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Conference on 'Food and nutrition security in Africa: new challenges and opportunities for sustainability'

Food and nutrition security: challenges of post-harvest handling in Kenya

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Presently, close to 1 billion people suffer from hunger and food insecurity. Statistics in Kenya indicates that over 10 million people suffer from chronic food insecurity and poor nutrition, 2–4 million people require emergency food assistance at any given time with nearly 30 % of Kenya's children being undernourished, 35 % stunted while micro-nutrient deficiency is wide spread. Key among the challenges contributing to inadequate foods include lack of certified seeds, seasonal production (rain-fed), high post-harvest losses and wastages, poor transportation, low value additions which reduce their market competitiveness. The present paper examines some of the underlying causes for high food wastage experience in Kenya and the associated challenges in addressing these problems. The paper also provides an overview of some of the basic solutions that have been recommended by various stakeholders. However, in spite of the recent efforts made to mitigate food wastage, there is still an urgent need to address these gaps through participatory, innovative community based interventions that will create resilience to climate change and enhance livelihoods of smallholder farmers in diverse ecosystems.

Food and nutrition security: Post-harvest handling: Food loss and wastage

Post-harvest handling is defined as the stage of crop production immediately following harvest. This process of deterioration begins as soon as a crop is removed from the ground, or separated from its parent plant. Post-harvest treatment will to a large extent determine the final quality of the crop whether it is sold for fresh consumption or used as an ingredient in a processed food product. Effective handling is therefore essential to decrease post-harvest losses[1].

World Food Program special operation SO 200671 summary report notes that post-harvest food loss (PHFL) is one of the largest contributing factors to food insecurity in Africa, directly impacting the lives of millions of smallholder farming families every year. Although there are great concerns regarding the global inability to feed a growing population of 10·5 billion by 2050[1] the answer does not just simply require an expansion of agricultural production. There is need to urgently establish sustainable solutions to the threat of global food shortages which will preserve the existing food production systems but will also address reduction of food losses[2].

Global food production, supply and consumption systems are not functioning to optimal efficiency, with food losses in sub-Saharan Africa alone exceeding 30 % of total crop production and representing more than US$4 billion in value every year[3]. These annual food losses far exceed the total amount of international food aid provided to sub-Saharan African countries each year.

Smallholder farmers manage approximately 500 million small farms and provide over 80 % of the total food consumed in sub-Saharan Africa. The highest area of food losses reported are pre-farm gate where poor harvesting, drying, processing and storage of crops occur[4]. There is evidence from other developing regions where improved farm management practices and storage technologies have resulted in dramatic food loss reductions. This has helped farmers to overcome the continual cycle of poverty, created by pressure to sell crops quickly when prices are low to avoid losses, only to buy grain

Abbreviation: PHFL, post-harvest food loss.

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later in the season at higher prices to meet their family's consumption requirements[5].

The Dutch Ministry of Economic Affairs, Agriculture and Innovation broadly defines food waste within a policy context to include quality considerations and residual and waste flows in addition to the food loss[6,7]. Food loss occurs for many reasons, which range from natural shrinkage (e.g. moisture loss), mould, pests, inadequate climate control and food waste[8]. Food losses can be qualitative, such as reduced nutrient value and undesirable changes to taste, texture, or colour, or quantitative as measured by decreased weight or volume.

Scale of the problem

The Food and Agriculture Organization of the United Nations[3], estimates that approximately one-third or about 1·3 billion metric tonnes of all edible food produced for human consumption is wasted or otherwise lost from the food supply annually[9]. Reducing this PHFL is increasingly important to mitigate the effects of food insecurity in Kenya[8].

What is food security?

Food security means that all people at all times have physical and economic access to adequate amounts of nutritious, safe and culturally appropriate foods[10]. Household food insecurity is a serious recurrent problem for Kenyan smallholder farmers for whom subsistence farming is all they depend on. The core concept of food security is access to healthy food and optimal nutrition for all. Food access is closely linked to food supply, so food security is dependent on a healthy and sustainable food system[11]. That should be well in place and strongly supported by the various government policies to support the entire population of that particular country. In order to achieve the millennium development goals it is therefore imperative that an elaborate food system is in place. The food system should include the production, processing, distribution, marketing, acquisition and consumption of local/indigenous foods, for food security[12,13]. This food system should at all times attempt to reduce or completely do away with food loss and waste. As the world population is expected to grow by more than 2·3 billion people by 2050, the reduction of food loss and waste is critical in improving food security and for environmental sustainability.

Food balance sheets describe *per capita* food consumption but do not represent food consumed[14,15]. National surveys could be useful in determining the socio-demographic, geography, environment and seasonality characteristics. Individual dietary surveys for given population groups can also be used to show key patterns, practices and accessibility and availability among other factors that influence food choices.

This is once more exhibited in the developing countries where they can hardly produce food to feed their populations due to several incapacitating factors including poor farming practices, uncertified seeds, poor land utilisation and other inferior farming technology. Yet they lose the little they have managed to tediously produce to post-harvest waste and loss[16].

Statistics in Kenya indicates that over 10 million people suffer from chronic food insecurity and poor nutrition, 2–4 million people require emergency food assistance at any given time with nearly 30 % of Kenya's children being undernourished with 35 % stunted and micro-nutrient deficiency is wide spread[17]. Hunger periods are periods of time in which the stocks of food staples, such as maize or cassava, are finished and household food security relies on available cash[18]. This may lead to inadequate diets and hence to nutritional deficiencies, which include the lack of some vital micro-nutrients, otherwise known as hidden hunger[19–22].

To address food insecurity Kenyans have embraced their indigenous or local crops. This is because these underutilised indigenous crops often excel in terms of environmental adaptability, low input requirements, fit to specific cropping systems, readily produced seed or propagates and convenient harvest and post-harvest processing characteristics.

This perception of indigenous crops as healthy food by affluent urban consumers, linked with the growth of urban markets for these crops, provides additional incentive for mainstreaming them as economically-important commodities[23]. These successes are changing national perceptions of indigenous plants as not only important parts of agro-ecosystems and good sources of rural incomes but also as part of the national heritage that can improve year-round nutrition for entire communities[23].

What is food loss and waste?

Food loss and waste refers to the edible parts of plants and animals produced or harvested for human consumption but not ultimately consumed by people. It represents a decrease in the mass, energetic and/or nutritional value of edible food intended for human consumption at any stage in the food value chain[24].

Specifically, food loss refers to food that spills, spoils, incurs an abnormal reduction in quality such as bruising or wilting, or otherwise gets lost before it reaches the consumer[25]. This usually occurs at the production, storage, processing and distribution stages of the food value chain, and is the unintended result of agricultural processes or technical limitations in storage, infrastructure, packaging and/or marketing.

Conversely, food waste refers to food that is of good quality and fit for human consumption but that does not get consumed because it is discarded, either before or after it spoils[25]. Food waste mostly occurs at the retail and consumption stages in the food value chain and is the result of negligence or a conscious decision to throw food away (Table 1).

What are the causes of food loss and waste?

A strategic analysis paper on an Overview of Global Food Losses and Waste by Future Directions International, in

Table 1. Estimated waste percentages for each commodity group in the food supply chains for sub-Saharan Africa

Food crop	Agricultural production (%)	Post-harvest handling and storage (%)	Processing and packaging (%)	Distribution (%)	Consumption (%)
Cereals	6	8	3·5	2	1
Roots and tubers	14	18	15	5	2
Oilseeds and pulses	12	8	8	2	1
Fruit and vegetables	10	9	25	17	5
Meat	15	0·7	5	7	2
Fish and seafood	5·7	6	9	15	2
Milk	6	11	0·1	10	0·1

Source: Food and Agriculture Organization[3].

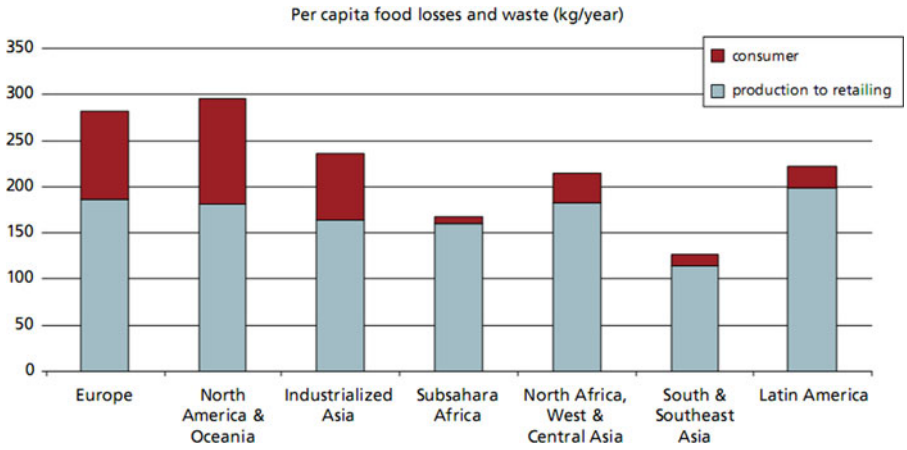

Fig. 1. (Colour online) Regional and Global Summary of Food Losses and Waste. *Source:* The Global Food Losses and Waste Report 2011, FAO.org.

2011 noted that in developing countries, food losses are mainly connected to limitations in infrastructure. Examples include: investment and technical issues, unfolding pre-harvest issues, lack of managerial competence, lack of sufficient storage or cooling facilities, inadequate packaging, uncoordinated transport networks, or simply having to cover post-harvest food stockpiles using nothing more than thin blankets. Smallholder farmers in hard to reach rural areas usually suffer the worst. These limitations will need to be addressed if tangible reductions in food losses are to be achieved. The losses also create a significant negative impact on the livelihoods of these farmers, as well as their low-income consumers, who have to bear the cost of increased food prices (Fig. 1)[26].

As to where the food is disappearing in developing nations, 40 % of losses take place during the post-harvest and processing phases, while 25 % of losses happen during the pre-harvest phase[4].

What are the implications of food loss and waste?

Case study of Kenya

Food losses contribute to food insecurity and low farm incomes not only in Kenya but also in other sub-Saharan African countries[27–29]. Kenya loses billions of shillings every year when large quantities of fruit, milk, fish and vegetables go bad in the market. It has food loss of 30–40 %, translating to 50 million bags valued at 30 billion shillings every year which are lost. For example, 93 % of the mangoes are sold fresh and an estimated 64 % goes to waste. The country also experiences 10–50 % damage to horticultural crops. (Sunday Nation Newspaper July 2014). Therefore, efficient post-harvest handling, storage and marketing can tremendously contribute to social and economic aspects of rural communities in Kenya as stipulated in Vision 2030[29]. On 19 February 2013, in Nairobi at the gala dinner of the United Nations Environment Programme governing council, 500 ministers, diplomats and senior officials from around the world dined on a delicious meal made from Kenyan-grown food that would otherwise have been wasted or fed to animals.

Farmers and suppliers in Kenya presently waste up to 40 % of what they grow, even though it is perfectly good food. In Kenya, farmers grow green beans, baby corn, broccoli, sugar snap peas and many other vegetables for the export market, but much of their harvest is wasted owing to the unnecessarily fussy cosmetic standards of British and European supermarkets, which are discarded for non-compliance. In addition to the onerous cosmetic standards, supermarkets often arbitrarily cancel forecast orders at the last minute, after the crop has been grown, harvested and brought to the pack house. The grower often has no option but to discard the food and bear the entire cost of the waste. Growers complained that they often pack the produce in the supermarket

packaging, fly it all the way to the UK, only for the supermarket to reject the entire consignment, again, entirely at the grower's cost[21].

Seasonal milk glut

The total quantitative losses in the dairy cattle milk supply chain in Kenya is estimated at 7·3 %. The critical points in the milk supply chain where improvements will contribute to reduced milk losses and improved quality are: (i) farm level (ii) collection points/ centres (iii) vendor outlets i.e. milk bars.

A 2011 study of the entire marketing chain found that milk loss was mainly due to spillage and spoilage occasioned by poor access to markets, rejection at markets, poor milk handling practices and irregular power supply in milk processing plants. Rejections were higher during the wet season, when production was high and roads impassable. In some areas, it was possible to market only the morning milk, creating a major constraint to increased production.

Research

An inquiry driven workshop in six countries Ghana, Kenya, Malaysia, Mexico, Nigeria and USA in February 2014 with 120 participants, identified 600 ideas to reduce post-harvest losses in Africa but narrowed to fifty promising innovations. The stakeholders included: producers, exporters, researchers, policy makers, food processors and others. The objectives of the workshop included eliciting feedback on present efforts to address PHFL in Kenya and other countries and clarifying opportunities to scale promising solutions to this challenge. The workshop settled on key insights along the four priority areas: accessibility, affordability, adoption and awareness in helping scale promising solutions for food storage and food preservation (Table 2).

Post-harvest losses

Post-harvest loss is defined as measurable qualitative and quantitative food loss along the supply chain, starting at the time of harvest until its consumption or other end uses. A significant portion of harvested produce never reaches the consumer due to post-harvest diseases. Various chemicals have been used to reduce the incidence of post-harvest diseases although some of them have been removed from the market in recent years due to economic, environmental, or health concerns. However, chlorination is an effective and a relatively inexpensive post-harvest disease control method that poses little threat to health or the environment[30,31]. In less developed countries, the main cause of loss is biological spoilage. Livestock products, fish, fruit and vegetables lose value very quickly without refrigeration. In contrast, roots, tubers and grain products are less perishable as they have lower moisture contents, but poor post-harvest handling can lead to both weight and quality losses. Cereal grain products are least susceptible to post-harvest losses, but grains may be scattered, dispersed or crushed during handling. They may also be subject to bio deterioration that may start as cereal crops reach physiological maturity, i.e. when grain moisture contents reaches 200–300 g/kg and the crop is close to harvest. While crops are still in the field, storage pests may

Table 2. Present efforts to address post-harvest food loss in Kenya and other countries

Present food storage solutions in use	Present food preservation solutions in use
1. *Storage pots (e.g. Zia pots, earthen/clay pots)	1. *Drying (e.g. sun drying of green vegetables, green house drying of fruit and vegetables; solar drying using artificial solar machine)
2. *Granaries (e.g. reed granaries, rat proof granaries)	2. Storing under shade for perishables
3. Tins	3. *Blanching and drying
4. *Sacks	4. Blanching and freezing or freeze drying (e.g. vegetables)
5. WiikHalls (i.e. portable storage structures)	5. Slicing, drying, then milling for cassava
6. Purdue improved cowpea storage bags	6. Chopping and vacuuming
7. Refrigeration	7. *Pulping and juicing fruits (e.g. mangoes)
8. Hanging over fire place	8. Cold storage for fruit and vegetables
9. Hanging dry grains over smoke paths	9. *Herbal preservation (e.g. use of Mexican marigold ground in grains; use of ashes in small quantities on grains)
10. Solar drying	10. *Chemical preservation
11. *Zero energy cold rooms	11. Fumigation
12. 'Cool bot' cold rooms	12. Hydro-cooling
13. Under tree shades	13. Dehydration
14. Woven baskets	14. Food canning
15. Metallic silos	15. Salting and smoking for meat
16. *Crates for distribution	16. Use of pawpaw latex for preserving sun dried meat
17. Antiseptic bags for processed fruit	17. Use of honey on milk and fruits
18. Dehydration	18. Jam making from fruits
19. Delayed harvesting	19. Making alcoholic beverages such as wine or vinegar (e.g. with banana)
20. Ground storage	20. Making condiments (e.g. with mangoes, chillies, and Asian vegetables
	21. *Minimal processing (e.g. for ready to cook vegetables in small bit of water)
	22. Biodegradable bags
	23. Introducing optimised harvesting for fruits
	24. Food canning
	25. Freeze drying
	26. *Waxing (e.g. for apples and avocados)
	27. *Modified atmospheric packaging to slow down ripening
	28. Ground storage

*Those solutions in use that could prove most transformative if scaled (in both cases).
Global knowledge Initiative 2014; Food loss challenge, Kenya.

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make their first attack and unseasonal rains can dampen the crop and result in mould growth[4].

Weather is also a key issue at harvest. In Kenya areas with hot climates, most smallholder farmers rely on sun drying to ensure that crops are well dried before storage. If unfavourable weather conditions prevent crops from drying sufficiently, then losses will be high. If climate change leads to more unstable weather, including damper or cloudier conditions, PHFL may increase. Poor-quality food may also lead to significant health costs, including costs for comorbidity associated with other health impinging factors such as HIV/AIDS. Suboptimal drying practices and poor storage of grain products can lead to the growth of mycotoxin-producing moulds, such as Aspergillusflavus, which produces aflatoxin, a potent carcinogen. Ingesting aflatoxin while infected with HIV/AIDS or malaria may lead to lower productivity, premature death and/or increased susceptibility to other fatal diseases[32].

Although minimising post-harvest losses of already produced food is more sustainable than increasing production to compensate for these losses, less than 5 % of the funding of agricultural research is allocated to post-harvest research areas. This situation must be changed to increase the role of post-harvest loss reduction in meeting the world's food needs. Kader[33] stated that 'while research on the improvement of agricultural production has received considerable attention and funding, until recently post-harvest activities have not attracted much attention from international research organisations such as (Consortium for Global Agricultural Research Partnership, Food and Agriculture Organization, Australian Center for International Agriculture, International Development Research Center, Centar Za Technologiju Zastite, Center for International Agriculture Research for Development, Natural Resource Institute, United States Agency for International Development)'[34].

What are some of the post-harvest loss solutions in use?

Plastic storage bags

Researchers at Purdue University (USA) have worked to reduce food loss by developing a simple reusable plastic storage bag, the purdue improved cowpea storage bag.

How does purdue improved cowpea storage work?. Purdue improved cowpea storage uses three bags nested within each other, with the innermost bag holding the crop being stored. After filling, each bag is tied tightly so as to form an airtight seal. Once the bag is tied, any pests remaining in the bag have a finite amount of oxygen to draw upon. As oxygen is depleted, the insects stop feeding on the cowpeas and become inactive, eventually drying out entirely and dying[35,36].

Case study: purdue improved cowpea storage in Nigeria. A study led by Research Into Use in Nigeria in 2009 distributed these bags to approximately 600 000 farmers with a view of introducing a commercially viable, non-toxic method of storing cowpeas[37]. Farmers who used the purdue improved cowpea storage bags registered an increase in cowpea-related income of 48 % on average, and cowpeas that had been stored in bags generally fetched a price 5–10 % higher than cowpeas stored using other methods[38,39].

Small metal silos

Small metal silos, generally hold between 250–1000 kg crops as insufficient storage is a major source of food loss for farmers, especially in developing countries, where storage structures often do not keep harvested crops in hermetic, or airtight, conditions. Failure to have airtight storage structures allows moisture and pests to enter containers, potentially causing mould, toxins, or pests to contaminate the crop[39].

Advantages of the metal silos. A study in Kenya compared metal silos with the use of a basic polypropylene bag for 6 months. The study found that while the polypropylene bag with no added pesticide experienced crop losses of 24 %, a metal silo with no added pesticide experienced crop losses of just 1·4 %.

The hermetic nature of metal silos makes them well-suited to long-term storage. They can safely store grains for up to 3 years, and the structures themselves can last up to 15 years[40–42]. They are relatively easy to construct and require minimal materials. In an ongoing project in sixteen developing countries to bring such silos to farmers, the Food and Agriculture Organization has been enlisting local tinsmiths to construct the silos hence gaining an income from such production; one estimate is that the production of metal silos alone brings individual tinsmiths an extra US$470 annually[40,41].

Plastic crates

Plastic crates instead of other forms of containerisation have demonstrated significant reductions in food losses during handling and storage. In developing countries, 19 % of fruit and vegetables loss occurs in the handling and storage stage of the food value chain[4,42]. Common storage containers used to transport fruit and vegetables lead to losses in quality, such as bruising, outright food loss due to being crushed or smashed during transport. Sacks and bags, commonly used transportation containers in many developing countries, provide little protection against quality losses from compression, puncture and impact. Conversely, a crate's rigidity leads to less damage from impact during transport, since the crate limits the amount of collision between the goods, and the smoothness of the material precludes the need for linings to reduce bruising.

Consumer awareness campaigns

Attitudes and behaviour of consumers play a big role in determining the amount of food wasted in households. It is not easy to change the way people consume and throw out food, however, communication campaigns can help influence consumer behaviour at the household level. For example proper food labelling and tips associated with improving food storage and lengthening shelf-life

for fruit and vegetables directly into the plastic produce bags in which customers place their purchases would go a long way in overcoming consumer misconceptions or ignorance about best storage practices and to assist customers in increasing the shelf-life of their purchases.

Appropriate mitigation measures

Investment in post-harvest technologies and food security would significantly reduce food losses in sub-Saharan Africa. An estimated US$4 billion (US$4·06 billion) worth of grain is lost each year, which could feed up to 48 million people[25] in the region, while between 10 and 20 % of post-harvest losses for a large proportion of crops is due, in part, to pests and pathogens. Losses on cereals are estimated to be high and account for about 25 % of the total crop harvested. These losses can be even greater in perishable products, and account for as high as 50 % of harvested fruits, vegetables and root crops.

A wholesale approach is therefore required to address infrastructure crisis and investment gaps to fully realise agricultural productivity. It is no coincidence that the worst areas of global food losses coincide with the areas bearing the highest indexes of global food insecurity[16].

What can be done to reduce post-harvest losses?

The adoption of agricultural technologies that have proven successful in other areas is a promising avenue. Government can aid this process directly, through public infrastructure investment in key areas like road works, electricity and water, or indirectly by reducing costs and obstacles to private and foreign investment. This can be achieved by incentives such as tax breaks, deregulation or subsidies and by supporting effective agricultural research[43], while engaging in participatory, innovative community based interventions that create resilience to climate change and enhancement of livelihoods of small holder farmers in diverse ecosystems. In Kenya post-harvest losses are estimated at 30 % of all stored produce and even higher in areas prone to the Lager Grain Borer and Aflatoxin. These areas can record up to 100 % loss depending on the severity of the outbreak. Stakeholders must therefore be held more accountable and community education on the matter emphasised. Different strategies are required to tackle these wastes as asserts Godfray *et al.*[44]. He observes that, in developing countries, public investment in transport infrastructure would reduce the opportunities for spoilage, whereas better-functioning markets and the availability of capital would increase the efficiency of the food chain, for example, by allowing the introduction of low-cost cold storage technologies. Investing in the modernisation of extension services is essential, including approaches such as farmer field schools[45], the use of rural radios and other mobile telecommunication methods[46].

Continuing research in post-harvest storage technologies is a key strategy to the mitigation of food loss and wastage. Improved technology for small-scale food storage in poorer contexts is a prime strategy for the introduction of incentives for innovation, with the involvement of small-scale traders, millers and producers[47].

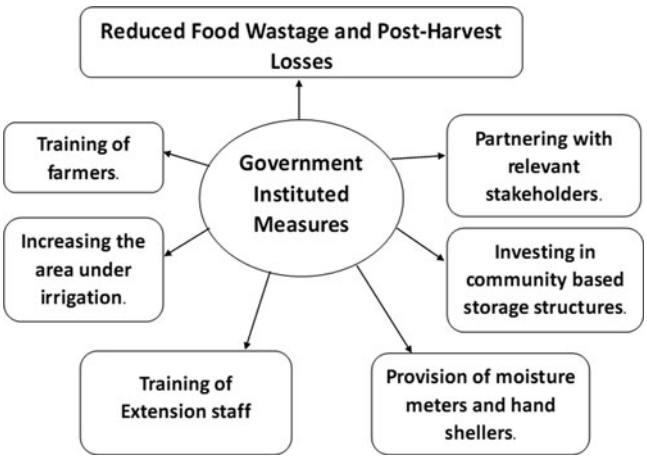

Fig. 2. A flow chart showing some of the measures instituted by the Ministry of Agriculture, Livestock and Fisheries, Kenya, to reduce crop post-harvest losses.

Developing knowledge and capacity for stakeholders involved in food production and supply (farmers, processors, distributors and retailers) will ensure safety standards are adhered to, thus preventing losses associated with disposal of substandard foods as in the one experienced by Kenyan horticultural products in the European market on the basis of incompliance.

Food processing firms should create awareness and promote post-harvest technology, both the traditional and modern methods of food preservation among farmers who produce the raw materials on how to preserve their harvest before it is bought and taken for processing. Such a venture would go a long way in ensuring that all the foods stored in periods of excess produce can be used during the dry season in perfect condition fit for human consumption, free from pests and fungus[48,49].

Strategies to curb post-harvest losses

The government through the Ministry of Agriculture, Livestock and Fisheries in Kenya has instituted various measures to reduce crop post-harvest losses which include among others: training of extension staff; provision of moisture metres and hand shellers; training of farmers, partnering with relevant stakeholders; investing in community based storage structures; increasing the area under irrigation; encouraging value addition at farm level to transform the produce to products with a longer shelf life and investing in long term solutions to the challenges of food, as shown in the flow diagram (Fig. 2).

Making post-harvest products more competitive in the market through value addition

A broad definition of value addition is to economically add value to a product by changing its present place,

time and from one set of characteristics to other characteristics that are more preferred in the marketplace. As a specific example, a more narrow definition would be to economically add value to an agricultural product by processing it into a product desired by customers. Producers involved in adding value are members of a food company that processes and markets product to consumers. Often, this involves building processing plants in the producers' geographical regions to process locally produced crops or animals.

To meet the emerging challenges, agriculture must diversify in favour of high-value enterprises. The emphasis should be on production of high-value commodities such as fruits, vegetables and fish with enhanced quality and specific nutritional and processing characteristics, rather than increasing production *per se* as in the past. This is because marketing of products is more remunerative than raw commodities. Farmer–processor linkages therefore are needed to add value according to demands of the consumers.

Conclusions

Looking forward, it would be beneficial for developed countries to provide national estimates of food waste and information on where to target resources to decrease food waste efficiently. There is also a wide range of priority areas for further research effort but key among these must be studies on the implications of climate change for on-farm PHFL and options for smallholder adaptation, and the development of an authoritative approach to cost–benefit analysis for post-harvest interventions, in order to guide policy making and the efficient use of resources. Research is needed into building the capacity of the private sector to service smallholder's needs. The drivers should include more wide-spread education of farmers in the causes of PHFL, better infrastructure to connect smallholders to markets and more effective value chains that provide sufficient financial incentives at the producer level, while providing also opportunities to adopt collective marketing and better technologies supported by access to micro-credit. It should encourage the public and private sectors sharing of the investment costs and risks in market-orientated interventions[32].

Recommendations

Food processing industries should organise small-scale farmers to scale up their production by sharing centralised transportation, storage, cooling and marketing facilities or by building processing plants near the areas of production. The UN recommends the exploration of traditional ways of preserving food. Major investments are needed to rebuild research and technology transfer capacity in Kenya in order to provide farmers with appropriate technologies and to enhance their skills through farmer field schools[49]. Experts agree that across the food value chain, better measurement and monitoring of food loss and waste is needed. Setting of quantifiable, time-bound targets for food loss and waste can raise awareness, stimulate focused attention and mobilise resources toward reducing food loss and waste. Adopted targets should cut across all the areas; Global, National, sub-National and Corporate targets.

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The author was solely responsible for all aspects of preparation of the paper.

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