the grantee.

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