

From food security to food and nutrition security: role of agriculture and farming systems for nutrition

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The concept of food security developed over the last 50 or more years addressed primarily the need for the production and access to adequate food grains to feed the world's increasing population. Nutrition security, a later development, was a much broader concept since nutritious and safe diets alongside adequate biological and proper social environments ensures appropriate growth and development in childhood and helps promote health and prevent disease in adulthood. The need for a paradigm shift in policy formulation from focusing on food security at the aggregate level to nutrition security at the level of each child and adult implied that the definition 'food and nutrition security' integrates both the conceptual frameworks of food security and nutrition security. This integrated approach aspires not merely to address the micronutrient malnutrition which is a bigger problem than food energy deficiency, but is a food-based approach that also tackles non-food factors such as water, sanitation and care practices.

Keywords: Farming systems, food security, nutrition security, role of agriculture.

Introduction

It is an honour to have been invited to write a review article for this Special Section. Although I have, like all Indians, known Professor (as M. S. Swaminathan is affectionately addressed) and met him on occasion when he visited the Food and Agriculture Organization (FAO) in Rome, it is only after I took over the UK AID funded LANSAs programme led by the M.S. Swaminathan Research Foundation (MSSRF) in Chennai a few years ago that I had the privilege to know him personally – and that I treasure as a true blessing indeed. He is widely recognized in India as a living legend and the architect of India's green revolution and its phenomenal journey to food sufficiency and worldwide for his yeoman contributions to increase agriculture production and food security in the developing world. I have hence chosen the theme

'from food security to food and nutrition security' for this review – the history of which is entwined closely with the evolution and development of Swaminathan's own thinking and the unparalleled role he has played in the process towards achieving this goal, for well over 50 years now.

From food security to food and nutrition security: the evolution of concepts

From a historical perspective, in its earliest usage, the term 'food security' referred to overall national, regional or even global food supply and shortfalls in supply compared to requirements. However, the recognition that despite overall adequacy of food supply at the national or regional levels certain vulnerable groups have insufficient food intake meant that the term food security had to be relevant at the community, household or individual level¹. The term was broadened beyond notions of food supply to include access², vulnerability³ and sustainability⁴. The concept and definition of food security continued to evolve over time and it was estimated nearly 15 years ago, based on a review of the literature, that there were well over 200 definitions and 450 indicators of food security⁵.

Concepts of food security have evolved over time since the World War II and have changed according to the changing views expressed at the time and through a sequence of definitions and paradigm shifts responding to global historical changes and our growing understanding of the problem of food insecurity and these have been well summarized in the literature^{6–10}. The earliest definition provided by the historic Hot Springs Conference held in Virginia, USA in 1943, to consider the goal of freedom from want in relation to food and agriculture merely stated, 'a secure, adequate, and suitable supply of food for everyone'^{11,12}. While this early definition was prompted by the need to dispose agricultural surplus commodities in the developed world after the World War II, by the 1960s, it was acknowledged that food aid was a barrier to progress towards self-sufficiency elsewhere and the concept of food for development was introduced and institutionalized⁷. The food crisis of 1972–1974 marked a

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dramatic turning point from an era of food abundance in donor countries to highly unstable food supplies and prices globally. This resulted in food security insurance schemes, which assured international access to physical food supplies and improved food security assurance was achieved through better coordination between donor organizations and agencies and food availability surveillance in recipient countries in the 1970s.

Since the 1974 World Food Conference in Rome, the whole concept of food security has 'evolved, developed, multiplied and diversified' and three main shifts were identified, i.e. (i) 'from the global and the national to the household and the individual'; (ii) 'from a food first perspective to a livelihood perspective'; and (iii) 'from objective indicators to subjective perception'¹³. The 1980s benefited from the success of the green revolution initiated in developing countries like India in the 1960s through the introduction of high-yield crop varieties and the application of modern agricultural techniques which led to dramatic increase in food production. The green revolution was spearheaded by Swaminathan in India and in other food insecure countries in the developing world which helped to increase national food production and thus food availability¹⁴. However, the increasing recognition that the fruits of the green revolution in the form of abundant availability of food did not lead to an absence of food emergencies or even famines provided a sharp focus on the issue of access to food². With the successes of the green revolution increasing food production and food availability in many parts of the world, mainly in Asia and Latin America, the awareness of the persistent vulnerability of specific communities to hunger due to decline in their purchasing power led to the concept of food security being broadened to include both physical and economic access to food. The definition of food security was thus broadened to include access and was defined as 'the access by all people at all times to enough food for an active, healthy life'¹⁵. The concept of food security had broadened beyond notions of food supply or availability to include access, stability and sustainability and this period also saw the promotion of poverty alleviation and the role of women in national and global development agendas.

In the 1990s, with the approach of the millennium, the primacy of reducing global hunger and undernutrition within the development agenda and the recognition of the human right to adequate food and nutrition was reaffirmed internationally. Reduction of hunger and undernutrition was increasingly seen in the context of overall development, poverty reduction and the achievement of the Millennium Development Goals (MDGs). According to FAO, food insecurity was defined as, 'a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life'¹⁶. What was implied was that food insecurity may be caused by

the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level.

The 1996 World Food Summit held at FAO in Rome, adopted the following definition: 'Food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.' Subsequently, with the sole addition of the word 'social' to the phrase 'physical, social and economic access', the amended definition was reaffirmed officially by FAO in the 2009 Declaration of the World Summit on Food Security¹⁷. This document also reiterated that the four pillars of food security are availability, access, utilization and stability. Thus according to the currently accepted definition, 'Food Security' is achieved when it is ensured that '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'¹⁶. Food is here defined as any substance that people eat and drink to maintain life and growth. As a result, safe and clean water is an essential part of food commodities. This definition already includes aspects of nutrition but was not sufficiently elucidated.

The term 'nutrition security', on the other hand, emerged in the mid-1990s and focused on food consumption by the household or the individual and on how that food is utilized by the body and thus in principle is more than food security. Building on UNICEF's conceptual framework of malnutrition, the International Food Policy Research Institute (IFPRI) in 1995 proposed that 'nutrition security' be defined as 'adequate nutritional status in terms of protein, energy, vitamins, and minerals for all household members at all times'¹⁸. The concept of nutrition security is hence broader than food security since the term utilization in nutrition also encompasses biological utilization⁷. From a nutritional perspective, adequate utilization refers to the ability of the human body to ingest and metabolize food. Alongside nutritious and safe diets, an adequate biological and social environment, and proper nutrition ensure the adequate utilization of the nutrients in food and this, in turn, helps to promote health and prevent disease. More recent interpretations of the importance of the external environment on biological utilization have led to the recognition of a persisting sub-clinical condition caused by constant faecal-oral contamination causing the blunting of intestinal villi and intestinal inflammation influencing the biological utilization of nutrients in the diet and is referred to as environmental enteropathy, also called tropical enteropathy¹⁹. The recognition of this causal entity in the tropics where much of the global undernutrition is prevalent emphasizes the crucial role of proximal determinants such as provision of safe water, toilets and waste disposal under nutrition security.

An understanding of nutrition security is thus incomplete without appreciation of the widely accepted conceptual framework for the analysis of malnutrition developed by UNICEF²⁰. According to this framework, the immediate causes of malnutrition are twofold – inadequate dietary intake and unsatisfactory health status. In developing countries, infectious diseases such as diarrhoea and acute respiratory infections are responsible for most nutrition-related health problems. Consequently good nutritional status is a function of both food intake and health status. The UNICEF conceptual framework also identifies the importance of the role of care in these two determinants and recognizes that the absence of proper care in households and communities, reflecting on the role of women, is a necessary element of the underlying causes of malnutrition. The conceptual framework also recognizes that these causal factors for poor nutrition operate at different social-organizational levels⁷. The immediate causes affect individuals, the underlying causes relate to families, and the basic causes are related to the community and the nation. The underlying causes may be due in part to tenuous access to health care or due to poor housing and/or environmental conditions. Hence, the more indirect the cause, the larger the population whose nutritional status is likely to be at risk. The two commonly used conceptual frameworks for food security and nutrition security thus show significant differences. The food security framework emphasizes an economic approach in which food as a commodity has a central focus while the nutrition framework adopts a biological approach in which human beings are central⁷. Both these frameworks promote interdisciplinary approaches and acknowledge that adequate food production alone is not sufficient to secure a sustainable and satisfactory nutritional status and therefore health and environment also need to be equally considered.

The necessity of incorporating nutritional concerns into the food security framework evolved over time²¹. Nutrition security is more than food security. The nutrition focus adds physiological requirements for different nutrients and the determinants of their bioavailability, i.e. the degree to which or rate at which the nutrient is absorbed and becomes available at the site of physiological activity, as well as aspects of caring practices and health services and healthy environments. While this definition illustrates the consideration of the need for food to ensure optimal supply of these nutrients in the diet to meet physiological needs, other components of the definition of nutrition security focus on the vulnerable individual and their needs associated with non-food factors. While pointing out the need for a paradigm shift in policy formulation from attention to food security at the aggregate level to nutrition security at the level of each child, woman and man, Swaminathan²² defined nutrition security as, ‘physical, economic and social access to a balanced diet, safe drinking water, environmental

hygiene, primary health care and primary education’. This latter definition of nutrition security involves both food and non-food factors.

In the last over two decades, the recognition that food cannot be separated from its nutritional role to meet physiological requirements in terms of quantity, quality, and safety and also to be socially and culturally acceptable has resulted in the convergence and integration of these two concepts to a unified definition and usage of the term ‘food and nutrition security’⁷. ‘Food and nutrition security’ is a way to combine elements of both food security and nutrition security. It is a term that has been used more frequently now and has been advocated in particular by the public health and nutrition communities to emphasize the need for greater integration of nutrition into food security policies and programmes. This term is preferred by those who wish to highlight the integral linkages between food security and nutrition security, not only linguistically but also conceptually, in particular at the household and individual level. The embedding of ‘nutrition’ between ‘food’ and ‘security’ emphasizes that raising levels of nutrition is the ultimate goal¹⁷.

IFPRI has used the term ‘Food and Nutrition Security’ since the mid-1990s, and UNICEF and FAO have both developed formulations for this term: ‘Food and nutrition security is achieved when adequate food (quantity, quality, safety, socio-cultural acceptability) is available and accessible for and satisfactorily used and utilized by all individuals at all times to live a healthy and active life²³.’ ‘Food and nutrition security exists when all people at all times have physical, social and economic access to food of sufficient quantity and quality in terms of variety, diversity, nutrient content and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health, education and care²⁴.’

The increasing awareness of over consumption and over nutrition not just in economically advanced countries but also in rapidly industrializing and urbanizing developing countries has added a new dimension to food and nutrition security²⁵. There is increasing concern over the emerging problem of over nutrition and its health consequences in developing countries which continue to struggle with the unfinished agenda of food insecurity, hunger and undernutrition thus contributing to the ‘double burden’ of malnutrition²⁶. To take this into account, it is even proposed that food and nutrition security be even more broadly defined to ‘encompass stability in availability, access, and utilization of safe and nutritious food to prevent both positive and negative deviation from nutritional balance for all, in a manner that is economically, environmentally, socially and culturally sustainable’ (Dube, *et al.*, McGill University, unpublished).

Food and nutrition security are fundamental to the achievement of the Millennium Development Goals²⁷ and to the emerging post-2015 Sustainable Development

Goals agenda²⁸ to reduce the burden of nutritional disorders that accompany economic development and urbanization of societies worldwide.

Leveraging agriculture for nutrition to address food and nutrition security

Agriculture plays a key role in increasing food availability and improving household incomes, by supporting livelihoods and contributing to the overall economy, and is thus central to improving food security. Agricultural growth also tends to enhance poverty reduction more than other forms of economic growth with cross-country analyses concluding that the poverty reduction from growth in agriculture is on average 2 to 4 times greater than from equivalent growth in other sectors largely the result of a greater level of poor labour participation in this growth compared to other sectors²⁹. Achieving food security by continuing to invest in agriculture sector's customary focus on productivity and yields rather than broadening agricultural interventions and investments to improve nutrition outcomes of populations in low and middle income countries will not promote food and nutrition security.

Accelerating food and nutrition security has to occur through a combination of direct nutritional interventions and indirect nutrition sensitive interventions. Nutrition-sensitive programmes will impact on the underlying determinants of poor nutrition by closer interaction with complementary sectors such as health, education and social protection as well as on water and sanitation. They are often implemented at a large scale and thus can be effective at reaching large vulnerable populations³⁰. Nutrition-sensitive programmes can also be leveraged to serve as delivery platforms for nutrition-specific interventions by increasing their effectiveness, coverage and scale and thus help accelerate progress towards improving the nutrition of the community. Nutrition-sensitive programmes are also important since their likely impact is via changes in food and non-food prices, the consequent increase in household incomes and through women's empowerment.

Agriculture can be leveraged to be nutrition sensitive and thus promote food and nutrition security. Since agriculture is the primary source of livelihoods in much of Asia's population, agriculture has the potential to be a strong driver of nutritional improvement. Agriculture can sustainably contribute to improving dietary diversity and nutrition outcomes by agricultural extension services that offer communities information and improved inputs such as seed and cultivars for better crop diversity and biodiversity; integrated agro-forestry systems that reduce deforestation and promote harvesting of nutrient-rich forest products; aquaculture and small livestock ventures that include indigenous as well as farmed species; education for greater nutrition awareness and social marketing

strategies that strengthen local food systems and promote cultivation and consumption of local micronutrient rich foods; cultivation of biofortified crops and livestock selectively to enhance nutritional quality, and reduction of post-harvest losses. Post farm gate food preservation, storage, preparation and processing and marketing with adequate attention to food safety can promote food and nutrition security. Further, by value addition and marketing locally processed foods can also contribute to increasing household incomes.

Several research and development programmes in the Asian region are active in promoting better nutritional outcomes by nutrition-specific and nutrition-sensitive interventions. Supported by the Department for International Development (DFID), i.e. UK AID, MSSRF a renowned institution in Chennai, India set up by M. S. Swaminathan with his World Food Prize over 25 years ago, is leading a research consortium Leveraging Agriculture for Nutrition in South Asia (LANSA) in this very topic. LANSA is a six-year multi-institutional research programme consortium in South Asia focusing on India, Pakistan, Bangladesh and Afghanistan, with international partners from the UK and USA. The core question that the LANSA programme attempts to address is: 'How can South Asian agriculture and related food policies and interventions be designed and implemented to increase their impacts on nutrition, especially the nutritional status of children and adolescent girls?' Research under LANSA is structured under three research pillars which will map fundamental, underlying and immediate determinants of nutrition, and address several key questions in this area³¹.

Farming systems for nutrition and the role of family farming

Improvements in agricultural production alone will not be able to address the problem of malnutrition and provide for food and nutrition security without interventions to improve education, health, sanitation and ensure appropriate care and feeding practices in the community. Innovative strategies that integrate agriculture and nutrition are essential and such nutrition-sensitive agricultural interventions can focus on how agricultural interventions in the field can be designed to improve nutritional outcomes whilst promoting livelihood security. To achieve this objective, Swaminathan and colleagues designed the Farming System for Nutrition (FSN) model³². The FSN model envisages developing and demonstrating a sustainable framework of farming to improve nutritional outcomes that can be used for up scaling and wider national adoption in India and the rest of South Asia. Hitherto, agricultural intervention and farming systems research in India has been largely focused on enhancing production, productivity and profitability of crop and animal

resources without much emphasis on better nutritional outcomes. The FSN model has been conceptualized to develop location-specific inclusive models to address the nutritional needs of farm and non-farm families based on their resource endowments and surrounding environment and the broad objective is to demonstrate the feasibility of nutrition-sensitive agriculture. The main components of the model are: (i) to survey to identify the major nutritional problems; (ii) to design suitable agricultural interventions to address the problems; (iii) to include specific nutritional criteria in the design; (iv) to improve small farm productivity and profitability; (v) to undertake nutrition awareness programmes and (vi) to introduce monitoring systems for assessing impact on nutritional outcomes³².

The FSN approach formulated by Swaminathan will specifically target the problem of malnutrition by (to use his own words), ‘the introduction of agricultural remedies to the nutritional maladies prevailing in an area through mainstreaming nutritional criteria in the selection of the components of a farming system involving crops, farm animals and wherever feasible, fish’³³. This approach calls for the integration of interventions in non-farm factors like hygiene and sanitation to improve nutrition and focus on differential human nutritional needs across gender and age groups through the life-cycle. The FSN intervention in India under the LANSA research consortium programme led by MSSRF will provide information on whether it is possible to tailor agricultural support to resolve defined nutritional problems in rural communities being now tested for feasibility in two different agro-ecological zones in Koraput district in Odisha and in Wardha district in Maharashtra.

The United Nations declared the year 2014 as the International Year of Family Farming (IYFF) to recognize the importance of family farming in reducing poverty and improving global food security. Family farming involves about 500 million families consisting of over two billion people. Swaminathan has said that the IYFF offers an opportunity for achieving a shift from food security to food and nutrition security. He states: ‘family farming tends to be based on crop, livestock, fish, agro-forestry, and mixed farming systems’³⁴. Therefore, they can be easily made nutrition and environment sensitive. Family farming is characterized by diversified crops and hence can be harnessed to support nutrition-sensitive agriculture. The steps needed to achieve such a change include survey and identification of the major nutritional problems prevailing in an area. Appropriate changes in crops to address the deficiencies can then be made on family farms.’ He clearly envisages family farming in offering ‘an effective and economic solution to help meet the challenge of making sure that each person has access not just to calories but to nutritious food’ and for family farms to have an important role in implementing the FSN model on a larger scale nationally.

The Secretary General of the United Nations announced at the Rio + 20 Conference the *Challenge of Zero Hunger* to eradicate hunger within our lifetime. Swaminathan in a recent editorial in *Science* stated categorically, ‘Without mainstreaming nutritional criteria in large-scale agricultural cropping and farming systems, the prospect for meeting the UN’s Zero Hunger Challenge by 2025 will be dim’. In this influential editorial he not only highlights the importance of achieving nutrition security and promoting nutrition-sensitive agriculture but also emphasizes the crucial role of ‘family farming’ as not only the key for achieving a hunger-free planet, but also for attaining sustainable food systems³⁵.

Epilogue

In the minds of several generations of scientists in the areas of agriculture and nutrition and among academics working in the developmental arena, Swaminathan will be considered among the legends and as one of the most influential scientists globally. This is attributable to the enviable role he has played in the agricultural destiny of India and its remarkable journey to food sufficiency. However, what is less known and so elegantly described by Kesavan and Iyer³⁶ is the less well-known fact that his record as an Indian scientist of distinction alone would have accorded him a cult status. By crossing the difficult line from science to practice – by the promoting science and technology-based applications for food and nutrition security – he has truly achieved a remarkable triumph which will endure in the hearts of the citizens of his country and especially among its farmers.

As the architect of the green revolution to address the primary objective of achieving adequacy in availability of food, Swaminathan recognized that the green revolution would only provide a short term solution and that agriculture needed to be transformed into an eco-friendly, resource-poor small and marginal farmer-friendly, sustainable agriculture to ‘achieve productivity in perpetuity without accompanying ecological and social harm’ – a concept he termed as the ‘Evergreen Revolution’³⁷. In a similar vein, Swaminathan in his address to the 14th World Congress of the International Union of Food Science and Technology (IUFOST) in Shanghai, China enlarged the vision of nutrition security to ‘achieving sustainable nutrition security for all and forever’²². The ‘Evergreen Revolution’ was thus intricately intertwined to ‘nutrition security for all and forever’, thus ensuring food and nutrition security for all. We owe Swaminathan a debt of gratitude forever.

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