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Food security, sustainability and agricultural innovation

Abstract

Currently, more than enough food is produced to feed the world's population of 7 billion inhabitants. However, latest FAO figures indicate that 842 million people were undernourished in 2011-13. Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. There are four dimensions of food security: the availability of food; access to food; utilization of food and food system stability. Looking to the future, there are also major challenges ahead from the rapidly changing socio-economic environment (increasing world population and urbanization, and dietary changes), climate change and erosion of natural resources. The projected food demand in 2050 will increase by 60 percent. The sustainable increase of productivity, based on the adoption of technological and organizational innovation in agriculture, is therefore key to achieving food security. Increasing productivity can improve food security in two ways. First, providing an opportunity for farmers to increase their incomes and to improve their livelihoods. Second, increased productivity can also lead to reduced food prices, benefiting many poor people in both urban and rural areas as poor households typically spend a large proportion of their income on food. Increased productivity should be achieved while simultaneously conserving the natural resource base upon which future productivity increases depend. In this way, the farmer's income growth can be combined with a truly sustainable resource use.

Keywords: *Food security, agricultural innovation.*

For FAO, food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 1996; Schmidhuber and Tubiello, 2007). There are four dimensions of food security: the availability of food; access to food; utilization of food and food system stability. For food security objectives to be realized, all four dimensions must be fulfilled simultaneously.

The first dimension covers the availability of good quality and nutritious food from local, regional and international sources. It therefore includes issues of food production and processing; trade imports and exports; availability of food stocks and food aid.

The second dimension involves physical and economic access to food for an active, healthy life. This includes marketing and transport infrastructure, food distribution systems and markets; purchasing power or having the money to buy the right food; and social protection programmes to ensure access to nutritious food. If food is available but people do not have the money to access it, they are food insecure.

The third dimension is related to the safe and healthy utilization of food. This includes good health status, since healthy individuals can make proper use of food; having nutritious food choices for all age groups; food safety and quality; and access to clean water and sanitation.

The fourth dimension covers the fact that to be food secure, a population, household or individual should have access to adequate food at all times and should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (FAO, 2006). This dimension is increasingly important with the economic crises and climate change related challenges facing the world, especially in developing countries.

The other side of the coin is food insecurity, 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. This may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, inadequate use of food at the household level or more of these factors together.

Thanks to technological and managerial innovation, world agriculture is currently able to produce sufficient food to feed the global human population, which is estimated to have surpassed the threshold of 7 billion people worldwide (UN Population Division, 2011). However, latest FAO figures indicate that a total of 842 million peo-

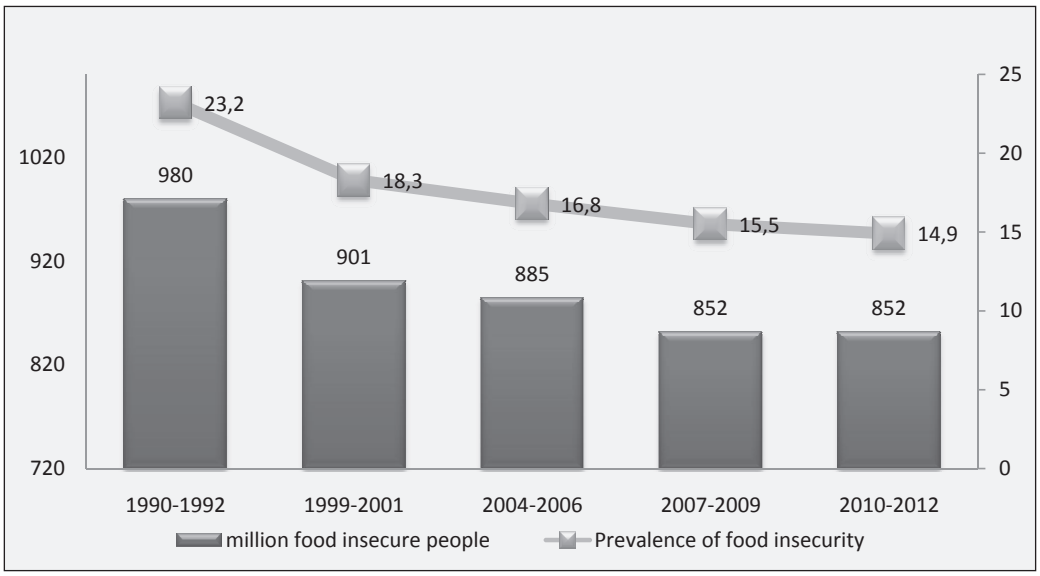

Fig. 1. Food insecurity in developing countries (*Source*: FAO, IFAD and WFP).

ple in 2011-13, or around one in eight people in the world, were estimated to be suffering from chronic hunger, regularly not getting enough food to conduct an active life (FAO, IFAD and WFP, 2013). The vast majority of undernourished people (about 98 percent, or one in six people) live in developing countries, where, in spite of recent progress, one in six people are still undernourished (Fig. 1). The region with the highest number of undernourished people is Asia and the Pacific, where 62 percent of the world's hungry live. The region with the highest proportion of undernourished people is sub-Saharan Africa, where the hunger prevalence reaches 30 percent.

Looking to the future, there are, in addition, some major challenges ahead that can drastically worsen this already unacceptable situation. The first is the rapidly changing socio-economic environment. The world's population is projected to increase to more than 9 billion people by the year 2050 (Fig. 2). Nearly all of this increase will occur in developing countries (UN Population Division,

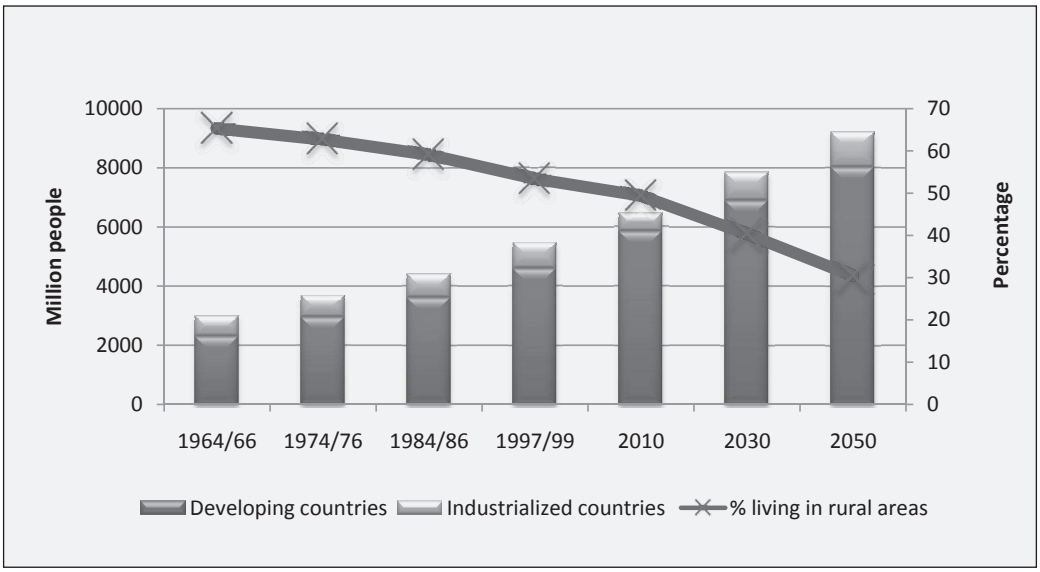

Fig. 2. World population and distribution (*Source*: UN Population Division).

2009). In addition, the ongoing migration from rural to urban areas is expected to continue, so that by 2050 about 70 percent of the world's population will be urban (compared to 50 percent today). Incomes in developing countries are also expected to rise in the future, resulting in dietary changes where the proportion of grains and other staple crops in diets will decline, while the proportion of vegetables, fruits, edible oil, meat, dairy and fish will increase. With this larger, more urban and, on average, richer population, it is estimated that the global demand for food in 2050 may be 60 percent higher than today (FAO, 2009). The second major challenge is the increasingly constrained natural resource base for agriculture: land, soil fertility, water, biodiversity, all resources upon which agricultural production depends, are often degraded and/or eroded by overexploitation or misuse. For example, 33 percent of soils are highly or moderately degraded, with the consequent loss of fertility. In addition, the agricultural natural resource base, including land and water, suffers from the increasing competition from other sectors (industrial use, civil utilization, etc.). For instance, the cultivated land area dropped from 0.45 ha per capita in 1961 to 0.22 ha per capita in 2009, a decrease of 51 percent.

The third major challenge is climate change, which affects the frequency of extreme weather events, alters agricultural growing patterns, as well as the distribution patterns of pests, weeds and diseases that threaten crops and livestock. The overall impacts of climate change on agriculture and food security are expected to be increasingly negative, especially in areas already vulnerable to climate-related disasters and food insecurity.

The needed increase in food production for the future may come only partially from further expansion of the agricultural frontier, because available land is becoming scarce in many areas of the world. The expansion of cultivated land would nevertheless happen at the expense of natural stands with the related detrimental effects on the environment. The majority of food production growth should therefore come from increased yields per unit of land.

The sustainable increase of productivity is therefore key to achieving and ensuring food security. Increasing productivity can improve food security in two ways. First, the increasing demand for agricultural products in low – and middle – income countries provides an opportunity for family farmers to increase their incomes and to improve their livelihoods. Second, increased productivity can improve food availability and so lead to reduced food prices, benefiting many poor people in both urban and rural areas, as poor households typically spend a large proportion of their income on food.

Increased productivity should be achieved while simultaneously conserving the natural resource base upon which future productivity increases depend. In this way, the farmer's income growth, and the related reduction of poverty, can be combined with a sustainable resource use.

Sustainable productivity increase can be largely met by bridging the agricultural productivity gaps across countries and between farmers within countries, and should therefore be based on the adoption of sustainable technological and organizational innovation. Extension services play an essential role in closing these gaps and ensuring that farmers have access to the benefits of research. When not in place, investing in functional demand-driven pluralistic, decentralized, participatory extension systems is essential.

Agricultural research plays a major role in generating appropriate technologies, adapted to the local needs of family farmers, helping them to sustainably improve their production and livelihoods. Agricultural innovation enables farmers to adapt rapidly when challenges occur and to respond readily when new opportunities arise.

There is substantial evidence and general consensus that investments in agricultural research and innovation have significant impacts on both agricultural growth and poverty reduction (Mogues *et al.*, 2012) and are key to promoting transition towards sustainable agriculture production systems. Nevertheless, agricultural esearch investments in most developing countries are still very low (Beintema *et al.*, 2012), and substantially below the recommended level of 1 percent of the agricultural GDP (ECOSOC, 2004). The Official Development Assistance (ODA) does not contribute to a change: investments committed to national agricultural research systems are only a minimal share of the ODA committed to the agricultural sector (2.2 percent in 2011) (Source: ADAM database). It is therefore necessary to substantially increase international and national investments in public agricultural research.

Family farms face numerous barriers which prevent them from adopting more sustainable and efficient practices that combine productivity increases with the preservation of natural resources. These barriers include restricted access to markets, insecure property rights and limited access to inputs, finance, and appropriate technologies.

In addition, improved practices often have high start-up costs and a long pay-off period. Lack of information and skills are one of the biggest hurdles for smallholder farmers, constraining adoption of technologies and reducing their efficiency if eventually adopted.

Effective and well-coordinated institutions could help overcome many of these barriers. Unfortunately, three regional needs assessment studies conducted by the Tropical Agriculture Platform (TAP) initiative highlighted that agricultural innovation systems in most developing countries are inadequate (TAP, 2013). Their components (research, extension, education, farmers' organizations, private sector) are under-resourced and range from weak to very weak from an institutional and organizational point of view. In addition, the functional linkages between the components are often missing or poor.

There is a clear need to establish effective agricultural innovation systems that focus on adaptive, results-oriented research and incorporate real accountability to farmers as clients, and direct involvement of public, private and civil actors, with innovation institutions working together towards clear development outcomes.

Current capacity development interventions undertaken by multilateral and bilateral development agencies are abundant in number but most of them are of limited size and duration, not well aligned with national needs, focused on individual capacity development, not coordinated with each other, and therefore not very effective, as reported in the above-mentioned studies (TAP, 2013). A well-coordinated and substantially resourced international initiative of capacity development of agricultural innovation systems in developing countries is therefore crucial and urgent.

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