

# Value Chain Development of Mamberamo Rice in Oe-Cusse-Timor Leste for Economic Sustainability

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## Abstract

Mamberamo rice value chain development towards economic sustainability in Oé-cusse Timor Leste. The research used descriptive and qualitative methods with a structured interview approach based on the prepared questionnaire. Main target of the research is rice farmers who have access to the agricultural land with a sample taken of 45 people. The sampling method randomly selected from 4 agricultural areas in Pante Makassar such as Costa, Lalicuk, Cunha and Lifau in which 5 representatives/ 100 ha selected for each area. The purpose of this research is to find out: (1) What are the current problems faced by the farmer related to the technologies and adoption of technologies to increase production? (2) What are the current problems faced by the farmer related to the storage system, processing, and marketing of Memberamo rice? The results of the study found that 36% of farmers answered that the problem they often faced was a lack of knowledge of technology to increase rice production, and 100% of farmers used inorganic fertilizers however 91% said it was very expensive. According to the result, after harvest, 98% of farmers prefer to store it at home, without temperature settings. In the Market Access variable, it was found that 87% of farmers found it difficult to bring their products to both local and national markets. Meanwhile, 56% of farmers answered that it was very difficult to access the market. Another finding is about the way they sell their products to the market – 78% of respondents sold their products without proper packaging.

*Keywords:* Economic Sustainability, Mamberamo Rice, Market Access, Value Chain.

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## 1. Introduction

Daengku Journal accepts 1) Original Research Papers (Regular Papers); 2) Review Articles; and 3) Technical Notes.

Based on the report of ADB-Country Partnership Strategy-Timor Leste (2020) for the past five years, agriculture production systems in Timor-Leste are among the least developed in the world. Subsistence systems dominate all subsectors, and most farming households are highly risk averse. Annual and perennial crop yields are extremely low when compared to neighbouring countries beside that agriculture is the primary livelihood for about 70 percent of the population in Timor-Leste, yet the majority of farmers lack access to the technologies and practices needed for sustainable and efficient crop production. Crop yields remain low due to the use of traditional, low risk and low-cost production methods and there has been limited adoption of yield increasing technologies such as irrigation, mechanisation, improved varieties and fertilisers (Tomak, 2016). Subsistence and commercial producers face significant constraints, including limited access to quality inputs, low yields and high post-harvest losses as well as limited market access. All these challenges mean that the rice agri-food chain in East Timor does not contribute robustly to the sustainable development of the country (dos Reis, 2021).

Rice is the most produced and consumed cereal in the world and it's the main cereal most consumed in Timor-Leste (Cabral & Pinto, 2022). While agriculture is a primary source of income for most households in Oé-cusse. In the agriculture sector, there are several potential sub-sectors that help to boost local economy such as horticulture, fruits, legumes, fishery, rice and vegetable crops. Although the majority of households in this region depend on agricultural products, there was a significant downfall in agriculture production in the recent cropping seasons. The statement above is strengthened by the Democratic Republic of Timor-Leste Oé-cusse Economic and Trade potential (2016) in

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Oé-cusse, 78% of the population is engaged in agriculture. Most agricultural production in Oé-cusse is subsistence agriculture and families typically grow a range of crops including maize and in some cases rice to serve family needs.

To enhance the production of cultivated rice, numerous ways have been taken: introducing various technological innovations that have been scientifically proven to result in enhanced production. One of the technological innovations is the use of improve varieties (Rizieq at al., 2023). Technological change and adoption are the major driving force for increasing rice productivity but in Oé-cusse the choice of technologies and their adoption to increase production and, productivity has been less to increase the farmer income. The farmers practice traditional methods in planting, harvesting and processing. Although most of the farmers adopt transplanting in establishing the rice mainly by manual method random transplanting is practiced. According to Ahmed (2022) in this 21st century, technology contributes above ninety percent of improving different aspects of life. This shows that developing any country for distinct areas depends on technological improvement of that country. Technology is a key principle of improvements in agricultural production and income growth for those with poor economic status.

Normally policies for agriculture, trade, research and development, education, training, and advice have strong influences on the choice of technology, the level of agricultural production and farm practices. It gives strength in facing challenges to meet growing demands for food, to be internationally competitive and to produce products of high quality for the farmers. Now in Oé-cusse, farmers, advisors and policy makers are not working for alternate choices and technologies. They must deal with the policies and new technologies throughout the rice value chain for the sustainability of the Memberamo rice farming systems. A proper extension system is also essential for the dissemination of new technology for the development of value chain. Arshad et al (2010) agricultural extension is one of the means available to help alleviate poverty and improve food security. Agricultural extension means a continued service that extends the farmers basic education mainly to rural population employed within the agricultural sector. It involves systematic and organized communication with farming communities and among farmers in order to give them a helping hand. Its objectives are particularly oriented to a better insight into farming practices, clear formulation of farmer's wishes and identification of their problems and looking for solutions.

With the varies of rain falls in Timor-Leste in particular Oé-cusse there are several difficulties that influenced by climate changes, where drive an impact to the water provision as it says according to the World Bank group and Asia Development Bank (2021) Timor-Leste's tropical climate is heavily influenced by the West Pacific Monsoon and its mountainous climate.

It is essential to develop a value chain which is to support the sustainability of the rice production in Oé-cusse with a wholistic approach. The focus of my research will be exploring to answer:

- a. What are the current problems faced by the farmer related to the technologies and adoption of technologies to increase production?
- b. What are the current problems faced by the farmer related to the storage system, processing, and marketing of Memberamo rice?

## 2. Literature Review

FAO (2018) rice (*Oryza sativa* L.) is the second most important staple crop, after maize, cultivated and consumed in Timor-leste, hence it is a commodity of strategic importance to the country's economy, food and nutrition security. It is a major source of carbohydrates, protein and fibre, and has high content of calcium, phosphorus, potassium, magnesium, etc. More than 45,000 smallholder farmers and a small percentage of medium scale farmers are engaged in rice production.

Rice is the second most cultivated crop in Oé-Cusse, with more than 2.100 ha of cultivated field along the region. It can be harvested twice per year provided there is sufficient water supply. Both the productivity and the quality of the rice paddy are low compared to Indonesia 3-4 tons of unhulled paddy or gabah/ha compared to the 2015 average of 5.3 tons/ha in Indonesia (UNDP, 2018). This is caused by natural constraints to expand agricultural production (such as poor land quality, limited water supplies, and degraded forests), before turning to human resource constraints (wellbeing, skills, and labor cost), and then policy constraints inputs, and data constraints (Democratic Republic of Timor-Leste Oé-cusse Economic and Trade potential, 2016). According to the report from UNDP (2018) the producers have little interest in improving quality as most of the production has been kept for household consumption. The key constraints are low yield and quality of the paddy, a lack of water supply, rudimentary processing techniques resulting in significant post-harvest losses, high competition (imported rice) and consequently, the lack of local

demand. Intervention to be considered is an increase in productivity to reduce costs and consequently stimulate local demand and support the creation of groups for collective purchasing of inputs and marketing.

### *2.1. Production*

The total cultivated area for rice paddy is 1.717 ha on flat land and 400 ha on hillsides, in the mountainous areas of Oé-Cusse. There is a potential to increase the total cultivated area to 2.500 ha. Although the precise data is difficult to acquire, it could be estimated from the total cultivated area that there are roughly 1.500 rice paddy producing households in the region. The paddy is typically harvested once per year, although in irrigated areas, it can be harvested twice per year, from January to May and then from June to November. The key rice paddy production areas are Kolamsina, Barasantu, Roti, Citrana and Betbenae (UNDP, 2018).

Misran (2014) said, the development of food crop agriculture, especially rice, remains focused on efforts increase in production which must be followed by the development of agribusiness-based farming in order can increase the income of farmers.

According to Winarno and Prayoga (2018) one of the technological components in integrated rice crop management is the jajar legowo cropping system. The jajar legowo cropping system, among other things, aims to increase the plant population per unit area. The jajar legowo cropping system is a cropping pattern alternating between two or more (usually 2 or 4) rows of rice plants and one empty row. The jajar legowo planting system was developed from the tile planting system that has developed in the community. The jajar legowo cropping system aims to regulate the plant population per unit area by arranging the layout of the plants and expanding the influence of edge plants. The advantage of the jajar legowo cropping system is that all plants or more plants become edge plants.

### *2.2. Agriculture Value Chain*

The rice value chain in Oe-Cusse, Timor Leste, involves a series of interconnected steps from rice cultivation to consumption, reflecting local agricultural practices and economic conditions, several key stages such as input supply, production, post-harvest, processing, distribution and marketing, consumption, (UNDP, 2018). A value chain is denoted as a series of connection activities creating value from raw products to supply finished products for end-user consumers and either continuing until the recycling process or creating another new value chain.

Value chains are integrated activities in which products and services are arranged, manufactured, and sent to customers with marketing agents' support. Higher value from products makes higher willingness of customers to pay, hence the critical success for the business competition is to create value continuously for customers (Sandra et al., 2024).

According to Porter (1985) the value chain model is an analytical tool which is useful for defining the company's core competencies in order to be able to pursue competitive advantage. The competitive advantage consists of cost advantage and differentiation. The cost advantage is achieved by reducing the costs of value chain activities. While the differentiation is done by focusing on competency-related activities core and perform better than competitors, besides that, Widyarini and Pawitan (2011) value chain analysis is the sequence analysis of related business activities (functions) from specific inputs for a particular product to primary production, transformation, marketing and up to final consumption. In other words, we can say that value chains are performing several functions i.e start from producer (rice producer or farmers), processors (farmer or trader), traders (retailer or wholesaler) and transporter (transportation and 4 storage are important functions in the rice channel distribution system).

### *2.3. Agriculture growth and Economic Sustainability*

The agricultural sector plays an important role in the Timorese economy, (Cabral & Pinto, 2022). Agriculture and economic sustainability in Timor Leste are integral to the nation's development, with the majority of the population relying on subsistence farming. Agriculture is the largest economic sector in Timor Leste in terms of participation of the population. 64% of households in Timor-Leste are involved in agricultural production activities and depend on agriculture as a principal source of income (Da Costa Junior, 2018).

According to dos Reis (2021) the people of Oé-cusse and Timor Leste in generally consume 135.000 tons of rice every year, and the consumption of rice per capita per year is 112 kg while domestic rice production only reaches 65 tons per year, which means that the government must import the remaining approximately 70 tons to meet the needs

of public consumption per year. Oé-cusse is an enclave located in the western part of the island of Timor which is bordered by Belu Atambua Indonesia in the east and, west is bordered by So'e NTT and south is bordered by Kefamenanu NTT and the north is a sea boundary with Indonesia, and the population of Oé-cusse based on the 2015 census was around 72,230 living in 4 sub district and 18 villages (Population and Household Census, 2015).

UNDP report under Agriculture Value Chain Development (2018) indicated that, rice productivity in Oé-Cusse is around 3-4 tons of grain per ha per year, from 1.717 ha of land in Pante Makassar, and this amount has not met the demand for rice, therefore it needs to be balanced with imports from Indonesia, Thailand, and Vietnam. Thus, if there are technological findings that are useful for increasing domestic rice production, it will automatically meet rice consumption at the regional level and contribute to reducing imported rice.

Ambali et al. (2021) agricultural productivity growth may be an important condition to achieve economic growth and development in developing countries, although the relationship between agricultural productivity and economic growth can be complex. Agricultural productivity growth may be achieved through farmer's adoption of improved agricultural technological innovation (e.g., high yield variety crops, genetically modified crops), along with a provision of good extension services, facilitating access to credit and insurance markets and irrigation facilities. All these may lead not only to yield, income, labor-saving, efficiency, and productivity improvements but also to environmental (e.g., mitigating effects on climate change) and health benefits.

### 3. Research Method

#### 3.1. Research Design

The research is descriptive and qualitative with a structured interview approach based on the prepared questions in the questionnaire, according to Obiaje et al. (2023) research is an activity of knowing, with the core objectives of to find solutions to problems and find answers to questions through the application of are liable and consistent procedure. To be reliable and consistent, research methods must be accessible, transparent, systematic, verifiable, objective, transferable, cumulative, and rigorous.

The research will be conducted in Oé-cusse Timor Leste by collecting data using a questionnaire technique. The respondents are rice farmers scattered around Pante Makassar who are using a productive land area of 1717 Ha for paddy. In this research, farmers will be selected as respondents from 4 agricultural areas. The respondents will be asked to answer the questions that had been provided according to the questionnaire form. Requirements to fill out the questionnaire in the study are active farmers who have access to land.

#### 3.2. Sampling and Sampling Technique

Main target of the research is rice farmers who have access to the agricultural land with a sample taken of 45 people. The sampling method will be randomly selected from 4 agricultural areas in Pante Makassar such as Costa, Lalicuk, Cunha and Lifau in which 5 representatives/ 100 ha will be selected for each area. Usually, a sample is selected that represents similar with the population from which sample comes from, (Deri, 2022).

**Table 1.** The object and research sample

Area	Total target of HH	Cultivation area (Ha)	# of sample
Costa	417	97.5	5
Lalicuk	1.780	383.4	15
Cunha	774	196.5	11
Lifau	1.022	277.93	14

Source; SRAG (Secretario Regional Agricultura, RAEOA TL (2021)

#### 3.3. Data and Instrument

This study uses questioners as an instrument to collect primary data. Roopa & Rani (2012) stated questionnaires are frequently used in quantitative marketing research and social research. A questionnaire is a series of questions asked to individuals to obtain statistically useful information about a given topic. The questionnaire will be developed and applied in the study consist of 38 questions that had been prepared according to the specified indicator variables. There are 3 variables used as parameter in this study:



## 4. Results and Discussions

### 4.1. Age Category, Profession, and Education

The age category of farmers is shown in table 12 13% of farmers are between the ages of 25 and 35, among them 2 females and 4 males. 38% of farmers are between the ages of 36 and 50, among them 4 females and 17 males. 55% of farmers are over the age of 51, among them 7 females and 15 males. This data indicates that women's engagement in rice cultivation is very low compared to that of men – 29% of farmers are females, and 71% are males. Young people's engagement in rice cultivation is also low.

Among all respondents, 91% are farmers, 2% are businessmen/women, and 7% are public servants. Their educational background varies – a dominating 42% of illiteracy, followed by 29% of respondents who attended secondary school, 13% elementary, 7% with a diploma, and only 2% at the pre-secondary level.

**Table 2.** Age Category & Profession

Age category	25-35	36-50	>51	Total	% M/F
F	2	4	7	13	29%
M	4	13	15	32	71%
% in age category	13%	38%	52%		
Profession	Agriculture	91%	Businessman/woman	2%	Public servant 7%

**Table 3.** Education

Education	Elementary	Pre-secondary	Secondary	Diploma	Bachelor	Illiterate
	6	1	13	3	1	19
F	3	0	1	0	0	7
M	3	1	12	3	1	12
% in education category	13%	2%	29%	7%	2%	42%

### 4.2. Production

Data in table 4 shows that 38% of farmers answered that pests and diseases were one of the main causes of decreased rice production in the region every year. Another main problem is water and technology, as 38% of farmers answered that the biggest issue, they face every season is water distribution. While 36% of farmers answered the technology system.

**Table 4.** Production

Problem issues	Respondent	Area	%
Technology	16	Lifau, Costa, Lalicuk and Cunha	36%
Water Issue	17	Lalicuk & Cunha	38%
Climate	1	Cunha	2%
Cooperative	4	Cunha	9%
Finance	5	Lifau & Lalicuk	11%
Pest & disease	17	Lifau, Costa, Lalicuk and Cunha	38%

Based on table 5 the agricultural land tenure system in Oé-cusse is generally dominated by private ownership and land leasing for cultivation. Data collected from farmers in several places such as Lalicuk, Cunha, Costa and Lifau show that 80% of farmers reported their lands are privately owned, 11% rent, and 9% choose both.

**Table 5.** Ownership

Ownership of the field Status	Owned	Rent	Both
	35	5	4
Area	Lifau, Costa, Cunha & Lalicuk	Lifau, Lalicuk & Cunha	Lifau, Costa, Cunha
%	80%	11%	9%

Meanwhile, table 6 shows the area of agricultural land owned by farmers. There are three categories: 0.1-0.3 Ha, 0.35-0.5 Ha, and above 0.55 Ha. Based on the responses, 50% of farmers cultivate land between 0.1 and 0.3 Ha, 32% between 0.35 and 0.5 Ha, and 18% above 0.55 Ha. This shows that the area of cultivated land per farmer is very small, which impacts rice production every season.

**Table 6.** Land Size

Land size of cultivation X2	0.1-0.3	0.35-0.5	>0.55
Number of farmers	22	14	8
%	50%	32%	18%

Table 7 shows the rice varieties planted by farmers in the Oé-cusse region. The farmers generally plant the Mamberamo variety, rather than other varieties such as Nakroma, Inpari and cakub. The main reason why they have kept this variety is because it is very smooth and delicious to eat. 80% of responses suggest that rice productivity is at a medium level. The main factors that cause productivity to remain at a medium level include the input supplies used by farmers, amid many other obstacles during the planting season. Meanwhile, 82% of responses suggest that rice production is below 1 ton per hectare per season, therefore it can be concluded that the production of rice farmers in Oé-cusse is solely for family consumption needs. Furthermore, the distribution of water on agricultural land is sometimes an obstacle to the process of rice growth in the vegetative and generative phases. The table below provides information about the concerns of farmers regarding the number of irrigation system distributions.

**Table 7.** Variety of the plan

Variety of the plant	Season planted/year	Rice productivity %			Production/ha %			
		High	Middle	Low	Less than 1 ton	1-3 tons	3-5 tons	5-7 tons
Mamberamo	1 season	9%	80%	11%	82%	16%	0%	0%
Nakroma		0%	0%	0%	0%	0%	0%	0%
Inpari 1, 2, 3 and 4		0%	0%	0%	0%	0%	0%	0%
CAKUB		0%	0%	0%	0%	0%	0%	0%

#### 4.3. Input Supply

Input supply is another major factor in increasing rice production. The study finds several kinds of organic and inorganic fertilizers as well as hormones used by farmers as growth boosters for vegetative and generative development. Table 8 shows the fertilizer used by farmers to help increase production. The dominant type of fertilizer is super phosphate sp 36-urea, which is used by 40% of the respondents; then followed by a single fertilizer, urea, used by 46% of the respondents, and urea-NPK used by 16% of the respondents. Among 45 respondents, 2 farmers used organic fertilizers such as gliceria leaves and fruits. The data in the below table 8 shows that farmers prefer to use chemical fertilizers rather than organic. Accessing the previously mentioned supply inputs is very difficult for farmers due to the distance and geographical location of the Oé-cusse enclave, and the very expensive price of fertilizer is an obstacle for food fighters in this country.

The data in table 9 shows that, compared to the national market, it is easier for farmers to find inorganic fertilizers in the local market. 29 respondents, 64% of all respondents, said that they could buy fertilizer at markets around Oé-cusse, but it was very difficult for them due to the unfriendly prices. Besides that, 18% of respondents import fertilizer from the national market, but it is very difficult for them to finance sea transportation. 7% of respondents brought in fertilizers from Indonesia. 91% of respondents said it is very difficult to access input supply due to the expensive prices.

**Table 8.** Fertilizer used

Type of fertilizer use	# of farmers used fertilizer	% of organic fertilizer used	% of inorganic fertilizer used
Organic fertilizer (gliceria, leaf and fruit)	2	4%	96%
NPK, Amonium sulfat ZA, Super fosfat SP 36	1		2%
Super fosfat sp 36, NPK	1		2%
Super fosfat sp 36, Urea	18		40%
Urea	16		36%
Urea, NPK	7		16%
Urea Petro	1		2%

**Table 9.** Source of fertilizer

Source of fertilizer (where you get fertilizers)	# of farmers accessed to the fertilizer in the market	% of farmers accessed to the fertilizer in the market	Category of the problem of getting fertilizers	# of farmers faced difficulty of getting fertilizer	% of farmers faced difficulty of getting fertilizer
Local Market	29	64%	Difficult	4	9%
Dili Market	8	18%	Very expensive	41	91%
Indonesia	3	7%			
Supermarket	1	2%			

Table 10 provides information on the types of hormones used by farmers. 51% of respondents use the Bassa-Santoa hormone and 13% use Bassa-green tonic as plant stimulants in order to increase rice productivity and production.

**Table 10.** Type of hormone used

Type of hormone used (yes/no)	# of farmer used hormone	% of farmers in getting access to hormone
Bassa	4	9%
Bassa, green tonik	6	13%
Bassa, Icon	1	2%
Bassa, kil top	1	2%
Bassa, santoa	23	51%
Bassa, santoa, green tonik	1	2%
Bassa, santoa, leon	1	2%
Green tonik	3	7%
Green tonik, santoa	3	7%
Santoa	1	2%

Table 11 according to the farmers, the use of fertilizers and pesticides in agricultural areas is accompanied by instructions from extension workers. The data shows that 53% of respondents received instructions in applying fertilizer and 56% received instructions in applying pesticides correctly and properly. 93% of farmers said the results were very good. However, the rice planting system is still predominantly traditional or conventional – 93% of respondents still plant traditionally.

#### 4.4. Processing

Post-harvest processing is still very traditional. In general, farmers use simple machines to grind rice or separate grain. The system for drying and storing grain is still traditional -- farmers keep paddy grain in sacks after drying and store it in a house or place that has been prepared. According to the data in the table 12 after harvest, 98% of farmers prefer to store it at home, without temperature settings.

**Table 11.** Application of the fertilizer and pesticides

Application of fertilizer (use technical instruction)		Application of Pesticides use technical instruction)		Result of applying fertilizer/pesticides			System of planting use		
Yes/no	Yes/no	Yes%	No %	Good	Very good	Enough	Conventional	Modern	Both
Yes %	No %								
53%	47%	56%	44%	93%	2%	4%	93%	4%	2%

**Table 12.** Storage system

Where do you store your paddy grain	Home	Warehouse	Both
# of farmers store at	44	0	0
% of farmers store at	98%	0%	0%
How do you store	Packing in the back/sack	Other	
# of farmers store at	42	3	
% of farmers at	93%	7%	

Based on the provided data in table 13 the majority of farmers engage in post-harvest activities involving grinding with a machine and drying manually. Specifically: 93% of farmers grind their rice with a machine and then dry it manually. 7% of farmers take additional steps after grinding and manual drying by storing the rice in a dry place.

**Table 13.** Machinery used

Post harvest activities	# of farmers	% of farmers
Grind with machine and dry manually	42	93%
Grind with machine and dry manually, and kept in dry place	3	7%

#### 4.5. Market Access

In the Market Access variable, it was found that 87% of farmers found it difficult to bring their products to both local and national markets. In the table 14 shows 56% of farmers answered that it was very difficult to access the market. Another finding is about the way they sell their products to the market – 78% of respondents sold their products without proper packaging. The transportation used by them to access the market is 100% public transportation. In sum, there remain many difficulties for them to access the market, mainly due to the distance to the market, difficulties in accessing transportation, and poor packaging system.

**Table 14.** Market access

Access to market		Difficulties to access to market			Where to sell product			How do you sell		Type of transport use for product		
Near by	Fair	Very difficult	Difficult	Other/not really	Local/traditional Market	National Market	Super market	Retail Packing	Car	Boat	Plain	
7%	7%	56%	38%	7%	96%	4%	0%	78%	22%	100%	0%	0%

## 5. Conclusion

Based on the result and discussion, the conclusion: (1) Found that there is limited knowledge of farmers to adopt new technologies to increase productivity and rice production every year, as it says that 36% of farmers answered that the problem, they often faced was a lack of knowledge of technology to increase rice production. (2) The use of inorganic fertilizers still dominates among farmers; thus, it is very difficult for them to access due to the prices are not affordable. The result shows 91% of farmers said it was very expensive. (3) In the post-harvest stage, the storage

system is still traditional, 98% of farmers prefer to store it at home, without temperature settings. (4) In the Market Access variable, it was found that 87% of farmers found it difficult to bring their products to both local and national markets. Meanwhile, 56% of farmers answered that it was very difficult to access the market. And (5) The processing system and marketing strategy is very low, at which 78% of respondents sold their products without proper packaging.

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