Food and Agriculture Organization of the United Nations

Food loss analysis: causes and solutions

Case study on the rice value chain in the Democratic Republic of Timor-Leste

Food loss analysis: causes and solutions
Case study on the rice value chain in the Democratic Republic of Timor-Leste

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, 2018

Required citation:
FAO. 2018. *Food loss analysis: causes and solutions - Case study on the rice value chain in the Democratic Republic of Timor-Leste*. Rome. 38 pp. Licence: CC BY-NC-SA 3.0 IGO.

ISBN 978-92-5-130671-0

Contents

TABLES

FIGURES

Foreword

Widescale global food losses and waste affect the sustainability and efficacy of food and nutrition systems, especially in the developing world. While food loss measurements are often limited by a dearth of data, high loss estimates in developing countries result from food supply chain failures. In 2011, the Food and Agriculture Organization of the United Nations (FAO) and the Swedish Institute for Food and Biotechnology published its Global Food Losses and Waste study which estimated that approximately one third of the total food produced for human consumption is either lost or wasted. While numerous studies have been undertaken to quantify food losses at the national level, information regarding the critical loss points, or areas where food loss in a specific food supply chain is most prevalent, is often unclear. Compounding the challenge, the underlying reasons for loss-inducing food supply chain failures also require further examination.

In order to improve global, regional and local knowledge about the underlying reasons for food loss, as well as to assess where critical loss points occur, FAO undertook a series of case studies involving numerous food supply chains in developing countries. Utilizing a defined food loss and waste analysis framework, the Organization and its partners identified nationally-important food products, and commissioned local-level studies of the losses in these chains. The findings of the study will be used to develop technically, economically, environmentally and socially feasible solutions to reduce food losses. These solutions will be developed both in the chains examined, as well as in similar chains in other countries, with due considerations for economic parity, agro-ecology and social conditions.

Rice is one of the most consumed food products in the Democratic Republic of Timor-Leste and is critical for food and nutrition security. The Ministry of Planning and Finance estimated that the 23 percent of households in the country were involved in rice production, covering a total of 36 700 hectares. However, rice production and availability are hampered by supply chain inefficiencies such as a reliance on rain fed agriculture. Production is further limited by an absence of large-scale rice industries or producers in the country.

Despite a recent increase in production in the 2006-2009 period, the crop is far from meeting yearly consumption needs. Timor-Leste's growing population is in urgent need to increase the production of paddy rice through an expansion of the cultivated area and the reduction of post-harvest losses. A critical examination of food losses in rice supply chains is required in order to develop worthwhile solutions for the significant farming communities across the island state.

FAO and its partners are grateful for the financial support and partnership of the Government of Ireland, who through its support of the the United Nations Joint Project (UNJP), made funding available for this assessment and final report.

Acknowledgements

The authors of the study Acacio da Costa Guterres, Vicente de Paulo Correia and Adelino Pimentel Do Rego from the National University of Timor Lorosa'e (UNTL) would like to thank the Government of Ireland, the Food and Agriculture Organization of the United Nations (FAO) and the International Fund for Agricultural Development (IFAD) for providing funding and technical support to conduct this research project. Special thanks are also go to Mr Cephas Taruvinga (FAO), Ms. Myriam Annette (FAO) and Ms Paula Lopes da Cruz (FAO Country Representative for Timor-Leste), who provided valuable guidance and support for this research project.

Their gratitude is extended to all staff at the Faculty of Agriculture, National University of Timor Lorosa'e (UNTL) for their support during the fieldwork. Special appreciation is especially extended to the final year students from the Department of Agro-Socio Economy and the Department of Agronomy. Finally, sincerest gratitute is extended to the village heads and other stakeholders in Lautem, Baucau and Dili for their guidance and support during this study.

Abbreviations and acronyms

ACELDA	Agribusiness firm working in partnership with MDF
ACIAR	Australian Centre for International Agricultural Research
ARP	Agriculture Rehabilitation Project
BNCTL	Banco Nacional Comercio de Timor-Leste
CLP	Critical Loss Point
DNS	Directorate of National Statistic
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Group Discussion
FSC	Food Supply Chain
GAP	Good Agriculture Practices
GHP	Good Hygiene Practices
GIZ	German Agency for International Cooperation
Ha	Hectare
HACCP	Hazard Analysis and Critical Control Points
Hoka	Local storage facilities for storing paddy rice
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
Kg	Kilogram
Kwh	Kilowatt
LLP	Low Loss Point
MAFF	Ministry of Agriculture, Forestry and Fisheries
MAP	Ministério Agricultura e Pescas
MCIE	Ministry of Commerce, Industry and Environment
MDF	Market Development Facility
MSME	Micro Small and Medium Enterprises
na	Not available
NGO	Non-Governmental Organization
NSD	National Statistics Directorate
NSSRV	National Seed System for Releases new maize Varieties
RDP IV	Rural Development Program (Phase Four)
RDTL	República Democrática de Timor-Leste (The Democratic Republic of Timor-Leste)
SDP	Strategic Development Plan
SoL	Seed of Life
SRI	System of Rice Intensification

TLHS	Timor-Leste Household Survey
TLMSP	Timor-Leste Maize Storage Project
UNFPA	United Nations Population Fund
UNJP	United Nations Joint Project
UNTL	Universidade Nacional Timor Lorosa'e
USAID	United States Agency for International Development
USD	United State Dollar
WFP	World Food Programme

Introduction to the case studies

About 1.3 billion tonnes of food losses and waste are estimated to occur every year globally (FAO, 2011), affecting the efficiency and sustainability of global food systems and nutrition. Accurate estimates of the magnitude of losses and waste are still lacking, especially in developing countries where most smallholder farmers produce and consume grains and pulses as staple food. Nevertheless, the high loss estimates suggest that food losses are significant and have a negative impact on food and nutrition security.

In light of the above, FAO and its partners launched the Global Initiative on Food Losses and Waste, which is a global effort to reduce food losses and waste using various approaches including awareness-raising, and developing a methodology to research post-harvest losses among other initiatives. Multiple partners have been supporting efforts at the national and regional levels through various projects, including the Project 'Food loss reduction through partnerships and evidence-based interventions', also known as the United Nations Joint Project (UNJP). The UNJP, which is funded by the Government of Ireland, is a collaborative initiative on food loss reduction between the FAO and IFAD.

This joint project between IFAD and FAO aims to support the provision of technical support to assess food losses. The project has been linked with IFAD-led field based activities including: national loss assessments in Ethiopia, Malawi and Timor-Leste; a regional workshop on food losses; and the development of awareness and knowledge materials in support of IFAD project design and implementation.

Food losses refer to the decrease in edible food mass throughout the different segments of the food supply chain – production, post-harvest handling, agroprocessing, distribution (wholesale and retail), and consumption. Food losses and their prevention impact the environment and climate change, food security and livelihoods for poor people and economic development. The exact causes of food losses vary throughout the world, and are very much dependent on the specific conditions and local situation in a given country, region or production area.

During recent decades numerous studies have been undertaken to assess the quantities of food losses in many countries around the world. Most of these studies were conducted at the national level, and based on literature reviews, statistical data and stakeholder interviews.

The analysis of literature and overall reports reveals a knowledge gap: while quantitative estimations of food losses have been produced, and there is certainty about the major causes of food losses, it is unclear which of the losses are the most important for specific supply chains, what is the impact of eventual solutions and which solutions are economically, environmentally and socially feasible. It is clear that food loss reduction will greatly benefit all actors in the food production and supply chain, will improve food security for poor people, advance climate resilience and make more efficient use of natural resources. The solution to food loss, however, should not be more expensive than the food loss itself, should not cause any negative impact or risk to consumers' health, should not place a higher burden on the environment and greenhouse gas (GHG) emissions. Solutions to food looses should ensure more food is available for the people who need it most and should be socially and culturally acceptable.

The Save Food Initiative has therefore designed the 'food supply chain' case studies for the most important food subsectors in developing countries. In these case studies, primary and empirical data is generated for the different causes of food losses, and solutions for food losses are analysed for their feasibility. Up to now, no standardized methodology has been used to conduct loss assessments. This has made it difficult to compare results between countries and regions. Using a standardized methodology across the participating countries will be useful for comparing results and sharing information.

A case study is just a one-moment recording of what is happening in a specific food supply chain in a specific season in a specific location; in another season or in a different location the situation can be very different again. It was therefore considered important that the Save Food Initiative should undertake many case studies in many different locations, so that the study results would provide significant trends and solutions. Further, the strategy aimed to use the results of the case studies to target opportunities for investment programmes and interventions, during which a wider geographical scope and seasonality would be analysed.

The assessment of post-harvest losses along the rice supply chain in Timor-Leste used the methodology developed by FAO under the Save Food initiative and adapted it to the specific conditions and local context. The rice subsector has been identified by the Government of Timor-Leste as a priority commodity for reduction of post-harvest losses. The case study involved smallholder farmers, cooperatives, transporters, traders, millers, warehouse managers of cooperatives, and daily labourers.

The main objective of this study was to obtain a clear view of the weak points in the chain where food losses occur, evaluate quantitative and qualitative losses, analyse their main causes, and identify key interventions to reduce food losses improve the efficiency of the food supply chain (FSC). These analyses will eventually lead to concrete proposals to implement a food loss reduction programme.

An effective supply chain food loss assessment involves the collection of data and its analysis. Assessments were carried out using qualitative and quantitative field methods. Subsequently, solutions and strategies for addressing food losses were formulated from the results and conclusions of the assessment. Through the formulation of food loss reduction strategies, the project adopts a holistic approach based on the entire supply chain, recognizing the strong role of multiple actors, including the role of institutional structures and policy environment.

Given the magnitude of food losses, making profitable investments in reducing losses and improving the efficiency of the food supply chain could help bring down the cost of food to the consumer, increase access to food, while at the same time improve economic returns to farmers and other actors in the value chains.

METHODOLOGY

The assessment of post-harvest losses along the rice supply chains used the methodology developed by the Save Food Initiative. The FAO loss assessment methodology involves the collection of data and its analysis using qualitative and quantitative field methods. Subsequently, solutions to food losses are formulated from the results and conclusions of the assessment. The FAO loss assessment methodology is described below.

Selection of countries and subsectors

Countries and subsectors that already have ongoing programmes are selected to provide the project partners to work and collaborate with in the field. Subsectors are chosen from the important food commodities in the country: cereals, roots and tubers, fruits and vegetables, oilseeds and pulses, fish and seafood, and animal products (meat, milk, eggs, etc.).

Identification of consultants

The field work is conducted by a team of two or three national consultants: a subsector specialist (who might be an actor in the food supply chain), an agricultural economist and a rural sociologist.

Selection of food supply chains

The main supply chains in the subsector are ranked by their importance in terms of economic impact and food security, as well as their contribution to national development objectives such as employment, poverty reduction and the generation of foreign exchange. Based on the information obtained, one or two FSCs in the subsector are selected for in-depth survey and sampling.

The basic criteria for selection of the FSCs are:

- based on smallholder producers;
- significant scale of food production;
- preferably including agroprocessing and urban market;
- if possible, included in an ongoing support programme for the subsector.

Uniform methodology

The methodology of the case studies was designed to be uniform for all countries so that the results are comparable and extrapolation is made possible. The methodology was developed specifically for this purpose. It is comprised of four ('S') elements:

- *Preliminary screening of food losses ('Screening').* This is done based on secondary data, documentation and reports, and expert consultations without travel to the field.
- *Survey food loss sssessment ('Survey').* This is done using different questionnaires for producers, processors or handlers/sellers (i.e. warehouse managers, distributors, wholesalers, and retailers)

and other knowledgeable persons in the supply chain being assessed, complemented by ample and accurate observations and measurements.
- *Load tracking and sampling assessment ('Sampling').* This is useful for quantitative and qualitative analyses at any step in the supply chain.
- *Monitoring and solution finding ('Synthesis').* This is used to develop an intervention programme for food losses, based on the previous assessment methods.

The consultants physically follow the product from production site to final retail outlet for four weeks, make direct observations and measurements, and discuss the causes and solutions for food losses with actors in the supply chain. Finally, the consultants draft a proposal for a food loss reduction strategy or plan.

Stakeholder validation

In a one-day workshop with stakeholders from public and private sectors, the study results and the proposed food loss reduction strategy are discussed and endorsed. A concept for a programme to finalize and implement the food loss reduction strategy or plan is prepared.

METHODOLOGY ADOPTED IN THIS STUDY

In this research, FAO's case study methodology described above was followed along selected supply chains in IFAD supported project areas.

Data was collected from direct observations and interviews with key actors in the supply chains. In addition, secondary data was collected from government and private institutions and through a review of the literature.

The case study was conducted with close consultation and coordination with the six heads of the villages, extension workers and leaders of farmer groups in order to obtain a clear picture of the activities being conducted by stakeholders in the supply chain.

This study was conducted from July to October 2015.

Preliminary screening phase

Activities to select the FSC included:
- Assemble and review technical information or literature, as well as recent economic data. Policy and strategy documents were reviewed as well as technical reports, quality standards and regulatory frameworks and mandates of relevant institutions.
- Conduct consultations with experts from MAFF, FAO Timor-Leste, SoL/the Australian Centre for International Agricultural Research (ACIAR), IFAD Timor-Leste, Universidade Nacional Timor Lorosa'e (UNTL), local NGOs, the private sector and community leaders.
- Identify indicators to assess or measure the impact of food losses on the local and national economy, and on local social systems.

Survey phase: collection of primary data

Thorough interviews with stakeholders of the selected FSC were conducted, including focus group discussions (FGD). The survey was complemented by observations of the FSC activities, systems and products.

The percentages of losses (kilogram/100 kg of grain) along the supply chain were computed from the data generated from the questionnaires. Corresponding monetary values were calculated taking into account the price of one kilogram of paddy rice (USD 0.40) and rice (USD 2.00).

Rice study

The rice study was conducted from July to October 2015 in the district of Baucau. The study area included the subdistricts of Baucau Vila, Vemasse and Laga.

Policy framework or national strategy

Timor-Leste's Strategic Development Plan (SDP 2011-2030) clearly defines the goals of the agriculture sector, which include the improvement of national food security, the reduction of rural poverty, supporting the transition from subsistence to commercial farming, and promoting sustainability and the conservation of Timor-Leste's natural resources (RDTL, 2011).

As a key area for rural development, increased agricultural productivity will lead to increased demand for other goods and services in rural areas. To achieve this, the Government has developed and implemented policies and regulations in support of agricultural production, post-harvest loss reduction and marketing, thereby enabling the sector to serve as a driving force for economic growth and social progress in the medium and long term.

Some of the key areas of these policies and regulations include:

- technological investment in agricultural mechanisation;
- optimisation of crop production (rice, maize, coffee, coconut, vegetables, etc.) and post-harvest loss reduction;
- promotion of farming seed centres and their distribution at regional and district level;
- reinforcement of technical training for farmers and extension workers; and the
- promotion of agricultural research and information.

The implementation of the above policies included the distribution of improved high-yield varieties of paddy rice, tractors, shelling and milling equipment, and storage facilities (silos and IFAD drums), government purchasing of rice and the allocation of extension workers at village level.

RELEVANT INSTITUTIONS AND THEIR ROLES

There are a number of institutions involved in the development of the rice sector in Timor-Leste. These institutions include the Ministry of Agriculture and Fisheries, the Ministry of Commerce, Industry and Environment, the National Bank of Commerce of Timor-Leste (BNCTL) and national and international agencies. In addition, the institution responsible for setting up food standards is the Ministry of Commerce, Industry and Environment (MCIE). So far, however, no specific food safety standards and quality criteria have been applied to rice in Timor-Leste.

TABLE A
Relevant institutions and their roles in the rice subsector

Institution	Role in terms of policy	Mandate and activities
MAFF	Policy development and drafting of regulations to support actitivies under MAFF.	Foster and oversee food production; and promote industry in the agriculture sector; create technical assistance centre for farmers.
MCIE	Design, execute and assess the policies for commerce, industry and environment.	Promote the development of the cooperative sector, especially in rural areas and agriculture; promote micro and small enterprises; purchase local products such as rice and maize.
BNCTL	Commercial bank that caters to Timorese individuals, micro, small and medium enterprises interests in urban and rural areas.	Provide financial access to poor Timorese (e.g. offer loans to farmers in rural areas).
SoL/ RDP IV	Focus on increasing yields by selecting and distributing improved varieties of superior genetic quality.	Improve agronomic practices, reduce post-harvest storage losses, and improve input supply arrangement for seeds.
IFAD	Guarantee food self-sufficiency and empower rural women and men to achieve higher incomes and improved food security.	Facilitate policy development on food security issues.
FAO	Support the improvement of institution and coordination mechanisms for policies, laws, regulations and programmes.	Supported the development of the post-harvest management strategic framework in 2013.
IFAD, SoL, USAID	Ensure sustainable post-harvest protection of seeds and grain stocks and improve crop production in rural areas.	Address seed system security issues to mitigate post-harvest storage losses for rice and maize and to maintain better quality seeds.
UNDP	Address local climate impacts, through strengthened local administrative capacity, accountability, and public participation to ensure that climate risks are properly weighted in local decision-making.	Provide technical advice and assistance to build strong and capable public institutions at national and subnational levels in justice, parliament, human rights, anti-corruption, police, economic development, environmental management and disaster risk management

Executive Summary

Rice is a major food commodity and is consumed by the majority of the population in the Democratic Republic of Timor-Leste. Most farming households in the country can be characterized as subsistence farmers, and rice is a key determinant of household food security. The demand on rice is high and the result is that local production cannot fulfill this demand. Consequently, a large quantity of rice is imported, and the volume continues to increase.

Because of the lack of market opportunities and low production, most of the rice production (85 percent) is for own consumption. There are no large-scale rice industries or producers in Timor-Leste. Most rice is produced by smallholder farmers and there is only a small percentage of medium-scale producers.

The average annual production of rice in Timor-Leste is around 50 000 tonnes; and productivity is 1.8 tonnes/ha. Of this, 15 percent of rice production is marketed, generating a market value of USD 4.95 million respectively.

In the past 10 years, the Government of Timor-Leste and various key stakeholders have invested much effort in increasing rice production, particularly in high potential areas such as Maliana, Baucau, Viqueque, Manatuto and Suai. The stakeholders involved in the rice subsectors include the Ministry of Agriculture, Forestry and Fisheries (MAFF), the German Agency for International Cooperation (GIZ), the Ministry of Commerce, Industry and Environment (MCIE), the Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), Seed of Life (SoL), the the United Nations Development Programme (UNDP), the World Bank, the Japan International Cooperation Agency (JICA), and local and international non-governmental organizations (NGOs).

Some examples of the interventions implemented include:

- providing training and technical assistance to farmers;
- promoting the use and distribution of improved seeds, storage facilities, agricultural machines and equipment;
- allocating extension workers in all villages around the country;
- improving linkages between products and markets; and
- rehabilitating irrigation schemes. Even if these programmes do not focus on food loss reduction, their interventions are key components for reducing post-harvest losses in the rice supply chains.

There are two types of supply chains in the rice subsector, formal and informal. In the informal chain, farmers sell their paddy/rice directly to the consumers at the farmgate, to their neighbours, and to friends and at the local market or village level. Most farmers in Timor-Leste are involved in this chain. In the formal chain of the rice subsector, farmers distribute their paddy rice to the processors. The processors sell the processed rice to the retailers, who in turn sell it to the consumers. Only a small number of rice producers sell their products directly to the consumers at the local or district market.

In this study, the formal and informal rice supply chains were selected for an in-depth field survey in the district of Baucau, following the methodology of the 'food supply chain' case studies.

It was found that losses occurred at all stages of the selected rice supply chains. In the rice supply chain, the critical loss points (CLP) identified were the stages of harvesting, threshing, milling and storage at the warehouse, with average estimated losses after each process of 3.5 percent, 5, 10 and 5 respectively.

The total losses of paddy rice estimated at the CLPs were 47 tonnes or 21 percent of the total annual production of 224.4 tonnes, which represents an economic loss of USD 10 900 for paddy rice (selling price: USD 0.40 per kg) and USD 24 000 for rice after milling (selling price: USD 2.00 per kg). The total economic losses in the studied supply chain are USD 35 000 or USD 350 per farmer.

The causes of losses are multiple: lack of labour, lack of equipment, rain during harvesting, inadequate and inefficient harvesting or production practices, lack of drying and storage facilities, poor management of these facilities, lack of transport equipment and poor road conditions. Quantitative and qualitative losses are mainly because of moulds, damage by rodents and chickens, spillage and germination.

To address these challenges, and reduce post-harvest losses (PHL) in the rice supply chains, the study recommends that the government and institutional partners introduce and promote proven post-harvest technologies, and provide training and extension services to raise awareness of post-harvest losses, their impact, value and how to address them.

Chapter 1
Introduction and background

STATUS AND IMPORTANCE OF THE RICE SUBSECTOR

Rice is the second most important staple crop after maize in the Democratic Republic of Timor-Leste. Rice is also a major source of income and employment in the rural areas and absorbs more than 50 percent of the total labour force in the agriculture sector.

The Ministry of Planning and Finance estimated that the percentage of households involved in the production of rice was approximately 23 percent in 2005, on a cultivated area of 36 700 ha (FAO/WFP, 2007). The average cultivated area per farm is 1.2 ha (Care International, 2004) and the average yield is 1.8 tonnes of paddy per hectare. In addition, with the use of improved seeds and fertilizers, and continued rehabilitation of irrigation schemes, rice production in Timor-Leste increased by about 22 percent between 2006 and 2009 alone (Table 1.1) (RDTL, 2011). Despite an increase in the production of paddy rice of 39 217 tonnes from 2006 to 2009, it is still far from meeting yearly consumption needs, which are estimated at about 63 000 tonnes. In 2015, the population growth rate was 2.4 percent and the volume of imports increased to 74 000 tonnes. This critical figure indicates the urgency of increasing the production of paddy rice through the expansion of the cultivated area and the reduction of post-harvest losses.

Table 1.1 shows that since 2009, the production of paddy rice has continued to decrease. One of the reasons for reduced production is the lack of rainwater because of the erratic climatic. Another reason is the lack of labour and marketing.

In addition, most paddy rice produced (85 percent) is for the farmers' own consumption and only around 10 to 15 percent is traded through traders and retailers. No cooperatives are involved in the distribution of rice to the end consumers as shown in Figure 1.2.

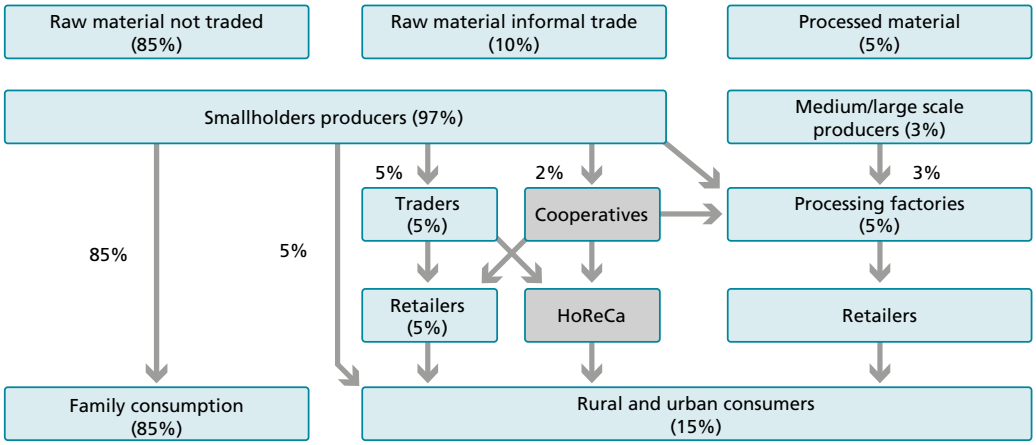
There are no large-scale rice industries or producers in Timor-Leste. Most of the rice is produced

TABLE 1.1
Rice production, consumption and rice import in Timor-Leste from 2006 to 2015

Year	Paddy production (tonne/year)	Rice production (60 % milling recovery)	Rice consumption (TLHS 95 kg/cap/yr)	Rice imports (tonne)
2006	55 414	33 248	92 055	64 348
2007	60 424	36 254	94 240	64 028
2008	77 418	46 451	96 520	57 811
2009	120 775	72 465	98 895	38 508
2010	75 000	45 000	101 365	63 865
2011	98 297	58 978	101 325	97 177
2012	119 166	71 499	103 757	98 189
2013	85 334	51 200	106 247	80 337
2014	88 823	53 293	111 435	na
2015	60 361	36 216	114 095	na

Source: RDTL, 2011; IMF, 2011; MAFF, 2015
TLHS Timor-Leste Household Survey

FIGURE 1.1
National production information for the rice subsector: actors and product flow



Source: authors' research (preliminary screening phase)

TABLE 1.2
National production information for the rice subsector

	Annual production (tonne/year)	Cultivated area (ha)	Average yield (tonne/ha)
Rice (averages for the period 2006-2015)	50 000	27 780	1.8
Average annual growth over the last 10 years (%)	2.4		
Average cost of production (USD/tonne)	190		
	On-farm consumption	**Marketed**	
Percentage of production	85	15	
	Volume (tonne/year)	**Value (USD/year)**	
Market product #1, rice	7 500	4.95 million	
	Small	**Medium**	**Large*** **
Level of processing operation	•	0	0
Level of trading/wholesale operation	•	0	0
Level of retail operation	•	0	0

Source: Young, 2013

by smallholder farmers (97 percent) and there are few medium-scale producers.

Description of the food safety management mechanisms

There are no food safety standards to regulate the food sold to consumers. Regular checks are conducted by the Ministry of Commerce, Industry and Environment (MCIE), which are mostly limited to the expiration date of imported foods. No specific food safety and quality criteria and standards are applied to rice.

INVENTORY OF ACTIVITIES AND LESSONS LEARNED FROM PAST AND ONGOING INTERVENTIONS IN RICE LOSSES

Success in increasing rice production depends upon effective extension programmes, timely input supply, and access to credit and support for mechanisation programmes.

From 2002, government interventions, with the support of various institutions, have focused on increasing rice output throughout the country, in particular in high potential areas through

TABLE 1.3
Food safety management mechanisms

Controller	Control	Actual situation in the FSC		Responsible Agent
Government regulation and requirements	National food safety/quality standards	Exists and applies to the whole FSC		MCIE Only apply for imported foods
		Exists but not rigorous	x	
		None		
	Frequency of checking (None, Low, Medium, High)	Harvest	None	MCIE
		Transport	Low	
		Storage	None	
		Process	None	
		Market	Low	
	Obligatory registration of the food processing/ preparation unit	Exists	x	MCIE
		None		
FSC actors - food safety management system	GHP/ GAP/ HACCP/ voluntary standards		None	
	Identification of potential hazards		None	

Source: secondary data

TABLE 1.4
Past and current government interventions in the rice subsector

Activities/Intervention	Institution/Project	Year
Improve food security (including rice) of selected poor households, increase agricultural production and promote rural growth and food security of rural families	ARP	2002 - 2007
Identification of rice varieties with good yield potential, tolerant to major abiotic and biotic stresses, with acceptable grain qualities for various rice ecosystems	SoL and MAFF	2000 - 2016
An assessment of rice growing technology in Timor-Leste concluded that the most significant opportunities for increasing rice yields are through the employment of improved growing practices (ICM)	University of Hawaii	2006 - 2007
Training of Timorese engineering workers on how to make high quality mechanical rice weeders	MAFF/JICA/GIZ/ USAID	2007 - 2008
Intervention focused on new irrigation scheme, purchasing of new tractors including recruitment of field staff or extension workers with the goal of fostering rice production	MAFF	2008 - 2012
Intervention efforts focus primarily on the rehabilitation of irrigation schemes and improving the production of rice using improved technology	JICA/GIZ/MAFF/ CARE INT/CONCERN	2012 - Present

Source: MAFF, 2006, MAP,2007; Janes et al. 2010; Young, 2013; JICA, 2014

the rehabilitation of irrigation schemes, distribution of tractors to farmers, free land preparation (ploughing), distribution of new seeds for paddy, distribution of fertilizers and chemicals, introduction of integrated crops management and training (RDTL, 2011; National Commission for Research and Development, 2008; MAFF, 2008a; MAFF, 2008b; RDTL, 2007).

In the last five years, farmers (or groups of farmers) have benefited from the:

- distribution of 315 medium and large tractors, 2 591 hand tractors, 24 rice-milling machines and 133 power threshers;
- rehabilitation and protection of irrigation canals (21 538 ha of the total area of non-functional irrigation schemes were rehabilitated);
- implementation of the System of Rice Intensification (SRI);
- free land preparation;
- transplanting of hybrid rice on 100 ha; and

TABLE 1.5
Type of training and assistance received by rice farmers in Baucau

No	Topics of training and assistance	MAFF (%)	NGO (%)	Univ. (%)	Agency (%)	Agribus/ (%)	Coop. (%)	Other (%)
1	Rice production	83.3	41.7	-	-	8.3	8.3	-
2	Technical advice	91.7	41.7	-	-	8.3	16.7	-
3	Improving quality and quantity of paddy rice	66.7	41.7	-	8.3	-	-	-
4	Value adding	25	16.7	-	8.3	-	8.3	-
5	Improving post-harvest handling up to storage	41.7	16.7	-	8.3	-		-
6	Market Information	16.7	16.7	-	8.3	-	7.7	-

Source: authors' research (field survey)

- distribution of fertilizers and pesticides and storage silos.

The lessons learned from past and present interventions show that little attention is given to rice marketing and to the issue of losses during production and post-production. It is known, however, that reducing losses can contribute to an increase in rice production and improvement of livelihoods. It is therefore important to develop and implement targeted interventions that will reduce post-harvest losses.

Assistance and training

Survey results show that 88 percent of respondents in the study area did not receive any assistance or training. For those who benefited from these capacity-building activities (12 percent of the respondents), the training topics included: specific technical advice, rice production, improving the quality and quantity of rice (see Table 1.5). In addition, most of the training and assistance were sponsored by MAFF and NGOs. Other stakeholders that also contributed to the provision of assistance and training in the rice subsector in Baucau were cooperatives, international agencies and a few agribusinesses. Respondents were asked to indicate which training they attended, as they may have participated in several trainings delivered by different institutions.

OVERVIEW OF THE MOST IMPORTANT FSCS IN THE RICE SUBSECTOR; SELECTION OF FSC

The main areas for rice production are Baucau, Viqueque, Manatuto districts and the subdistricts of Maliana, Same and Suai. In 2015, the highest production was recorded in Baucau with a total production of 13 200 tonnes, while the lowest was in Dili with a total production of 60 tonnes (MAFF, 2015). In addition, the total number of smallholder rice producers is higher in Oecusse compared to other areas (10 800 households) (NSD and UNFPA, 2011).

Detailed information on the rice supply chains in the different geographical areas of production is provided in Table 1.6.

Table 1.7 evaluates the importance of the rice supply chains in terms of economic impact and food security:

As indicated earlier, most paddy rice in Timor-Leste is produced by smallholders. Around 98 percent are poor smallholders who depend on this subsector as a main source of income and livelihood. The annual income generated from this subsector varies from one FSC to another. For example, in FSC 3, rice production generates an income of around USD 600 per year; while for FSC 4, the estimated income generated is around USD 1 000 per year, as shown in Table 1.8.

There are two types of supply chains in the rice subsector: formal and informal. In the informal chain, farmers sell their paddy/rice directly to the consumers in the villages, at subdistrict level. In this chain, most farmers do not sell their paddy/rice to the main market at the district and national level because of high transport costs and low prices for the product. Most farmers in Timor-Leste are involved in this chain. Farmers continue to engage in this chain because most lack the skills and knowledge of marketing, lack information about input and output prices and have limited capital. In some cases, the transaction occurs between neighbours in the village.

In the formal chain, farmers distribute their *paddy rice* to the processors, who in turn sell the

TABLE 1.6
Food supply chains in the rice subsector categorized by geographical area of production

FSC	Geographical area of production	Final product	Volume of final product (tonne/ year) in 2015	Number, age, and sex of smallholder producers (households)	Market of final product, Location, buyers	Project support
1	Baucau *	Rice	13 175	9 300	Baucau/Dili	GIZ
2	Viqueque *	Rice	4 050	5 883	Viq/Baucau	
3	Maliana *	Rice	4 440	5 219	Maliana	GIZ
4	Manatuto *	Rice	2 636	2 080	Manatuto/Dili	JICA
5	Same *	Rice	1 292	1 758	Same	
6	Suai *	Rice	1 530	2 938	Suai	
7	Oecusse	Rice	2 640	10 835	Oecusse	
8	Lospalos	Rice	1 265	2 154	Lospalos	
9	Liquica	Rice	412	504	Liquica	
10	Ainaro	Rice	368.5	1 026	Ainaro	
11	Ermera	Rice	1 463	2 140	Ermera	
12	Aileu	Rice	620	1 395	Aileu	
13	Dili	Rice	58	439	Dili	

Source: NSD and UNFPA, 2011; Ministry of Finance, 2011; MAFF, 2011; MAFF, 2015
* Districts with high production potential

TABLE 1.7
Importance of the rice supply chains at national level

No. FSC	Economic importance (USD)	Generation of foreign exchange	Contribution to national food (rice) consumption (Percentage)	Contribution to national nutrition	Environmental impact
1	2 331 780	na	3.46	2	1
2	3 088 800	na	4.60	2	1
3	3 063 060	na	4.55	2	1
4	2 392 500	na	3.55	2	1
5	1 955 580	na	2.91	2	1
6	3 245 880	na	4.82	2	1

NB. 1=low; 2=Medium; 3=high

TABLE 1.8
Importance of the rice supply chains for the actors

Food Supply Chain	Percentage of produce by smallholder (%)	Income generation (USD/ smallholder producers/year)	Involvement of the poor (%)
1	100	251	98
2	100	525	98
3	100	587	98
4	100	1 150	98
5	100	1 112	98
6	100	1 105	98

Source: authors' research (preliminary screening phase)

TABLE 1.9
Preliminary screening of rice losses in the Baucau FSC

FSC Geographical area: Baucau Market product: Rice		
Step in the FSC	**Expected loss points**	
	Quantitative CLP or LLP	**Qualitative CLP or LLP**
Harvesting	CLP – Harvesting of wet grains, rats, spoilage, late harvesting, strong wind, broken grains, birds, germination, pests	CLP – Mould, weevils, dirt
Homestead transfer	LLP – spillage	LLP – dirt, discoloration
Drying	LLP – broken grains, chicken/birds, other animals	LLP – dirt
Cleaning	LLP – spillage	LLP – dirt
Milling	CLP – spoilage	CLP – contamination
Packaging	LLP – broken grains, spillage	LLP – dirt
Storage	CLP – rats, pests, fermentation, spillage, birds	CLP – discoloration, mould, weevils, dirt
Loading	LLP – spillage	LLP – dirt, contamination
Off-loading	LLP – spillage	LLP – dirt, contamination
Transportation	LLP – poor roads, lack of materials to cover the product, poor vehicles	LLP – discoloration

Source: authors' research (preliminary screening phase)

processed rice to the retailers for distribution to consumers. Only a small percentage of farmers are engaged in this chain.

Based on the selection factors presented in Tables 1.6, 1.7 and 1.8, the Baucau district supply chain was selected for study. The following factors determined the selection of the Baucau supply chain:

- Baucau's high potential for paddy rice production;
- the involvement and long-standing experience of farmers with rice production;
- the importance of the crop for food supply and income generation, farmers depend on this crop for their livelihoods;
- the research revealed the presence of small firms (e.g. ACELDA) in the formal chain that are engaged in purchasing, processing and marketing of the product. It should be noted that the only firms involved in the rice subsector in Timor-Leste are in Baucau district.

To undertake an in-depth study, the Baucau district supply chain was further broken down into formal and informal supply chains, both of which were then analysed. In the study area, 95 percent of the rice supply chains are informal. This report provides a synthesis and analysis of the data collected from both formal and informal chains.

PRESUMED FOOD LOSSES IN THE BAUCAU SUPPLY CHAIN

The preliminary screening phase has enabled the pre-identification of the critical loss points (the stages of harvesting, milling and storage) and low loss points (the stages of drying, packing, loading, transporting, among others) in the selected rice supply chain.

Chapter 2

The rice supply chain – situation analysis

DESCRIPTION OF THE SELECTED RICE SUPPLY CHAIN

This study was conducted from July to October 2015 in the district of Baucau. The study area included the subdistricts of Baucau Vila, Vemasse and Laga. Some of the reasons for choosing this site are that the dominant rice systems in this region are rain-fed lowlands and uplands. The potential cultivated area of paddy rice is 14 400 ha, but only 8 100 ha are planted (56 percent). This cultivated area produced around 26 350 tonnes of paddy rice in Baucau district in 2015 (MAFF, 2015).

As stated, the Baucau supply chain was further broken down into formal and informal supply chains. In the formal chain, farmers sell their **paddy rice** to processors (ACELDA), who process it into **rice** and distribute it to the retailers and end consumers both in Baucau and Dili. ACELDA is a local business that operates in the agricultural sector. Its activities also include buying and selling of paddy/rice. Farmers also sell their **rice** directly to final consumers, particularly in Baucau.

In the informal chain, farmers sell their **paddy rice** to their neighbours. They do not sell their product at the market centers, for examples, in Baucau. The volume of the product sold per transaction is very small compared to the volume marketed in the formal chain. For example, in the informal chain, cans of 12 kg are usually used to sell paddy rice, while In the formal chain, the types of containers used are sacks of 15 or 30 kg and small plastic bags of 5 to 10 kg.

Paddy rice in Baucau is usually planted in January and February and harvested in June or July. The main variety of paddy rice grown by farmers include Nakroman, local red and IR64. Other varieties that are also grown by farmers are Siheran, Membramo, Singapura and Siaun.

TABLE 1.10

Detailed description of the rice supply chain in the sub-district of Vemasse – basics

Stage in Food Supply Chain	Geographical location	Months of the year		Main products	Quantity (tonne)	Duration/ distance	Services
		from	to				
Primary production	Motagade	Jan.	April	Paddy	222.30	10 m/1.5 km	
Harvest	Motagade	April	July	Paddy	222.30	10 m/1.5 km	Labour
Post-harvest handling	Motagade	June	July	Paddy	222.30	10 m/1.5 km	Labour
Storage	Vemasse Vila	July	June	Paddy		5 m	
Transportation	Motagade	Sept.	Oct.	Paddy		10 m/1.5 km	Truck
Market sales	Vemasse Vila	July	Oct.	Paddy	22.20	200 m	Bemo
Agroprocessing	Sukaer laran	July	June	Rice	44.50	5 m/1 km	Miller
Storage	Vemasse Vila			Rice		5 m	
Transportation	Vemasse Vila			Rice		5 m/1 km	Truck
Wholesale							
Retail	Vemasse Vila			Rice		200 m	

Source: authors' research (field survey)

Description of the Baucau supply chain

The FSC activities for paddy rice in the study area are as follows:

- Harvesting – manual harvesting using knife or 'arit'
- Transportation to the field house – manually
- Threshing – using thresher machine
- Winnowing – manually
- Packing – using sacks and local packaging materials
- Storage – using 'hoka' (local storage facilities for storing paddy rice) and sacks to store in the field house
- Transportation – using trucks and 'karosa' to transport paddy rice to the warehouse
- Drying – sun drying
- Transportation – using 'karosa' or 'bemo' or trucks to transport paddy rice to the milling house
- Milling – household milling machine

The following details the activies at each stage of the supply chain.

Harvesting – of paddy rice includes cutting the rice stalk, laying the cut crop in the field and bundling it for transportion to the farmhouse.

Farmers in the study site harvest their paddy rice in May, June and July. The harvesting process starts with cutting the paddy rice manually, putting it together and tying up the bundles of rice before transporting them to the farmhouse for threshing and winnowing. After harvesting, 72 percent of farmers leave their paddy in the field for a few days.

To determine whether paddy rice is ready for harvesting, farmers look at its colour and harvest when it turns yellow. The time spent harvesting paddy rice ranges from 2 to 21 days, depending on the availability of labour and the size of the harvesting area.

Storage – The results of the study showed that 98 percent of farmers store their paddy after harvesting and the average quantity of paddy stored in 2014 was 1 360 kg per farm household. Most farmers (96 %) said they store their paddy in sacks (*'hoka'* in the local language). Only a small per-

FIGURE 1.2
Flow diagram of the selected FSC

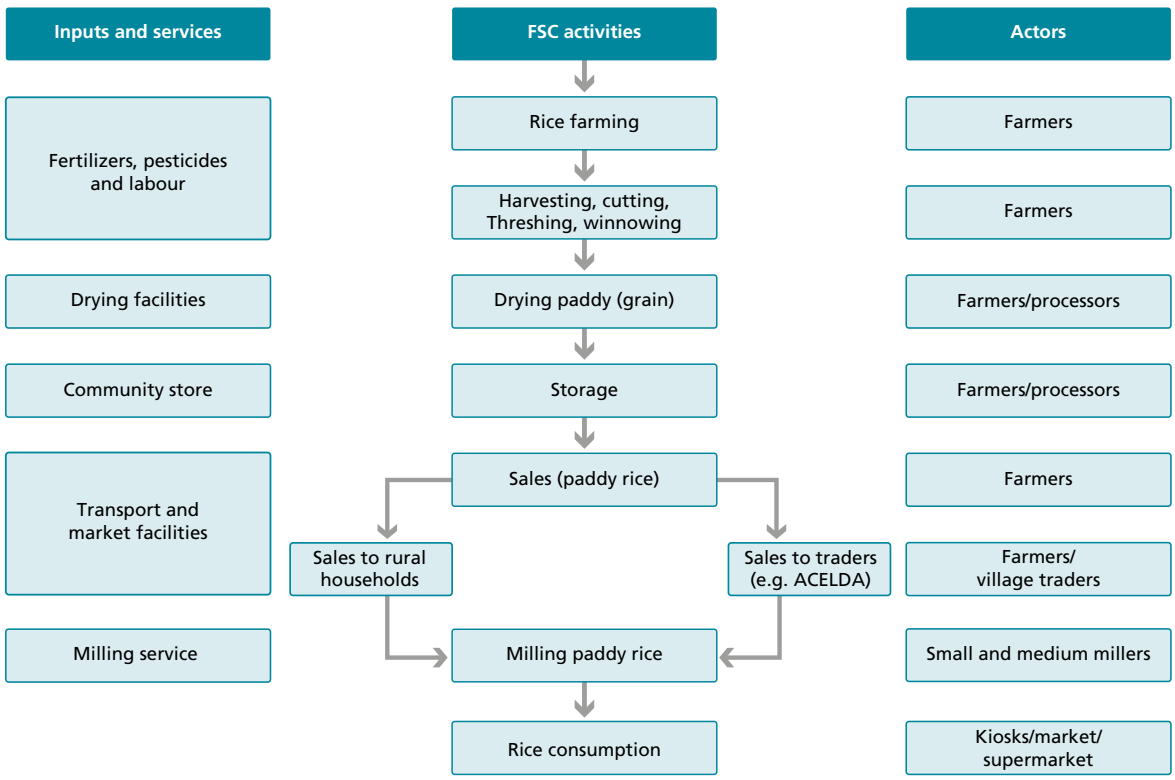


FIGURE 1.3
Manual harvesting by women

©FAO/UNTL

FIGURE 1.4
Ready to transport to the farm house

©FAO/UNTL

FIGURE 1.5
Threshing

©FAO/UNTL

FIGURE 1.6
Winnowing

©FAO/UNTL

FIGURE 1.7
On-farm storage

©FAO/UNTL

FIGURE 1.8
Storage at home (warehouse)

©FAO/UNTL

centage of farmers store their paddy in airtight containers and in elevated houses.

The average time for storing paddy rice is 8.5 months, with a minimum of 3 days and a maximum of 24 months. Farmers store their paddy for such a long period because of over-production and few buyers to purchase the product.

Types of storage observed during field visits can be seen in Figures 1.7 and 1.8

Drying – Most farmers dry their paddy rice prior to milling. The time taken to dry paddy rice is 1 to 14 days, depending on the duration of sunshine. Most farmers in these areas rely on sun drying to ensure their paddy is sufficiently dried for milling. The result of the study shows that approximately 50 percent of farmers in the study area only need one day to dry their paddy, while others need 3 to 7 days.

Most drying is done at home, while a small number of farmers dry their paddy in the field. Most farmers dry their paddy on a tarpaulin (*biti*) spread on the ground.

There are a number of ways of knowing whether the paddy is dried or not. First, farmers just look at the grain. If the colour is yellow, they know it is dry. The second way is by pressing the grain. If it is hard, they also know it is dry. Lastly, by testing with the teeth, the farmer can also know whether the grain is hard enough (dried) or still soft (not dried). However these traditional methods need experience to accurately determine the level of dryness.

Processing – Rice in the study area is usually processed using milling machines. There are around ten small rice milling machines, owned by the community, and one large machine owned by ACELDA, which is the only firm that runs a business in the rice sector (see next section). Farmers can only bring their paddy for milling when the stock for consumption is finished or if they need to give it to needy relatives. The quantity of rice milled is around 50 to 100 kg per household. In addition, the average milling rate for paddy to rice is between 50 to 60 percent but this depends on the variety of paddy. ACELDA usually collects paddy rice from farming collection centres. In 2014, around 120 tonnes of paddy rice was milled. After the paddy has been milled, the product is packed in bags of different sizes to be sold to consumers in Baucau and Dili.

FIGURE 1.9
Sun drying

©FAO/UNTL

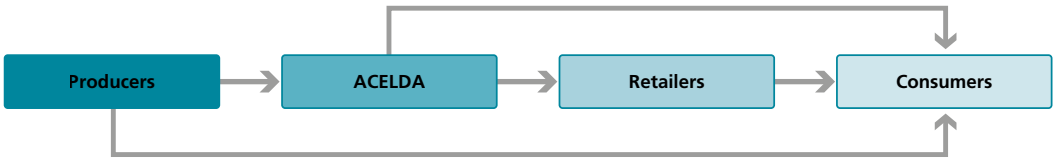
FIGURE 1.10
Rice ready to be transported to the milling house

©FAO/UNTL

FIGURE 1.11
Processing/milling

©FAO/UNTL

FIGURE 1.12
Actors in the rice supply chain in Baucau



Transportation – Paddy rice is usually transported from the field to warehouses using trucks, motorbikes and hand threshers (*Karosa*). Paddy is usually packed in bags of 25 to 50 kg and loaded onto the truck. The distance from the field to the warehouse is around 1 to 2 km. Farmers usually use *Karosa* to transport paddy to the mill, as the volume is small and the distance from warehouse to the mill is only around 200 to 300 metres. In addition, most farmers or transporters do not cover the product during transportation. ACELDA usually use their own truck to pick up the paddy from the production centres and deliver it to the warehouse over a distance of 15 to 150 km, which takes 1.5 to 5 hours depending on the road conditions.

Market sales – Farmers usually sell paddy rice to processors and to their neighbours. Rice is sold in small quantities directly to the consumers in the local and district markets. After paddy rice has been processed, processors sell the rice through the retailers in Baucau and Dili markets, at mini shops and supermarkets, that then sell to consumers.

EXISTING MARKETING SYSTEM IN THE RICE SUPPLY CHAIN

Paddy/rice has been traded for many years based on a system of trust between farmers and traders in the village, and at subdistrict and district level. However, because of the lack of market for this product, farmers have lost the motivation to continue growing paddy rice for marketing. Today, only a few farmers continue to trade this commodity. Farmers market rice to pay the school fees for their children and for other needs.

The study shows that most respondents (92 percent) do not sell their paddy rice at the market, only 8 percent does. This is in line with a study carried out by Care (2004) on paddy rice, which showed that more than 70 percent of farmers at rice production centres do not sell their produce.

During the past few years, the Government has been the only buyer of rice, which has distorted the market. There is no permanent buyer of rice. Recently, however, in Baucau, ACELDA set up a medium-scale rice milling activity. ACELDA buys paddy rice from farmers, processes it (e.g. milling, grading and packing) and sells it to consumers in Baucau and Dili. The capacity of the business is very small. ACELDA therefore only purchases small quantities of paddy rice produced by farmers.

In the traditional marketing system, producers process and package their produce themselves and transport it to the local market and to Baucau market. Only a small number of producers sell their rice directly to Dili market. At the local market, rice costs USD 1 for a 0.5 kg tin, meaning that 1 kg costs USD 2.

The total paddy rice sold in the study area in 2015 was 25.4 tonnes. This represents a total value of about USD 10 000 (farmers sell 1 kg of paddy rice for USD 0.40 at the farmgate or at home). This result reflects that paddy rice alone can offer a significant improvement in income of about USD 1 250 per farm household in the study area.

Most farmers sell their paddy rice in July, September and October.

In terms of market information, skills and technologies on post-harvest management, farmers learn from fellow farmers (48 percent) and from historical data (63 percent). The two main sources of information are extension workers (14 percent) and radio programs (1 percent).

ACTORS IN THE SUPPLY CHAIN: INVOLVEMENT, BENEFIT, JOB CREATION AND INCOME

A number of stakeholders, including MAFF, MCIA, GIZ, JICA, Care International, the United States Agency for International Development (USAID), FAO, and the private sector (e.g. ACELDA) have conducted interventions to improve rice production. As a government

institution, MAFF has invested more compared to the others.

The programmes implemented have benefited more than 115 500 people. For example, the construction of irrigation structures and land preparation for paddy rice alone benefited about 81 000 farmers. It was estimated that 700 new jobs were created for those who manage tractors (MAFF, 2008a; MAFF, 2008b).

In addition, in order to support all MAFF activities at the field level, including free land preparation of 20 000 ha throughout the country, MAFF indirectly created jobs for the delivery of fuel and tractor operators. MAFF also recruited 442 extension workers to be stationed in villages. In the last five years, 11 200 participants, including farmers and MAFF staff, have benefited from training and workshops.

Gender and socioeconomic patterns

Rice production plays a critical role in the community life of Baucau, particularly in areas with high potential in terms of paddy rice production such as Vemasse, Seical, and Laga. As their livelihoods depend very much on this commodity, there is significant involvement of both men and women in rice production and marketing.

Men are responsible for land preparation, threshing and milling while women engage in harvesting, winnowing, drying, cleaning and storage. Men and women work together in marketing, packing and transportation. Children usually support these activities but not fulltime.

In rice production areas, labour is hired only for certain activities, including planting and harvesting, which are mostly performed by women. This has become a tradition in some areas where the involvement of women for such activities is significant. Therefore, women spend most of their time in the field during the planting and harvesting seasons.

The wages per person per day both for harvesting and planting activities is USD 5.00. However, when the demand for these activities is high, the wages will also rise. In 2014 wages increased to USD 7.50/person/day. Another reason for the increase in wages was the lack of labour (women) during the planting and harvesting seasons because young people have migrated to the capital Dili for jobs, other opportunities, or to study. There is no difference between wages for men and women for planting and harvesting.

It is interesting to note that in the past, it was a tradition for people in the community to help each other carry out farming activities. Exchanging labour was common. When someone's paddy was ready for planting/harvesting, people would come from the community to help do the work. The owner of the farm would only provide meals and drinks and there would be no payment. In the last ten years, however, this tradition has been evolving and people now receive money or

TABLE 1.11
Detailed description of the rice supply chain – social structures

FSC steps	Women			Men			Gender/social patterns (additional obs & remarks)
	No. child	No. adult	Qualifier	No. child	No. adult	Qualifier	
Primary production	na	na	na	na	100	95	Men
Harvest	35	40	60	na	25	25	Women and girls
Post-harvest handling	na	20	10	15	65	50	Men and boys
Storage	na	35	30	20	45	40	Women and men
Transportation	na	10	na	20	70	50	Men and boys
Market sales	na	30	30	na	40	40	Men and women
Agroprocessing	na	na	na	na	5	5	Men and boys
Storage	na	35	30	20	45	40	Women and men
Transportation	na	10	na	20	70	50	Men and boys
Wholesale	na	na	na	na	na	na	-
Retail	na	na	na	na	na	na	Men and women

Source: authors' research (field survey)

TABLE 1.12
Detailed description of the rice supply chain – Economics

FSC stage	Main products	Cost of production (USD/kg)	Value of products (USD/kg)	Value added/margins (USD/kg)
Primary production	Paddy	0.19	0.40	0.21
Harvest	Paddy	0.025	0.40	0.375
Post-harvest handling	Paddy	na	na	na
Storage	Paddy	na	na	na
Transportation	Paddy	0.030	0.40	0.37
Market sales	Paddy	na	na	na
Agroprocessing	Rice	0.021	2.00	1.979
Storage	Rice	na	na	na
Transportation	Rice	0.020	2.00	1.98
Retail	Rice	na	na	na

Source: authors' research (field survey)

a contribution in-kind for providing assistance. Only a few communities in remote areas still practise this tradition.

In the household, both the husband and the wife make the decisions regarding activities of production, processing and marketing. Men make decisions related to production, harvesting, threshing, processing, transportation and marketing, while women make decisions related to winnowing, drying and storage.

Chapter 3
Food losses – Study findings and results

DESCRIPTION OF THE RICE SUPPLY CHAIN: RISK FACTORS

Nakroman is one of the high-yield varieties that is resistant to pests and disease. The values observed in the present study are 'low' for variables such as packaging materials, market information, knowledge of FSC actors and consumer access to food products (Table 1.13), thus contributing to the risk of food losses.

CRITICAL LOSS POINTS

For most respondents, quantitative and qualitative losses of paddy rice occur at all stages: harvest and post-harvest, storage and processing. The critical loss points are the stages of harvesting, threshing, milling and storage (see Figure 1.13 and Table 1.14).

Losses are caused by mould, rodents and chickens at the stages of storage and drying, and by spillage during cleaning, loading, off-loading and transportation. In addition, breakage occurs in a small volume of paddy rice kernels during packaging, as well as germination because of late harvesting and rain.

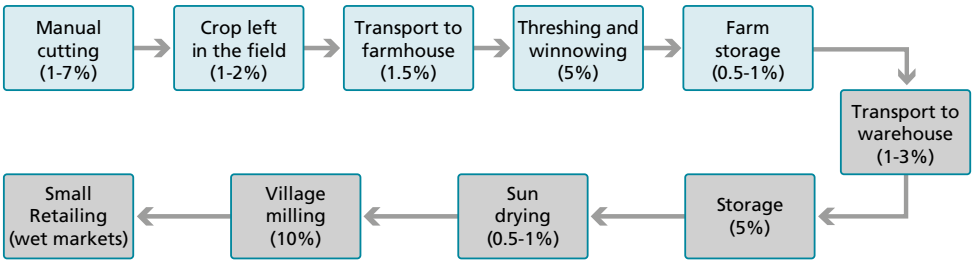
If the farmer has enough money to hire workers and mechanical threshers, post-harvesting activities take place earlier and are carried out quickly and the level of losses can be lowered. On the

TABLE 1.13
Food Loss Risk Factors

Variable	Unit	Parameter in relation to food losses	Value (observed in the case study)
Crop variety	***Name***	***Resistant variety***	***Nakroman***
GAP	Y/N	Yes	No
Rainfall during production	Mm	Optimum range	Minimum range
Production supply/demand ratio	Ratio	<1	
Rainfall during post-harvest phase	Mm	Low rainfall	Low rainfall
Post-harvest technology	L/M/H	High	Low
POs/Coops	Y/N	Yes	No
Processing technologies	L/M/H	High	Low
Good manufacturing Practices	Y/N	Yes	na
Packaging materials and facilities	L/M/H	High	Low
Cold chains	Y/N	Yes	No
Transport duration	Hour	Low duration	na
Market information	L/M/H	High	Low
Price incentive for quality	Y/N	Yes	No
Knowledge of FSC actors	L/M/H	High	Low
Consumer access to food product	L/M/H	High	Low

Source: authors' research (field survey)

FIGURE 1.13
Estimated losses along the post-harvest chain in the study area



contrary, if the farmer does not have sufficient financial resources to pay for labour and threshers, harvesting will take longer and post-harvesting activities will be delayed in the field, leading to high levels of losses of paddy rice.

As indicated earlier in this report, in the section describing the Methodology, quantitative and qualitative losses were estimated based on interviews with farmers and other stakeholders involved in the supply chains, complemented by direct observation and focus group discussions.

The critical loss points for paddy rice are the stages of harvesting, threshing, milling and storage. Some of the causes identified at the microlevel are listed below:

- Extended field storage – weeks elapse between the time of harvest and the time when paddy rice is transported to the farmhouse, depending on the availability of labour.
- At threshing, spillage occurs because of the poor conditions of the machines, leading to significant losses of paddy rice at this stage.
- It is difficult for farmers, who lack the necessary skills, to set up the machines effectively.
- Farmers grow different varieties of paddy rice, which have different physiological properties such as water content, which contributes to losses at this stage.
- Farmers use local and traditional storage facilities, which are inadequate.

The level of losses is significant for rice farmers in Baucau. The total losses of paddy rice at the CLPs for the study site are 47 tonnes or 21 percent of the total production of 224.4 tonnes.

In terms of economic losses, this amount is equivalent to USD 10 900 for paddy rice (USD 0.40 per kg); and USD 24 000 for rice after milling (USD 2/kg). The total economic losses in the studied supply chain were USD 35 000 or USD 350 per farmer.

CAUSES OF LOSSES AND POTENTIAL LOSS REDUCTION MEASURES

Harvesting

Shortage of labour – There is always a shortage of labour during the harvesting season. This affects both the time and the duration of harvesting activities. Delaying harvesting when the paddy is ready contributes to loss.

Regarding the duration of harvesting, the results of the study showed that some farmers need two to three weeks to harvest their paddy. Again, shortge of labour is the cause of this long duration.

The shortage of labour – is usually because there is a lack of capital for hiring labour. Other secondary causes identified are the lack of harvesting technology, the lack of financial services in rural areas and the poor services delivered by MAFF.

Lack of equipment – Most famers use only knives and *sabit* for cutting. If the knife is not sharp enough, the efficiency of harvesting is hampered. The lack of appropriate harvesting equipment, compounded by the absence of financial services in the rural areas, contribtes to loss.

Rain during harvesting – In some areas, rain continues during May and June when harvesting is in progress. The farmers continue with the harvest, notwithstanding, and this causes the grains that fall to germinate, which results in lost paddy.

TABLE 1.14
Summary result matrix of rice losses

Stage in FSC/ Process	Type of loss (quantity/ quality)	Percentage lost in this process	Percentage lost of the initial quantity	Quantity lost (kg)	Percentage of the product that incurred quality loss in this process	Cause of loss	Economic loss (USD)	CLP/LLP	Destination of food loss	Impact/FSC actors affected (men/women)
Harvesting	Quantity	3.5	3.5	7 850	na	Lack of labour, lack of equipment, waterlogged, rain during harvesting, manual method of harvesting	3 140	CLP	For animal feeding or product thrown away	Men and women
Homestead transfer	Quantity	1.5	1.45	3 250	na	Poor transport, lack of packing, poor vehicle and poor roads	1 300	LLP		Men, women and children
Threshing	Quantity	5	4.75	10 660	na	Poor machine set up, paddy is too dry, mix paddy, Poor machine set up, variety	4 260	CLP		Men
Sun drying	Quantity	0.5	0.45	1 010	na	Lack of drying facilities and lack of labour	400	LLP		Women and children
Cleaning	Quantity	0.5	0.45	1 010	na	Manual method and lack of equipment	400	LLP		Women and children
Milling	Quantity & quality	10	8.9	20 000	1-2	Poor machine set up	24 000	CLP		Men
Packaging	Quantity & quality	0.5	0.4	900	0.2	Lack of packing and manual method	360	LLP		Men
Storage (warehouse)	Quantity & quality	5	3.93	8 800	2-5	Lack of storage facilities and lack of packing	3 500	CLP		Men
Loading	Quantity	1	0.74	1 700	na	Lack of packing, lack of labour and lack of equipment	680	LLP		Men
Off-loading	Quantity	1.5	1.1	2 500	na	Lack of packing, lack of labor and lack of equipment	1 000	LLP		Men
Transportation	Quantity	1	0.7	1 600	na	Poor roads and poor transport	640	LLP		Men

Source: authors' research (field survey)
* This is the loss of paddy during milling

Threshing and milling

Lack of threshers – Most farmers in the study area depend on threshers to process their product. There are very few threshers, however, and farmers have to wait a few weeks after harvesting as the demand for threshers is high at this time. They have no choice but to leave their paddy rice in the field during this time.

The lack of capital to purchase thresher machines and the lack of financial services for loans to farmers have been identified as a secondary cause for the limited number of threshers.

Milling machine and efficiency of manual threshing – Farmers lack the requisite skills to set up threshers and milling machines and this contributes to losses. For example, if the machine (thresher) is not set up properly, there will be spillage. In addition, the fact that farmers grow different varieties of paddy rice, which are not uniform and have different physiological parameters, including water content, contributes to the losses of paddy and rice at this stage.

The milling rate is an estimated 60 percent. Nevertheless, some farmers said the rate is variable and depends on the moisture content of the paddy, which varies according to rice variety, as well as on the adjustment of milling machines.

FIGURE 1.14
Threshing inefficiency

©FAO/UNTL

FIGURE 1.15
Poor storage

©FAO/UNTL

Storage

Lack of storage facilities – The main constraints faced by farmers in relation to storage include the lack of adequate and safe storage facilities and poor storage management. Most farmers in the study area still use traditional storage facilities, including '*hoka*'. This kind of storage is not safe as it is made of palm leaves or plastic. So far there is no other alternative for farmers to store their paddy. Rodents and chickens therefore easily damage the product. Other problems include weevils, mould and decay.

Identified secondary causes – the lack of training on how to manage storage, the lack of improved storage facilities and lack of capital and financial services.

LOW LOSS POINTS

The low loss points in the paddy rice supply chain occur at the stages of drying, cleaning, transfer to the homestead, packaging, loading and off-loading and transportation. Good practices contributing to the low losses at this stages include:

- Use of tarpaulins to cover the ground to dry paddy;
- Use of sacks (25, 30, 35, 50 kg) for packing and transporting the product both to the warehouse and the mill. These practices enable farmers to avoid spillage during loading and off-loading, which would otherwise occur as a result of the heavy loads.

Chapter 4

Food loss reduction strategy – conclusions and recommendations

IMPACT OF FOOD LOSSES IN THE SELECTED FOOD SUPPLY CHAIN

As indicated above, the level of losses is significant for rice farmers in Baucau. The total losses of paddy rice at the CLP stages: harvesting, threshing, milling and warehouse storage amount to 47 tonnes, which is 21 percent of the total production of 224.4 tonnes in the study area.

In terms of economic losses, this amount is equivalent to USD 35 000 (USD 350 per farmer).

These losses affect not only the farmer's socio-economic prospects, but they also represent a waste of resources at the level of production for example land, water, energy and other inputs. Thus, the losses of paddy rice have an immediate impact on the livelihoods of smallholder households, affecting farmers' ability to feed their families, not to mention their ability to invest in technologies that will help them reduce such losses in the next season.

Food loss reduction measures

Micro-level interventions

- One of the solutions for reducing dependency on labour, and further decreasing loss of paddy, is to introduce harvesting machines into the rice potential areas. In addition, it is also important to improve farmers' harvesting and post-harvest equipment.
- It is important to increase the number of threshers so that the long waiting period for threshing is effectively reduced. The quicker the paddy goes for processing (threshing) after harvesting, the lower paddy losses will be.
- In addition, introducing new storage facilities such as silos and drums to replace traditional local storage facilities is critical in curtailing losses at this stage. So far, farmers do not have alternative storage facilities where they can store paddy safely.

Meso-level interventions

- Improving the skills and knowledge of the operators of milling and threshing machines, through training and assistance, would ensure they can manage the equipment efficiently.
- Providing training to farmers in the areas of harvesting, post-harvesting, handling and storage is key to enhancing their skills and improving the effectiveness of the results in the supply chain. Given the magnitude of food losses, making profitable investments in reducing losses and improving the efficiency of the food supply chain would help reduce the cost of food to the consumer, increase access to food, while at the same time improve economic returns to farmers and other actors in the value chain.
- These technologies should be promoted through awareness-raising regarding the costs and impact of post-harvest losses, dissemination of training and knowledge, and increasing farmers' and other actors' access to financial assistance for the purchase or rental of machinery .

The combination of all these measures would result in lowering the level of losses during production and postproduction and improve the quality of the product.

COST-BENEFIT ANALYSIS OF IDENTIFIED FOOD LOSS REDUCTION MEASURES

Budget calculation for rice loss reduction – mechanical threshers

Table 1.15 shows a breakdown of calculations to reduce losses in the rice supply chain using mechanical threshers.

Table 1.15 shows that the intervention is feasible as the loss reduction savings over 10 years is higher (around USD 33 200) than the cost of intervention of USD 14 000. In addition, a thresher costs USD 3 500 and can be imported from Indonesia

TABLE 1.15
Budget calculation for rice loss reduction – using mechanical threshers

	Item: Stooking	Value	Unit	Comments
a	Product quantity	224.4	tonne/year	
b	Product value	400	USD/tonne	
c	Loss rate	4.75	%	
d	Anticipated loss reduction	77.5	%	
e	**Cost of intervention**	14 000	USD	USD 3 500/thresher x 4 threshers
f	Depreciation	10	years	
g	Yearly costs of investment	1 400	USD/year	e / f
h	Yearly costs of operation	600	USD/year	USD 150/thresher/ year x 4 threshers
i	Total yearly costs of solution	2 000	USD/year	g + h
j	Client costs per tonne product	8.9	USD/tonne	i / a
k	Food loss	10.66	tonne/year	c x a
l	Economic loss	4 260	USD/year	k x b
m	Loss reduction	8.26	tonne/year	k x d
n	Loss reduction savings	3,300	USD/year	m x b
o	Total Client costs	2 000	USD/year	i = a x j
p	Profitability of solution	1 300	USD/year	n - o

Source: authors' research (field survey)

or China. The beneficiaries of this solution will be farmer communities in rural areas: four groups of farmers or around 100 farmers (one group has around 25 farmers).

The financial resources will come from farmers, agencies and the Government. Farmers can afford this intervention as the annual income from paddy rice per farmer is around USD 300. The annual income of one group of 25 farmers will then be USD 7 500 (USD 30 000 for 100 farmers).

This intervention is expected to reduce the losses at the threshing stage, thus improving the value of the product and increasing the income of farmers in rural areas. Table 1.16 gives a summary of rice losses, causes and solutions.

FOOD LOSS REDUCTION STRATEGY

The total production at national level of paddy rice is 50 000 tonnes per year, of which 15 percent is marketed. Farmers face many challenges, including the lack of marketing opportunities. High quantities of rice are imported into the country annually.

There are no interventions in the rice sector to reduce losses at harvesting and processing. Levels of losses are high compared to other paddy rice producing countries. To address this problem, technical investment is required focussing on the introduction of new storage facilities and threshers, complemeted with training and technical assistance to empower farmers and other stakeholders.

Introducing more thresher machines, through targeted investments by the Government and the private sector, would reduce losses of paddy rice. The targeted beneficiaries of these investments will be farmers, operators and the community in general who are involved in this activity. To estimate the number of threshers needed in one area, further analysis is required of the quantity of the product that can be processed by one threshing machine per day. By doing this an estimate can be made of how many threshers are needed in one area.

Increasing the number of thresher machines would not be enough to address the issue of losses at the harvesting stage. Training and technical assistance would enhance the capacity of farmers and operators. Training could be carried out by extension workers and other stakeholders, including NGOs.

TABLE 1.16
Summary table of rice losses, causes and solutions

Critical loss point	Magnitude of losses in the FSC (per year)			Causes of losses			Interventions to reduce loss			Loss reduction		Cost of interventions (USD) (10 years)
	Percentage	Weight (kg)	USD	Primary causes (direct)	Secondary causes (1)	Secondary causes (2)	Microlevel	Meso level (1)	Meso level (2)	Percentage	USD/ year	
Harvesting	3.5	7 850	3 140	Waterlogged soils, harvesting of wet grains, use of manual method of harvesting	Lack of harvesting equipment, lack of labour, rain during harvesting, lack of capital	Lack of harvesting technology, lack of financial services in rural areas, poor services delivered by MAFF	Introduce harvesting machines	Training and assistance	Ensure financial services are available to farmers in rural areas and improve MAFF service delivery	75	2 360	
Threshing	5	10 660	4 260	Poor machine set-up, Lack of skills, paddy is too dry, mixing of paddy varieties	Poor skills and knowledge	Lack of training, poor services delivered by MAFF	Continuous assistance to farmers and operators	Increase the number of threshers, more training to improve farmers' skills	Improve MAFF service delivery	77.5	3 300	14 000
Storage	5	8 800	3 500	Lack of equipment, use of manual methods	Lack of storage, lack of labour, lack of capital	Lack of improved storage, lack of financial services in rural areas	Introduce new storage facilities such as drums, silos, etc.	Ensure the availability of new storage facilities for farmers	Ensure financial services are available to farmers in rural areas	50	1 750	
Milling	10	20 000	24 000	Poor machine set-up, mix paddy variety	Poor skills, mixed rice variety, high/ low moisture content	Lack of capital, lack of training	More assistance to farmers and operators, grow uniform rice variety	More training to improve farmers' skills	Ensure financial services are available to farmers in rural areas	80	19 200	

Source: authors' research

Furthermore, silos, drums and other storage facilities should be introduced to replace the traditional facilities currently used. Adoption of the equipment could be reinforced by capacity-building activities for farmers and communities on how to manage new storage facilities effectively and efficiently. Government and international agencies could support farmers and communities by distributing these new storage facilities.

Raising awareness of the impact of food losses is also important, and can be accomplished through seminars, focus group discussions with farmer groups and communication interventions (distribution of pamphlets, brochures, etc.)

Bibliography

Care International. 2004. *Rice marketing survey report in Manatuto, Maliana, Suai, Viqueque and Oecusse*. Timor-Leste, Care International.

FAO/WFP. 2007. *Crop and food supply assessment mission to Timor-Leste*. Rome, FAO/WFP.

IMF. 2011. Democratic Republic of Timor-Leste: 2010 Article IV consultation - Staff Report, IMF Country Report No. 11/65. Washington, D.C., International Monetary Fund.

Janes, J.A., Rubzen, M.F., Da Costa, A.G., Do Rego, A., Ximenes, M.A., Mahareswa, G. & Silva, O. 2010. *Analysis of constraints and potential for rice and maize production in Baucau, Manufahi and Bobonaro districts*, Timor-Leste, ACIAR.

JICA. 2014. *Impact of agricultural subsidy policy on Timor-Leste rice farmers*, Working Paper. JICA.

MAFF. 2006. *Rice: An Overview, Commodity Profile Series No. 1 Version 1.* Dili, Timor-Leste, Directorate of Agribusiness, Ministry of Agriculture, Forestry and Fisheries,.

MAFF. 2008a. *Annual report of the financial year of 2008*. Dili, Timor-Leste, Planning Division, Ministry of Agriculture, Forestry and Fisheries.

MAFF. 2008b. Agribusiness Timor-Leste. Dili, Timor-Leste, *Agribusiness newsletter Volume* 3(1) February 2008. Agribusiness Division, Ministry of Agriculture, Forestry and Fisheries.

MAFF. 2011. *Ministry of Agriculture, Fisheries and Forestry Annual Report 2011.* Dili, Timor-Leste, Planning Division, MAFF.

MAFF. 2015. *Data on the potential areas, area cultivated and maize production 2010-2015*. Dili, Timor-Leste, National Directorate for Agriculture and Horticulture (DNAH), Ministry of Agriculture, Fisheries and Forestry.

MAP. 2007. *Realizasoes do Ministerio da Agricultura, Florestas e Pescas: Relatorio de cinco anos 2002– 2007*. Dili, Timor-Leste, Ministério Agricultura e Pescas.

Ministry of Finance. 2011. *Timor-Leste Demographic and Health Survey 2009-2010*. Dili, Timor-Leste.

National Commission for Research and Development. 2008. *State of Nation Report, Vol. 4.* Dili, Timor-Leste, Ministry of Economy and Development, RDTL.

NSD and UNFPA. 2011. *Population and housing census of Timor-Leste 2010, Volume 3*. Dili, Timor-Leste, National Statistic Directorate and United Nations Population Fund.

RDTL. 2007. *Rising agricultural income and productivity*. MAFF, Timor-Leste.

RDTL. 2011. *Timor-Leste Strategic Development Plan 2011–2030*. Dili, Democratic Republic of Timor-Leste.

Young, Philip. 2013. *Impact of rice imports on rice production in Timor-Leste*. Commissioned Study for the Seeds of Life programme. Dili, Timor-Leste, Ministry of Agriculture and Fisheries.

Food and Agriculture Organization of the United Nations (FAO)
Viale delle Terme di Caracalla, 00153 Rome, Italy
www.fao.org

ISBN 978-92-5-130671-0

9 789251 306710

BU739EN/1/09.18