



BACKGROUND PAPER

Perspectives to Reducing Post-harvest Losses of Agricultural Products in Africa

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EXECUTIVE SUMMARY

Food waste and loss is a large and increasingly urgent problem and is particularly acute in developing countries where food loss reduces income by at least 15% for 470 million smallholder farmers and downstream value chain actors, most of whom are a part of the 1.2 billion people who are food insecure.

Globally, food waste and loss consumes a quarter of global freshwater and a fifth of farmland on unconsumed food. The world population will reach 9 billion by 2050, and with 2 billion more mouths to feed. If food loss is not reduced, food production in developing countries will need to increase by an estimated 70% and this requires an investment of \$83 billion per year.

Major barriers to reducing food loss include: limited knowledge of the issue and of ways to prevent and reduce it, broken distribution channels for loss-reducing technology, limited technical know-how of smallholder farmers, limited access to credit and financing and difficulties in efficiently and cost-effectively linking adequate smallholder supply to buyer demand.

Broad changes in Africa's food markets and value chains point to areas where new ways of operating can reduce food loss and waste. These includes (1) changing market demand for agricultural products fuelled by rapid urbanisation and the growth of the region's middle class, (2) Sustainable local sourcing as many large corporations are seeking to make their supply chains more efficient by identifying cost-effective, reliable sources of local supply (3) the private sector has committed to sourcing from African farmers. (4) Many technologies for reducing food loss exist, but they are vastly underutilized and (5) African governments, public and private organisations are prioritizing agricultural sectors such as horticulture (Kenya) and value addition to staple food crops (Nigeria).

The Rockefeller Foundation views postharvest loss as solvable and has designed an approach that will reduce food losses by at least 50% in representative value chains, improving millions of rural lives. Our emerging conclusion is that social, environmental and economic impact is viable.

The approach leverages existing relationships between value-chain actors for example, agro-dealers and farmers, farmers and processors, and processors and buyers and catalyzes new ones to integrate four components—market linkages, aggregation, finance, and technologies—to break across these silos and integrate stakeholders into well-functioning value chains that minimize food loss. This integrated approach—particularly the focus on links with both large anchor buyers and alternative local markets—is different from previous efforts to reduce postharvest losses.

To accomplish this goal, the Rockefeller Foundation has identified an innovative integrated approach that brings together four components in ways that will reduce food loss: Linking smallholder farmers to market demand of both large anchor buyers and local alternative markets; Aggregating farmers for training on postharvest management, promote adoption of technologies, and aggregate crops to meet buyer quantity and quality requirements; developing innovative finance mechanisms to promote agricultural investments and facilitate distribution and acquisition of technologies, particularly among smallholder farmers and promoting the adoption of appropriate loss-reducing technologies to improve crop handling, storage, and processing.

To implement this integrated approach, we will require different actors to play specific roles within the value chain system. These will include (1) **large anchor buyers** signal demand by making commitments, (2) **implementing partner NGOs**, aggregate and train smallholder farmers on how to reduce on-farm crop losses and meet market standards for quality and quantity, (3) **Smallholder farmers** produce the required quality and quantity of agricultural ingredients, while adopting postharvest loss reducing practices and technologies, (4) **Agro-dealers** develop new channels for distributing postharvest technologies to smallholder farmers, (5) **Financial institutions** provide loans to finance farmers' acquisition of postharvest technologies, using anchor buyers' sourcing commitments as collateral, (6) **Existing aggregation** and procurement centers are used, or new centers are established, to create one-stop shops where traders and consolidators can purchase crops and pass them on to processors or buyers. **Alternative local buyers**—supermarkets, local processors, restaurants, hotels, and grocers—are also linked to smallholder farmers and aggregation centers.

1. BACKGROUND

Food waste and loss is a large and increasingly urgent problem and is particularly acute in developing countries where food loss reduces income by at least 15% for 470 million smallholder farmers and downstream value chain actors. It is estimated that 1.2 billion people are food insecure. Globally, food waste and loss uses a quarter of global freshwater and a fifth of farmland on unconsumed food. The world population will reach 9 billion by 2050, and with 2 billion more mouths to feed, if food loss is not curtailed, food production in developing countries will need to increase by an estimated 70% and this requires an investment of \$83 billion per year to meet growing demand.

Food losses refer to the decrease in edible food mass throughout the *part of the* supply chain that specifically leads to edible food for human consumption. Food losses take place at production, postharvest and processing stages in the food supply chain (Parfitt *et al.*, 2010). Losses occurring at the end of the food chain (retail and final consumption) are referred to as “food waste”, relates phenomenon linked to retailers’ and consumers’ behavior. (Parfitt *et al.*, 2010).

“Food” waste or loss is measured only for products that are directed for human consumption, and it excludes feed and parts of products that are not edible. Per definition, food losses or waste are the masses of food lost or wasted in *the part of* food chains *leading to* “edible products going to human consumption”. Therefore food that was originally meant to human consumption but which fortuitously gets out the human food chain is considered as food loss or waste even if it is then directed to a non-food use (feed, bioenergy...). This approach distinguishes “planned” non-food uses to “unplanned” non-food uses, which are hereby accounted under losses.

In developing countries, 90% of wastage occurs from food loss within the value chain. It directly impacts poor producers through foregone income and impacts poor consumers by reduced food availability, increased prices, and decreased nutritional content.

Crop foods account for the primary source of food loss in developing countries. Together, crop foods (e.g., grains, fruits, vegetables, tubers, pulses) and dairy comprise 92% of developing world losses, with the remaining 8% occurring in meat (4%) and fish (4%). Meat and fish are a small part of overall food loss, and are comparable to other crops as a percentage of production in their category.

In developing countries, the root causes of food loss are interlinked and complex, but the primary drivers include: lack of extension services to build skills in handling, packaging, and storage; insufficient postharvest storage facilities or on-farm storage technologies; and poor market access that leads to spoilage before sale.

Although there is little evidence of gender-specific dimensions of food loss, women generally have less access than men to transportation and services which help reduce losses. Children are most vulnerable to the impact of decreased availability of fruits and vegetables, resulting in malnutrition and stunting.

The problem of food loss in Sub-Saharan Africa is acute: more than 30% of the food produced for human consumption across the continent is lost because of inadequate postharvest

management, lack of structured markets, inadequate storage in households and on farms, and limited processing capacity.¹ With more than 70% of Africans drawing their livelihoods from agriculture, finding sustainable solutions for postharvest losses holds tremendous promise for enhancing regional economic growth and well-being.²

Support for agricultural improvements across Sub-Saharan Africa is fairly robust, but only 5% of investments in agricultural research over the past 30 years has been directed toward preventing postharvest losses.³ This neglect is due largely to lack of awareness among many actors in the food chain. Both buyers and farmers view loss as a cost of doing business but are not aware of the full extent of the losses. Now, many in the food security world are waking up to the fact that not only are significant losses occurring, but these losses compromise both the profitability and the long-term sustainability of value chains. There are number of initiatives designed to reduce post-harvest loss in Africa. We have highlighted some of these in the table below.

Table 1: Selected post-harvest loss interventions in Africa

Name of intervention	Description	Number of people reached	Quantification of impact
Cowpea Storage Project (Purdue University)	Researchers partnered with the Gates Foundation to develop and sell improved bags for cowpeas, spending \$11.4M in five years from 2007-2011.	1 million bags sold since 2007, out of a projected 1.7 million goal for West and Central Africa. No estimates available on actual number of people reached.	Expecting annual income increases of \$150 per farmer.
Poverty reduction and women's empowerment project (UNDP)	\$19M over four years (2008-2011) was used to establish 600 rural agro-enterprises in Burkina Faso, Mali and Senegal.	Goal was to directly impact 0.9 million people in rural areas through improving off-farm livelihoods.	Butter processing increased household income
Yam Improvement for Income and Food Security in West Africa (IITA, AGRA)	\$12M from the Gates Foundation will engage the International Institute for Tropical Agriculture to improve yam varieties and lower postharvest losses.	Goal is to reach 200,000 yam farmers in Ghana and Nigeria.	Overall yam income is expected to double.

¹ Across Africa, fruits and vegetables feature the highest rate of losses as a proportion of production—approximately 50%. A significant proportion (~40%) of roots and tubers are also lost after harvest. Cassava, a staple crop critical to food security in much of Africa, has a shelf life of less than 48 hours and is often not processed in time or adequately stored to prevent spoilage. Although losses are typically lower for grains and cereals, an average of ~20% of such crops produced are still lost after harvest. [Post-Harvest Grain Losses in Sub-Saharan Africa', IFDC]

² World Bank - data.worldbank.org 2015

³ Kader 2005; Kader and Roller 2004; WFLO 2010

Hybrid seed and postharvest storage program (USAID, Ethiopia, DuPont)	\$3M from DuPont over three years (2013-2015) will distribute improved seeds and increase access to improved postharvest storage.	Goal is to reach 32,000 maize farmers in Ethiopia.	Yields are expected to rise by up to 50% and losses decrease by 20%.
Rwanda Post-Harvest Handling & Storage Project (CARANA, ACDI/VOCA)	USAID is spending \$8.6M on a five-year program to support farmers' acquisition of storage and processing equipment, training in postharvest handling, and access to finance.	Supported 37,500 farmers acquire storage and processing technology; trained 40,000 farmers in postharvest handling.	Unmeasured.

2. CHALLENGES

The agricultural value chain comprises production, harvest, handling and storage, processing, distribution and, finally, consumption. Food loss occurs all along this chain but is most acute between harvest and distribution in developing countries, which accounts for 50% of the loss.

In developing countries, the root causes of food loss are interlinked and complex, but the primary drivers include: lack of extension services to build skills in handling, packaging, and storage; insufficient postharvest storage facilities or on-farm storage technologies; and poor market access. Research and interventions in developing countries have largely focused on technology-based approaches that look for solutions to specific food loss problems at single points in the value chain—for example, on-farm storage in hermetically sealed bags, fruit and vegetable refrigeration through solar powered coolers, and mobile drying systems for grain. More recently, however, donors have taken a wider market-based approach to improving the efficiency of the value chain as a whole, rather than focusing on single points.

Major barriers to reducing food loss include:

- limited knowledge of the issue and of prevention and reduction techniques
- broken distribution channels for loss-reducing technology
- limited technical know-how of smallholder farmers
- limited access to credit and financing
- difficulties in efficiently and cost-effectively linking adequate smallholder supply to buyer demand

Over the past two years, the Rockefeller Foundation has been designing an initiative to reduce post-harvest loss in the food value chain. The goal of the Rockefeller Foundation's food loss initiative is to reduce food losses by at least 50% in representative value chains, improving millions of rural lives. To accomplish this goal, the Rockefeller Foundation has identified an innovative approach that brings together four components in ways that will reduce food loss:

The proposed postharvest loss reduction initiative offers an opportunity to ensure that food that is grown reaches markets and is not lost or wasted. Having sparked the Green Revolution, The Rockefeller Foundation views this initiative as a signature opportunity to bring about its second

phase—one focused not just on growing more food with the land and water resources we have, but emphasizing storing, processing, and efficient transportation.

The primary focus is on reducing postharvest crop losses—the food lost in farmers’ fields, after harvest, at initial storage, during processing, and during transportation. These postharvest losses are mainly a challenge in developing countries, particularly those in Africa. Lack of awareness among many actors in the food chain and the perception among both buyers and farmers of loss as a “cost of doing business” contributes to these gaps. Often the full extent of loss that is occurring is not realized. While no silver bullet exists, small changes in behavior among a few key actors can improve the system—but all of these small changes need to occur together. The initiative represents an innovation in process, by combining existing but disconnected elements into a system that will reduce postharvest loss.

The Foundation’s Approach in Addressing PHL reduction:

The Rockefeller Foundation views postharvest loss as a solvable problem. We believe our reputation and deep experience in agriculture positions us well to take on the role of systems integrator in addressing the problem, helping to stimulate innovations, demonstrate integrated approaches to drive measurable impact at scale, and influencing markets and governments to scale and sustain systemic change.

Through our initiative, we aim to reduce food losses by at least 50% in representative value chains, improving millions of rural lives. This initiative will demonstrate an innovative model for change that catalyzes reduction in post-harvest food crop loss and optimizes for impact in three of RF’s issue areas simultaneously: Secure Livelihoods, Revalue Ecosystems, and Advance Health. Our emerging conclusion is that a “triple bottom line” of social, environmental and economic impact is viable, and could bring both a differentiated problem framing and intervention model to the space.

The initiative model leverages existing relationships between value-chain actors for example, agro-dealers and farmers, farmers and processors, and processors and buyers and catalyzes new ones to integrate four components—market linkages, aggregation, finance, and technologies—to break across these silos and integrate these actors into well-functioning value chains that minimize food loss. We believe this integrated approach—particularly the focus on links with both large anchor buyers and alternative local markets—distinguishes us from previous efforts to reduce postharvest losses. The field has yet to see the transformative impact made possible by bringing these four components to bear to reduce food loss.

The Initiative Model:

To accomplish this goal, the Rockefeller Foundation has identified an innovative integrated approach that brings together four components in ways that will reduce food loss:

- Linking smallholder farmers to market demand of both large anchor buyers and local alternative markets
- Aggregating farmers to train them in postharvest management, promote their adoption of technologies, and aggregate their crops to meet buyer quantity and quality requirements

- Using innovative finance mechanisms to promote agricultural investments and facilitate distribution and acquisition of technologies, particularly among smallholder farmers
- Promoting the adoption of appropriate loss-reducing technologies to improve crop handling, storage, and processing

All four components are needed to implement the model and optimize a value chain for crop loss reduction. Moreover, the components must be sequenced in ways that align the incentives for each actor to adopt desired behavior changes.

At the heart of the initiative is the link between market demand and aggregation of farmers' supply. This link creates the primary point of connection for pulling in technology and finance. Market demand, the prime mover of this model, must be met with aggregated supply. Without this connection, farmers will have no incentive to acquire or adopt loss-reducing technologies. Technology suppliers and manufacturers will have no market for their products. Finance providers, with no assured markets for smallholders' crops or loss-reducing technologies, will not risk lending to value-chain actors. In short, securing market demand, aggregating farmers, and linking the two are necessary for the model to succeed. .

By making this supply-demand link, the model seeks to leverage the market transformation already taking place in Sub-Saharan Africa. It focuses on engaging key market makers and market push and pull actors to address loss in their specific food-crop value chains. As an entry point, we would identify the potential partners (e.g., Coca-Cola, WFP, Flour Mills Nigeria, Dangote Group, Cargill, Nestlé, and Unilever) whose food-crop value chains experience significant losses. We propose to work with them to develop appropriate interventions in those value chains, particularly those including smallholder farmers. By leveraging and partnering with some of the continent's most important market actors, we plan to create new norms and practices for how actors approach smallholder farmer inclusion, food loss reduction, and sustainable sourcing.

The various actors in the value chain each play a part in this integrated system:

- Large anchor buyers signal demand by making commitments and arranging contracts with their suppliers (local processors) to purchase specified quantities of smallholder farmers' products.
- Implementing partner NGOs, aggregate and train smallholder farmers on how to reduce on-farm crop losses and meet market standards for quality and quantity.
- Smallholder farmers produce the required quality and quantity of agricultural ingredients, while adopting postharvest loss reducing practices and technologies
- Agro-dealers develop new channels for distributing postharvest technologies to smallholder farmers. Individual farmers may not need to purchase or own these technologies; it may be more efficient for farmer organizations or other actors in the value chain to collateralize buyers' crop orders, acquire loans, purchase technologies, and lend or lease the technologies to farmers.
- Financial institutions provide loans to finance farmers' acquisition of postharvest technologies, using anchor buyers' sourcing commitments as collateral.

- Existing aggregation and procurement centers are used, or new centers are established, to create one-stop shops where traders and consolidators can purchase crops and pass them on to processors or buyers.
- Alternative local buyers—supermarkets, local processors, restaurants, hotels, and grocers—are also linked to smallholder farmers and aggregation centers. These alternative buyers will spread the adoption of practices that reduce postharvest losses by creating a source of demand for surplus production and processed derivative products, as well as helping farmers adapt to supply fluctuations caused by weather and other factors (by, for example, purchasing products that do not meet anchor buyers’ grading or aesthetic standards).

We plan to use postharvest loss reduction interventions in specific value chains to bring about transformational change across all major food crop categories (fruits and vegetables, roots and tubers, cereals and grains). We believe we can achieve catalytic demonstrations of this approach in seven years. We see this implementation plan unfolding in three key phases of activity and investment. The first five years will be dedicated to reducing food loss in approximately eight diverse value chains, and establishing the value proposition of loss reduction for key actors.

Phase 1 demonstrates how to reduce postharvest loss across four key chains:

- *Mango in Kenya* (fruits and vegetables loss reduction intervention)
- *Maize in Tanzania* (cereals and grains loss reduction intervention)
- *Tomato in Nigeria, and* (fruits and vegetables loss reduction intervention)
- *Cassava in Nigeria* (roots and tubers loss reduction intervention)

In the case of fruits, vegetables, and roots and tubers, anchor buyers often require particular varieties and levels of quality, and they can be motivated to provide upfront commitments to source a specific quantity of supply from smallholder farmers. In these chains, we will focus on leveraging buyers’ local sourcing commitments to establish market linkages between buyers and producers. The Foundation will help anchor buyers and their suppliers identify opportunities to profitably source from smallholder farmers. Activities will include financing technical assistance for traders and processors to link smallholder farmers and buyers, influencing buyers to commit to purchasing local production, tracking loss and connecting alternative buyers of fresh and derivative products with smallholder farmers and traders.

In the case of cereals and grains, anchor buyers will be motivated to source from smallholder farmers based upon the quantity of crop available, since these staple crops vary less in quality or variety. Our emphasis in these chains will be on establishing aggregation and procurement centers. The Foundation will support implementation partners to finance and build one-stop aggregation and procurement centers to meet aggregated market demand for crops. In addition, we will work with the center operators to foster financial viability and facilitate connections between them and the anchor and alternative market buyers.

Phase 2 activates paths to scale and is driven by proof points and momentum from Phase 1 to pull in new actors into four additional country and crop value chain interventions. The final two years, **Phase 3 secures sustainability** and will be focused on more targeted interventions and influence activities to ensure sustained impact, disseminate learning, and motivate others

to adopt our approach so that we may responsibly exit while ensuring that the Foundation’s role in catalyzing change is both recognized and respected.

We believe this integrated approach—particularly the focus on links with both large anchor buyers and alternative local markets, along with the value chain interventions to bring about transformational change across all of the major food crop categories —distinguishes us from previous efforts to reduce postharvest losses.

3. OPPORTUNITIES

Broad changes in Africa’s food markets and value chains point to areas where new ways of operating can reduce food loss and waste.

- *Changing market demand:* Agricultural demand is rising in Africa, fuelled by rapid urbanization and the growth of the region’s middle class. Increasingly more prosperous and urban consumers are purchasing fruits and vegetables and processed and packaged foods. The production, processing, packaging, and distribution of these crops creates new income opportunities for smallholder farmers and rural people in general—particularly women. Fruit and vegetable production is also characterized by high losses and has high natural-resource intensity.
- *Sustainable local sourcing:* Many large corporations are seeking to make their supply chains more efficient by identifying cost-effective, reliable sources of local supply. Multinational supermarket chains as well as African local and regional entities are increasingly sourcing directly from local smallholders to meet domestic and export retail-related needs.
- *Smallholder participation in value chains:* Local sourcing activities represent an unprecedented opportunity to link farmers to more reliable and consolidated large-scale markets, as well as local ones. These links could generate market infrastructure within which postharvest loss could be more effectively addressed. Coca-Cola and Unilever, for example, have both launched programs to engage smallholder farmers in their supply networks.
- *Loss-reducing technologies:* Many technologies for reducing food loss exist, but they are vastly underutilized. Our analysis of more than 60 technologies revealed 12 that can cost-effectively reduce food loss and yield benefits across our Secure Livelihood, Revalue Ecosystems, and Advance Health issue areas. Examples include hermetic bags, heavy molded-plastic containers, and mobile processing units. These innovations have a small unit cost and are suited to individual use. These can also be, easily scaled up to meet growing demand. More complex solutions, such as cold storage, cost more, are better suited to multiple users and are less commonly used but can have a systemic impact under the right conditions.
- *Rising public and private investment in African agriculture, including postharvest loss.* African governments are prioritizing agricultural sectors such as horticulture (Kenya) and value addition to staple food crops (Nigeria). Other public and private organizations, such as the U.S. Agency for International Development (USAID), the Swiss Agency for Development and Cooperation (SDC), the African Development Bank, the Food

and Agriculture Organization (FAO), the World Food Programme (WFP), and the Gates Foundation, are investing or exploring investments in postharvest activities. Large multinational companies have adopted sustainability goals linked to reducing food loss and waste. These trends are encouraging large private-sector actors—both retailers and food and beverage companies—to collaborate for addressing supply chain challenges. There is an increasing trend of sourcing from smallholder farmers who grow 90% of Africa’s food.

4. SUGGESTED ACTIONS

Various actors in the value chain can each play a part in this integrated system:

- Large anchor buyers signal demand by making commitments and arranging contracts with their suppliers (local processors) to purchase specified quantities of smallholder farmers’ products.
- Implementing partner NGOs, aggregate and train smallholder farmers on how to reduce on-farm crop losses and meet market standards for quality and quantity.
- Smallholder farmers produce the required quality and quantity of agricultural ingredients, while adopting postharvest loss reducing practices and technologies
- Agro-dealers develop new channels for distributing postharvest technologies to smallholder farmers. Individual farmers may not need to purchase or own these technologies; it may be more efficient for farmer organizations or other actors in the value chain to collateralize buyers’ crop orders, acquire loans, purchase technologies, and lend or lease the technologies to farmers.
- Financial institutions provide loans to finance farmers’ acquisition of postharvest technologies, using anchor buyers’ sourcing commitments as collateral.
- Existing aggregation and procurement centers are used, or new centers are established, to create one-stop shops where traders and consolidators can purchase crops and pass them on to processors or buyers.
- Alternative local buyers—supermarkets, local processors, restaurants, hotels, and grocers—are also linked to smallholder farmers and aggregation centers. These buyers can promote the adoption of practices that reduce postharvest losses by creating a source of demand for surplus production and processed derivative products, as well as helping farmers adapt to supply fluctuations caused by weather and other factors (by, for example, purchasing products that do not meet anchor buyers’ grading or aesthetic standards).

5. ESTIMATED COSTS AND SUSTAINABILITY

We are taking the upfront cost of proving the model, the largest costs are around training and aggregation of farmers. We are hoping that other partners will take up the cost of different components.

To demonstrate the potential of the model to reduce PHL, RF will invest in the upfront cost of operating as the systems integrator by bringing all the actors together. This includes training of

small holder farmers, creating connections between buyers and suppliers, investing in supply chains for post-harvest technologies and brokering connections between financial institutions and different actors in the value chain. Though the initial investment of systems integrators is very high, a key element of our model is to showcase the value proposition and then transition costs to the different actors.

6. CONCLUSION

PHL levels are currently very high across value chains in SSA and action is required as a reduction in post-harvest losses has a direct impact on food security, promote efficient resource utilisation and to secure livelihoods of smallholder farmers.

Leveraging on increased investment by the private sector in sourcing from SHFs responsibly provides an opportunity to integrate PHL interventions to demonstrate the business case and value proposition to catalyse system change.