CHALLENGES AND MARKET OPPORTUNITIES IN DEVELOPING SUSTAINABLE FOOD SYSTEMS

ONE THIRD
Think Tank on Prevention
of Food Loss and Food Waste

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Introduction

The Danish think tank ONE\THIRD gathers minds and interest groups from civil society, the private sector, public authorities, and research representing the entire food chain from 'farm to fork' to help combat and prevent post-harvest loss[1] (PHL) and food waste.

The overall purpose of the think tank's international work is to contribute to the global efforts on reduction and prevention of food loss and food waste. In particular, the think tank aims to support countries that have not yet achieved progress in this area, and aid developing countries' efforts to reduce food loss and secure food supply. This with the ambition to achieve tangible impact working with global partners to effect real change in food loss and waste internationally, specifically with focus on achieving the UN Sustainable Development Goal 12.3.

Box 1: Sustainable Development Goal 12.3

The aim of Sustainable Development Goal 12.3 is halving per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses by 2030.

ONE\THIRD sets out to develop and implement a solid foundation of accountable programs, research and initiatives carried out within all layers of the food value chain, thus strengthening Denmark's position as a global leader in the fight against PHL and food waste.

As a part of ONE\THIRD's international focus, four feasibility studies on concrete market opportunities have been initiated in 2020 in collaboration with the Trade Council of the Ministry of Foreign Affairs and Access2innovation. The studies include Nigeria, Kenya, China, and Brazil with the later not being finalized due to COVID19.

Following an overall introduction to the global challenges of PHL especially in a developing country context, a summary of the studies is compiled in this report along with:

- Challenges and opportunities in developing sustainable food systems in Nigeria, Kenya & China.
- 10 recommendations for reducing PHL in a developing country context.
- Opportunities and Financing ahead.

[1] Food and Agriculture Organization of the United Nations defines post-harvest loss as a measurable quantitative and qualitative loss in each product.

Introduction to post-harvest loss

By 2050 global food production needs to increase by 70%[2], calling for a significant global demand for improved agribusiness. Developing inclusive, sustainable, and efficient food systems plays a key role in achieving the Sustainable Development Goals (SDG) and in meeting the demands from a growing world population of 8.5 billion people in 2030 and 9.8 billion in 2050.

Box 2: Facts on global post-harvest loss (PHL)

- One-third of food produced for human consumption is lost or wasted globally. This amounts to about 1.3 billion tons per year, worth approximately USD 1 trillion (http://www.fao.org/food-loss-and-food-waste/flw-data).
- Globally, around 14% of food produced is lost between harvest and retail. Significant quantities are also wasted in retail and at the consumption level (http://www.fao.org/climate-change/our-work/areas-of-work/food-loss-and-waste/en/).
- In developing countries, 40% of losses occur at post-harvest and processing levels. In industrialized countries, more than 40% of losses happen at retail and consumer levels (http://www.fao.org/3/mb060e/mb060e02.pdf).
- All the food produced but never eaten would be sufficient to feed 2 billion people - more than twice the number of undernourished people across the globe https://www.wfp.org/stories/5-facts-about-food-waste-and-hunger).
- If wasted food were a country, it would be the third largest producer of carbon dioxide in the world, after the USA and China (https://www.wfp.org/stories/5-facts-about-food-waste-and-hunger).
- Consumers in rich countries waste almost as much food as the entire net food production of Sub-Saharan Africa each year https://www.wfp.org/stories/5-facts-about-food-waste-and-hunger).
- In Sub-Saharan Africa alone, 30-50% of production is lost at various points along the value chain (https://dalberg.com/our-ideas/food-loss-and-waste-africa/).
- PHL causes as much as USD 936 billion per year in economic losses (http://www.fao.org/3/bb144e/bb144e.pdf).

Decreasing PHL also reduces poverty and hunger and fights climate change. Regarding the latter, PHL is responsible for about 7% of global greenhouse gas emissions and nearly 30% of the world's agricultural land is currently occupied to produce food that is ultimately never consumed. Further, agriculture already plays a significant role in deforestation and water scarcity, and 38% of total energy consumption in the global food system is utilized to produce food that is either lost or wasted. Hence, the benefits of reduced PHL and increased agricultural productivity will affect the individual economies in general and thus the global economy.

[2] http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf

Challenges and market opportunities in developing sustainable food systems

In collaboration with the Danish Trade Council, four feasibility studies have been undertaken to examine certain “touch-down points” in the PHL value chain in four third-countries. The following briefly highlights the key findings with a focus on current challenges and opportunities to address PHL in Nigeria, Kenya, and China.

Study 1: Nigerian vegetable, root, and dairy value chain

The study was initiated by the Danish Trade Council in Nigeria with the goal of investigating current market balance issues for targeted value chain products within

- Vegetables (tomatoes and peppers).
- Root crops (cassava and yam).
- Milk production.

This with the aim to identify activities leading to PHL, the causes of the losses and to analyze the financial impact. Finally, the objective has been to identify business opportunities within PHL. Please note that while challenges are described in all value chains, not all include business opportunities.

Tomatoes and Peppers Value Chain

Challenges in tomato value chain

Tomato production suffers some of the highest losses of products through the value chain in Nigeria. The survey results showed that losses were 27.7% in Oyo State and 28.9%in Osun State. However, over 30% of tomatoes are transported from the north to the south and on this trip over 40% of the product can be lost. These losses were incurred despite the use of plastic crates from farm to wholesaler and despite good facilities at the collection centers. However, between collectors and dealers, about 20% of product was lost, and much of this was caused by:

- The transport conditions (open trucks and pick-ups) and delays.
- Harvest of tomatoes was made in a ripe or fully ripe stage which means they become over-ripe within a day or two, and then are more susceptible to damage.
- The lack of refrigerated conditions means that any delay causes deterioration in tomato quality, softening of the fruit and resultant damage when loaded, offloaded and during the trip.

Market opportunities in tomato value chain

Based on the analysis, the following business proposals has been made:

- Distribution and wholesale business model.
- Tomato processing business.

The two business proposals involve larger scale investors. However, within the two proposals, there will be a need for the large-scale investors to source input suppliers and service providers

which will present opportunities for Danish providers (besides those who may be interested in the large-scale investment). Vertical integration is incorporated into the two tomato projects: one producing for the local supermarkets as a distribution and wholesale business, and the second processing tomatoes into paste and concentrate. These businesses present hurdles but involve small-scale farmers who will be versed in best practices and their margins will hopefully increase significantly.

To ensure a viable and sustainable tomato business it is essential to adopt best practices from the farm to the consumer; that is, at all stages of the value chain. Poor handling practices result in lower average quality and losses in quantity of tomatoes through damage, disease, and spoilage. Consequently, any business proposal must include all aspects of best practices through the value chain to ensure its success. Focusing on an isolated issue within the value chain may result in temporary improvement but gains in value-adding may be lost if actors downstream continue using old and inefficient practices.

Cassava value chain

Challenges in cassava value chain

Losses in cassava were estimated to be 25.4% (Benue State). Losses occur most commonly on the farm and during processing of the FCR (Fresh Cassava Roots). There are also losses during the collection of the FCR from the farms and their transport to the processors. Yam loss amount to 12.6% where most losses occurred on-farm, particularly during storage; treatment of these stored tubers could reduce losses. Wholesalers rejected 3.6% of tubers from collectors because of damage (physical and lest damage).

These losses compound the issue of low producer yields from these value chains; that is, once the product reaches the consumer the volumes of produce are significantly reduced and obviously the consumer price rises. Tomato prices increased from the farmer to the consumer by up to 209% (Osun State), Cassava by 143% (Benue State) and yam by 71% (Benue State). Peppers demonstrated the lack of resilience in a value chain that uses intermediary traders; that is, losses were made by the traders and consequently farmers made direct sales to retailers in the village market (68% of their produce) by-passing traders and facilitating higher margins for them and the retailers.

Market opportunities in cassava value chain

The project proposal includes a local foodstuff processor (vertical integration). This concept is based on parameters which ensure enhanced returns to all players in the value chain from the farmers to the retailer. The concept attempts to avoid the weaknesses in the value chain, or at least mitigate them, and attempts to mitigate the threats. Well controlled vertical integration from the famer to the consumer ensures this. The organization of the project is critical:

- A project would be based around units (clusters) of small farmers with a small sized mill. This would constitute an operating unit which could be replicated through the area. The actual size would need to be determined by financial analysis to determine returns on capital investment needed.
- Installation of small-sized mills within a cluster of cassava growers (30 km maximum distance to the mill) would overcome many of the problems with transport from the farm to

the processor. The controlling company (miller - processor) could own small mills in a localized area from which they could coordinate delivery of processed product to their off-takers (urban markets).

- These smaller processing units could be owned by one company; this would avoid the need for constructing a large processing unit which immediately presents difficulties in delivery from farms further away and problems with supply consistency.
- There would be strong vertical linkages in the value chain between the farmers the processors, and the market; that is, it would be vertically integrated with the processing company being the controlling agent. This would be ensured by reducing the number of players in the chain, with no collectors.
- Strong linkages would enable and include technical assistance and input procurement for the farmers ensuring good production levels; that is, yields.
- The processing plant could provide production by growing cassava on-farm; this could be considered “core production” and would ensure greater supply stability.
- Farmers must be close to the processor reducing transport costs, unnecessary repairs and maintenance caused by poor roads and tolls.
- The processing plant and equipment must be up-to-date and efficient. Power must be sourced cost-effectively. If the grid is unreliable, solar energy must be considered or reasonably priced generators. Reasonably priced power is a pervasive problem affecting all machinery powered operations.

Milk Production (dairy) Value Chain

Challenges in the dairy sector

The study concludes that about 2% of fresh milk was lost in the current value chain. Milk from traditional producers is sold directly to consumers immediately, and processed products within a day or two so no added margins are incurred. However, production is low (1 to 2 liters per cow per day) compared with up to 20 liters in open field production globally. Commercial integrated dairies have much higher production levels but cater for more up-market clientele.

The overall result is a high demand for milk products from the average consumer and this is being met through imports. Challenges in the dairy sector include:

- 79% identified inadequate feed – water
- 68% no proper dairy facilities
- 25% lack of dairy knowledge
- 9% lack of efficient marketing system
- 7% inefficient milking methods
- 4% lack of static milk pricing
- 0.3% showed power failure

Further, the spatial distribution of traditional livestock producers and the unfavorable terrain makes it difficult to reach the producers, and affects costs, access to markets and business development services. Illiteracy, mutual distrust, erosion of traditional leadership, all combine to compound the problem of organizing pastoral livestock producers into associations or cooperatives. Strategic infrastructure such as water, roads, and electricity, which are required to support dairy

development, is lacking or is inadequate. The cold chain and collection networks require a steady supply of clean water, efficient and effective power supply, and good road network, respectively.

Market opportunities in the dairy sector

Intervention priorities have been proposed in various forms to overcome some of the challenges mentioned above (some of which have been implemented). Prioritized areas of interventions are:

- Livestock data project
- Support farm service and technical training
- Business model programmes
- Cooling tank program and mobile milk collection units
- Bulk vending of pasteurized milk: MILCOPAL Model
- Dairy cluster business model program
- Development of milk sheds
- Model farm program and establishment of infrastructure
- Nigerian green field project (develop commercial hay markets)
- Livestock business advocacy program

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Link to report: Nigeria PHL

Study 2: Kenyan horticulture and maize value chains

The study in Kenya is carried out by Policy and Market Options Ltd. for the Royal Danish Embassy in Nairobi. The study has addressed needs within the horticultural sector and maize value chain based on harvesting, storage, logistics, and infrastructure needs with concept, business model and operations for local and export operations. Following to the analysis, five strong cases of specific business opportunities in both value chains has been identified.

Horticulture value chain

Challenges in the horticulture value chain

PHL is a major problem in Kenya's domestic horticulture. These losses occur throughout the value chain at the farms during production, in the logistics and at marketing operations both at wholesale and retail levels. PHL in Kenya are estimated to be as high as 50%. The level of losses varies across different horticultural products. It also varies according to seasons. The losses are mainly caused by poor storage and handling practices. They impact businesses along the value chain in different ways. Farmers are however the most affected. Efforts to PHL have the potential to improve business incomes and build more resilient value chains. In addition, reducing PHL will alleviate the need to bring additional land under cultivation, thereby mitigating negative environmental impacts from agriculture.

Managing PHL is limited by poor coordination in the supply chains of horticultural commodities. There is remarkably high uncertainty by farmers, traders, and service providers on whether business will be stable. This discourages investments in post-harvest management technologies. Vertical coordination across the different stages of the value chain is largely lacking in Kenya's domestic horticulture. Efforts to manage PHL is therefore concentrated at specific nodes in the value chain, and this simply shifts losses from one node to another. It also erases incentives for adoption of new technologies and practices. Reduction of PHL therefore depends on the simultaneous mobilization of the key actors. For example, reducing the loss of perishable products at harvest has shown to have limited value for farmers when they are not able to get their produce to market quickly.

Generally, reducing PHL in horticulture requires that a cold chain is maintained. Produce needs to be cooled to the required temperature as soon as it is harvested, and that the temperature is maintained all the way to the consumer. At the consumer level, whatever is not sold within a day is dumped. This is a challenge for suppliers because supermarkets will only pay for produce that is sold. Suppliers have reported dumping of up to 50% of produce that they stock in supermarkets.

The produce is handled by different players from farmers to aggregators, to transporters, to wholesalers and retailers before reaching the consumer. These are distinct businesses that require necessary technologies that are relevant at their levels to maintain the cold chain. When one part of the value chain does not control causes of PHL, it discourages other parties in the chain from investing in post-harvest management technologies. This is the situation in Kenya. Investments by companies marketing domestic horticulture produce is held back by uncertainty on whether there will be enough volumes of produce of good quality to optimize utilization of the cold stores. Low-cost technologies to maintain the cold chain have been promoted by learning institutions, the government and development projects. Small scale farmers can neither afford such investments nor produce enough volumes to optimize utilization of stores of this size. It requires group investments. However, unity among farmers in groups is still a challenge and it will have to be addressed for farmers to afford and manage such storage technologies.

Market opportunities in the horticulture value chain

Based on the challenges above, the following market opportunities has been identified as a way to solve the challenges and reduce PHL.

Cold storage at produce aggregation and marketing

The number of aggregators who are formalizing their operations through companies that supply a variety of quality fruits and vegetables for the domestic market are increasing. Their business models involve sourcing produce from many farmers, aggregating them and selling to a variety of markets including hotels, restaurants, schools, and informal vegetable vendors. This contrasts with wholesalers in open air markets who rely on walk-in customers. Most aggregators handle 10 to 60 tons of produce every week. The key products are tomato, onions, banana, potato, and leafy vegetables.

Small scale harvesting technologies for tubers (potato and onion) and fruits (avocado and mango):

Harvesting of tubers and fruits is mainly done by hand. This process is laborious and expensive for the farmer. It is also causing significant mechanical damages to potatoes, onions, avocado, and mangoes. Harvesting of tubers is done by hoes, and fruits done by shaking the tree or plucking with a stick and the fruit falls to the ground. The labor cost in harvesting is also high. Further, the process is slow, and this leads to prolonged exposure of harvested tubers to sunlight and field heat which reduces the post-harvest quality. Investments in potato mechanization has been done by county governments of Nyandarua, Nakuru and Uasin Gishu. The use of these equipment by farmers is low because of frequent breakdown and too less equipment serving many farmers.

Packaging and logistics

Packaging of horticulture produce largely depends on the destination markets and the relationships that exist in the value chain. Formal contractual arrangements in the export and formal domestic markets have strict quality standards and package their produce in plastic crates. This produce is also often transported in reefer trucks or insulated trucks. The informal domestic market on the other hand has loose relationships in the value chain and packing is often done in plastic gunny bags (for potatoes, leafy vegetables), wooden crates (for tomato and papaya) or produce is stored and transported in bulk without any packaging (for banana, oranges, and mangoes). A few businesses are starting to formalize in the domestic market and the formalizations comes with the need to improve their efficiency by reducing PHL. They are preferring to use crates for packaging of produce. These businesses are embracing contracts with supplier farmers and investing in storage spaces for holding produce.

Maize Value Chain

Challenges in the maize value chain

The Kenyan maize reserve system has suffered a couple of incidences of aflatoxin and maize rotting in the last 10 years leading to losses of more than 2.5 million (90 kg equivalent) bags, while its estimated that farmers loose about USD 300 million per annum to post harvest wastage, including rodents, poor handling and also aflatoxin. The big grain millers and feed handlers and large-scale farmers do have facilities to address PHL, but the untapped market is the smaller scale facilities and units which would serve the numerous small and medium scale farmers spread out in the whole country that produce 60 -70% of the maize in the market.

Kenya is one of the world’s hotspots for aflatoxins, with what is believed to be the highest incidence of acute toxicity ever documented. Kenya suffered severe outbreaks of illness from aflatoxins in 2004 and 2010, poisoning more than 300 people in the 2004 event alone, and killing more than 100. Domestic animals that consume feeds contaminated by aflatoxins can also become sick and die.

Storage involves substantial costs and risks as well as potential benefits for farmers. Storage competes with other activities valued by smallholder farmers, and it is important to understand where any new storage technology being introduced fits in to the entire farming system, and household economy in order to establish the probability of their uptake. This stems from the realization from previous studies that any 'improvements' in storage will only be attractive to farmers, traders, or governments if the perceived benefits substantially outweigh the costs. Technical superiority is generally insufficient (although it can be attractive for its prestige value), and farmers and traders are likely to tolerate quite high storage losses before undertaking complex

or expensive changes to their storage systems. Some of the largest cereal producers in Kenya achieve 8-12 tons/hectare of maize on commercially run private farms, almost double current yields on large government-owned farms.

The only way to prevent molds from growing and spreading is to dry maize grain quickly at harvest to moisture levels of less than 13%, keep them in a dry condition and off the ground during storage. However, it is common to see maize being dried in the sun in open spaces and the roadside on tarpaulins during the harvesting season. Overreliance on heat from the sun has been cited as a major cause of aflatoxin contamination in Kenya.

Market opportunities in the maize value chain

Based on the challenges in the maize value chain, the following market opportunities has been identified to solve these challenges and reduce PHL.

Hermatic storage bags

There is growing interest from the Government at National and County, as well as development partners to address PHL for the staple crop at the household level through promoting the use of hermatic bags at the household level. They are proving to be easy for storing a few bags of maize for the poor household until the next harvest, or until the price is right.

With a projected production of 5,009,400 MTs in 2020 and an estimated 66 percent for immediate consumption in various ways, including milling, leaves some 18 million bags to be stored. The demand may extend exponentially when storage of other grains, including sorghum, are considered.

Hermetic bags are more attractive than hermetic silos for small-scale producers because of capital investments required for the later. Besides, they produce lesser volumes which makes the bag most appropriate. The bags are also easier to transport or move around with unlike the silos.

The hermetic storage bags have been well received in the market and their demand is growing rapidly. However, adoption rate is still low (estimated at about 14%). This is due to the lack of awareness on the technology, lack of knowledge and/or information on their effectiveness and use, especially among farmers who are not organized in groups and also those who access their farm inputs directly from the agro dealers.

Mobile dryers

Kenya is one of the world's hotspots for aflatoxins. Therefore, as the regulation tightens around food safety, its expected there will be increased investments around drying services in order to meet desired quality standards. Introduction of the warehouse receipt system (WRS) as the mode of purchase for maize will also increase the demand drying services by the farmers so as to meet the quality required by the WRS certified stores.

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Link to report: Kenya PHL

Study 3: Chinese dairy and meat value chains

The study in China was carried out by the World Resources Institute for the Royal Danish Embassy in Beijing. The objective has been to conduct a review of the current development of China's meat and dairy industries, and based on this, identify reasons for meat and dairy industry loss and waste and hence identify potential window of opportunities for investors, and meat and dairy companies, with a focus on international development and cold chain.

Challenges in the dairy and meat value chains

Both the demand for meat and dairy products will continue to increase in the next decades in China. However, about 22.5% meat and 11.2% dairy product are lost or wasted annually in China. Similar to other countries in the world, reducing meat and dairy product loss and waste is critical for China to achieve the synergies on food, health, environment, and climate. Increase in income, the rising living quality, the preference for healthy food and the rapid urbanization led to the increase in Chinese consumers' demand for meat and dairy product in the past and will continue to drive the domestic demand in the next decade.

Meat loss and waste is identified mainly at the distribution, processing, packaging, and consumption stages of the meat supply chain while the loss of dairy product mainly happens during the production and consumption stages. Compared with other countries and regions, 35.5% of the meat loss and waste happens during the consumption process while 26.7% and 22.2% loss are identified during the distribution and processing and packaging respectively in China. In addition, the production and consumption stages are the main reasons for the loss and waste of China's dairy sector by accounting for 31.3% and 44.6% of the total loss and waste.

Market opportunities in the dairy and meat value chains

Based on the challenges in the dairy and meat value chains in China, the following market opportunities has been identified to solve these challenges and reduce PHL.

Technical upgrade to improve the resource use efficiency: Cold chain development:
China will strengthen the construction of cold chain logistics facilities, and gradually build a cold chain logistics facility network between the main production areas and the main sales areas of livestock. This could be an opportunity for investors/companies that have advanced experiences on integrated solutions which provides advanced cooling and energy efficiency and big data technologies to leverage.

International collaboration on meat and dairy industry development:
To transform the meat and dairy industries from the traditional model to the green and sustainable manners, the national development plans for the meat and dairy industries require to focus on industry integration, optimizing resource allocation, adopting the circular economy approach to extend the value chain of both meat and dairy sectors and improve the comprehensive utilization of resources, energy conservation and emission reduction, and protect the ecological environment. The national plans encourage strengthening the collaboration with developed countries in the following areas:

For the meat industry, the national development plans for the meat and dairy industries calls for:

- Strengthening exchanges and cooperation with developed countries in pig breeding, feed development, breeding management, waste disposal and other aspects, so as to enhance the comprehensive production capacity of China.
- Conducting international collaboration in the fields of herbivorous livestock and poultry variety resources, improved breeding, epidemic disease diagnosis, feed development, livestock product processing and quality safety.
- Supporting and promoting the establishment of direct and stable trade relations between domestic and foreign enterprises.
- Accelerating the development of enzyme preparations, microbial preparations, plant extracts and other new feed additives, promote the reduction of drug feed additives, and develop environment-friendly feed products with low nitrogen, low phosphorus, and low minerals.

For the dairy industry, it is encouraged to learn from international experiences on technology and industrial management, strengthen exchanges and cooperation with developed countries in dairy farming, dairy product processing, forage planting and processing, and quality control. Adhere to the principle of domestic supply, supplemented by import adjustment, to meet the diversified consumption demand of dairy products.

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Link to report: China PHL

10 recommendations for turning post-harvest loss into sustainable business opportunities

In general, the debate on PHL have traditionally had a significant focus on technology. However, as the studies indicates, investing in a better understanding of PHL in different value chains is crucial before further investments and attention to reduction technologies or processes that may have little payoff. The three initial studies on PHL in Nigeria, Kenya, and China is a first step towards creating this understanding.

Findings across the reports suggests that a more holistic approach is needed with an emphasis on *organization* as a critical factor. This could include organizing farmers in clusters, improved education of local farmers, access to financing, use of bi-products, and adaptation of existing technologies.

This does not mean that technologies and innovations are not important, but they must not be looked at in isolation, which the four reports emphasize as well. As an example, the report from Nigeria mentions how entering a cooperative system can assists small-scale farmers with production and marketing which in the long-term can have spin-off benefits in the community, stimulating better production practices. Organization of group production, processing and marketing facilitates economies of scale which subsequently allows investment in e.g., cool chain facilities and improved transport (vertical integration). There is negligible systematic evidence of quality premiums paid to staple crop producers, which might help encourage investment in PHL remediation and quality control processes. In general, this means focusing on more efficient value chains.

Based on the studies from Nigeria, Kenya, and China, case studies in Box 3-5, and recent research[3], the following 10 recommendations is suggested to have in mind when developing food systems for reducing PHL. Please note that these are general and broad recommendations that are relevant across all countries studied, but that the weight of each may vary from country to country. As an example, in China there is a significant focus on developing a cold chain, and while this is important in Nigeria and Kenya as well, organizational matters are more prevailing issues here.

1. Be aware of farm logistic and physical accessibility to market, including what has been exploited by middlemen.

2. Consider supporting and organizing smallholder farmers in farmer groups and do contract farming, which can facilitate economies of scale and ease marketing and logistics.

3. Understand the market power. This includes the degree and type of information asymmetries, competition among buyers and sellers, transaction transparency, protection, and enforcement of rights, all of which can negatively influence the marketing of farmers' produce and hence cause PHL in the chain.

[3] Creating Mutual Value: Lessons Learned from Ventures Serving Base of the Pyramid Producers (London et. al 2010)

4. Be aware of the extent of market security. This includes degree and type of continuity, fluctuation in prices, and cyclicality in demand. When working against farmers, these factors often lead to PHL.

5. Engage in capacity building of partners as it is a key success factor. It includes the accessibility, affordability, and quality of technical and business knowledge, technology, and equipment in the value chain. It is especially advisable to focus on training of farmers and agronomist services.

6. Lack of appropriate storage at the farm level is a major cause of PHL. Address the need for decentralized cooling / storage units.

7. Secure access to financing, e.g., for local customers buying technology and equipment, or for cooperatives setting up farmer groups.

8. At the distribution level, it is highly recommendable to reflect that distance between production and market is often hundreds of kilometers on bad roads.

9. As the case is on farm level, the development of cold chains is equally important when distributing the produce.

10. Downstream transport facilities that are able to protect the produce is important, as a significant amount of especially horticulture products is damaged and bruised during transport.

As far as technological products and services in Sub-Saharan Africa concerns, the authors of the report would like to emphasize that especially point 7 is vital for solving many challenges related to PHL. The core problem in many value chains in Sub-Saharan Africa is the lack of local buying power. E.g. a Danish company selling a PHL reduction technology that a local customer cannot afford. One of the main reasons are high interest rates, meaning that local companies have difficulties in taking a loan for financing products and services.

Box 3: Twiga Foods

Since 2014, Twiga has been bridging gaps in food and market security through an organized platform for an efficient, fair, transparent, and formal marketplace.

They source quality fresh and processed food from thousands of farmers and food manufacturers and deliver from their pack house to thousands of vendors, at prices fair to everyone.

For more information see: https://twiga.com/

A case example that works to solve many of the challenges is Twiga Foods from Kenya. The Twiga Food business model solves point 1, 2, 3, 6, 7, 8, and 10, and indicates a 70% reduction in PHL by increasing efficiency and organization on these parameters (see Box 3).

Box 4: Integrated GrainHubs

By combining and introducing drying, cleaning, storage, stone milling and seed treatment technologies, the development objective of the GrainHub project is to improve livelihood in rural areas in Uganda.

This is done by creating employment opportunities especially for women and youth, and to help mitigating the problem of PHL through the introduction of village based GrainHubs. The Danish partners in the project are the companies Engsko, BM Silo and Gl. Buurholt.

For more information see: https://www.access2innovation.com/en/access2innovation-and-experts-improve-the-conditions-of-poor-farmers-in-uganda/

Box 4 and 5 are examples of other business models that encounter or implement some of the challenges / proposed interventions mentioned above.

Box 5: The Fresh Fruit Nexus project

The five-year project is administrated by DanChurchAid and established in partnership with the business partners Nordic Fruit and Lishe to create more than 2000 jobs and boost local market development. Further, Maersk and Rema 1000 are part of the project as well.

The Fresh Fruit Nexus project aims to improve livelihoods in one of Uganda's poorest areas, the West Nile region in Northern Uganda.

The objective is to support the development of decent employment opportunities for refugees and host communities by training smallholder farmers to grow certified organic fruit for export through an effective cold chain, and thereby reducing PHL.

The partners involved in the project connect the entire supply chain from community mobilization, organic production, fresh handling, cooling, and import to Danish supermarkets.

For more information see: https://www.noedhjaelp.dk/erhverv/forretningsudvikling/soede-kartofler-i-uganda/

Opportunities and financing when addressing post-harvest loss

Along with the developed analysis, recommendations, and insight from the ONE/THIRD partner group, a joint project proposal have been developed under the heading "Sustainable food production for Denmark and Africa", calling for a comprehensive multi-stakeholder platform (see box 6).

An initiative that meets the SDGs call for action and new approaches if we are to meet the significant global challenges. A necessary global change that, according to an analysis, also opens new market opportunities for Danish companies worth USD 60 billion per year in 2030 (A World of Opportunities for Danish Businesses 2019).

Box 6: Project proposal developed by the ONE/THIRD international working group

By 2050, world access to food must increase by 70% to reach global demand. In sub-Saharan Africa, 30-50% of production is lost in the value chain.

The project “Sustainable food production for Denmark and Africa” will provide a multi-stakeholder innovation platform where Danish MNE’s will provide access to their strategic value chains in Africa. Here selected Danish SMEs will develop needed products in joint effort with NGOs, researchers and Danida sector experts. This to optimize the Danish MNE’s value chain, show-case the viability of the SME’s solutions to the regional market and develop needed partnerships and financing modalities.

However, if we are to meet the SDGs and realize the promising market potential, it requires us to work across organizational and institutional boundaries, as well as a match between the phases in project development and public- and private funding. A financial ecosystem that is yet to be developed, but currently holds the public financing opportunities outlined in box 7.

Box 7: Funding opportunities

Access2innovation (www.access2innovation.com)

Danish SMEs, in collaboration with knowledge institutions and NGOs, can access funding of up to DKK 0.5 million for developing and testing new products and services for the African markets

Innobooster (https://innovationsfonden.dk/da/programmer/innobooster)

Innobooster is a grant to companies that wish to develop and make a new product or service ready for the market or to improve a process that increases the company's competitiveness and creates growth. The grant may help reduce the company's project-related risks. Companies can apply for DKK 50,000 - DKK 5 million.

Danida Innovation and Business Explorer (https://um.dk/da/danida/danida-business/partnerskaber/danida-innovation-and-business-explorer/)

Danida Innovation & Business Explorer offers financial support to Danish companies, including start-ups, that wish to investigate concrete business opportunities contributing to the achievement of the SDGs (DKK 500,000)

MUDP (https://ecoinnovation.dk/)

The vision of the MUDP is that Danish companies should be among the best in the world at developing, commercializing, and applying environmental technology solutions of the future. Therefore, the fund makes DKK 140 million available for projects that promote new, innovative ideas, contribute to a greener world, create jobs in Denmark and export environmental technology. Companies can apply for DKK 300,000 – DKK 15 million

P4G (https://p4gpartnerships.org/)

Partnering for Green Growth and the Global Goals 2030 is an initiative commenced in 2018 with the ambition of becoming the world's leading forum for developing concrete public-private partnerships at scale to deliver on the SDGs

Horizon Europe (https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en)

Horizon Europe is the EU's key funding program for research and innovation with a budget of EUR 95.5 billion. It tackles climate change, helps to achieve the SDGs, and boosts the EU's competitiveness and growth.

NEFCO (Nordic Environment Finance Corporation) (https://www.nefco.int/)

NEFCO provides financing for economically viable green projects with positive environmental or climate-related impact through loans, equity-type financing, and conditional loans to Nordic small and medium-sized enterprises (SMEs) and midcap companies for green investments carried out on global markets

- Loans and equity-type funding – up to EUR 2.5 million. 50 % of total
- NEFCO COVID loan: EUR 500,000
- NEFCO Feasibility: EUR 50.000. 40% of total budget

For more information on the funding opportunities, please contact Jacob Ravn at jr@access2innovation.com