
Editorial: The future of postharvest research and education and implications for Africa's Green Revolution

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1 Introduction

In recent times, food and agriculture have come to the top of global economic and political agenda. First, there was the sharp rise in food prices and volatility of supply in 2008 and thereafter, and second, in combination with the first, was the general global economic downturn which saw stocks and financial markets crashing around the world. The fear of food shortages led some countries to ban exports of some staples including rice and wheat, and this further sent panic in international markets, especially in countries that depend largely on food imports to feed their people. Two major economic developmental issues have emerged out of these crises: first is the greater awareness about the need to improve agricultural productivity, especially in the least developed regions such as Africa, and the second is the widespread recognition of the importance of reducing postharvest losses and food waste as important elements of the arsenal against food insecurity.

It is generally widely recognised that food production can be increased by increasing the area under cultivation or by intensification of production in the same area of cultivated land. With increasing global recognition of the negative impacts of deforestation and current intensive agricultural production practices on the environment, including fresh water contamination, developing and applying sustainable agriculture and food systems has become one of the challenges of modern times. Tackling the challenge of feeding an ever increasing world population in sustainable agriculture and food systems requires novel approaches to the ways we increase productivity of natural resources and people. It demands a hard look at the issue of losses and wastage in the food system, from field to the consumer. This is particularly important given the huge amount of resources (such as land and fresh water), inputs (such as seed, fertiliser, agrichemicals) and investment in labour, machinery and equipment needed to produce, handle, process, store, transport and prepare the food. Depending on the length and sophistication of the value chain, current knowledge indicate that over 70% and up to 85% of the value of food (expressed as market price) may be attributed to postharvest (beyond the farm) activities. Reducing postharvest losses and waste in agriculture and the entire food system offers an opportunity to improve the productivity, efficiency and

profitability of agriculture to address food and nutrition insecurity without the need for further investments in expanding cultivated areas and related negative environmental impacts.

2 The problem of postharvest losses and waste

In response to the widespread problem of food insecurity in the 1970s which affected many developing countries, the Committee of the US National Academy of Sciences on postharvest food losses in developing countries (NAS, 1978) estimated that in 1976 over 107 million tonnes of food was lost in developing countries, valued at US \$11.5 billion. The study concluded that the losses in cereal grains and legumes alone would provide more than the annual minimum caloric requirements of 168 million people. Recent analyses of global postharvest food losses and waste have uncovered the magnitude of the problem in both developing and developed countries (Gustavson et al., 2011) and the huge impacts on resources such as fresh water (Lundqvist et al., 2008). The review by Gustavson et al. (2011) showed that up to 1.3 billion tonnes of food, representing about one third of the global food production, are lost or wasted annually. These losses and wastage occur at all steps in the food supply chain, and in low-income countries, most losses occur during production, while in developed countries much food – about 100 kilograms per person and year – is wasted at the consumption stage. In concluding, Gustavson et al. (2011) argued that there are major gaps in the knowledge of the magnitude of global food loss and waste, and recommended that further research in the area is urgent. The need for reliable and accurate data on the incidence and amount of losses, under specific local conditions, to guide both policy and promote the development of interventions to reduce postharvest food losses was echoed in a previous *IJPTI* editorial (Opara, 2010). Although both food losses and waste occur in developing and countries, there is now a consensus that ‘postharvest loss’ (due to lack of or inadequate application of loss saving techniques and procedures) is used to refer to the kinds of food losses prevalent in developing countries, while ‘food waste’ (where raw food material or prepared food is discarded even if it is ‘perfectly good to eat’) refers the kind of losses in developed countries, often further downstream in the value chain.

With regards to implications for Africa, further examination of the review by Gustavson et al. (2011) showed that on-farm and postharvest losses of cereals, roots and tuber, and total losses of meat and dairy products in the value chain were highest in Sub-Saharan Africa (SSA) compared to other economic regions in the world. For fruits and vegetables, losses during processing and distribution were also highest in SSA.

Further inspection of these findings highlights some of the significant challenges facing the postharvest sector and its relevance towards achieving Africa’s Green Revolution. These include:

- a Inadequate cold chain facilities and infrastructure. Meat and dairy products are particularly sensitive to temperature management and deteriorate rapidly at higher temperatures. Cold chain technologies such as refrigerated storage, freezing and packaging are necessary to extend shelf life, maintain quality and control spoilage and microbial contamination. Consumption of contaminated food creates additional disease burdens in already impoverished communities.

- b Lack of processing industry in many communities to handle and transform agricultural (including horticultural and fishery) raw materials into food products, thereby supporting off-season marketing and consumption of a wide range of safe and nutritious food products.
- c Lack of novel postharvest technologies and their application to reduce losses and extend the storability of roots and tuber crops such as cassava and yams, and including plantain and cooking bananas, which remain the food crops that feed millions of Africans. It was quite disheartening to see tonnes of badly bruised and immature plantains in an open market in Uganda, knowing that these would only have shelf life of a couple of days (and/or will have bad eating quality) while the demand for quality plantain remains unmet in major cities in Africa and around the world such as Abuja, Cape Town and London. After several bad experiences of buying very poor quality plantain in Cape Town, I have decided to wait until I travel to a producing country to be able to enjoy the flavourful taste of mature and ripe plantain!
- d The persistent high incidence of postharvest losses of cereal grain losses in Africa, often due to inadequate on-farm and postharvest drying and storage techniques and infrastructure. The implications of inadequate grain drying and storage on contamination with mycotoxins and associated health and disease risks in Africa is well documented in global scientific literature.

3 A postharvest innovation triad

To address these challenges in a systematic and sustained manner, there is a need to re-examine the status of postharvest in Africa, through what I call the *postharvest innovation triad*, comprised of *knowledge, infrastructure and policy* (KIP). Postharvest knowledge encompasses the education needed to build human capacity and research necessary to generate new and better understanding of the techniques, processes and novel ways to harvest, handle, store and process harvested produce. Postharvest infrastructure deals with the network of communication, road and rail networks, transportation, marketing and distribution centres, warehouses, power supply and financial institutions that are necessary to facilitate commerce and exchange of goods and services. Postharvest policy focuses mainly the strategies of government to create the enabling socio-economic environment supporting and promoting the development of postharvest activities, including support to farmers, infrastructure development, facilitating market access, and creating conducive business environments to attract investments targeting the postharvest sector. All three elements of this proposed postharvest innovation triad are essential for the development of a vibrant postharvest sector; however, I would like to highlight in particular, the role of education and research.

During the past half century, the African continent has been a stumping ground for experimentation of economic development theories, encapsulated by the structural adjustment programmes of the 1980s to 1990s, including access and funding of social services such as education, and debates about government support to agriculture (Opara, 2012). Throughout this period and up till now, investments in quality education and development of vibrant research and innovation systems have remained largely underserved. Consequently, Africa remains hugely underrepresented in terms of its

contribution and impact in the global scientific knowledge system. Recent estimates suggest that Africa accounts for less than 1% of total global research outputs despite representing nearly 15% of global population. For too long, Africa has depended on the technological innovations that have arisen from long term investments in education and research by other parts of the world. Africa's Green Revolution will not happen if this trend is not reversed by ensuring targeted and strategic investments to build and sustain local capacity of African countries and institutions to lead and innovate by harnessing education and research for sustainable socio-economic development.

Given this lack of adequate and sustained investments in Africa's education, research and innovation systems, it is therefore not surprising that in the Continent we now know more about improved methods for the production, postharvest handling, preparation and utilisation of food crops that largely feed the rest of the world (like rice and wheat) than the crops that feed Africa such as millet, sorghum and cassava. Many of the crops that feed Africa remain or will likely become what is now often called 'orphan foods' or food for the poor and the unsophisticated consumer. During the past decade, many global supermarkets have expanded into major African crowded cities and these shops are filled mostly with imported food products many of which are 'new' food products with special cuisine. While we enjoy the food and kitchens of the rest of the world in our own cities and suburbs, Africa has yet to transform its food products and cuisine to make them part of the regular shopping items in supermarkets and on the menu in mainstream restaurants outside the Continent. During a recent food security conference in England, I met someone who spent many years working in Nigeria eager to share his wonderful experiences in the country but complained that the food (gari in this case) was 'awful' and 'had no taste'. He went on to say that gari is just 'a pack of carbohydrates'. While I tried in vain to explain that the contents of the ofe (sauce) used to eat the gari often contains vegetables, meat and fish, this conversation made me think further about the food we eat in Africa today and the challenge of developing and sustaining Africa's Green Revolution if we do not have a vibrant postharvest system, including development of novel and sought-after food products from the crops that feed Africa. My encounter with the colleague in London may be an isolated case; however, it does highlight one of the important challenges facing Africa's Green Revolution – that is, the need for a value chain approach, from field to plate. The harvest and food products from Africa's Green Revolution must be able to compete for supermarket shelves in African cities and around the world.

Today, many African governments are investing heavily in efforts to boost rice and wheat production to counteract increasing import bills on these commodities. Meanwhile, many of these good quality food commodities (such as rice) are imported from developing countries (such as Vietnam and Thailand), who have invested considerably over the past two decades to improve production and postharvest management through education, research and policies that promote agriculture. Agricultural science students in these countries learn about the crops grown in their countries and the food they eat, while their scientists and engineers research on the production, postharvest handling, processing and consumption patterns of these crops. Through a combination of concerted efforts and targeted investments in their knowledge systems, backed by the right policies to stimulate production and agribusiness, these developing and emerging countries are now exporting food to feed Africa, despite the abundant agricultural land and other natural resources which remain largely untapped in Africa.

It is very unlikely that educators and researchers outside Africa will spearhead and develop the human capacity, innovative technological solutions and policies needed to raise agricultural productivity and reduce the high incidence postharvest losses in the Continent. It is therefore important for African academia, researchers, policy makers and political leaders to take the lead in revitalising the tertiary education system, including engineering and agriculture to create a dynamic pool of leaders in agribusiness and other economic sectors. This requires curriculum reform and investments in research and development, especially on technological innovations for postharvest loss reduction and value addition. There is a need for vibrant and market-oriented research centres of excellence focusing on key food crops that feed Africa, taking a value chain approach from productivity improvement to market access and food products development. Increasing on-farm agricultural productivity and yields is only half the battle to achieve Africa's Green Revolution. Investments in postharvest education and research are needed to promote and catalyse innovation and value addition in the African food system. Postharvest management and agro-processing are essential in linking production to markets. It is only when the link is made between production and markets through 'postharvest' that a true Green Revolution can take off and be sustained. Africa's Green Revolution must not only contribute to economic growth; it must create meaningful and sustainable jobs and income for farmers and many more others in the value chain. Harnessing technological innovations to improve agricultural productivity and yield, and addressing the problem of high incidence of postharvest losses offer good opportunities to create employment opportunities for Africa's teeming young population.

The papers included in this issue of *IJPTI* highlight some of the opportunities for realising added value by investing in postharvest research and development, including cold chains, refrigerated storage, microwave drying, and fresh produce packaging in polymeric films. I take this opportunity to thank our reviewers who have contributed to the development of *IJPTI* into an international peer-reviewed scientific forum for the exchange of novel postharvest ideas and technology.

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