

## Nutrition, Food Safety and Quality in Sub-Saharan Africa

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### Abstract

Humans have long been concerned with the safety of the food they eat. Improving nutrition can boost mental and physical productivity, improve health status, and help alleviate poverty. A wide spectrum of cost-effective interventions at national and community levels must be undertaken to redress malnutrition, food safety and quality. Malnutrition continues to be one of the world's most serious development problems. The prevalence rate of malnutrition in children is one of the most widely used indicator to characterize poverty and food security conditions in developing countries. High growth rates of gross domestic product per capita are a key factor in reducing food insecurity and malnutrition. However, economic growth per se it is not a guarantee of food security neither a balanced nutrition, food safety and quality. Micronutrient deficiencies, infectious diseases, poor sanitation and water quality need continued attention in Sub-Saharan Africa. Family farms although very poor and with low productivity can serve as a catalyst for sustained rural development levels. Education is considered critical in the area of food safety and quality. Agriculture is an important, but not a sole condition for the food availability. A multidisciplinary approach is necessary for better understanding of malnutrition and food safety. Informal markets, accounting in Africa for 40% of the GDP, are highly preferred, and likely to persist. Programmes designed to respond to a crisis in a timely and efficient way to protect the brand, the public health and the food industry are key to the planning and preparedness process as African informal food markets are likely to continue for decades.

**Keywords:** Malnutrition; food safety; food security; informal markets in Africa

### Introduction

Humans have long been concerned with the safety of the food they eat. Eating involves intimate contact between the gastrointestinal tract and material from outside the organism. The thin and delicate tissue of the gastrointestinal tract is one of the barriers that protect the body against toxins, bacteria or other hazards. Technical understanding of the scientific and medical issues involved in food safety and quality has been developed slowly over the years.

Poverty and malnutrition are intrinsically linked. Productivity losses, poor cognitive development, and increased health care costs in malnourished populations lead to significant economic losses at both the individual and national level. Improving nutrition, therefore, can boost mental and physical productivity, improve health status, and help alleviate poverty. A wide spectrum of cost-effective interventions at national and community levels must be undertaken to redress malnutrition, food safety and quality.

Interventions ranging from those designed to improve food intake or reduce nutrition-inhibiting infection to those addressing underlying determinants of malnutrition can contribute to accelerating global progress in eliminating food insecurity. Malnutrition continues to be one of the world's most serious development problems. Exacerbating the consequences of infectious diseases, malnutrition was responsible for 45% of the 6.3 million of deaths in under-5 children in 2013 [1].

There are still too many circumstances in which the poor do not sufficiently benefit from economic growth. This may happen because economic growth originates business areas that do not generate sufficient employment for the poor, or because they lack secure and fair access to productive assets, in particular land, water and credit. Or it may happen because the poor cannot immediately make use of the opportunities provided by economic growth as a result of authorities' corruption, food insecurity, and low levels of education, ill health, age or social discrimination.

Developed countries' authorities and agencies are responsible for the food safety guidelines worldwide. Developing countries are unable to comply with all the range of demands since these guidelines are not adjusted for the African reality. In order to comply with them, food safety guidelines should be at least adapted in a phased manner if it is not possible to adapt at once.

### Nutrition and Undernourishment: A Global View

Nutrition is a complex discipline. It draws on several health, biological and social sciences; actually, it should be regarded as a multi-science. Competent nutritionists require several years of theoretical and practical training. Furthermore, the very field of nutrition should be better defined; currently its specificity and boundaries are hazy. Nutrition encompasses the various dimensions of the relationship of human beings with their food: not only biological but also psychological, social, political, economic, and environmental. When these dimensions are ignored the discipline is no longer nutrition but it is more food science, biochemistry or agriculture.

Malnutrition is comprised of a) Under nutrition (stunting, underweight, wasting, and micronutrient deficiencies) and b) Over nutrition (overweight and obesity). Most of the world has done a miserable job of improving people's nutrition and indeed the last World Food

Summit in Rome in 2014 revealed that 162 million children under five are stunted (short for their age). The number of undernourished people in the world has fallen since 1990, but only by a fifth, and now stands at about 900 million. As the world's economy has grown, the prevalence of undernourishment – eating too few calories to sustain an active life – has fallen only half as fast as poverty [2]. The world has done so poorly on nutrition compared with poverty partly because of people's choices. Many habitants of whole villages are stunted and people see undernourishment as normal and people often prefer to buy a new cellular phone or bike rather than better food.

Micronutrient deficiency is not falling at all and some 2 billion people suffer from micronutrient deficiency. As undernourishment has fallen, the number of people eating too many calories has risen correspondingly, meaning that many developing countries suffer all three manifestations of malnutrition – undernourishment, micronutrient deficiency and obesity – simultaneously. It used to be thought that malnutrition could be solved by growing more food or providing dietary supplements. By and large, the quantity of food has not been a problem in Africa as most countries grow or import enough. But programmes for specific deficiencies have been patchy and reach half or less of their target audience.

In most of Sub-Saharan Africa, more than 30% of the population has no access to treated water or sanitation. Dirty drinking water and bad sanitation causes gastrointestinal illnesses that prevent the body from absorbing essential nutrients. Girls give birth extremely young and their babies are likely to be underweight and to fail to thrive. Since poor girls are more likely to become young mothers, malnutrition is passed on through generations. Teaching about nutrition, food safety and quality also matters, which is best done by decent health systems with plenty of not only nutritionists but namely of nurses and midwives, which few poor countries have, with nutrition knowledge.

The prevalence rate of under nutrition (undernourishment) in children is one of the most widely used nonmonetary indicators to characterize poverty and food security conditions in developing countries or regions [3,4]. Thus, where a significant and lasting decrease in under nutrition prevalence has been observed, it is generally considered a confirmation or at least a strong indication of an overall reduction in poverty and an improvement in the food security situation. The contrary is also true, where over a certain period of time an increase in under nutrition is being observed, it is considered an indication of overall deteriorating conditions with respect to general human well-being.

At the country level, information on under nutrition prevalence in children can be considered a proximate of the overall nutritional and food security conditions. At smaller geographical units level, relationships are less straightforward, and are hypothesized to depend, at least partially, on the relative importance of food and non-food factors in the ethiology of under nutrition [5].

*'The persistence of malnutrition, especially among children and mothers, in this world of plenty, is immoral'*. This was the opening statement of a report published in 2000 by the Commission on the Nutrition Challenges of the 21<sup>st</sup> Century and was presented to the United Nations (UN) System Standing Committee on Nutrition. The report title was 'Ending Malnutrition by 2020' [6]. We know now that under nutrition – the new name for an old outrage – is liable to persist indefinitely. Why?

Some reasons are given in the *Lancet* series on maternal and child under nutrition. The fifth and final paper in this series [7] asks why all the efforts to alleviate under nutrition are so ineffective and proposes some ways forward. The paper, in common with the others in the series, is the product of the work of a large study group from all continents including senior people from relevant UN agencies, whose judgments have been informed by testimony from many other sources.

The world is rapidly shifting from a dietary period in which the higher-income countries are dominated by patterns of degenerative diseases (whereas the lower- and middle-income countries are dominated by receding famine) to one in which the world is increasingly being dominated by degenerative diseases. It is to note that many, though not all, developing countries have enjoyed remarkable rates of growth during recent decades. High growth rates of gross domestic product (GDP) per capita are a key factor in reducing food insecurity and malnutrition. However, economic growth per se it is not a guarantee of food security neither a balanced nutrition, food safety and quality.

Where problems of under nutrition in children are serious, but where adults appear to be, on average, in a relatively better nutritional condition, factors other than household level food shortages are likely to be responsible for the occurrence of under nutrition in children. Among these factors are, for example, frequent occurrence of infectious diseases, and associated poor water and sanitation conditions, poor quality of diets with deficiencies in micronutrients (vitamins, minerals), and insufficient opportunities for mothers or other caretakers to provide their children with adequate care [8].

The following major micronutrient deficiencies need continued attention in Sub-Saharan Africa: iron, vitamin A, zinc and copper, iodine and selenium. Food production, purchasing, processing and preservation, preparation and promotion of appropriate indigenous knowledge throughout the food processing and marketing chain needs to be developed to ensure that issues of sufficiency and quality are addressed in a holistic manner. Information on which foods are rich in which micronutrients needs to be made more widely available and disseminated to support food-based initiatives complemented by supplementation and fortification programmes (e.g. salt iodization).

### **Role of Anthropometric Information**

The role of anthropometric information for the assessment of poverty and food insecurity must be evaluated. Over the past decades there have been continuing efforts to develop methods for the assessment of poverty, which are less dependent on incomes or expenditures [9].

With respect to under nutrition, ethnic differences in physical characteristics might also play a role. For example, it has been shown that differences exist in body measurements (standing height, sitting height) between, for example, Asians, Africans and Caucasians, and these bodies build characteristics also affect body mass index (BMI). One approach in attempting to account for such differences in body build has been the introduction of the Cormic index, but its use appears not to be widely accepted [10]. Thus, there are still a number of critical issues to be considered for the appropriate use and interpretation of anthropometry in the assessment of under nutrition.

In regions where poor anthropometric results are being observed in both children and adults, limited overall levels in household food supply are most likely to play an important role in the causation of under nutrition.

The so-called Human Development Index (HDI) incorporates information on income, health and education into one composite indicator [11]. In addition, various other related indicators have been developed such as the Human Poverty Index (HPI) and the Gender Related Development Index (GDI) [11]. While these indicators play an important role in assessing trends in development and monitoring progress in eradicating or reducing poverty, there remains the disadvantage that the constructed indices still depend on, to some extent, the arbitrary weighting of the contributing factors. Another approach in circumventing the tedious task of collecting information on incomes and expenditure has been the development of asset indicators [12]. In response to these problems with respect to the various indicators of human development and poverty, over recent years anthropometric information is increasingly being used and accepted as an indicator of overall human well-being [13-15].

### **Family Farming**

Farmers experiment and innovate continuously and have done so for millennia. Their efforts led to the domestication of the many crops and livestock species used in the modern food system. Formal scientific research in agriculture is a relatively recent phenomenon and has been largely responsible for the enormous growth in agricultural yields since the mid-twentieth century. Local indigenous knowledge – often implicit in farmers' practices – and formal scientific research should both be involved in the overall innovation system needed to enable family farms to achieve sustainable productivity growth and adapt to changing environmental circumstances. Building closer cooperation between formal and informal parts of the research system can help ensure that agricultural research and development supports innovation by small family farms.

The problems of the international nutrition system are long-standing and deeply embedded in organizational structures and norms. All those involved in the international nutrition system should identify and establish a new global governance structure that can provide

both greater accountability and greater participation of civil society organizations and the private sector. Fragmentation was found to be a common and persistent theme in the analysis conducted. There are reams of uncoordinated normative guidance from multiple and often competing projects and agencies with almost indistinguishable acronyms. There are more than 400 journals publishing so-called new research on under nutrition [16]. This fragmentation makes difficult for any organization to muster sufficient resources to act at scale and makes difficult a shared understanding of the range of interventions that are currently being deployed. Linkages with national-level processes need to be significantly enhanced, so that priorities that are felt at country level are better reflected in international normative guidance, donor funding, research and advanced training.

There is a need for a rigorous analysis of the linkages between nutrition outcomes and global change processes such as climate change, trade liberalization, international migration and remittances, and long-term trends in energy prices. There is also a need to assess the effect on nutritional status outcomes of changes in agricultural technologies and policy and research into the quantity and effectiveness of international aid for improved nutrition, including modalities such as country-level technical assistance, budget support (sector and general) and humanitarian intervention, as well as investment in nutritional global public goods. This research should include rigorous assessment of the effect of public-private partnerships in nutrition, food safety and quality [7].

There are about 500 million family farms in the world and they represent more than nine out of ten of all farms in the world. Although most of them being very poor and with low productivity, they can serve as a catalyst for sustained rural development levels. For all these farms, the implementation of innovative systems are needed to make their productivity sustainable. Family farms are part of the solution for achieving food security and sustainable rural development; the world's food security and environmental sustainability depend on hundreds of million family farms that form the backbone of agriculture in most countries. Thus, strategies to support them require innovative systems that should recognize the natural diversity among family farms and must focus on increasing yields, preserving natural resources and raising rural incomes.

In order to do so, an innovation system that facilitates and coordinates the activities of all stakeholders involved in agricultural innovation should be implemented. It begins with an enabling environment for innovation, including good governance, stable macroeconomic conditions, and transparent legal and regulatory regimes, secure property rights and market infrastructure, but includes much more [17]. Public investment in agricultural Research and Development (R&D) and advisory services must be developed and focused both in the sustainability and on the increment of the productivity of small and medium-sized farmers. R&D and extension services must be inclusive and responsive to farmers' needs. Investments in education and training should be increased. Farmer's innovative capacity also depends on their organization as well as networks and linkages allowing different actors in the innovation system to share information on food safety and quality and work towards common objectives [17].

Research and training groups in high-income countries should review how they could contribute to new theoretical and practical knowledge on food safety and quality in the process of scaling up successful nutrition projects, programmes and policy initiatives. All countries need a certain level of domestic research capacity, but for those with limited financial resources and limited capacity to maintain strong national research programmes, the most effective strategy will be to look close at the research done by other countries and to focus on adapting these to their domestic circumstances.

The current state of the art with respect to research and development activities that concerns food systems in Sub-Saharan Africa were discussed in several fora [17] and focused around five major themes: 1) Food, nutrition and health; 2) Food safety and quality management; 3) Impact of urbanization on food systems; 4) Agro-food enterprises: adding value and meeting consumer demand; and 5) Food security: access and quality.

More research on the effects of processing to enhance bioavailability is needed. The effect of storage, packaging and food preparation methods on nutritive value, food safety and quality needs to be taken into account. In addition, it is important to recognize where nutrient

interaction can play a role in a balanced diet, particularly for vulnerable groups. More research is also needed on the potential for vulnerable groups to gain nutritional benefits from traditional and indigenous foods.

Research and development efforts on improved food processing technologies should be based on the needs of the local environment. Also, all interventions to improve food-processing operations must be market-orientated. It is important to promote establishment of medium scale processing technologies close to rural areas to create employment and to reduce the need for transport of fresh perishable commodities. The development of mobile processing units for farm gate processing would be an advantage. This could contribute to rural employment, reducing losses, reducing rural-urban migration and increase the stability of the products.

The ability to accurately and precisely determine the nutrient content of foods, and therefore the level for food and nutrition safety and quality, is a basic requirement for nutrition research in Sub-Saharan Africa. This is currently restricted by insufficient laboratory analytical capacity and capability, and restricted access to accredited laboratories that provide reliable food safety information for internal evaluation and certification for export purposes.

The United Nations (UN) has declared 2014 the International Year of Family Farming. This provides an occasion to highlight the role that family farmers – a sector that includes small and medium-scale farmers, indigenous peoples, traditional communities, fishers, pastoralists, forest dwellers, food gatherers and many others – play in food security and sustainable development.

### **Food and Nutrition Security and Insecurity: Concepts and Definitions**

Food security is a concept originated in the mid-1970s, in the discussions of international food problems at a time of global energy and food crisis [18]. Food and nutrition security is a flexible concept as reflected in the many attempts at definition in research and policy usage. There has been a tendency to give food security a too narrow definition, little more than a proxy for chronic poverty. On the opposite, there is a tendency of international committees to negotiate an all-encompassing definition, which ensures that the concept is morally unimpeachable and politically acceptable, but unrealistically broad. Even a decade ago, there were about 200 definitions in published writings [19].

Food insecurity can be defined as the limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways. Famine and hunger are both rooted in food insecurity. Chronic food insecurity translates into a high degree of vulnerability to famine and hunger; ensuring food security presupposes elimination of that vulnerability [20].

Food insecurity is a household situation, not an individual situation. While food insecurity affects everyone in a household, it may affect them differently. Therefore, it is not correct to state that specific individuals in a food insecure household (such as children) definitely experience outright hunger or specific coping mechanisms.

Rather than describing these individuals as being 'food insecure', they should be referred to as 'living in a food insecure home.' Food insecurity is a yearlong measure often episodic and cyclical. Food insecurity refers to lack of food access based on financial and other material resources.

In general, the objective of food security indicators and measures is to capture some or all of the main components of food security in terms of food availability, access and utilization or adequacy. Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Food insecurity exists when people do not have adequate physical, social or economic access to food. Since food insecurity is about risks and uncertainty, the formal analysis should include both chronic sub-nutrition and transitory, acute insecurity that reflects economic and food system volatility.

While achieving food security in Africa is a huge concern, food safety has been overlooked in light of bigger food security issues like famine, malnutrition and starvation. Access to stable, consistent and safe food is a pressing problem on the African continent. However, as African countries engage in efforts to develop, societal expectations change and the result is that governments need to consider food quality and safety policy and systems. Another reason to focus on food safety is as African countries develop their agricultural production and export food products they face serious nontariff barriers to trade in the form of standards for food safety and quality [21].

The State of Food Insecurity in the world presents updated estimates of undernourishment and progress towards the Millennium Development Goal (MDG) and World Food Summit (WFS) hunger targets. A stocktaking of where we stand on reducing hunger and malnutrition shows that progress in hunger reduction at the global level and in many countries, has continued but that substantial additional effort is needed in others [17].

Food and Agriculture Organization (FAO) has developed the Food Insecurity Experience Scale (FIES) as a tool to fill a gap in global food security monitoring, particularly for assessing the access dimension at the individual and household levels [22].

The FIES directly measures the severity of food insecurity defined as the extent of people's difficulties in obtaining food. This latent trait cannot be directly observed, but its extent can be inferred from the experiences that people report when they face restricted access to food. This approach appears to be more effective than trying to infer the extent of problems with food access indirectly, by measuring food expenditures or by assessing nutritional outcomes through anthropometric measures [23].

### Food Safety and Quality

Food-borne risks to human health can arise from hazards that are biological, chemical or physical in nature. Ensuring food safety to protect public health and promote economic development remains a significant challenge in both developing and developed countries. Considerable progress to strengthen food safety systems has been achieved in many countries, highlighting the opportunities to reduce and prevent food-borne disease.

Food safety is an umbrella term that encompasses many facets of handling, preparation and storage of food to prevent illness and injury. Included under the umbrella are chemical, microphysical and microbiological aspects of food safety. Pathogenic bacteria, parasites, viruses, fungus and toxins produced by microorganisms are all possible contaminants of food and impact on food safety.

In Africa, food safety and quality management is becoming increasingly important at both the national and international levels. Access to export markets may be limited where producers are not able to comply with international food safety requirements (for example FAO/WHO Codex) and those of importing countries. At the national level, improvements in food safety and consumer health may be hindered by the need for appropriate food safety and consumer health policies, fragmented institutional systems, effective food law and enforcement, food producers and caterers working under unsanitary and unhygienic environments and staff who have minimal education. The majority of African consumers may not make the link between ill health and unsafe food; an example of this is the consumption of staple foods (e.g. cassava and maize) contaminated with high levels of mycotoxins [24].

Concerns over food safety have been compounded by the increasing urbanization that can lead to stresses on the emerging urban infrastructure. Livelihoods and consumer health, particularly the urban poor and young may be at risk if concerns over food safety are not addressed. Urban agriculture, actually in vogue in developed countries due to lack of land, is not a solution in Africa where vast amount of land is available. Both under-nutrition and over-nutrition are considered important. Access to sufficient food of an appropriate quality and quantity needs to be achieved so that a diet can be considered balanced.

Considering national food production systems, it is recommended that food safety should be considered using a food safety management systems approach, for example hazard analysis and critical control points (HACCP) and, as part of this, Good Agricultural Practice (GAP) and Good Manufacturing Practice (GMP). It is considered important to identify the main food safety hazards, where they occur in

the food production and marketing chain and their potential risk to consumer health thus, a multi-disciplinary approach to hazard identification, based on risk assessment, is proposed.

All risk assessment steps of evaluating food safety and quality demands the existence of national structures that coordinate multidisciplinary activities in different sectors, transversal to several ministries, usually through a national food agency, that most African countries do not have, with autonomous authority including policy and fiscal activities.

Therefore, there is a need to define appropriate food safety legislation, which responds to both global and domestic challenges. Access to information on international food standards is considered difficult for many individuals and organizations in Sub Saharan Africa. Enforcement of food standards is a major issue that further to specific police force, demands almost unlimited resources for inspection, enforcement, and access to accredited laboratories that provide reliable food safety information. The laboratories should be national to avoid sample transfer through countries or even continents, and they must hold ISO certification (ISO 17025) so that recognition of analytical results is automatic.

Sensitization of consumers and food handlers about food safety is important. The informal food-processing sector (e.g. street food vendors) should receive specific attention with respect to legislation since it provides a significant proportion of food consumed in many of Sub-Saharan Africa's cities. Coordination between local authorities and food standards and regulatory bodies is considered necessary. In support of the required regulatory framework, it is important to ensure that national staff is trained and that their working conditions are sufficient to reduce the risk of corruption.

Education is considered critical in the area of food safety and quality. There is a need to improve consumers and processors understanding of food safety issues. There is a lack of information concerning the availability and suitability of lower cost, safer local alternatives for use by poor people and whether consumers are willing to pay more for safe food and if this can be used as an incentive for producers and processors to produce safer foods. Education programmes should also include cost-benefit comparisons and take into account cultural preferences and patterns of behaviour. It is considered important that education in food safety should be addressed throughout society, for example in schools, households, workplace and in food processing and catering businesses.

Food availability remains a major element of food insecurity in the poorer regions of the world, notably Sub-Saharan Africa and parts of southern Asia, where progress has been relatively limited. Agriculture is an important, but not a sole condition for the food availability. Similarly, self-sufficiency cannot be equated with food availability; this would only happen on a very small scale for subsistence farmers. The problem is how to move from small-scale subsistence food production to a wider system that ensures food security and safety [25].

Consumers' Associations must exist as they play important roles in addressing food quality, prices, safety and environmental concerns. Currently there are few, consumer associations in Sub-Saharan Africa but their numbers are increasing. It is considered that these associations could potentially play an important role if supported and integrated at both local and international levels.

### **Food Safety and Public Health**

Food safety is receiving major attention worldwide as the important links between food and health are increasingly recognized. It is also an important focus of consumer concerns, policy responses and strategic industry initiatives [26] with both developed and developing countries establishing new institutions, standards, and methods for regulating food safety and increasing investments in hazard control.

Food safety and quality is becoming more important in food markets due to several structural changes in the world food system. These changes include advancements in the science of public health, changes in how consumers obtain and prepare food, and increased international trade in food products.

Advances in public health (faster and more sensitive tests for pathogens as well as better epidemiology) permitted improved surveillance for foodborne illnesses, linked specific foods and companies with pathogens, and linked known human illnesses to complications of acute foodborne infections. Estimates of foodborne illness are always uncertain because most illnesses go unreported. New pathogens are evolving and posing new threats to the food supply [27]. Many, including *Salmonella*, *Escherichia coli* O157:H7, *Campylobacter* and *Yersinia enterocolitica*, have reservoirs in healthy food animals, from which they spread to an increasing variety of foods. These pathogens cause millions of cases of sporadic illness and chronic complications, as well as large and challenging outbreaks over many states and nations.

Unsafe food contains hazardous agents, or contaminants, that can make people sick-either immediately or by increasing their risk of chronic disease. Such contaminants can enter food at many different points in the food production process, and can occur naturally or as the result of poor or inadequate production practices. Hazardous agents that are receiving attention from policymakers include microbial pathogens, zoonotic diseases, parasites, mycotoxins, antibiotic drug residues, and pesticide residues. Even genetically modified foods and their potential to contain allergens or toxins not found in conventional foods have begun to receive attention as well in developing countries [28].

At the same time that risks from foodborne pathogens are better understood, science has also increased public awareness of new and highly uncertain risks. The outbreak in Europe of mad cow disease and its subsequent linkage to new variant CJD in humans has captured media attention. The unknown nature of this risk and the unusual method of transmission make it highly alarming to consumers. Another potential unknown are the risks from genetically modified organisms. While regulatory agencies in the USA have certified approved genetic modified organisms (GMOs) as posing little or no health threat, many consumers remain unconvinced and some food firms have acted to restrict their sources of supply. Science can provide the basis for understanding and assessing risks, but it cannot always provide answers with the degree of certainty that assures consumers.

A multidisciplinary approach is necessary since better understanding of how pathogens persist in animal reservoirs, including in wild animals, is critical to successful long-term prevention. In the past, the central challenge of foodborne disease lay in preventing the contamination of human food with sewage or animal manure. In the future, prevention of foodborne disease will increasingly depend on controlling contamination of feed and water consumed by the animals themselves.

International food trade is growing with reduced barriers to trade and increased demand for diversity and freshness. In particular, the trade in fresh and minimally processed food products has expanded rapidly during the 1990s in Africa [29]. As many of these products are consumed fresh, they require greater care to prevent food safety hazards. Handling at all points of the food chain can influence food safety and quality, and this becomes more important as fresh foods are shipped over greater distances. Increased international trade has the potential to introduce new or different food safety risks into the food supply of importing countries [30].

All countries share similar concerns about food safety, but the relative importance of different risks varies with climate, diets, income levels, and public infrastructure. Some food safety risks are greater in developing countries, where poor sanitation and inadequate drinking water pose greater risks to human health than in developed countries [31].

Local and indigenous foodstuffs with high nutritional and medicinal value relevant to people with certain illness (e.g. HIV/AIDS) in Sub-Saharan Africa offer a potential resource that is currently underutilized [32].

### **Food Safety on Informal African Markets**

Safer food can generate both health and wealth for the poor but attaining safe food and safe food production in developing countries requires a radical change in food safety assessment, management and communication, not necessarily and immediately similar to that described above from FDA and EFSA.

By “informal markets” it is meant markets where many actors are not licensed and do not pay tax (e.g. street food markets and backyard poultry and pastoralist systems), markets where traditional processing, products and retail prices predominate (e.g. wet markets,

milk hawking systems and artisanal cheese production), markets which escape effective health and safety regulation (most domestic food markets in developing countries). Most of the meat, milk, eggs and fish produced in developing countries, as well as all vegetables, are sold in traditional, domestic markets, lacking modern infrastructure and escaping effective food safety regulation and inspection.

Much attention has been paid to the role of informal markets in maintaining and transmitting diseases but little to their role in supporting livelihoods and nutrition. And informal markets do exist in developed countries however under strict sanitary control. Policy-makers often respond to health risks by favouring industrialization and reducing smallholder access to markets. These changes are often based on fear not facts. Without evidence of the risk to human health posed by informally marketed foods or the best way to manage risks while retaining benefits, the food eaten in poor countries is neither safe nor fair.

Informal markets, accounting in Africa for 40% of the GDP, are highly preferred, and likely to persist, by African people while food safety matters to both poor and wealthy consumers. Hazards do not always matter, but risks do. In Africa people favour values and cultures as they are considered more important drivers of food safety than pathogens [33]. Food is often sold in at lower prices, fresher and tastier in informal markets, through trusty and friendly vendors and food safety is considered a fixable problem.

Conventional food safety as described above for developed countries tend to increase regulation and shift food out of risky channels into more formal channels and this is considered bad news for small farmers. Food safety is a growing constraint to smallholder value chains because of its multiple burdens on human health, livestock production and product marketing. Safer food can generate both health and wealth for the poor, but requires radical-based change in how food safety in informal markets is assessed, managed and communicated [34].

Southern Africa is comprised of 15 countries that are all members of a regional multilateral agreement named Southern African Development Coordination Conference and its main goal is to coordinate SPS issues in the region. It was formed in 1980 as a loose alliance of nine states in southern Africa and is actually best known as SADC [35].

### **Southern Africa and UN Nutrition System**

A number of international institutions maintain particular roles or functions in global food safety regulation. Within Southern Africa, the main actors of the food safety complex are the WHO, FAO, the Codex Alimentarius, WTO, Sanitary and Phytosanitary (SPS) Agreement, the World Animal Health Organization (OIE), external donors and the Southern African Development Community (SADC). Each institution plays a specific role in global food quality and safety governance and overlap in cooperative endeavours that reinforce institutional roles and responsibilities in food safety regulation. Trade, law, risk assessment, scientific cooperation, human health, animal health, plant health are all aspects that feed into a food safety regulatory framework.

The UN Standing Committee of Nutrition is – or should be – the focal point of the international nutrition system. The whole system is made up from the 19 UN agencies with an interest in food and nutrition policy, together with bilateral government and other donor organizations, academia, civil society organizations and the private sector. This system is fragmented and dysfunctional. A reform is needed so that it can perform key stewardship functions, mobilize resources, provide services in emergencies, and strengthen capacity in low- and middle-income countries [16].

The UN agencies do indeed have problems working together. Their activities in addressing nutrition problems provide in most cases a poor example for coordinated and effective actions at the national or regional level. The system is broken and the processes are ineffective. The UN system is slow to respond to change. Current processes for producing normative guidance are laborious and duplicative, and fail to produce guidance that is prioritized, succinct and evidence-based. UN Programmes' evaluation is weak or non-existent, and insufficient resources are devoted to analysing and responding to major global challenges. Stewardship means managing assets without owning them, anticipating future trends and making plans to address problems as they arise [7].

The complexity of the multiple micronutrient-focused organizations is presented and discussed in a *Lancet* paper [36]. It highlights the need for all to work together to produce a single set of succinct, up-to-date, evidence-based position papers on different options for effective interventions based on different local contexts. Instead, we have competing initiatives. These country-level nutrition practitioners often exhaust the capacity of the limited human and technical resources that must deal with them.

The funding provided by international donors to combat food and nutrition insecurity is grossly insufficient and poorly targeted. Also, it is inappropriately dominated by food aid and supply-led technical assistance. The international community devotes few resources to nutrition-relevant organizational development in low and middle-income countries [6]. Total donor investment in basic nutrition in developing countries is some ten times less than the food aid allocations per year [7].

### **New Technologies in Africa**

Biotechnology alone will not bridge the food gap in Africa. Because agriculture accounts for some 35% of gross domestic product in Africa, improvements in infrastructure are crucial to the continent's development. Educating Africa's leaders about the role of technology in agriculture is a key to helping the continent reap the benefits of innovation. The application of science and technology to agriculture requires extensive coordination across many actors and sectors. It is essentially a political process, and political leadership is essential.

The African Union heads of state and government, in fact, recently adopted a new 10-year vision of science, technology and innovation—including eradication of hunger and ensuring food and nutrition security as one of the six designated pillars. Although most African nations have eyed biotechnology warily, it is believed that educating countries about genetically modified (GM) crops is important as more evidence becomes available about the technology's safety and potential benefits. A recent report from the Alliance for a Green Revolution in Africa (AGRA), for example, suggests that there is growing public opposition to GM crops in Africa that is best described as a fear of the unknown. It is essential to explain to Africa's leaders the importance of science and technology, rather than advocating for one kind of innovation over another. Policy-making is a learning process [37].

The accrued benefits and/or disadvantages vary widely across the countries and depend on the governance structures in each country. On the one hand, GM crops can increase export revenues; on the other hand, developing countries' resulting dependency on Western biotechnology companies could grow and threaten local farmers, especially smaller ones. Moreover, some claim that genetically modified organisms (GMOs) is leading to a reduction in biodiversity. More and more GM monoculture crops (like soya or maize) are being harvested for export and not primarily for domestic consumption, like staple/sustenance crops (e.g. sorghum or cassava). This trend may lead to a dependency on multinational biotechnology companies and endanger the existence of smaller farmers. Without an accompanying social security system, poor harvests may have dramatic consequences on local farmers. At a more fundamental level, only a resilient and sustainable agriculture that is based on a wide variety of crops can assure a country's food security. The current support for GMOs may thus endanger traditional crops as well as biodiversity as a whole [38].

Besides public opposition to GM crops, the cultivation of GMOs has increased in the last years in developing countries. In 2011, more than half of all agricultural land allocated to growing GM crops - a total of 160 million hectare - was found in developing countries [38-41].

### **Concluding Remarks**

Work continues around the world to minimize health risks from farm to table, to prevent outbreaks and to promote food safety and quality, which also will safeguard trade and support economic development. This global issue requires a multi-disciplinary and collaborative approach to developing responses effective at domestic, regional and international levels. Food production in developing countries requires a radical change in food safety assessment, management and communication, not necessarily and immediately similar to those existing in the developed world. The complexity of food safety is vast and the direct transfer to Africa of a number of directives and guidelines from major agencies is not presently justifiable or feasible.

Food safety and quality has been identified as a public health priority, because unsafe food causes illness in millions of people every year and many deaths. Serious outbreaks of foodborne disease have been documented on every continent in the past decade and in many countries rates of related illnesses are increasing significantly. Key global food safety concerns include the spread of microbiological hazards, chemical food contaminants, assessments of new food technologies (e.g. genetically modified food), transmission of antibiotic resistance and strong food safety systems in most countries to ensure a safe global food chain.

Improved food safety standards, international trade and market integration are all required to address critical issues arising from the globalization of the food supply. All stakeholders have important roles to play in improving global food safety and quality systems and supporting better access to domestic and global food markets. As countries increase their demand for food ingredients and raw materials globally, the need to safeguard public health while promoting food security, international trade and economic development throughout the entire value chain must be met.

The bottom line for minimizing risk with the global food supply chain is to trust but verify. This starts with a clear understanding of the vulnerabilities both upstream and downstream across a supply chain, and flows to iterative preventive controls and food defence programmes that are verified and validated at an adequate frequency. Programmes designed to respond to a crisis in a timely and efficient way to protect the brand, the public health and the food industry are key to the planning and preparedness process as African informal food markets are likely to continue for decades.

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