



The Food Loss Reduction Advantage

Building sustainable food systems

GRAIN

The Food Loss Reduction Advantage

Building sustainable food systems

Acknowledgements

This report was prepared by IFAD's Sustainable Production, Markets and Institutions (PMI) Division based on project documentation and references, with contributions from the Swiss Agency for Development and Cooperation.

Researched and written by Leonardo Cini, consultant (PMI).

Internally reviewed by Robert Delve, Lead Global Technical Advisor, Agronomy (PMI); Antonio Rota, Lead Global Technical Specialist, Livestock (PMI); Richard Abila, Senior Global Technical Specialist, Fisheries and Aquaculture (PMI); Marco Marzano, Special Advisor (PMI); Maria Elena Mangiafico, Knowledge Management and Grants Officer (PMI); Marie-Aude Even, Senior Regional Technical Specialist, Agronomy (PMI); Putso Nyathi, Senior Regional Technical Specialist, Agronomy (PMI); Ronald Hartman, Country Director, Timor-Leste (APR); Nicolas Syed, Programme Officer, Timor-Leste (APR); Joseph Nganga, Programme Officer, Eritrea (ESA); Aimable Ntukanyagwe, Programme Officer, Rwanda (ESA); Aissa Toure, Country Programme Manager, Burundi (ESA); Ronald Ajengo, Country Programme Officer, Kenya (ESA); Custodio Mucavele, Country Officer, Mozambique (ESA); and the Programme Management Units of the five countries involved in the case studies.

Externally reviewed by Mireille Totobesola, Project Manager, Nutrition and Food Systems Division (Food and Agriculture Organization of the United Nations; FAO).

Editorially reviewed by Brian Thomson, Communications Manager Thematic Priorities (International Fund for Agricultural Development; IFAD).

© 2019 by the International Fund for Agricultural Development (IFAD)

The opinions expressed in this publication are those of the authors and do not necessarily represent those of IFAD. The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of IFAD concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The designations "developed" and "developing" countries are intended for statistical convenience and do not necessarily express a judgement about the stage reached by a particular country or area in the development process.

All rights reserved.

Cover photo: ©IFAD/Christopher Neglia

ISBN 978-92-9072-939-6

Printed September 2019

Table of contents

Introduction	4
Timor-Leste: reducing the hungry season through on-farm storage	9
Rwanda: dealing with food loss in a changing climate	12
Mozambique: cooling down the loss in the fisheries sector	16
Kenya: a market-oriented solution to food loss in the dairy sector	19
Burundi: equipment and infrastructure for reduced losses	23
RBA partnership: building evidence for food loss reduction investments	26
Conclusions and way forward	29
Bibliography	31



©IFAD/Asad Zaidi

Introduction

Why reducing food loss matters

The global population is set to reach nearly 10 billion people by 2050, leading to an estimated increase in demand for agricultural produce of almost 50 per cent (FAO, 2017; UNDESA, 2017). Increasing agricultural yields remains key to meeting this rising demand for food, but this will put additional pressure on the sustainable use of natural resources and on the environment. To ensure that everyone is adequately fed while the environment is protected, it has become imperative to reduce the losses within the global food supply chain.

The most recent attempt at estimating global levels of food losses indicates that approximately one third of the food produced globally is lost or wasted along the supply chain (FAO, 2011).¹ These losses affect all agricultural produce, from fruit, vegetables, grains and pulses to meat, dairy, fish and animal products, with perishable products being affected the most. The magnitude of food losses varies significantly across different regions and value chains; for example, food loss in sub-Saharan Africa is estimated to be 13.5 per cent for grains (African Postharvest Losses Information System, APHLIS²; World Bank, 2011) while, for fruit and vegetables, food loss can be as high as 50 per cent (FAO, 2011).

¹ This figure includes both food losses occurring before retail and food waste occurring at the consumer level. A more accurate estimate of the amount of food lost before it reaches the retail market will be released by FAO in the forthcoming State of Food and Agriculture (SOFA) report in 2019. The new estimates will not be comparable to the 2011 FAO estimates because of differences in the scope of coverage and the methodology used.

² See www.aphlis.net

Box 1: What is food loss?

Food loss refers to any decrease in the quantity or quality of products intended for human consumption occurring up to, but excluding, retail (FAO, 2014). Quantitative food loss is defined as a decrease in the mass of food, while qualitative food loss is defined as a decrease in the quality attributes of food (i.e. macro- and micronutrients such as proteins, fats, carbohydrates, vitamins and minerals).

The 2030 Agenda for Sustainable Development has recognized the importance of reducing food loss in achieving Sustainable Development Goal (SDG) 12 (ensuring sustainable consumption and production patterns) and has called for food loss to be halved by 2030 through SDG Target 12.3. This target has spurred progress worldwide towards the reduction of food loss, driven by both governments and private-sector companies. According to the 2018 progress report on SDG Target 12.3, countries and regional blocs covering around 30 per cent of the global population have adopted measures aligned with this target (Champions 12.3, 2018). This notably includes the Malabo Declaration adopted by the African Union, which calls for all its member states to halve food losses by 2025. As of 2018, however, only five African Union member states are on track to achieve this target: Malawi, Mauritania, Rwanda, Togo and Uganda (African Union, 2018).

On the private-sector side, progress is even more promising, with nearly two thirds of the 50 largest food companies participating in programmes that align with SDG Target 12.3 (Champions 12.3, 2018). Most of these companies, however, are food retailers and manufacturers and only a few of them are working to set food loss reduction targets with suppliers and smallholder producers in developing countries.

Through its programme of loans and grants, the International Fund for Agricultural Development (IFAD) has been working with both governments and the private sector to reduce the food losses experienced by smallholder farmers. As the case studies below will demonstrate, these interventions have brought benefits in terms of food security, nutrition, food safety and income opportunities to farming households, while contributing to the global advancement towards the achievement of SDG Target 12.3. This report illustrates the advantages of investing in food loss reduction for smallholder farmers, drawing on practical examples taken from the IFAD programme of loans and grants.

What are the causes of food loss?

Food loss can occur for a variety of reasons, which differ widely across commodities and regions. For example, crops can rot in the field owing to insufficient workers to harvest and dry the crop on time or because of market price fluctuations that make it uneconomic to harvest and sell the crop; at the storage level, the produce can be affected by pests and diseases, especially aflatoxins; during transport, fresh fruit and vegetables can spoil owing to physical damage and lengthy transportation without adequate refrigeration; and animal products can be contaminated through inefficient and unhygienic processing methods.

It is beyond the scope of this report to provide an exhaustive account of all the different causes of the loss of food.³ In general, these losses are the result of a series of constraints that prevent the adoption of effective solutions. Such constraints are associated with a lack of post-harvest infrastructure, equipment and capacity or with the presence of bottlenecks (e.g. limited access to credit, knowledge and market opportunities). As we shall see, IFAD investments are addressing these constraints at all levels of the food supply chain.

A sustainable contribution to rural development

Food security: Reducing food loss can contribute to all four dimensions of food security (i.e. food availability, access to food, utilization and stability). Indeed, on-farm loss reduction in developing countries can directly increase the availability of food for smallholder household consumption while improving access to food further down the value chain. The effective reduction of the loss of food quality will also improve utilization, as the nutritional value of the food produced is maintained. Finally, more efficient post-harvest operations can protect produce from shocks related to weather events and so increase the stability of the food supply.

Nutrition: Evidence supported by different studies shows that food loss reduction can improve nutrient supplies and reduce the micronutrient deficiencies that cause malnutrition (Global Panel, 2018). For example, fisheries represent a key source of nutrients in low-income countries that are largely dependent on staple foods. Fish, however, is a highly perishable commodity and improving post-harvest handling is essential to reducing the loss in both quantity and nutritional quality. This can improve nutritional diversification at a low cost while using locally available produce (see the Mozambique case study).

Food safety: The same practices that lead to qualitative and quantitative food loss reduction are also effective at improving food safety. For example, improved drying and storage reduces the incidence of aflatoxin contamination in grains, while refrigeration reduces the risk of bacteria developing, such as *Salmonella* in chickens and *Vibrio* in shrimp. Reducing food loss, however, can also have a negative impact on food safety if, for example, chemical pesticides are applied to prevent food loss. To avoid this risk, food loss reduction activities should always take into account food safety, for example by promoting the use of locally available biopesticides (see the Rwanda case study).

Income opportunities: Reducing food losses can create income opportunities for the rural poor. Any reduction of on-farm losses increases the amount of produce that farmers can sell to the market, providing them with an opportunity to increase their income. Furthermore, the quality improvements from better post-harvest management can improve access to higher value markets, where farmers can fetch a more profitable price. The improved post-harvest activities that are required to reduce food losses can also generate employment opportunities for the rural population, increasing their disposable income, which can be used to access more, better quality and diversified livelihoods (see the Timor-Leste case study).

³ For a detailed review, please see HLPE (2014), chapter 2 “Causes and Drivers of Food Loss and Waste”, pp. 39-55.

Box 2: Gender and food loss

Women play a significant role in post-harvest handling, but they face considerable obstacles in adopting effective loss-reducing practices owing to persistent gender inequalities (FAO, 2018). Experience also shows that addressing post-harvest management issues has positive impacts on reducing women's workloads. Promoting labour-saving technologies and practices can contribute to alleviating women's drudgery, while also reducing post-harvest losses.

Environment: Producing, transporting and processing food generates large greenhouse gas emissions and involves the use of large amounts of land and water. If food production is made more efficient by reducing food loss and the associated wasteful use of resources, the related carbon, land and water footprint can be reduced. Food loss reduction solutions can, however, bear negative trade-offs for the environment. For example, the adoption of cold storage and plastic packaging, although effective in reducing food loss, may lead to an increase in the total energy use and environmental footprint. Environmental trade-offs can be minimized by adopting climate-sensitive solutions, such as green cold storage options and reusable and/or compostable packaging (see the Rwanda case study).

Investing in food loss reduction

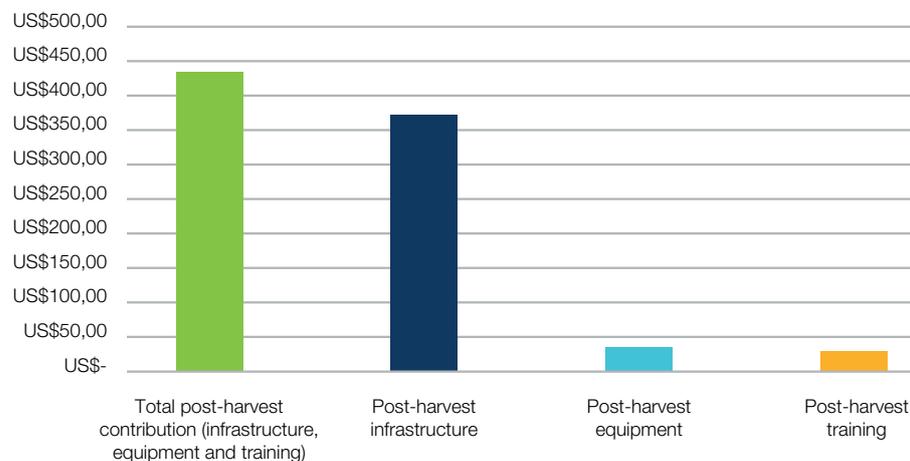
IFAD's investment in food loss reduction is informed by the value chain approach followed by many of its loan projects. As value chain development became established within IFAD, more and more loan programmes have started promoting food loss reduction. Between 2013 and 2016, IFAD has approved the disbursement of at least US\$433 million (12 per cent of total disbursement) for upgrading post-harvest infrastructure, equipment and capacities, which are essential for enabling poor farmers and entrepreneurs to minimize food losses along food supply chains (see figure 1). Of these funds, US\$371 million were earmarked for improved post-harvest infrastructure, including roads, collection centres, storage warehouses, and processing and packaging facilities; US\$35 million were allocated to upgrading equipment for harvest, post-harvest handling, drying, cooling, storage, processing and transport; and approximately US\$27 million were allocated to training farmers, farmer groups and value chain operators on adequate post-harvest techniques.

Scaling up food loss reduction

In addition to its work through loan and grant programmes, IFAD has also partnered with a range of donors to scale up its impact on food loss reduction, with a strong focus on knowledge generation and policy engagement. These partnerships include the following supplementary funded grants:

- the ongoing project "Mainstreaming food loss reduction initiatives for smallholders in food deficit countries", funded by the Swiss Agency for Development and Cooperation (SDC) and jointly implemented by the Food and Agriculture Organization (FAO), IFAD and the World Food Programme (WFP) between 2014 and 2020;

Figure 1: IFAD funds allocated to post-harvest infrastructure, equipment and training, 2013-2016 (US\$ million)



- the ongoing grant “Catalysing Post-harvest Management for Food Systems Transformation”, funded by the Rockefeller Foundation in 2019;
- the “United Nations Joint Project”, funded by the Irish Government and implemented jointly by IFAD and FAO between 2013 and 2015;
- the “Smallholder Post-harvest Innovations Project”, funded by the Innovations Mainstreaming Initiative of IFAD and the UK Department for International Development between 2012 and 2013.

Case studies

The following case studies showcase IFAD’s investments in food loss reduction and the advantages they have brought to beneficiaries. They cover crops, fisheries and livestock value chains and provide evidence of different approaches to food loss reduction. The Timor-Leste case study demonstrates the advantages of improving food security by reducing losses through the improvement of on-farm storage. The Rwanda case study instead demonstrates the potential of climate-smart investment in post-harvest loss reduction to improve the income of smallholders. The three case studies that follow these first two are examples of IFAD support in enhancing fish preservation in Mozambique and in improving milk as well as rice handling in Kenya and Burundi. The final case study focuses on the Rome-based agency (RBA) partnership and on its efforts to generate evidence on food loss reduction and mainstream it in national policy frameworks.



©Ronald Hartman

Timor-Leste: reducing the hungry season through on-farm storage

Key facts

Project name	Timor-Leste Maize Storage Programme (TLMSP)
Dates	2011-2015
Financing	IFAD, Government of Timor-Leste and project beneficiaries
Targeting	Poor upland maize farmers
Programme objective	Improving food security for maize-growing households in Timor-Leste by reducing losses of maize stored on farms

The sustainable development challenge

Timor-Leste's population is one of the poorest in the world, with 70 per cent of the workforce employed in agriculture. When this IFAD-funded intervention was designed, food insecurity and malnutrition were widespread among upland farming communities. It was estimated that 95 per cent of households experienced a first hungry season without sufficient staple food for 3.9 months, while 31 per cent also experienced a second hungry season for 3.6 months. Furthermore, 15.1 per cent of children under 5 years had acute malnutrition, 58.7 per cent suffered from chronic malnutrition and 41.8 per cent were underweight.

Maize has long been the single most important crop in Timor-Leste, accounting for 36 per cent of agricultural production in 2011. However, the production of this crop is affected by high storage losses associated with traditional drying and storage



techniques. Farmers traditionally hang maize cobs on racks or in trees to complete drying after the harvest and then store the cobs in a loft above the kitchen fire, in a storage barn on stilts or suspended in a tree. In the highlands, it was estimated that at least 15 per cent of the maize dried and stored this way was lost to rodent and weevil damage. Such losses equate to about 31,250 Mt of maize each year and an annual national cost of about US\$17.5 million.

IFAD action

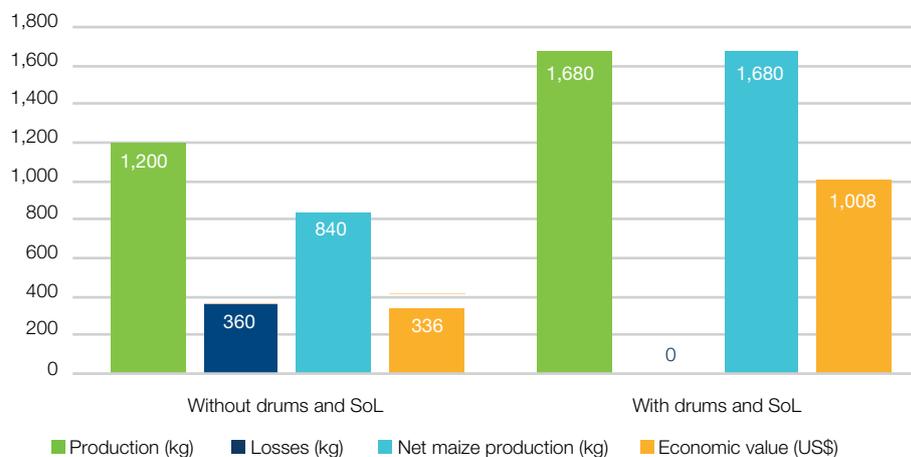
The Timor-Leste Maize Storage Programme (TLMSP) is a successful example of a project design focused on a clear and achievable objective – reducing on-farm maize storage losses to improve the food security of poor and hungry families in Timor-Leste’s upland farming zone. This objective was pursued by providing farmers with storage drums at a subsidized cost and training them in their appropriate use and maintenance.

During its implementation, the programme distributed 41,337 steel drums to 23,000 poor maize-growing households. These drums were chosen for their proven potential to reduce on-farm storage losses and for their suitability to the local context. Being fully hermetic, they required no added treatment to prevent insect infestation. Furthermore, they had a lifespan of at least 25 years if well maintained, making them very cost-effective even for poor smallholder farmers.

The project used a participatory and community-based approach as a framework for drum delivery. Young university agricultural graduates were hired as facilitators to support the communities for the whole drum delivery and extension process, and to train beneficiaries on appropriate drum use and maintenance. This approach not only was instrumental to providing young people with meaningful employment opportunities, but also contributed to social empowerment of the community as a whole.

Previous government programmes that had provided storage drums free of charge had typically experienced the misuse of drums and/or the use of drums for non-storage purposes. To encourage appropriate use and maintenance of the storage drums, the TLMSP asked farmers for a US\$10 contribution, matched by a project contribution of US\$40. Although minimal, this beneficiary cash contribution proved effective in achieving high rates of adoption and appropriate use among poor rural households.

Figure 2: Combined per capita impact of TLMSP and SoL



Source: SoL evaluation – summary presentation for Timor-Leste agriculture, 2016

The vast majority of drum owners were found to be committed to continued maintenance of their drums, with 93 per cent of drums used for food storage or, if empty, not misused.

The TLMSP worked closely with the Australian Aid-funded Seeds of Life III (SoL) programme to boost the complementary impact of storage drums and higher yielding maize seeds. The TLMSP distributed SoL’s improved seed variety at the same time as drums were distributed, while SoL used TLMSP drums to store around 100 Mt of maize seed in 2015. The combined effect of improved seed and storage generated a 100 per cent increase in food production for beneficiaries (see figure 2).

Impact

The Timor-Leste Maize Storage Programme (TLMSP) successfully reduced storage losses from 15 per cent to less than 1 per cent among farmers who adopted the drums. This resulted in an estimated saving of 1,079 Mt of incremental food (about 80 kg of staple food per target family) every year. Furthermore, the improved storage technology significantly reduced the occurrence of moisture-reliant pathogens in the area, which now exhibits the lowest occurrence of mycotoxin in the country.

The food security of 23,000 target households was substantially improved as a result of the intervention. According to the final impact assessment, the percentage of households experiencing a first hungry season reduced from 95 to 33 per cent, while the percentage of households experiencing a second hungry season dropped from 31 to 6 per cent. Among children under 5 years, acute malnutrition was reduced by 3.2 per cent, chronic malnutrition was reduced by 3.3 per cent, and the rate of underweight children was reduced by 14.1 per cent in the area in which the programme was run.

The intervention also had a positive impact on the incomes of poor rural households. Investing in subsidized drums generated an annual return of nearly 300 per cent and the drums were proven to have the potential to generate an attractive return of 38 per cent even in the absence of a subsidy. When the storage drums were coupled with SoL’s maize varieties, net maize production doubled and the value of the maize produced tripled, resulting in a return on investment of 400 per cent for subsidized drums and 52 per cent for non-subsidized drums.



©Leonardo Cini

Rwanda: dealing with food loss in a changing climate

Key facts

Project name	Climate-resilient Post-harvest and Agribusiness Support Project (PASP)
Dates	2014-2020
Financing	IFAD including the Adaptation for Smallholder Agriculture Programme (ASAP), the Government of Rwanda, commercial banks and beneficiary contributions
Targeting	Poor smallholder farmers engaged in producing and processing maize and beans, Irish potato, cassava, dairy and horticulture Individual farmers and entrepreneurs who have the potential to drive new investments and employment opportunities for vulnerable groups, including the landless poor
Programme objective	Increasing the incomes of smallholders and rural labourers by supporting transformation and value addition

The sustainable development challenge

Agriculture is the leading economic activity in Rwanda, employing more than 70 per cent of the country's workforce. The Rwandan Government has invested heavily in agricultural development, particularly in the intensification of key staple crops. Despite significant improvements in agricultural productivity, post-harvest



losses have remained high in many key value chains. In 2014, average losses were estimated at approximately 30 per cent of harvested products for key value chains (maize, beans, Irish potato, cassava and dairy). This was due to limited knowledge and skills in post-harvest handling and on-farm storage, paired with the limited access to appropriate post-harvest equipment and drying, storage and cooling infrastructure.

The recent changes in rainfall patterns linked to climate change have further increased the likelihood of crop losses. Rwanda has been experiencing a shift in the timing of the two cropping seasons that characterize the country's farming system. Farmers are now faced with an increased incidence of rainfall during the harvesting season, which, in the absence of adequate means to dry and protect their produce from the rain, is leading to increased crop losses. The incidence of aflatoxin has also significantly increased as a result, posing significant threats to food safety and increasing losses during storage.

IFAD action

The IFAD-funded Climate-Resilient Post-harvest and Agribusiness Support Project (PASP) provides an illustrative example of the use of demand-driven matching grants to finance investments in food loss reduction. PASP aimed to increase the incomes of smallholders and rural labourers by supporting climate-smart post-harvest and agribusiness investments. Crucial to the achievement of this objective is the reduction of the post-harvest losses that affect the country's major food crops, specifically maize and beans, Irish potato, cassava and milk, as well as horticulture.

The project was designed following the hub model developed by Heifer International. The model focuses on the creation and strengthening of hubs, which are defined as multifunctional business centres that constitute the first significant point where primary produce is aggregated. The hubs identified by the project are cooperatives, farmers' organizations, and small and medium-sized enterprises with a proven potential to develop inclusive business activities that benefit poor smallholder farmers.

PASP assisted the targeted hubs in identifying and addressing their business management and financial skills gaps. In partnership with established business

One of PASP's grant recipients is Pasta Rwanda, a small enterprise producing the first pasta made in Rwanda and sourcing its entire flour supply from the nearby maize cooperative IABM. The funding enabled Pasta Rwanda to purchase biodegradable packaging equipment and to equip its facilities with rainwater harvesting tanks, biogas cookers and solar panels.

©Leonardo Cini



development service providers, the project supported the hubs in the preparation of viable business plans for post-harvest and agribusiness investments, including both physical capital and the acquisition of capacity and equipment. Eligible investments included climate-resilient drying, processing, value addition, packaging, storage, logistics, distribution and other post-harvest activities.

The project then worked with eligible hubs to leverage commercial loans to finance their business plans. PASP provided a performance-based matching grant covering a set portion of the investment, conditional upon the grantee securing funding through their own contribution or commercial financial institutions. A specific grant window was created for joint ventures between farming organizations and the private-sector organizations, as well as for public-private-producer partnerships. Matching grant beneficiaries were also given access to an ASAP-funded grant facility to support resilience to climate change.

As of November 2018, 202 business plans had been approved for matching grant financing. The majority of approved business plans funded the construction and rehabilitation of warehouses for the collection and storage of crops. Many business plans also focused on the acquisition of transport equipment (particularly trucks and motorcycles), but also on processing and post-harvest handling (see table 1). Approximately half of the business plans financed by the project received an ASAP grant to climate proof their post-harvest infrastructure and to support the acquisition of climate-smart equipment and technologies, such as solar-powered dryers and coolers.

In addition to matching grant finance, PASP also provided training on technical post-harvest skills to farmers linked to identified hubs. As of July 2018, around 14,000 cooperative members were trained in improved post-harvest handling and storage practices for maize, beans, cassava and Irish potato. The project also funded two food loss assessment studies on beans and cassava, as well as the identification of crop and forage varieties that mature earlier and are more tolerant to floods and droughts. Finally, PASP piloted and tested a range of locally available biopesticides to counter the unsafe use of chemicals in household storage practices.

Table 1: PASP post-harvest operations funded by business plans

Operation	Number of business plans
Post-harvest handling	24
Storage	125
Transport	30
Processing	23
Total	202

Impact

The 2018 project evaluation estimated that around 44,000 smallholder households have gained access to new climate-smart post-harvest technologies through PASP. These improvements are expected to significantly contribute to reducing food loss and improving food security, while increasing rural incomes and creating employment both on and off farms.

Specifically, a 20 per cent reduction in the level of post-harvest losses over the baseline is expected by project completion. This will contribute to improved food security by reducing the prevalence of child malnutrition by 5 percentage points among beneficiary households. Finally, the new employment and income opportunities created by the supported cooperatives and enterprises are expected to contribute to an average income increase of at least 10 per cent for project beneficiaries in the targeted value chains.



©IFAD/Rodrigue Mbock

Mozambique: cooling down the loss in the fisheries sector

Key facts

Project name	Artisanal Fisheries Promotion Project (ProPESCA)
Dates	2011-2019
Financing	IFAD, the European Union, the Organization of the Petroleum Exporting Countries (OPEC) Fund for International Development (OFID), the Government of Mozambique, the private sector and domestic financing institutions
Targeting	Poor and very poor fishers and fish traders
Programme objective	Increasing the returns from fish sales for artisanal fishers and small-market operators on a sustainable basis

The sustainable development challenge

Fisheries are an important resource in Mozambique and contribute significantly to the nutrition of the country's population. Small-scale artisanal fishing is far more common than large-scale commercial fishing, generating about 90 per cent of the total marine catch. At the time of project design in 2010, it was estimated that approximately 334,000 people depended directly or indirectly on artisanal fishing in the country. Most fishing communities are small, isolated and poor and generally combine fishing and fish marketing with subsistence agriculture.



Fish is marketed in three forms in Mozambique: dried/salted, smoked and fresh/frozen. The issue of post-harvest loss affects fishing operations at all levels of the different value chains. The limited availability of ice and insulated containers increases the risk of losses for fresh fish, while inadequate processing equipment and practices lead to high levels of losses for salted/dried and smoked fish, particularly in the rainy season. The poor conditions of local roads combined with the lack of refrigerated trucks adds to the risk of losing produce during transport, while, at the final sale, inadequate market infrastructures with little or no ice or cold-storage facilities further increase the likelihood of losses.

IFAD action

The Artisanal Fisheries Promotion Project (ProPESCA) was designed to improve the incomes and livelihoods of poor households involved in artisanal fisheries in Mozambique. Central to achieving this goal is increasing the returns from fish sales for artisanal fishers and small-market operators. The project targeted all levels of the value chain, including fishing operations, the transport of fish, handling and processing operations, marketing and ultimately sales. Throughout the different stages, particular attention was given to facilitating investment in refrigerating capacity, which is key to reducing the high levels of loss in the target area.

ProPESCA facilitated the development of higher value fish marketing by building the capacity of different stakeholders while developing market infrastructure. The project trained 13,000 fishers in improved handling, processing and conservation of fresh and frozen fish, which resulted in a reduction in post-production losses. Furthermore, 16 fish markets were restored and 15 were newly constructed: eight for first sale and seven for retail. Each market is now equipped with sanitation facilities, water and electricity. Fish traders at these markets reported that the supported infrastructure greatly improved their capacity to preserve and sell their fish.

To improve linkages between fishing centres and markets, the project funded the improvement of 525 km of roads. Thirty-eight district technical staff were trained

in road maintenance to ensure sustainability and ownership of the infrastructure. Furthermore, 127 km of electricity lines were constructed to link fish markets with the national grid and eight markets were provided with solar panel systems for ice making and cold storage. The resulting increase in access to ice and refrigerators has contributed to improving the quality of the fish produced and reducing the losses, while better roads have led to lower transportation costs and better access to markets.

To increase the delivery, outreach, appropriateness and sustainability of financial services in artisanal fishing communities, ProPESCA also formed 2,783 credit groups and opened five financing windows to fund their business plans. Among these is the well-performing Fund for the Promotion of Women Entrepreneurs, a flexible fund for women's microenterprises targeting poor women and women's groups in particular. Through the matching grants provided, 2,113 women entrepreneurs have accessed US\$233,870 and were hence able to invest in a range of microprocessing activities to increase the value of fish products. Most of the women have purchased cool boxes and freezers, resulting in an increased capacity to store products, avoiding losses and generating income.

Nutrition interventions promoted by ProPESCA have also been remarkable. This is demonstrated through improved household nutritional status, emanating from the increased production and consumption of innovative, diverse and nutritional dishes. Cumulatively, a total of 596 home gardens were established, 2,152 cooking demonstration sessions with locally available products were conducted with 12,391 women, 95 hours of nutrition education radio programmes were broadcast on community radio stations, and 5,704 students received training in nutrition education. The processing and conservation techniques promoted by ProPESCA are enabling beneficiaries to increase the shelf life of products, thereby ensuring the availability of food throughout the year, and this is reported to have facilitated an increased consumption of vegetables.

Impact

ProPESCA contributed significantly to improving the efficiency of the targeted fish value chains. Project beneficiaries reported a drop in post-production losses as a result of the introduction of improved fish handling, preservation and processing facilities and techniques. The increase in ice production capacity and the improvement of rural roads will also contribute to reduce losses, particularly for higher value fish.

The reduction of post-production losses coupled with the productivity increases generated by the project are expected to lead to a substantial increase in the volume and value of the fish marketed by beneficiaries. As of 2018, the yearly value of higher value fish marketed by fishers in the project area increased from US\$55 million to US\$204 million, while for dried fish and fresh fish the value of yearly sales is expected to increase by project completion from US\$31.5 million to US\$42 million and from US\$14 million to US\$31.5 million, respectively. This will translate into a general improvement in the income, nutrition and food security of poor households involved in artisanal fisheries in the project area.



©IFAD/Susan Beccio

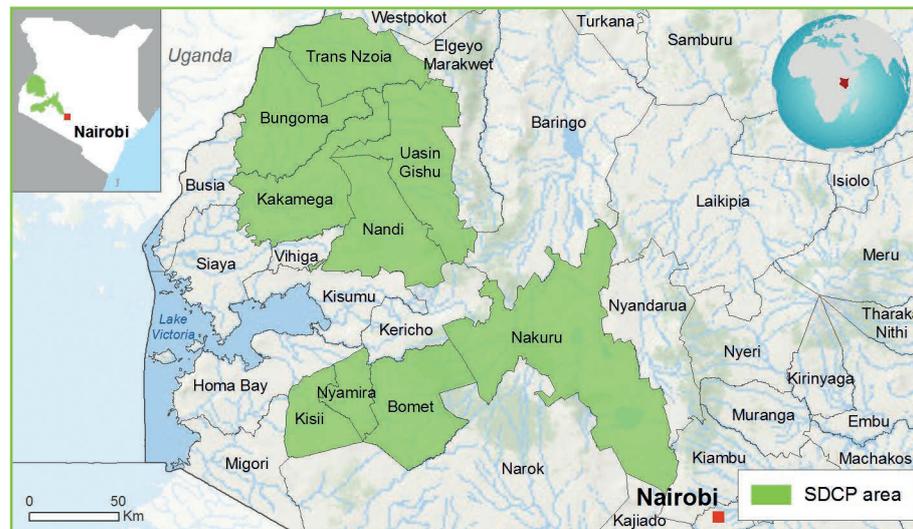
Kenya: a market-oriented solution to food loss in the dairy sector

Key facts

Project name	Smallholder Dairy Commercialization Programme (SDCP)
Dates	2006-2019
Financing	IFAD, the Government of Kenya and beneficiaries
Targeting	Smallholder dairy producers, small-scale processors and milk traders
Programme objective	Increasing the incomes of poor rural households that depend substantially on the production and trade of dairy products for their livelihoods

The sustainable development challenge

Kenya has one of the largest and most developed dairy sectors in sub-Saharan Africa, accounting for about 4 per cent of the country's gross domestic product. Over 80 per cent of the national milk output is produced by smallholder farmers and sold into the informal market. While the informal milk trade has created substantial employment opportunities for the rural poor, there are concerns about the public health risks from informally marketed milk owing to the potential for adulteration and poor hygiene in milk handling. The lack of appropriate post-production facilities (e.g. coolers, dispensers and pasteurisers) that affects the informal sector significantly limits the longevity of the produce, resulting in high physical and quality losses.



In most rural areas in Kenya, roads connecting farms to markets are inaccessible and poorly maintained. Considering that milk is a highly perishable product, the remoteness of farms coupled with poor road infrastructure results in high transaction costs, product deterioration and high levels of losses. A study supported by IFAD in 2010 found that 2,686,847 litres of milk worth K Sh 53,736,940 (US\$521,140) are lost every year owing to poor rural infrastructure in all of the 27 dairy commercialization areas across the Rift Valley region and western and south Nyanza regions. Improving the state of rural infrastructure and building the capacity to appropriately process milk are therefore crucial to reducing losses and developing a market-oriented dairy sector in Kenya.

IFAD action

The IFAD-funded Smallholder Dairy Commercialization Programme (SDCP) was launched in 2006 and moved into its second phase in 2015, with an expected completion date of 30 September 2019. Its goal is to increase the incomes of poor rural households that depend substantially on the production and trade of dairy products for their livelihoods in Kenya. While the programme has provided significant support to the upstream stages of the milk sector by promoting improved production technologies, it has also crucially worked downstream to foster the development of the local milk marketing chain. Specifically, the project has invested over one third of its resources into improving the access of small-scale milk producers, traders and processors to local milk markets and the processing industry.

The entry point for programme interventions is dairy groups and apex organizations that comprise smallholder dairy producers. As of March 2019, SDCP had supported 1,096 dairy groups with a membership of over 33,000 farmers. While building dairy groups' capacity in organizational and enterprise skills, the project also provided competitive access to investment grants to support their graduation to higher development stages. A total of 259 dairy groups and 30 apex bodies were awarded grants worth K Sh 182,475,706 (US\$1,737,864) to support their dairy enterprises, upon payment of a 10 per cent beneficiary contribution in cash



Lisy Nyabuti tests the milk after delivery at the Soitaran Multipurpose Farmers' Cooperative Society Limited, one of the apex organizations supported by SDCP. The cooperative operates a milk-cooling plant where programme beneficiaries and other dairy farmers are able to access milk markets, dairy inputs and financial, artificial intelligence and extension services.
©Petterik Wiggers

or in kind. Most of these grants were geared towards the acquisition of improved post-production capacity, which is essential for reducing losses and accessing the formal market, including bulk handling of milk, cooling, refrigerated transport and value addition through processing.

SDCP also supported the targeted dairy groups in developing their capacity to market milk and dairy products. In particular, SDCP supported selected groups in the purchase and installation of equipment to collect their milk and handle it in bulk, including connections to the water supply and electricity grid. Planned activities included the procurement and installation of 60 milk coolers with capacities between 2,000 and 6,000 litres, 10 pasteurizers with capacities between 2,000 and 3,000 litres, and 20 dispensers that also included small coolers. To further improve milk quality, SDCP contracted the Dairy Training Institute to conduct residential training of "community resource persons" on hygienic milk production, loss reduction and value addition.

Given the importance of transport infrastructure for the development of market access, the programme worked with county governments to mobilize funding for the improvement of marketing infrastructure in the dairy sector. Specifically, in 2017, SDCP commissioned a study into identifying the impact of poor rural infrastructure on the profitability of the dairy sector. The findings of the study identified roads and milk collection centres as the main constraining factors behind milk marketing inefficiencies and high post-harvest losses. Based on the outcome and recommendations of this study, the county governments improved a total of 2,000 km of rural roads and installed 10 milk bulk handling and cooling facilities in the programme area, using local resources.

Impact

By improving access to appropriate post-production facilities and markets, SDCP has reduced milk losses by 26 per cent in the project area. Based on current milk prices, the value of the amount of milk saved equates to an overall economic gain of K Sh 24.5 million (US\$240,000) per year.

A member of the Board of Evangelism dairy processing self-help group in Ndal, Bungoma County, Kenya.

The group has received business and technical training through the project and has opened a milk bar to sell fresh dairy products such as yogurt, cheese, butter and pasteurized milk.

©Susan Beccio



Combined with the increases in milk yields generated by the adoption of production technologies, this result has led to a significant improvement in the marketing of milk. Downstream, the expected results include a 50 per cent increase in the quantity of milk delivered to the processing industry and a 20 per cent increase in the amount of value-added milk marketed, which, as of March 2019, have been achieved at 86 and 95 per cent, respectively.

The improvement of milk marketing fostered by SDCP is expected to have a positive influence on the incomes, livelihoods and nutrition of 63,000 households. As of March 2019, the average income increased from K Sh 130/day (2009 baseline) to K Sh 720/day for 80 per cent of smallholder dairy farmers and 50 per cent of small traders targeted by the project.

Through nutrition education, the income accrued from milk sales has enabled households to purchase a greater diversity of nutritious foods that are not produced by households. By project completion in September 2019, SDCP is expected to contribute, alongside other players, towards a reduction in the incidence of child malnutrition, from 16.4 per cent (2009 baseline) to 11.4 per cent.



©IFAD/Susan Beccio

Burundi: equipment and infrastructure for reduced losses

Key facts

Project name	Value Chain Development Programme – Phase II (PRODEFI-II)
Dates	2015-2021
Financing	IFAD, ASAP Trust Fund, OFID, the Government of Burundi and beneficiaries
Targeting	Smallholder rice growers and livestock keepers, as well as the rural poor within and downstream of the rice and milk value chains
Programme objective	Increasing physical productive capital by increasing the resilience of production systems to climate change; intensifying crop and livestock farming to improve nutritional status; and structuring the milk and rice value chains to promote youth employment and strengthen the capacity of the actors

The sustainable development challenge

Burundi is among the world's poorest countries with a poverty rate of 74.7 per cent (World Bank, 2018). The country's economy is heavily reliant on the agricultural sector, which, despite the paucity of arable land, employs 80 per cent of the population. The incidence of poverty remains high, with 67 per cent of the population living below the poverty line. Poverty overwhelmingly affects small rural farmers. Family farming, which provides 95 per cent of the food supply, does not meet nutritional needs and the rate of self-sufficiency in food production is estimated to be just over 42 per cent.



Livelihoods in agriculture are increasingly difficult to sustain as a result of high population growth and land degradation, leading to excessive fragmentation of arable land. Moreover, rapid population growth has muted the potentially positive impact of increased food production on rates of food security and nutrition. The lack of adequate transport, storage and processing infrastructure across the country further leads to high post-harvest losses of key crops. These losses are estimated to be 14.5 per cent for wheat, 18 per cent for maize and 12 per cent for rice.⁴ Reducing such losses is key to improving the food security and livelihoods of the country's increasing population.

IFAD action

In 2015, IFAD started the second phase of Value Chain Development Programme (PRODEFI). The first phase of PRODEFI greatly contributed to the expansion of the rice and dairy sectors, particularly through the promotion of rice farming and community livestock breeding. While the project also worked downstream by creating 12 rice farming cooperatives and establishing 18 milk collection centres, the processing and marketing of crops and dairy produce was still lagging behind. The second phase of the project (PRODEFI-II) will strengthen the downstream stages of production in the dairy and rice value chains.

To foster the sustainable development of these value chains, the project has been developing targeted financing and supporting the value chain's organizational framework. Key programme interventions in these areas are the development of financial instruments to finance production and processing cycles and storage, and the professionalization of dairy cooperatives and rice growers' cooperatives to enable them to provide services to their members. Throughout its first and second phases, PRODEFI has also constructed and improved over 420 km of rural roads.

4 Source: APHLIS (http://archive.aphlis.net/?form=losses_estimates).

PRODEFI-II is also providing targeted interventions along the value chain for both dairy and rice. In the dairy value chain, the project has established 29 milk collection centres with a capacity of 9,000 litres, equipped with refrigerated tanks and various equipment. In addition, 25 sale points have been erected around these collection centres. Three of the five planned mini-dairy units have been installed, each with a capacity of 1,500 litres/day when operated at full capacity. By the end of 2019, all five mini-dairies will be operational and able to process 4,500 litres/day, hence contributing to boosting local milk consumption.

In the rice value chain, the main investments in post-harvest activities and in value addition are (1) the formation of 20 rice farming cooperatives, (2) the installation of drying infrastructure and equipment providing 7,500 m² of new drying space and (3) the installation of storage facilities for a total capacity of 6,100 metric tons. The project has also set up two improved husking units with a capacity of 2 metric tons/hour and two mini-rice mills to increase quality. These investments have greatly improved the quality of rice (a maximum of 15 per cent broken grains), which attracts a premium price.

All of these interventions have been done in parallel with intensive technical, managerial, governance and marketing capacity-building activities among cooperatives. As a result, the stronger cooperatives have supplied 850 metric tons of rice to WFP's school feeding programme through two institutional contracts. One cooperative has also set up a small processing unit for briquette production from rice and other agriculture wastes in partnership with a private-sector company to replace firewood and charcoal. The capacity of the unit is 40 metric tons/day, representing a saving of 1.5 hectares of tree plantation.

Impact

PRODEFI-II is expected to generate a reduction in food losses at the different levels of the rice and milk value chains of at least 20 per cent. This, together with improved quality and access to markets, will contribute to increasing the yearly revenues of the supported milk collection centres by between US\$18,000 and US\$50,000, depending on their capacity. In the rice value chain, increased husking capacity has reduced losses and added value to 9,000 metric tons of rice per year, generating net annual revenues of US\$140,550, amounting to an annual increase of US\$122,746.

Taken together, the interventions supported by the project are expected to lead to a 30 per cent increase in revenues for beneficiaries. They are also expected to contribute to reducing chronic child malnutrition by 15 per cent and the rate of underweight children from 30 to 22 per cent. This should lead to a reduction in the prevalence of food insecurity in the country from 75 to 65 per cent by project completion.



©IFAD/Mwanzo Millinga

RBA partnership: building evidence for food loss reduction investments

Key facts

Project name	Mainstreaming Food Loss Reduction Initiatives for Smallholders in Food-deficit Areas
Dates	2014-2020
Financing	SDC
Partner organizations	FAO, WFP and IFAD
Targeting	Smallholder farmers in food-deficit countries
Programme objective	Improving food security and income generation through the reduction of post-harvest food losses in targeted value chains

The sustainable development challenge

Although it is now widely accepted that the level of food losses in developing countries remains unacceptably high, accurate data on the causes and volume of the issue are still lacking. This is an important limitation, as it prevents accurate targeting, assessment and identification of food loss reduction interventions. Following the call to reduce post-harvest loss issued by the 2030 Agenda for Sustainable Development within SDG Target 12.3, developing countries have started committing to using consistent methods to generate a reliable baseline for national food loss levels. However, the geographical coverage of available data remains scattered and there is still inadequate knowledge on the critical loss points for different value chains and country contexts.



This knowledge gap is matched by a policy gap, as national strategies for the reduction of food loss remain a rarity, despite the seriousness of the issue. The issue gained momentum in Africa following the Malabo Declaration issued by the African Union in 2014. The Declaration calls on all African Union member states to halve post-harvest losses by 2025 by establishing effective post-harvest loss-reduction systems on the continent. Many African countries have committed to this goal and, as a result, have expressed an interest in incorporating evidence-based information into national agricultural strategies, but in most cases they lack the expertise and resources to do so.

IFAD action

In response to this knowledge and policy gap, IFAD has teamed up with FAO and WFP to implement an SDC-funded RBA initiative entitled “Mainstreaming Food Loss Reduction Initiatives for Smallholders in Food-deficit Areas”. The project, managed by FAO, implemented activities at the field and global levels, with the overall aims of developing the evidence base on food loss reduction and of mainstreaming food loss reduction strategies into the national policy environment. Project implementation started in 2014, entered a second phase in 2017 and will end in 2020.

At the field level, the project activities focused on three African countries: Burkina Faso, Uganda and the Democratic Republic of the Congo. During the first phase, the project carried out detailed food loss analyses to identify critical loss points for different grain crops in each of these countries, following the FAO case study methodology (FAO, 2016). Three reports documenting the results of these studies have been published and mainstreamed through the RBA network (FAO, WFP and IFAD, 2019a, b and c). The solutions recommended by the food loss analyses studies were then piloted through mini-grants in each country, seeking synergies with IFAD loan projects to maximize impact. These technologies included dryers, shellers, plastic silos, tarpaulins and hermetic bags and were accompanied by capacity-building activities among stakeholders on improved post-harvest management.

The second phase aimed at consolidating the results of the previous phase, while scaling up these results and implementing them in national policy frameworks. As of June 2019, the project strengthened the capacity of the three countries in undertaking food loss analyses by training national staff in the use of the FAO case study methodology,

which is instrumental to identifying critical loss points and recommending appropriate solutions. Based on the results of the food loss analyses studies conducted in the first phase, the project also supported the development of policy briefs to advocate food loss reduction in the policy environment. The project then engaged policymakers in the development of national strategic frameworks specifically targeting food loss reduction.

With project support, each country integrated food loss reduction into relevant policy frameworks. Specifically, in Uganda, the government initiated the elaboration of a “National strategy and action plan for reduction of post-harvest losses in grain value chains”, while, in the Democratic Republic of the Congo, the ministry of agriculture developed a “Ministerial Decree on Measures for the Reduction of Post-Harvest Losses” and Burkina Faso integrated post-harvest loss reduction into the review of the “Sectoral Policy for Agro-Sylvo-Pastoral Production” and the related national action plan, a key framework for agricultural development in the country. In addition to supporting the development of national policy frameworks, the project has also promoted the integration of food loss reduction in the ongoing activities of the RBAs. For example, in the Democratic Republic of the Congo, evidence generated by the project has been integrated into the IFAD country strategic opportunities programme, which will guide IFAD loan investments in the country between 2019 and 2024.

At the global level, the project established a trilingual Community of Practice (CoP) on food loss reduction hosted by FAO.⁵ The platform facilitates global access to relevant information and existing solutions on post-harvest loss reduction, as well as knowledge-sharing and networking through a range of webinars and online forum discussions. With over 1,200 registered members across the world and more than 3,000 visits per month, the CoP has become a global convener of knowledge on food loss reduction. The project further developed an e-learning course on the FAO case study methodology for the analysis of critical loss points, available in English and French through the FAO training centre.⁶ Both resources are global public goods available in the whole world free of charge.

Impact

The SDC-RBA joint project has successfully contributed to filling the knowledge and policy gaps in the three target countries. The food loss analyses studies generated detailed knowledge on the critical loss points for major crops in Uganda, Burkina Faso and the Democratic Republic of the Congo, providing a solid basis for designing future interventions. These three countries have also been developing policy instruments to align them with the Malabo Declaration, which, if implemented, will lead to a substantial reduction in national food loss levels. In this regard, this project constitutes a good practice that is replicable in other contexts and contributes to the achievement of SDG Target 12.3.

The impact of the project is likely to be strong in the long term, as the strategies that have been developed are financed and the initiatives that were piloted have been scaled up. Public goods such as the CoP and the e-learning course will remain globally available for the foreseeable future and will continue to provide knowledge to the world. Finally, the knowledge developed through FLA and the pilot initiatives is likely to be consolidated and scaled up through ongoing and planned investment programmes supported by the RBAs, a process that has already started in the Democratic Republic of the Congo.

5 FAO, “SAVE FOOD: Global Initiative on Food Loss and Waste Reduction – Community of Practice on Food Loss Reduction”, www.fao.org/food-loss-reduction/en/

6 FAO, “E-learning Centre”, <https://elearning.fao.org/course/view.php?id=374>



©IFAD/Leonardo Cini

Conclusions and way forward

The 2030 Agenda for Sustainable Development has reminded the world that we need to address food losses, particularly in developing countries, as part of the strategy to develop a sustainable and environmentally neutral food system. As the above case studies have shown, IFAD is committed to contributing to this global advancement. Its loan portfolio has consistently invested in improved post-harvest infrastructure, equipment and capacity, which are essential for enabling smallholders to reduce losses in different crops, fisheries and livestock value chains.

Taken together, the case studies in this report demonstrate that reducing food loss can be a powerful ally in achieving broader development objectives, including food security, nutrition, food safety and increasing household incomes. While stand-alone interventions to reduce food loss can be beneficial when they occur at the farm level, all agricultural development projects should promote food loss reduction activities to maximize project impacts. Indeed, the lessons learned through IFAD's experience make a strong case for enshrining food loss reduction in broader value chain development interventions, even though food loss reduction may not be the main objective of the project.

Whether they follow a single entry point or value chain approach, the projects analysed in the different case studies are not yet at the scale required to achieve SDG Target 12.3. If global food losses are to be halved by 2030, successful solutions need to be scaled up globally, regionally and at the national level. The Champions 12.3 initiative, of which the current IFAD President, Gilbert Houngbo, is a champion, was set up to provide a framework for mobilization and monitoring of Target 12.3. The road map designed by the initiative set ambitious targets for both governments and

the private sector worldwide, as both will need to be engaged to appropriately scale up solutions (Champions 12.3, 2017).

IFAD is ideally placed between government and the private sector and, as the SDC-RBA case study showed, is in a position to produce the evidence to influence policy change. IFAD is increasingly leveraging private-sector investments in food loss reduction at the local and national levels and, by further expanding partnerships with other development agencies and international financial institutions, it can scale up food loss reduction solutions and amplify their impact so that they reach a larger number of smallholder farmers.

Bibliography

- African Union. 2018. "African Union Launches Africa Agriculture Transformation Scorecard (AATS)—a Revolutionary New Tool to Drive Agricultural Productivity and Development", press release, 29 January, African Union, <https://au.int/en/pressreleases/20180129/african-union-launches-africa-agriculture-transformation-scorecard-aats-%E2%80%93>
- Champions 12.3. 2018. *SDG Target 12.3 on Food Loss and Waste: 2018 Progress Report*, <https://champions123.org/2018-progress-report/>
- Champions 12.3. 2017. *Road Map to Achieving SDG Target 12.3*, <https://champions123.org/wp-content/uploads/2017/09/champions-123-roadmap-to-achieving-sdg-target-123.pdf>
- Committee on World Food Security. 2014. *Food Losses and Waste in the Context of Sustainable Food Systems*. Rome: High Level Panel of Experts on Food Security and Nutrition.
- Food and Agriculture Organization. 2010. *Reduction of Post-harvest Food Losses Project in Timor-Leste*. Final Report OSRO/TIM/802/NZE. p. 20. Rome: Food and Agriculture Organization.
- Food and Agriculture Organization. 2011. *Global Food Losses and Food Waste – Extent, Causes and Prevention*. Rome: Food and Agriculture Organization.
- Food and Agriculture Organization. 2014. *Definitional Framework on Food Losses*. Working Paper. Rome: Food and Agriculture Organization, www.fao.org/fileadmin/user_upload/save-food/PDF/FLW_Definition_and_Scope_2014.pdf
- Food and Agriculture Organization. 2016. *Food Loss Analysis: Causes and Solutions – Case Studies in the Small-scale Agriculture and Fisheries Subsectors – Methodology*. Rome: Food and Agriculture Organization, www.fao.org/3/a-az568e.pdf
- Food and Agriculture Organization. 2017. *The Future of Food and Agriculture – Trends and Challenges*. Rome: Food and Agriculture Organization, www.fao.org/3/a-i6583e.pdf
- Food and Agriculture Organization. 2018. *Gender and Food Loss in Sustainable Food Value Chains – A Guiding Note*. Rome: Food and Agriculture Organization, www.fao.org/3/I8620EN/i8620en.pdf
- Food and Agriculture Organization, World Food Programme and International Fund for Agricultural Development. 2019a. *Analyse des pertes alimentaires: causes et solutions – Études de cas sur le sorgho, le maïs, le niébé au Burkina Faso*. Rome: Food and Agriculture Organization, World Food Programme and International Fund for Agricultural Development. 206 pp., www.fao.org/3/ca3464fr/ca3464fr.pdf

Food and Agriculture Organization, World Food Programme and International Fund for Agricultural Development. 2019b. *Analyse des pertes alimentaires: causes et solutions – Études de cas sur le maïs et le riz en République démocratique du Congo*. Rome: Food and Agriculture Organization, World Food Programme and International Fund for Agricultural Development. 188 pp., www.fao.org/3/ca3469fr/ca3469fr.pdf

Food and Agriculture Organization, World Food Programme and International Fund for Agricultural Development. 2019c. *Food Loss Analysis: Causes and Solutions – The Republic of Uganda*. Beans, Maize, and Sunflower Studies. Rome: Food and Agriculture Organization, World Food Programme and International Fund for Agricultural Development. 212 pp., www.fao.org/3/ca4524en/ca4524en.pdf

Global Panel. 2018. *Preventing Nutrient Loss and Waste Across the Food System: Policy Actions for High-quality Diets*. Policy Brief No. 12. London: Global Panel on Agriculture and Food Systems for Nutrition.

Hanson, C. and Mitchell, P. 2017. *The Business Case for Reducing Food Loss and Waste*. Champions 12.3.

National Statistics Office and Fafo Institute for Applied International Studies. 2013. *Eritrea Population and Health Survey 2010*. Asmara, Eritrea: National Statistics Office and Fafo Institute for Applied International Studies.

United Nations Department of Economic and Social Affairs, Population Division. 2017. *World Population Prospects: The 2017 Revision*. ESA/P/WP/248. New York: United Nations.

World Bank. 2018. *Piecing Together the Poverty Puzzle*. Washington, D.C.: World Bank, <https://openknowledge.worldbank.org/bitstream/handle/10986/30418/9781464813306.pdf>

World Bank. 2011. *Missing Food: The Case of Postharvest Grain Losses in Sub-Saharan Africa*. Washington, D.C.: World Bank, <https://openknowledge.worldbank.org/bitstream/handle/10986/2824/603710SR0White0W110Missing0Food0web.pdf?sequence=1&isAllowed=y>



International Fund for Agricultural Development
Via Paolo di Dono, 44 - 00142 Rome, Italy
Tel: +39 06 54591 - Fax: +39 06 5043463
Email: ifad@ifad.org
www.ifad.org

-  facebook.com/ifad
-  instagram.com/ifadnews
-  linkedin.com/company/ifad
-  twitter.com/ifad
-  youtube.com/user/ifadTV

September 2019

