

## Overview

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**M**ost people would say agriculture is about growing food; they are right. Agricultural performance, after all, is measured in terms of production—for example, yield or grain production. The purpose of agriculture, however, does not stop there. At a deeper level, the purpose of agriculture is not just to grow crops and livestock for food and raw materials, but to grow healthy, well-nourished people. One of farmers' most important tasks is to produce food of sufficient quantity (that is, enough calories) and quality (with the vitamins and minerals needed by the human body) to feed all of the planet's people sustainably so they can lead healthy, productive lives. This is effectively one of the goals of agriculture, although it is rarely made explicit.

Could agriculture do more to meet this goal? Recently the international development community has turned its attention to the potential for the agriculture, nutrition, and health sectors to work together to enhance human well-being. In some ways, of course, agriculture, health, and nutrition are already deeply entwined. Agricultural production is an important means for most people to get the food and essential nutrients they need. And in many poor countries, where agriculture is highly labor intensive, productive agriculture requires the labor of healthy, well-nourished people. Yet, in other ways agriculture, health, and nutrition are quite separate: professionals in these three fields usually work in isolation from one another, with their efforts sometimes dovetailing in mutually beneficial ways and sometimes working at cross-purposes.

In an ideal world, consumers would be fully aware of the merits of nutritious foods, and producers, processors, and marketers, in turn, would know how to produce, process, and market these high-quality, nutrient-rich foods. Market forces would provide the incentives, through product prices, to all involved in producing or consuming nutrient-rich foods. Unfortunately, our world is less than ideal, and market prices do not provide an adequate incentive for producing nutritious food. And, even if prices did reflect the nutritional value of food, they could put nutritious foods out of reach of poor people. This means public interventions are needed to correct market failures (when prices do not reflect the nutritional value of foods) or to improve affordability (for poor people).

How much more could agriculture do to improve human well-being if it included specific actions and interventions to achieve health and nutrition goals? What kinds of changes would maximize agriculture's contribution to human health and nutrition, and how could human health and nutrition contribute to a productive and sustainable agricultural system?

### **Room for Improvement**

Over the past century or so, agricultural development has been based on a paradigm of increasing productivity and maximizing the production of cereals. This paradigm has produced an agricultural system that is the world's primary source of calories and employs 60–80 percent of people in low-income countries (IFC 2009). The ramping up of cereal production in the Green Revolution, for example, saved countless lives in Asia (Hazell 2009), and agricultural growth there has served as a springboard for a blistering pace of economic growth, improving the lives of millions. At the same time, agricultural intensification has led to a concentration on grain production; crowded out nutrient-dense crops like pulses, fruits, and vegetables; increased the risk of agriculture-associated diseases; led to the development of new diseases (such as the evolving forms of influenza); and exacerbated environmental degradation that can have negative consequences for human health. Moreover, millions of smallholders who produce food still suffer from poverty and hunger, and recent food price hikes have made those who are net buyers of food even more vulnerable.

A look at the current global health and nutrition situation suggests agriculture can make an even greater contribution to health and nutrition. Indeed, leveraging agriculture for health and nutrition has the potential to speed progress toward meeting all eight of the Millennium Development Goals. The world's farmers already provide billions of people with diverse, healthy diets—yet more needs to be done. About one-seventh of the world's population is going hungry (FAO and WFP 2010). In developing countries, one out of four children—about 146 million in all—is underweight (UNICEF 2006). Millions of people suffer from serious vitamin and mineral deficiencies. For example, vitamin A deficiency compromises the immune systems of about 40 percent of children younger than age five in developing countries and results in the early deaths of about 1 million young children each year. Iron deficiency impairs the mental development of 40–60 percent of the developing world's children aged 6 to 24 months and leads to the deaths of about 50,000 women a year during pregnancy and childbirth (Micronutrient Initiative and UNICEF 2004). The economic cost of micronutrient deficiencies is estimated to be 2.4–10.0 percent of gross domestic product (GDP) in many developing countries (Stein and Qaim 2007). Thus the Copenhagen Consensus has ranked vitamin

A and zinc supplements for children and iron and iodine fortification of food as numbers one and three, respectively, in its solutions to the most important human challenges (Copenhagen Consensus Center 2008). Hunger and malnutrition have effects that last throughout the life cycle, with poorly nourished children growing up to be less healthy and productive than they could be. Girls who do not get the nutrition they need are at great risk of becoming undernourished women who, in turn, are at increased risk of giving birth to the next generation of undernourished children (ACC/SCN 2000).

While some people are getting too little food, others are getting too much of the wrong food. Diets centered on cheap, calorie-dense, nutrient-poor foods (including both “fast foods” and nutrient-poor staples) are deepening the emerging epidemic of obesity and chronic diseases in countries undergoing economic and nutrition transitions. Overweight affects more than 1 billion people globally, and obesity affects at least 300 million. Since 1980, obesity rates have risen threefold or more in some areas of North America, the United Kingdom, Eastern Europe, the Middle East, the Pacific Islands, Australasia, and China (WHO 2010; Nugent 2011).

The chapters in this volume look at the links among agriculture, nutrition, and health and their potential to convey more benefits to poor and hungry people. The authors come at the issues from many perspectives, examining not only the overall links among the three sectors, but also the specific roles played by economic and agricultural growth, innovations in crop science and food supply chains, the health of agricultural laborers, agriculture-associated diseases, women’s place at the intersection of the three sectors, and the challenges of advocacy and policymaking.

### **Conceptualizing the Links**

In Chapter 2 of this volume, John Hoddinott describes a conceptual framework that clarifies the links among agriculture, nutrition, and health. This framework includes the physical, social, legal, governance, and economic settings in which people live and work; the resources—time and capital—at their disposal; and the processes associated with agricultural production and determinants of health and nutritional status. These elements of the framework suggest pathways through which agricultural production and markets can affect health and nutrition, including changes in incomes, crop varieties, production methods, and allocation of resources within households. A clear framework that shows the relationships among agriculture, nutrition, and health can help decisionmakers exploit the links in policies and programs.

It is also possible to look beyond agriculture to the whole food system and its interaction with nutrition and health (see Chapter 3 by Per Pinstrup-Andersen). The food system includes not only agriculture but also natural resources and inputs;

transport, storage, and exchange; secondary production; and consumption. Each of these food system activities can interact with health and nutrition, in both obvious and less obvious ways. Integrated actions related to, for example, zoonotic diseases, HIV/AIDS, crop protection, sustainable management of natural resources, and food safety can not only promote agricultural productivity, but also improve nutrition and health and help overcome poverty traps.

### **The Role of Growth in Improving Nutrition**

It is natural to assume that economic growth has a positive impact on people's nutritional status through increased incomes and food expenditures, but the limited evidence available shows that, in a number of developing countries, economic growth has failed to result in better nutrition.

Various studies show that in many agrarian countries agricultural growth is more effective than growth in other sectors in reducing undernutrition (see Chapter 4 by Shenggen Fan and Joanna Brzeska and Chapter 5 by Derek Headey). The composition of growth, the distribution of growth, and the conditions under which growth takes place all matter. Growth in agricultural subsectors where poor people are engaged, such as staple crops, contributes more to reducing poverty and increasing calorie intake than growth in, for instance, export crops. Later in the development process, growth in other sectors besides agriculture becomes more important in improving food and nutrition security. Neither agricultural nor nonagricultural growth alone, however, is sufficient to reduce child undernutrition or micronutrient malnutrition (see Chapter 6 by Olivier Ecker, Clemens Breisinger, and Karl Pauw and Chapter 7 by Karl Pauw and James Thurlow). Complementary programs in nutrition, health, water and sanitation, and behavior change communication also need to be implemented and targeted to vulnerable populations, especially women and young children. More broadly, improvements in healthcare access and female education and reductions in fertility rates and poverty will help make nutrition more responsive to growth.

Despite great strides in food production, agricultural growth has not had its expected benefits for nutrition in India, which is home to one-third of the world's undernourished children (see Chapter 20 by Stuart Gillespie and Suneetha Kadiyala). One part of the solution to this "Indian enigma" likely involves focusing on crops and livestock that have large nutritional impacts on both farmers and consumers. Another part may involve addressing socioeconomic factors that affect the link between agriculture and nutrition, including the distribution of assets, particularly land; the role and social status of women; rural infrastructure; and rural health and sanitation. Yet another part involves addressing other drivers of undernutrition by, for example, improving education and social welfare systems.

## **Opportunities to Meet the Challenge**

Although the agriculture, health, and nutrition sectors all seek to improve human well-being, agriculture has rarely been explicitly deployed in this way. However, opportunities exist all along the agricultural value chain to improve nutrition and reduce health risks. In Chapter 9, Corinna Hawkes and Marie T. Ruel examine how a value-chain approach to development can incorporate nutrition goals and thereby make nutritious foods more available and affordable for the poor. This approach starts by looking at every component of the food supply chain from the field to the table—including production, postharvest processing, marketing, and trade—and determining where value for nutrition can be integrated. Incentives are created in ways that do not interfere with the creation of economic value for supply-chain actors. New initiatives are emerging in several developing countries to explore the value-chain approach's potential to improve nutrition.

Another innovation for leveraging agriculture to improve nutrition is biofortification—the breeding of new varieties of food crops with improved nutritional content. When people in malnourished communities receive these varieties to grow and eat, biofortified crops can contribute to the overall reduction of micronutrient deficiencies in a population. Compared with other approaches to micronutrient malnutrition, such as supplementation and fortification, biofortification offers several advantages: it targets poor people and rural areas; it is cost-effective because after the initial investment in research, the crops are available year after year; and it is sustainable because it relies on staple crops that people are already accustomed to eating. A pilot program in Mozambique and Uganda that has disseminated varieties of orange sweet potato with high levels of vitamin A has already shown increased vitamin A intakes in vulnerable groups (see Chapter 10 by Howarth Bouis and Yassir Islam). Successful results depend on high levels of bioavailability or bioconversion of the nutrients and high rates of farmer and consumer adoption.

Part of the pressure on the global food system in recent years has come from rising incomes and rapid urbanization in developing countries, which have increased global food demand. IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) shows that rich countries' dietary shift toward healthier and less-meat-intensive diets could increase calorie availability and reduce child malnutrition in poor countries. This finding suggests governments in rich countries should consider encouraging consumers to move away from meat-intensive diets through, for example, nutrition education and government-sponsored feeding programs (see Chapter 8 by Siwa Msangi and Mark W. Rosegrant).

While agriculture can improve health through improved incomes or improved nutrition, it may also increase risks for certain diseases. Additionally, the food value chain involves many hazards: microbiological hazards, such as food-borne

pathogens; physical and chemical hazards, such as plant toxins and pesticides; and occupational hazards, such as accidents. Poor people face challenges in producing and consuming safe food. Policymakers are increasingly using risk analysis to help them decide on regulatory and other actions to reduce health risks along the food value chain (see Chapter 11 by Pippa Chenevix Trench, Clare Narrod, Devesh Roy, and Marites Tiongco).

Another way of classifying agriculture-associated diseases is based on transmission pathways; high-burden categories include zoonoses, food-associated diseases, water-associated diseases, and occupational diseases. Such diseases sicken and kill billions of people a year and impose enormous economic costs, especially on poor countries. It is important to assess the full costs of these diseases, not only to human health but also to agricultural productivity, the food economy, and the ecosystem. Because the causes and effects of these diseases are complex, they call for interventions that integrate several sectors, including agriculture and livestock production, human medicine, veterinary medicine, and environmental science (see Chapter 12 by John McDermott and Delia Grace). Malaria, for example, is often linked to irrigation development and changes in land use associated with agriculture. It imposes heavy healthcare costs on small-farm households and impedes agricultural development by leading to declines in labor. The problem of malaria makes a clear case for coordination of health and agricultural policies (see Chapter 15 by Kwadwo Asenso-Okyere, Felix A. Asante, Jifar Tarekegn, and Kwaw S. Andam).

It is clear that disease cuts the productivity of farm labor in both the short and long terms and that farm labor itself can harm people's health and nutrition status. This means that health and agriculture interventions should be designed with these two-way linkages in mind. But does it follow that health investments necessarily improve agricultural productivity? Research on this question is sparse. The available evidence suggests that some inexpensive health interventions (such as micronutrient supplements) can have large effects, that health interventions are most effective when combined with education and infrastructure investments, and that improving children's health can lead to increased adult productivity in the long term (see Chapter 13 by Paul E. McNamara, John M. Ulimwengu, and Kenneth L. Leonard and Chapter 14 by Kwadwo Asenso-Okyere, Catherine Chiang, Paul Thangata, and Kwaw S. Andam).

Women are an important group linking agricultural development and human health and nutrition. They are not only responsible for food preparation and caring for young children and ill household members, but in many countries women are also the main agricultural producers. Strengthening women's position both within the agricultural sector and within the household can significantly improve households' nutrition and health. Experiences from several agricultural development strategies show much scope exists for increasing women's access to and control

over resources, such as household income (see Chapter 16 by Ruth Meinzen-Dick, Julia Behrman, Purnima Menon, and Agnes Quisumbing).

### **Policymaking across Sectors**

Making policies that leverage agriculture for nutrition and health poses particular challenges. Malnutrition and poor health are the result of many factors and require action in a whole range of sectors. Although the health and agriculture sectors have well-established institutions within government, they are not organized in ways that readily allow for cross-sectoral action. And the nutrition sector often lacks a high-profile place in government. It suffers from a lack of awareness about the consequences of and solutions to malnutrition, weak commitment from political leaders, and limited resources for public investment. Nonetheless, there are ways to promote action on nutrition and across sectors, including advocacy by civil society and community groups and the cultivation of policy champions (well-connected and well-informed people with access to the policy process). Agriculture-associated health problems require joint agriculture and health solutions. Achieving these joint solutions may involve creating incentives for intersectoral collaboration, implementing multisectoral policy reviews, carrying out health-impact studies of agricultural development projects, and promoting joint agriculture, nutrition, and health policy formulation and planning (see Chapter 17 by Todd Benson, Chapter 18 by Robert Mwadime, Chapter 19 by Brenda Shenute Namugumya, and Chapter 21 by Joachim von Braun, Marie T. Ruel, and Stuart Gillespie).

The best approach to finding positive synergies among agriculture, nutrition, and health may depend on a country's position in the dietary transition, where stage one is a diet low in calories and micronutrients, stage two is a diet adequate in calories for most people but with inadequate micronutrients, and stage three is a diet that provides excessive calories, still with possible micronutrient deficiencies. In stage one countries, government's primary task is to provide public goods that contribute to improvements in agriculture, nutrition, and health, such as infrastructure, education, and health services. During stage two, the task is to deliver targeted agricultural, nutritional, and health services to people who do not experience the benefits of growth. At stage three, governments must regulate the growing private sector, including commercial farms, food manufacturers, retailers, and restaurants (see Chapter 22 by Robert Paarlberg).

Breaking down the siloes between the sectors will require a change in thinking. Education in all three sectors can do more to highlight the synergies among them and develop a shared body of knowledge that will follow students into their professional lives. Professionals in the three sectors should retain their deep expertise in their subject areas, while also gaining a greater familiarity with the other sectors'

main concerns and opportunities. By developing cross-disciplinary programs, educational institutions can produce graduates and professionals who—in their capacity as extension workers, healthcare providers, or nutrition counselors—can effectively translate the linkages among agriculture, health, and nutrition in the field for the benefit of all. In addition, evaluations of projects and programs in all three sectors should take the other sectors into account, to help implementers gain feedback and to create incentives for collaboration.

### **Regional Experiences**

The links between the three sectors—and consequently, potential solutions—will undoubtedly look different in different countries and regions, given the variations in agricultural systems and practices, food systems, and health and nutrition status. Initial efforts in some countries can point the way to potentially effective approaches and show what works and what does not. It is important to examine how successes can be adapted and scaled up in different regions because the lessons learned from experience to date will suggest areas for investment and policy change.

In Africa, poor nutrition and health remain persistent problems. Although a new focus on agriculture in the region presents an opportunity for countries to exploit the links among agriculture, nutrition, and health as they revise their agricultural policies and direct more funding to the sector, many policymakers at the national, district, and local levels still do not see nutrition as a development issue that should play a role in agricultural planning—despite the existence of several programs linking the sectors in that region. Raising nutrition's profile in African policymaking circles will thus require strong advocacy from civil society to senior policymakers.

In South Asia, malnutrition is disturbingly high. Important questions remain about why strong economic growth in the region, especially in India, has not done more to push down rates of malnutrition there. It is clear, however, that investments are needed to improve safety net systems and targeted nutrition programs; increase the production and consumption of nutritious foods; enhance gender equity; and strengthen agricultural technologies, rural infrastructure, information technology, and irrigation, water, sanitation, agricultural extension, and credit systems. In addition, programs often rely on nongovernmental organizations (NGOs) for funding and support; when NGO funding stops, so do the programs. Consequently, it is important to ensure program sustainability to improve people's nutrition and health.

Although East Asia does not suffer from as much undernutrition as some other regions, problems of malnutrition remain. For a number of countries in East Asia, agriculture means rice production. Impressive gains in the productivity of rice farmers in recent decades have helped raise incomes and reduce hunger.



Nonetheless, many farmers still have problems getting access to high-quality seeds, fertilizers, water, rural infrastructure, and machinery for processing. It is also important to promote more diverse diets and educate farmers in the region about the potential for growing more nutritious crops, such as fruits and vegetables. A holistic, community-based approach to linking agriculture, nutrition, and health has worked well in some countries, including Thailand. Experience there shows the importance of teaching people about nutrition at the community level, teaching agricultural skills, and making sure farmers have the land, credit, and postharvest technologies they need.

Walking the line between undernutrition and overnutrition has proven difficult in many parts of the world. In Latin America, hunger overlaps with overweight and obesity, sometimes even in the same family, so efforts are needed to deal with both undernutrition and health problems related to overnutrition. Argentina, for example, has recognized that overweight is concentrated among its poor citizens. Joint public and private action is needed to help reduce sugar, salt, and saturated fat in manufactured food products. Brazil has one of the world's largest school feeding programs, which brings together agriculture, nutrition, and health, but poverty- and hunger-related social programs have not yet reached all poor and marginalized groups, so more remains to be done.

Finally, in the high-income countries, overweight and obesity are reaching epidemic levels. In many of these countries, government policies are designed to maximize the export value of crops and enable low food prices at home, with deleterious effects on the health and nutrition of citizens. Unfortunately, evidence of cost-effective countrywide approaches to decreasing overweight and obesity is extremely scant. As with micronutrient interventions, overweight and obesity prevention will likely need a much more multisectoral approach. Educational programs on nutrition and health in schools and communities can build awareness, but they must also take into account the psychology of consumers and the difficulty of changing their behaviors.

## **Looking Ahead**

The world food system, where the agriculture, health, and nutrition sectors come together, faces serious challenges in the coming years. High and volatile food prices are likely to be a reality for the foreseeable future. They pose difficulties not only for food consumers, who often shift their diets to cheaper, less-nutritious foods, but also for food producers, who may reduce their investments in agriculture in the face of increased input prices and uncertain output prices. Rising populations and changing diets are putting pressure on farmers to produce more food with the same resources. And climate change creates risks for agriculture and health—and

by extension, nutrition—that are only beginning to be understood. This is the context in which decisionmakers at all levels and in many sectors will need to act (see Chapter 23 by Shenggen Fan, Rajul Pandya-Lorch, and Heidi Fritschel).

At the same time, attention to the agricultural sector is growing, along with an interest in leveraging agriculture for nutrition and health. Now is an ideal time to look for solutions that will not only help make the agricultural system highly productive and sustainable, but also maximize its contributions to human well-being.

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