MITIGATING FOOD LOSSES

Status and Way Forward for Postharvest Research and Innovations in Malawi

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Food security is an important development challenge in food-deficit countries in sub-Saharan Africa (SSA). Yet, a large volume of food, valued in excess of USD 4 billion (grain alone), is harvested each year. There is now consensus that increasing food production in isolation, without addressing postharvest (PH) losses, is inadequate in addressing food insecurity, thus a renewed global interest to mitigate PH losses. In Malawi, smallholder farmers live on the margins of food insecurity, with over USD 275 million spent annually to import food. A reduction in food losses could have an immediate and significant impact on livelihoods. Over the years, several improved technologies have been promoted among smallholder farmers to mitigate PH losses, especially for stored grain. However, there is limited evidence of success, although at the same time, data on magnitude of losses are scanty, and for many commodities such, data does not exist. The government, development agencies, donors and research institutions must adopt new PH loss research and mitigation approaches. A systematic research, which conceptualises postharvest losses and innovations in a matrix, comprising all levels of value chains, and all the possible types of losses, including physical and economic losses, is needed. Regarding innovations, what is required is adaptive research and knowledge management leading to holistic, market-oriented and economically appealing innovations along commodity chains. The target should be transfer of technologies through organised farmer groups or SMEs as

DID YOU KNOW?

- **PH losses are a constraint to food security in SSA.**
- **Over USD 275 million is used to import food in Malawi annually.**
- **Annual value of PH losses for grains alone in SSA exceeds USD 4 billion.**
- **Up to 47% of USD 940 billion that needs to be invested to eradicate hunger in SSA by the year 2050 will be required in the PH sector.**

Food insecurity is a chronic problem in Malawi. Overall, dietary energy supply is barely sufficient to meet energy requirements, and about a third (28%) of Malawian population is estimated to be undernourished. A number of factors, including adverse climatic conditions and low agricultural productivity and poverty, are responsible for this calamity. Inefficiencies in managing harvested produce also contribute to the problem, as part of the produce becomes unavailable or unfit for human consumption. Food losses have a direct negative impact on all actors along food value chains. For many families, such losses threaten household food security, whereas for many others, early selling at low prices for fear of heavy losses poses a threat to household incomes. For traders such losses culminate in lost opportunity or apparent inventory loss. Many Malawians live on the margins of food insecurity and most are net buyers of food. Mitigating PH losses could have immediate impact on livelihoods by increasing both food availability and accessibility to households.

There have been initiatives to deal with postharvest losses in Malawi in the past. Over the years, several improved technologies for grain storage have been developed and promoted by local research institutions, such as Chitedze Research Station, and development agencies. Adoption of these technologies among smallholder farmers, however, is very limited for a number of reasons: (i) they demand extra labour; (ii) the cost is beyond what farmers can afford; (iii) inadequate promotion of technologies by research institutions and partners; (iv) development of the technologies without the input of the end users; and (v) social-cultural reasons. A most recent initiative is a study conducted in

Fig. 1: Geographical location of Malawi. Malawi is located in southeastern Africa, south of the Equator

2009–2010 by the Ministry of Agriculture to estimate postharvest losses for maize. The need to reduce PH losses is also reflected in the national agricultural development strategies such as the Agricultural Sector Wide Approach (ASWAp) as well as the Pest Management Plan of the ASWAp. Despite these initiatives, extent of postharvest losses along value chains of major food commodities is still an unanswered question in Malawi. The direction that PH innovations should take so as to achieve meaningful impacts without the risk of past undertakings also requires to be examined. Furthermore, in many parts of SSA reducing PH losses has been difficult to ascertain because the baseline loss magnitudes are unknown or unreliable, and mitigation strategies do not always resonate with needs and dynamics of commodity value chains.

Magnitude of PH losses in Malawi

Reliable PH loss data, which identifies postharvest loss hotspots, is important, as it lays the foundation for effective mitigation of PH losses. It also provides a tool for evaluating impact of innovations employed to combat losses by providing a baseline on which to infer comparisons. The International Centre of Insect Physiology and Ecology (*icipe*), with financial support from International Development Research Centre (IDRC) conducted a systematic review of past literature on PH losses and PH innovations in Malawi. The review targeted 7 commodity categories: cereals (maize, rice), pulses (beans), fruits (mango, banana), root and tuber crops (cassava, sweetpotato), vegetables (cabbage, tomato), oil crops (groundnuts) and fish. The aim of this exercise was to establish the status of PH research with regard to magnitude of losses, as well as to build a knowledge base of innovations that were promoted to address those losses. The review traced through online databases and organisational libraries of relevant studies conducted in Malawi between 1980 and 2012, and screened them for relevance and methodological appropriateness. Those that passed preset screening criteria were then reviewed.

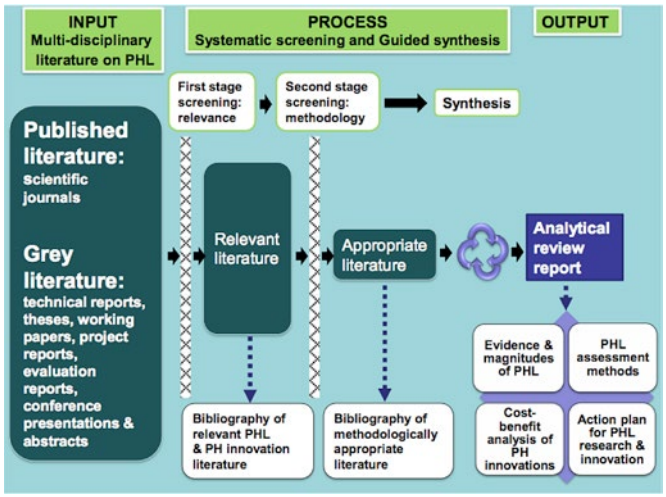

Fig. 2: Methodological framework of the review

A total of 94 relevant articles (36 published, 58 unpublished) were located in the exercise. Of these screened articles 53% investigated PH losses, 31% both PH losses and PH innovations, and 16% PH innovations alone. However, only 16 articles were appropriate for review, majority of which were on maize (50%) and beans (19%). On the whole, PH loss data in Malawi is indeterminate, and the following limitations were apparent from this review: (i) the bulk of information contained within these articles was on storage losses, with a focus on losses resulting from insect infestation; (ii) there are no credible studies on the other 5 categories, i.e. fruits, vegetables, root and tuber crops, oil crops and fish; (iii) none of the articles investigated PH losses at different levels along the value chains with the exception of one survey conducted on maize by the Ministry of Agriculture and FAO in 2010; and (iv) none of the studies reviewed addressed the aspect of storage withdrawal for consumption or sale, in the assessment of losses.

Past PH innovations in Malawi targeted storage losses (beans and maize). These include selection of varieties that resist attack by storage pests, use of improved storage structures, chemical insecticides, inert dusts and botanicals. There is lack of information on costs and benefits of most of the innovations. Furthermore, field use or extent of adoption and impacts, could not be ascertained. It is, however, recognised that cost, inadequate promotion of the innovations, and socio-cultural reasons have constrained innovation adoption in the past. Introduction of the metal silo, for example, faced resistance because metal silos initially targeted communal use whereas farmers' main approach to storage was to have the produce inside their houses or in their compounds, which they consider cheaper, more convenient, and more secure.

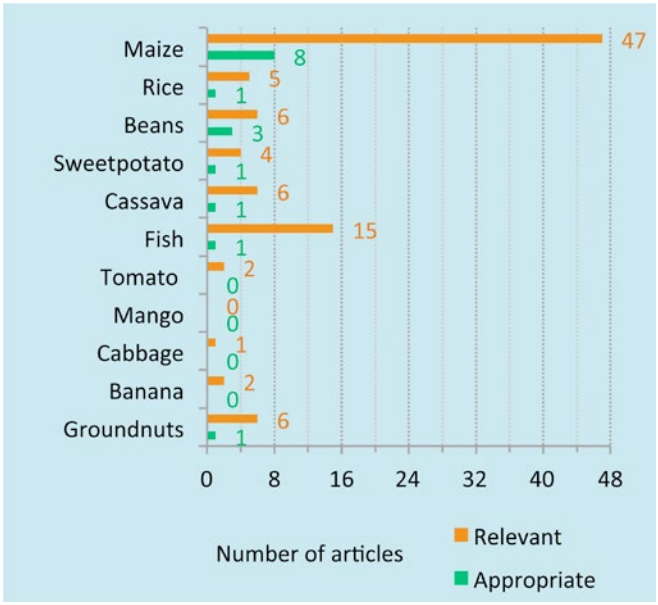

Fig. 3: Distribution of articles retrieved and articles found appropriate for review

Physical losses of various commodities		
Commodity	***Losses and (chain level)***	***Innovations mentioned***
Maize	7.6% (Storage)	Hermetic triple layer (PIC) bag; metal silo; improved granaries (concrete or mud plastered); chemical insecticides (pirimiphos-methyl); inert dusts; insect growth regulators
Rice	8–26.9%	-
Beans	4.2–9.1 (storage)	Variety selection; Actellic Super®; inert dusts, botanicals
Cassava	12–30% (storage)	-
Groundnuts	10% (storage)	-
Fish	18–22% (Blowfly infestation during drying)	Pirimiphos-methyl

Core issues in PH chains of important food commodities

Cereals: Maize and rice are the most important cereals in Malawi. Maize is grown by 97% of farmers, and alone, contributes over 60% of national calorie intake. About 70–80% of harvested maize goes to self-consumption and does not leave households, except for local milling into maize meal for household use. Thus, close to 80% of maize is stored at farm level. On-farm storage facilities include traditional granaries. Off-farm storage facilities include metal silos and communal warehouses, although the popularisation of these is hampered by cultural and socio-economic reasons. Maize markets are largely local. In the rural areas, maize is milled using hammer mills which are in most cases strategically located to serve communities within a 5-km radius. Maize may be traded through several organisations before being sold to a consumer or processor. Large-scale maize storage is done by the National Food Reserve Agency (NFRA) as

A farmer in her maize granary

well as large traders and processors such as ADMARC, Mulli brothers and Rab Processors. The traded maize moves from a large and highly differentiated group of farmers, through an equally diverse group of primary assemblers and transporters, before reaching the silos and warehouses owned by major actors in the supply chain, and eventually the consumer. Large-scale maize millers process maize mainly into maize meal, while a small fraction goes to brewing and animal feed processing. There is an export market in Zimbabwe, South Africa, Zambia and Mozambique during surplus years. Maize is also imported from most of these countries during years of low domestic production.

Rice, on the other hand, contributes about 5% of per capita daily energy intake. Consumption of rice is more common in urban areas. In rural areas, rice consumption is high in the growing regions: the lakeshore zone around Lake Chirwa in the south which covers Zomba, Phalombe and Machinga districts; the lakeshore areas of Lake Malawi, which covers Salima and Nkhotakota districts in the central region; and Nkhatabay and Karonga districts in the northern region. Farmers are able to sell paddy rice to vendors, or have it milled at village level before selling to traders or directly to retail outlets. Milling plays a major part in the value addition of paddy rice. At farm level, farmers use village and toll mills to mill rice. Milling technologies are poor and result in huge proportion of broken grains, which impacts on price. Depending on the quality of paddy 20–25% would be husk, 10% rice bran, 1% admixture, 8–10% broken rice and about 57% polished rice for sale. Presently, small mills and toll mills cannot compete with the large millers as yield of quality unbroken polished rice realised is much lower.

Pulses: Beans are the most important grain legume in Malawi. Smallholder farmers produce 80% of the beans produced whereas commercial farmers produce 20%. About 75% of bean harvest is sold in local informal markets for domestic consumption whereas 25% is sold to trading companies. Beans are exported to Zimbabwe and South Africa and are also traded through informal cross border channels with Zambia, Mozambique and Tanzania.

Beans and pulses at a market in Malawi

Root and tuber crops: Cassava and sweetpotato are important food crops in Malawi. Regarding cassava, over 70% of production is consumed at household level and 30% sold for off-farm consumption and starch processing. Delayed harvesting, improper handling and delays in delivery of sweetpotato and cassava to markets result in deterioration of the crop. Processing of these commodities is limited, and concentrated at the small-scale level.

A smallholder farmer prepares sweetpotato for market

Fish: About 30% of the dietary animal protein needs in Malawi comes from fish. Over 96% of total fish catch comes from capture fisheries whereas 4% is from inland fish farming. Malawian fisheries can be categorised into small-scale (often called traditional or artisanal category), semi-commercial and commercial categories. Fish caught by small-scale actors is either processed before selling (mainly dried), or sold fresh to processors and traders. On the average, the artisanal fisheries contribute 85 – 90% of the total fish landings. The artisanal fisheries comprise of a wide range of fishing units, ranging from traditional fishing gears and crafts (such as fish traps and hand lines operated from dugout canoes), to relatively modern ones (such as seine nets operated from planked boats powered by outboard motors). On the other hand, commercial fisheries are mechanised, capital intensive and use mainly trawling and purse seining. Landed fish is either sold to the consumer fresh, chilled, frozen, smoked, sun-dried or parboiled and dried. Fish processing and distribution are major occupations among many fishing communities. Most landing sites in Malawi are also market sites. Most of these sites have limited chilling facilities, and so fishermen have to sell hastily to avoid spoilage losses. Fish intended for distant markets is preserved.

About 90% of the fish from capture fisheries is preserved by means of smoking or roasting (40%) and sun-drying (50%), whereas only 10% is handled and sold in fresh, chilled and frozen forms. A number of processing facilities are used, ranging from the traditional type, like dug-out smoking ovens and drying racks made of reeds and mats to the improved facilities such as Bena kiln (modified Ivory Coast kiln) and wire drying racks. Fish distribution modes are diverse, but many are rudimentary. Modes of transportation range from bicycles to lake steamers, public bus services to private trucks/pick-ups. Generally, handling, processing, value adding and marketing inefficiencies due to lack of facilities and technical knowhow contribute to losses. Furthermore, fish processing and quality management are not well developed due to a shortage of skilled personnel.

Solar drying of fish at Kachulu Beach

Oil crops: Groundnut is the second largest crop produced by acreage in Malawi after maize. It accounts for 25% of the income of smallholder farmers.The main growing areas include the plains around Lilongwe, Kasungu, Mchinji and Mzimba, and parts of Salima, Balaka, Ntchisi, Dowa and Thyolo. In most of these areas groundnuts are produced by smallholder farmers (93%), except in Kasungu where estate farms dominate. About 60% of produce is consumed at farm level whereas 40% is channelled to processing, wholesale and retail markets. A main cause of PH losses in groundnuts in Malawi is aflatoxin contamination. In the past, aflatoxin contamination has had harmful effects on export markets. Some processors also consider that 15–20% losses are incurred as a result of contamination (stones, dusts and fungi).

Aspergillus flavus *infected groundnuts*

SUMMARY OF CORE ISSUES

1. **Maize, rice, beans, cassava, sweetpotato, fish and groundnuts are among the most important food commodities in Malawi.**
2. **Losses along the PH chains are fuelled by inefficiencies in handling, storage and preservation methods.**
3. **Markets are weak and inefficient. The larger share of produce is traded through village-based local markets or cross-border trade dominated by informal channels.**

The way forward for postharvest research and innovations

Conceptualising PH losses and innovations along value chains

Losses can occur at several points along value chains. Yet loss assessment studies conducted in Malawi do not provide loss figures for entire commodity chains. Recent studies are also few and most of them are unpublished. For some crops, especially fruits and vegetables, loss data have not been established at all. Systematic assessment of PH losses is needed for all major food commodities. A value chain approach is recommended so as to also identify loss hotspots and, therefore, the critical points for interventions.

Past efforts to mitigate PH losses in Malawi focused mainly on grain storage. The majority of innovations examined technical efficacy of the technologies, in some instances, at experimental scale. Triple layer hermetic storage (PICS bags), metal silos, storage pest resistant varieties, insecticides and concrete plastered silos are some of the innovations that have the potential for reducing storage losses in grains. However, their adoption cannot be ascertained, as cost–benefit studies are lacking or limited. Furthermore, there are no adoption or impact studies on the innovations. There is need to incorporate socio-economic dimension in innovation studies in the future. Cost–benefit analysis needs to be integrated as part of suitable innovations identification. Efficacy trials need to include participatory on-field/ on-farm approaches as well.

A comprehensive knowledge of commodity value chains will be needed for assessment of PH losses and identification of appropriate interventions along value chains. Apart from establishing commodity paths, it is also necessary to understand the volumes moved, processes involved, activities, goals, motivations and behaviours of the people/groups/organisations participating in those processes, so as to uncover underlying factors for decisions taken at the various points of value chains (production, distribution, marketing, processing, etc.) by chain actors. This detailed analysis will further facilitate participatory identification of interventions that are problem-centred and socio-economically appealing by engaging chain actors in: (i) diagnosis of key PH problems and constraints; (ii) identification of existing strategies to mitigate specific problems and constraints, including baseline information on their uptake; and (iii) development of loss mitigation strategies for specific commodities.

Selecting appropriate innovations and their transfer

Increasingly, agricultural products are not consumed in their raw form, and postharvest activities such as transportation, storage, processing and marketing are becoming important parts of commodity value chains. Whereas not many technologies other than storage-related ones are documented as having been transferred to deal with PH losses in Malawi, majority of PH technologies have been promoted as standalone interventions in SSA and other parts of the world, for instance Asia, where PH challenges are fairly similar to those in SSA. These technologies can be accessed. What is required, for Malawi, is knowledge management and application, leading to appropriate innovations along commodity chains. Adaptive research and technology transfer should, therefore, form the basis of PH innovations. However, to ensure that technologies fit within the local socio-economic, technological and policy environments, focal points for the adaptive research will have to include assessments of: (i) technical efficacy; (ii) costs and benefits; and (iii) social and policy contexts that may influence adoption and continued technology utilisation. Other research needs include testing and evaluating the innovations in selected pilot sites, optimising innovations for wider dissemination, training to build the necessary capacity, assessing preliminary impacts on stakeholder behaviour leading to technologies uptake, and upscaling.

A small group trains on how to use a motorised grating machine for cassava processing

Market-oriented innovations: value addition and agro-processing

Markets, both local and export, are now increasingly typified by demand for safe, convenient, nutritious and quality food. Value addition and processing have, therefore, become important undertakings in PH chains of agricultural commodities. Also, with increasing urbanisation, commodities are being moved over longer distances thus, requiring greater efficiency in this segment

Participation in value addition processing would expand access to new markets

of value chains. As a result, PH innovations can no longer concentrate on managing on-farm PH activities alone but instead have to extend to other value chain levels that more closely link producers and consumers. However, the full potential of value addition and processing has not been realised in Malawi. The reason being that many agro-processing technologies are still limited to farm- or household-level, and, therefore, the economic incentive for uptake is low. Upscaling will enable more to benefit from processing as a value addition tool. The transfer of upscaled processing innovations will require training and capacity building. This could be achieved through establishment of 'learning centres' and stronger policy advice. Transfer of technologies will further require increased access to affordable credit services. Farmers who are organised into business units (farmer groups or SMEs) are better adapted for uptake of innovations as they could enjoy economies of scale, access to credit services and markets, shared risk and stronger negotiating power. Thus, future innovations intended to reduce PH losses should target such organised groups as opposed to individual smallholder farmers.

PARTICIPATION BY SMES

An example is a market-oriented supply chain that incorporates a horizontally linked producer base with the export market. Smallholder rice farmers in Karonga (Northern Malawi) have formed a market chain with Scottish buyers through the Scotland–Malawi Trade Partnership. The rice is processed by a mill owned by the Karonga Small Holder Farmer Association (KASFA) in Karonga and then shipped to Scotland after undergoing quality sampling.

Strengthening national policy and legislation

National policy and legislation actions could promote initiatives for PH losses reduction. Examples include:

1. PH extension policy to promote postharvest best practices and build local capacity;
2. Government structured policies for facilitating access to credit and markets;
3. Rural infrastructure development policy; and
4. Formal–informal sector gap bridging policy to promote SMEs participation in PH entrepreneurships.

Conclusion

There is paucity of data on the magnitude of postharvest losses and the effectiveness of PH loss innovation in Malawi. Studies on PH have concentrated on few commodities with maize being highly featured. No information is available for fruits and vegetables whereas other commodities are poorly represented. Some available loss estimates do not have transparent methodologies and are, therefore, unreliable. PH loss estimates and innovation studies focused mainly on physical losses during storage. There is need for systematic research which conceptualises postharvast losses and innovations in a matrix comprising all levels of food value chains and all the possible types of losses, including quality and economic losses. Innovations such as PICS bags, metal silos, storage pest resistant varieties, insecticides and improved storage structures are some of the innovations that have potential for reducing postharvest losses and could qualify for expansion programmes. However, the costs and benefits of these technologies are unclear, and would need to be investigated. In addition, postharvest losses research, in future, needs to address the willingness of chain actors to adopt technologies in the context of their socio-economic environment.

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