

Perspective: The evolving dimensions and perspectives on food security – what are the implications for postharvest technology research, policy and practice?

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Abstract: Food security is a difficult concept to define and complex challenge that has continued to haunt humanity despite remarkable progress in increasing global food production during the last century. Starting as a problem of deficit global supply (production) of cereals, especially in tropical countries, work led by United Nation agencies through the World Food Conference in 1974 and World Food Summit in 1996 led to the emergence of three main dimensions of food security: availability, access and utilisation. Improved understanding of the role of poverty, entitlement and deprivation at the household level and globalisation of the food system highlighted the importance of asset creation and volatility/stability of price and supply as importance elements of sustainable food security. Understanding the evolving dimensions and orientations of food security is important in developing integrated and sustainable measures to reduce it, including the role of nutrition-sensitive postharvest technologies in reducing wastage.

Keywords: food loss; food waste; asset creation; food access; food availability; nutrition-sensitive postharvest; postharvest technology; food security; nutrition security; food utilisation.

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1 Introduction

Food security is recognised as one of the large number of existential environmental challenges for the sustainable development of humanity and planet Earth (Bouma and McBratney, 2013). Providing sufficient quantity, quality and safe food to meet the rising demand of a global population, which has grown from 5.8 billion in 1997 to 7 billion in 2012 and predicted to rise over 9 billion in 2050, is an enormous challenge (Godfray et al., 2010a, 2010b). Although enough food is produced on a global scale to adequately meet the dietary requirements of current population, thanks to major technological advances in agricultural science and postharvest technology, nearly 1 billion (the current population of Africa) still do not have enough to eat and frequently go to bed hungry. This situation begs the question: is it possible to have a food-secure world that produces sufficient food for everyone and at the same time assures access to food for all? How do people view food security in different socio-economic settings such as industrialised and non-industrialised economies, between urban and rural agricultural societies, across growing seasons, etc.? While the quantity of food is paramount, quality and safety of food are also important. A food-secure world must assure not only a good balance between availability and diverse nutritional requirements for food; it should also be devoid of seasonal or chronic under-nutrition, over-nutrition and micro-nutrient deficiencies. Increasing realisation of the critical importance of the nutrition function of food, especially in relation to human health, has spurred global interest in adding the word 'nutrition' in discussion about food security, resulting in the emergence of 'food and nutrition security' (Opara, 2010b; Benson, 2004; IFPRI, 2004). Some experts have even gone further to consider food security of a country as the most important dimension of national security (Bazga, 2012).

Given these complex array of perspectives on its importance, food security has emerged as a basic human right, which can be achieved when increase in food availability far exceeds increase in population and demand for food, where there is adequate income and balance of power within households to meet the food needs of every member of the household, where there are safety nets for emergency assistance and entitlements provisioning when needed, especially for the most vulnerable, and where the capability exists for people to adapt to future unexpected events that exacerbate food insecurity such as drought, famine, loss of income, etc. (Chen and Kates, 1994). Consequently, several global instruments have long recognised food as a basic human right, including the Universal Declaration of Human Rights, the International Covenant on Economic, Social and Cultural Rights, and the Geneva Conventions of 1949 which covers situations of conflict (Alston, 1984). At national level, many countries such as South Africa have enshrined food security as a constitutional right of citizens and gone further to develop an integrated food security strategy (Department of Agriculture, 2002).

Over the years, perspectives on food security have changed in response to improved understanding of the factors that contribute to it and the wide range of coping mechanisms. For instance, better understanding of the geospatial and temporal dimensions of food security have uncovered the need to consider food security in terms of the level of human organisation – from the individual to household, community, country and global. Food security may also be viewed in terms of aggregate quantity of food that can be produced or that can be accessed (e.g., by purchase or transfer) at these

different levels of human organisation. Pinstrup-Andersen (2009) has argued that achieving household food security is of limited value as an indicator of individual food security given the interaction between household food access (usually referred to household food security), and household acquisition and allocation behaviour. The author concluded that if nutritional security is the goal of interest, estimates of access to food should be combined with estimates of access to clean water and good sanitation, and that individual anthropometric measures are likely to be more appropriate than food security estimates to target policies and programmes to improve child nutrition. Notwithstanding these considerations, other investigators have concluded that traditional indicators of food and nutrition security such as calorie adequacy and anthropometric indicators were found difficult to incorporate into ongoing monitoring and evaluation systems (Haddad et al., 1994).

There is sufficient evidence showing that global food security will remain a worldwide concern for the next half century and beyond, especially in developing countries (Rosegrant and Cline, 2003). Therefore, understanding the evolving dimensions and perspectives on food security is important in developing appropriate suite of policies and interventions to address the problem. These different dimensions and perspectives on food security and the indicators thereof have implications in understanding and harnessing the role of postharvest technology in reducing food insecurity (Opara, 2006a, 2006b, 2009, 2010a, 2010b).

2 Different lenses on food security: from three pillars to multiple dimensions

A plethora of definitions of food security has emerged during the past 50 years to the extent that there is now no universal agreement. By the early 1990s, an inventory of 194 different studies on the concept and definition of food security and 172 distinctive studies on indicators were reported by Maxwell and Frankenberger (1992). During the same period, over 200 different definitions of food security were reported (Hoddinott, 1999; Maxwell, 1996; Smith et al., 1992). Modern concepts of food security and its importance in achieving sustainable development have been popularised by the World Food Conference of 1974 and the World Food Summit of 1996, both held in Rome. Since then, the use of the term 'food security' has evolved, developed, multiplied and diversified (Maxwell, 1996).

2.1 Production and supply

The definition of food security contained in the Report on the World Food Conference reflected the considerable concern at the time on global food supply and prices, especially in developing countries, marked by the sharp rise in food prices in the preceding couple of years. Food security was defined (United Nations, 1975) as the availability at all times of adequate world supplies of basic food-stuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices. Clearly, this definition focused on supply and the associated risks with the world running out of food stock.

2.2 Access and food quality

Twenty-two years later, the definition of food security that emerged from The World Food Summit in 1996 expanded the concept of food security to include ‘access’ and ‘quality’ of food: Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996). This definition of food security is also widely accepted and used, especially among agricultural development experts. A World Bank policy study published during the same period offered what is arguably the most cited succinct definition of food security, especially among food policy experts (Chen and Kates, 1994) as “access by all people at all times to enough food for active, healthy life” (World Bank, 1986). This definition offered a major departure from the preceding perceptions and dimensions of food security by focusing on individual access to food, in all seasons and at all times, and to enough food not just for survival, but for active participation in society (Maxwell, 1996).

To track the status of food security, two variables were often required:

- a the per caput availability of food for direct human consumption
- b the distribution of food supplies within each country.

From this conventional perspective, food security may be computed as per caput food supplies (calories per day), which is equal to 1.55 times the basal metabolic rate (BMR). On this basis, a person may be classified as chronically undernourished if the access to food is below this level.

2.3 Three dimensions of food security – availability, access and utilisation

Based on the various definitions of food security, three core pillars or determinants have emerged, namely: food availability, access and utilisation. Food availability refers to the physical availability of food through local production, imports, and handout (such as food aid). A wide range of factors can affect food availability, from production index to good postharvest management which maintains quality and food safety, to incidence of reduce losses; hence, adequate availability of food does not translate into food security at all levels, from individual to country and global level. On the other hand, access to food could be physical access in the market or economic access (purchasing power) at the household level. Hence, the ability to spend on food (through income) is a good measure of access to food. Physical access to food in the market could also be affected by the availability (or lack) of infrastructure such as good road networks, transport, and postharvest handling and storage facilities.

Food utilisation as a core determinant of food security refers to the consumption of food (in quantity and quality) that is sufficient to meet the calorie (energy) and nutrient requirements, with optimal uptake of nourishment. In this context, nutritional status is considered to be an outcome of food intake and health status. The importance of food utilisation and factors affecting its effectiveness in ensuring food security was alluded to by Pinstrup-Andersen (2009) when he posed these questions: “But what about those individuals who are food secure but exposed to unclean water and poor sanitation? Is food security a goal in itself or a means to achieve good health and nutrition?”

According to the USAID (1992), food utilisation is achieved when “food is properly used; proper food processing and storage techniques employed, adequate knowledge of nutrition and child care techniques exist and are applied, and adequate health and sanitation services exist”. This definition clearly identifies two forms of food utilisation (Renzaho and Mellor, 2010); namely:

- a physical utilisation, which reflect the ability to have all the physical means to use available food (cooking utensils, knowledge, cuisine, etc.)
- b biological utilisation, which covers the ability of the body to effectively use the nutrients from the food consumed.

These factors highlight the importance of access to clean water, sanitation, housing, and health care in achieving effective utilisation of food.

2.4 Food entitlements and preferences

Guided by the seminal work of Sen (1981) on poverty, entitlements and deprivation which popularised the well-known fact that people can suffer famine because of their inability to access food even when food is available (i.e., demand failure), researchers have stressed the need to consider the subjective dimensions of food security, with particular emphasis on the most vulnerable in the society and pursuit of human dignity. Taking a cue from this, Maxwell (1988; cited in Maxwell, 1996) offered the following definition of food security: A country and people are food secure when their food system operates in such a way as to remove the fear that there will not be enough to eat. In particular, food security will be achieved when the poor and vulnerable, particularly women and children and those living in marginal areas, have secure access to the food they want. Interestingly, the inclusion of ‘food they want’ in this definition mirrors the ‘food preferences’ in the FAO (1996) definition of food security, and further highlights the importance of acceptability of food as a dimension of food security (Boon, 2004). Hence, transforming agricultural materials through processing and value addition into food products that are acceptable to people is vital to meet their taste preference.

2.5 Asset creation

More recently, researchers have also recognised the critical importance of asset creation as a pillar of food security (Renzaho and Mellor, 2010), which involves putting systems and structures in place that sustain individual’s or household’s ability to withstand sudden shocks that threaten their access to food. Such shocks include economic and climatic crises or seasonal food shortages, and the asset creation needed to address these shocks can be built on five types of capital assets, namely, human, natural, financial, social and physical. With particular relevance to postharvest technology, human capital development is essential, including the creation of new knowledge and development of thought leaders and practitioners in various stages of the agricultural value chain – including food production, postharvest handling, processing, packaging, storage, logistics, waste management, marketing and trade policy.

2.6 Supply/price stability/volatility

Furthermore, the recent global food crises and related instability of supplies that were commonly attributed to sharp rise in prices of staple commodities, concern about the competition between the food and (bio)fuel for maize and other staple crops, and potential impacts of climate change in reducing harvest, have added new dimensions and perspectives on food security. Reacting to these, some researchers have added price volatility and stability of food supply as important dimensions of food security (Bazga, 2012), in addition to the core three pillars discussed earlier. Put together, these new dimensions and perspectives on food security have cast the spotlight on the role of traders and market speculation on food supply, even in the midst of abundant harvest.

3 What implications for future postharvest research, policy and practice?

Since the World Food Conference of the 1970s and the World Food Summit of the 1990s, global attention on food and nutrition security has not been on a higher spotlight than recently. Some would say that food is back on the menu, so to speak, and no one interested in transforming the broken food system should miss the opportunity offered by the crisis. In simple terms, a world that is food-secure implies that enough food is produced for the population and all people have access to food. This provisioning must go beyond balancing food availability with requirements; it must also banish famine, seasonal and chronic under-nutrition, micro-nutrient deficiencies, nutrient depleting diseases and death from malnutrition.

The brief overview in the preceding section has shown that food security is a complex and multi-dimensional problem. Consequently, different conceptions and perspectives on food security have evolved and emerged. While the availability and access to food continue to dominate the discussion, the incidence of food insecurity is no longer simply seen as a problem of agriculture and a failure of food production at the national level, but instead as a failure of livelihoods to guarantee access to sufficient food at household level (Devereux and Maxwell, 2001). We therefore argue that these evolving and complex dynamics present a challenge as well as opportunity for researchers and development practitioners to find suitable entry points for action to improve our understanding of the multi-faceted aspects of the problem as well as offer potential strategies to reduce food insecurity, especially in developing regions such as Sub-Saharan Africa.

3.1 Improve productivity from field to plate

Improving agricultural productivity through sustainable intensification is critical in ensuring the availability of sufficient amount of diverse food products to meet the demand of current and future populations. While there is limited scope, notably in Sub-Saharan Africa, to expand production areas, novel technologies which increase existing yield frontiers of major plant and animal food sources, and the reduction of current high levels of food losses and waste, offer the best bet. Improvements in postharvest handling and processing not only reduce wastage; they also create employment opportunities through value-adding economic activities (cleaning, sorting, packaging, storage, minimal processing, new product development, etc.) and new opportunities for trade through

market access (Opara, 2013). The crucial importance of the postharvest sector in assuring sustainable food security can be demonstrated by examining the distribution of value along the food value chain, which shows that up to 80% of food value may be associated with postharvest activities. For instance, analysis of the supply chain cost structure of apples from the Southern Hemisphere in a European market in 2008 showed that the profit received by the grower is only a small portion (approx. 10%) of the cost that consumers pay at retail (ISHS, 2012). The study also showed that the majority of values were linked to postharvest operations such as grading and packing, transport and other logistics, and retailing. Overall, this study shows that through asset creation in skill development and income through employment in value adding activities, improvements in postharvest management can contribute to access to food and improved livelihood.

3.2 Nutrition-sensitive postharvest technologies

Effective utilisation of food (another pillar of food security) requires improved food processing and storage technologies (both hard and software) as well as knowledge of the effects of production, postharvest handling and processing on nutritional content, sensory quality and safety of the food. These have received little attention and more work is warranted through collaboration between multidisciplinary teams including agricultural and food scientists, engineers and technologists, and nutritionists (plant/animal and human). For instance, our recent studies have shown that maturity and ripening status have significant impacts on the nutritional content and antioxidant components of tomatoes, and hence, the amount needed to meet the recommended dietary allowance (Opara et al., 2012). Other studies showed that the antioxidant contents of pre-packed fresh-cut fruit and vegetables differed in comparison with whole produce (Opara and Al-Ani, 2010a), and cooking methods affected carotenoids contents in fish (Opara and Al-Ani, 2010b). Based on these findings, the age-old saying that ‘an apple a day keeps the doctor away’, which has recently been supported by evidence from new medical research (Briggs et al., 2013), now raises new questions such as “which cultivar, with or without the skin, what maturity status, after how long in storage, what processing and cooking method, etc.?”

4 Concluding remarks

Understanding the dimensions of food security is important to guide research, policy and practice. Food and agricultural policy analysts and nutritional experts have contributed considerably to our understanding of the factors affecting food security during the past half century. The multiple dimensions and perspectives on food security offer new opportunities for food scientists, engineers and postharvest technologists to apply new and novel knowledge to create new food value propositions, which not only enhance food availability and access, but also promote the effective utilisation of food materials to meet the ever-increasing demand for steady supply of sufficient quantities of diverse, nutritious and pleasurable foods. Rising global population and urbanisation, declining proportion of people involved in growing what they eat, competition for agricultural land and fresh water supplies for rapidly expanding urbanisation of human habitats, and growing concern about the impacts of climate change in food production have assured a future for food security in the global development agenda. Postharvest research has an important

role to play in enhancing productivity and reducing food losses. Developing novel postharvest technologies which add value, create new employment opportunities, and enhance the effective utilisation of food products for optimal nutrition, offers new opportunities for multi-disciplinary and collaborative postharvest research and practice to tackle food and nutrition security.

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