

Part II: Transforming Sectoral Actions



CHAPTER 6

From the Ground Up

Cultivating Agriculture for Nutrition

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FEW SECTORS HAVE clearer links to nutrition than agriculture. Most simply, of course, agriculture is a source of food. Because many poor households around the world grow food that they both consume and sell for income, agricultural interventions can have a massive effect on the lives of people in developing countries. Through the decades, and most famously in Asia's Green Revolution, development projects have sought to boost agricultural production of staple foods as a way of improving people's nutrition.¹ Yet, while consuming a sufficient quantity of calories is important, especially among undernourished populations, quality matters too. Thus, the traditional focus on producing enough food to meet people's calorie needs has evolved into a deeper understanding that to improve nutrition, we also need people to consume balanced, high-quality, and diverse diets that contain enough essential nutrients to meet their daily requirements.

Beyond food production, agriculture is linked to nutrition in a host of other ways, both positive and negative. Agriculture employs the majority

of the world's rural poor people, who can use the income they earn to purchase more nutritious and diverse foods or to invest in education, health, or water and sanitation—all of which are crucial for improving nutrition. National and global agricultural policies also affect nutrition. Policies on subsidies, taxes, and trade determine the prices of food and nonfood crops, which in turn affect the income of net sellers and the purchasing power of poor consumers. Growth in agriculture as a sector has been projected to have benefits for nutrition: a simulation model suggests that an additional US\$8 billion invested annually in agriculture would, by the year 2050, reduce the number of hungry people in the world by 210 million and the number of underweight children by 10 million.² At the same time, agriculture can expose farming households to hazards that can harm people's nutrition, such as vector-borne diseases from irrigation or zoonotic diseases from animal husbandry.³

Gender roles also link agriculture and nutrition. Women play a pivotal role in agricultural livelihoods and in most regions of the world make up the

majority of agricultural laborers—up to 80 percent in Africa, for example.⁴ Agricultural investments, when implemented in a gender-sensitive way, can improve female farmers' control over resources and assets and increase their power to make decisions about household investments in food, health, and education. Research has shown that women's control of resources is linked to a larger share of the household budget allocated to food as well as greater height-for-age Z-scores (reduced stunting). It has also found that greater female empowerment in agriculture (defined as having decision-making power over agricultural production and productive resources, control over use of income, leadership in the community, and time for work and leisure) is linked to higher per capita calorie availability and household dietary diversity and overall better maternal nutrition.⁵ On the flip side, however, the

time women spend on agriculture is also time they cannot spend feeding and caring for their children and themselves.

These many links between agriculture and nutrition are complex, and research is currently under way to build up and improve the evidence base so that we can gain a better understanding of them, especially in developing countries. Even so, a number of experiences offer lessons that can already be gleaned. This chapter focuses on two promising stories in the world of agriculture and nutrition. The first is homestead food production—an approach that combines home gardens and animal husbandry with information to help people adopt better agriculture, health, nutrition, and hygiene practices, as well as with actions that give women more control over resources and decision-making authority in their households. This case



HarvestPlus

Children in Mozambique enjoy beta-carotene-rich orange sweet potatoes that can improve their vitamin A status.

study was first highlighted in the book *Millions Fed: Proven Successes in Agricultural Development* and is updated here with emphasis on its potential when implemented alongside interventions that emphasize behavior change communication and gender. The second is biofortification, in which plant scientists breed micronutrients into the staple crops that poor people commonly eat. The chapter also touches on the potential of another new way of thinking about agriculture and nutrition: the value-chain approach, which involves finding ways to maintain or boost the nutritional value of foods as they move along the different stages of the value chain from farmers' fields to consumers' tables. While these stories focus on big, scaled-up initiatives, they also illustrate the potential of agricultural interventions, both small and large, to address malnutrition in all its forms.

Roots at Home: Enhanced Homestead Food Production

In the early 1980s, two national nutrition surveys in Bangladesh revealed a worrying trend: 3.6 percent of preschool-age children, or 1 million children, suffered from night blindness.⁶ Caused by severe vitamin A deficiency, the night blindness was higher in households without home gardens. In response, Helen Keller International (HKI), an international nonprofit organization, decided to test a new concept: homestead food production (HFP). The HFP model encouraged women to grow gardens of vitamin A-rich fruits and green leafy vegetables for their households, building on existing local practices and using local varieties. The focus on women was not a coincidence: rural Bangladeshi women have historically been responsible for homestead food production and distribution in households.⁷

In 1990 HKI launched two small pilots covering 1,000 households.⁸ The pilots aimed to increase

households' consumption of home-grown vegetables and fruits rich in vitamin A, provide nutrition education, and improve the health and nutritional status of women and children. As the project expanded over time to address deficiencies of multiple micronutrients, including iron and zinc, it integrated animal husbandry into the model, since the iron and zinc in animal-source foods are more bioavailable, or easily absorbed by the human body. By 2003, the project was reaching more than 870,000 households, or half of the country's subdistricts, and partnering with more than 70 local non-governmental organizations and the government of Bangladesh.⁹

In the late 1990s and early 2000s, researchers began documenting the impact of home gardens and homestead food production, which had now expanded to other countries.¹⁰ Research suggested that these programs were generally successful in increasing households' production of beneficial foods, such as vegetables, eggs, lentils, and animal products. Poorly designed evaluations, however, meant that it was impossible to determine whether HFP improved the participants' consumption of nutritious foods and micronutrients and contributed to dietary diversity.¹¹ Additionally, no one studied the cost-effectiveness of the approach compared with other interventions.¹² Just as important, there was little evidence that these programs affected mothers' or children's nutrition status (anthropometry or micronutrient status).¹³ Vitamin A intake and status was a possible exception, with a review showing a serum retinol (the predominant form of vitamin A in the blood) improvement of 2.42 micrograms per decaliter ($\mu\text{g}/\text{dl}$) in young children (a serum retinol level of less than 20 [$\mu\text{g}/\text{dl}$] is usually used to determine vitamin A deficiency among preschool-aged children).¹⁴

HKI responded to these findings by collaborating with researchers to improve the intervention model. It combined the gardening and animal

husbandry intervention with better communication about optimal agriculture, health, nutrition, and hygiene practices as well as a stronger emphasis on the role of women, by providing them with training on best HFP practices, and enlisting other women to impart knowledge on health and nutrition.¹⁵ A 2012 evaluation of this Enhanced HFP (E-HFP) model in nearly 30 villages in Burkina Faso suggested that the combined model was more promising, leading to reported increases in vegetable production and intake among participants. Results also suggested improvements in women's status: women gained control over the gardens and profits from surplus sales. More work was needed to address looming challenges, such as scarce water for gardening, lack of home visits for beneficiaries, sparse knowledge in some areas of nutrition, and limited adoption of nutrition-related practices.¹⁶

Another recent evaluation of a variation of the model in Burkina Faso showed a wide array of results. This E-HFP model was targeted solely to women and children in the first 1,000 days of life, and it integrated strong health behavior change communication and women's empowerment activities, such as building up assets and knowledge of optimal agriculture, health, nutrition, and hygiene practices. Among children, researchers found a marginally statistically significant 0.5–0.7 g/dL increase in mean hemoglobin levels (levels less than 11 g/dL in children aged 6 months to 6 years indicate anemia) and an 8.8 percentage-point reduction in wasting (low weight-for-height), as well as a statistically significant 15.9 percentage-point decrease in diarrhea and a 14.6 percentage-point decrease in anemia.¹⁷ New findings also suggest that the program decreased the prevalence of underweight among mothers by 8.6 percentage points and increased their intake of fruits, as well as raising their meat intake and dietary diversity by marginally statistically significant amounts.¹⁸ Results suggest that beneficiary mothers gained

control over their produce, agricultural assets, small animals, and profits from surplus sales and expanded their power in healthcare and purchasing decisions. There were also potentially positive spillover effects on indicators for other members of the household two years after the end of the program, including children's weight-for-height Z-scores and prevalence of wasting and mothers' body mass index and prevalence of underweight.¹⁹ There were no significant impacts on the prevalence of stunting or underweight among children.²⁰ This evaluation represents one of the first studies to provide rigorous evidence that agriculture, coupled with behavior change communications and women's empowerment activities, can improve maternal and child nutrition during the first 1,000 days. Given the importance of this 1,000-day window for lifelong health,²¹ this model of HFP shows potential.

Around the world, the HKI model has inspired countless interventions based on home gardening, either used alone or combined with education or behavior change communication initiatives around the world. The Sustainable Cocoa Production Program in Indonesia, for example, has provided 21,000 cocoa farmers, 80 percent of whom are women, with nutrition education and gardening skills, setting up more than 1,000 vegetable demonstration plots.²² The project has self-reported modest increases in dietary diversity. More research is needed to document nutritional impacts from these and other similar initiatives, to generate more lessons, and to help improve the design of future enhanced homestead food production models. Furthermore, ultimate judgment on the viability of the home garden model of intervention will depend on proving the cost-effectiveness of this approach relative to other kinds of nutrition interventions and on documenting sustainability over time. These aspects have not been extensively studied so far.

Breeding for Nutrition: Biofortification

What if an extra boost of much-needed minerals and vitamins could be bred into widely consumed food crops, without negatively affecting their appearance, taste, or smell? What if, for example, rice and wheat seeds could be bred to contain extra iron and zinc that were undetectable to farmers or consumers but able to improve public health in a big way?

In 1993, this idea was posed by a group of scientists from CGIAR (then the Consultative Group on International Agricultural Research). At the time, many economists held firmly to the idea that global malnutrition could best be addressed by ensuring that people consume adequate calories. But burgeoning research showed otherwise—it suggested that good nutrition, as reflected by greater height and less illness, requires not only energy, but also vitamins and minerals. These extra vitamins and minerals could come from a diverse diet, rich in more nutritious staple and nonstaple foods and animal products.

Initially, the development community was skeptical. The prevailing thought was that a crop with higher levels of vitamins and minerals would also be lower yielding, making it unappealing to farmers.²³ Researchers soon showed that wheat seeds with higher levels of zinc actually used that zinc to improve their productivity and yields. Armed with this new evidence, CGIAR scientists secured initial funding to screen germplasm and prove that high-yielding and high-nutrient crop varieties could be achieved through conventional breeding.²⁴ A few years later, other donors came on board with major funding, and the Biofortification Challenge Program, later renamed HarvestPlus, was born in 2004.

Biofortification must go through a number of steps before it can be considered successful in reducing micronutrient malnutrition. An acceptable level of micronutrients must be bred into

and retained by the crop, and it must be bioavailable. The biofortified crop must then be accepted and adopted by farmers on a large scale, as well as accepted and consumed by target populations.²⁵ HarvestPlus and its alliance of more than 70 partner organizations have applied some of these steps to three micronutrients (vitamin A, zinc, and iron) in seven crops (cassava, maize, sweet potato, bean, pearl millet, rice, and wheat). In Brazil, China, and India, where these targeted crops are produced and eaten in significant amounts, the alliance sponsors country programs.

Two decades after the initial idea, there is convincing evidence that breeding biofortified crops is possible and that the micronutrients are retained and bioavailable. People who consume iron-biofortified rice and beans, for example, have shown improved iron status. A study in the Philippines showed a 20 percent increase in serum ferritin and body iron among women consuming high-iron rice.²⁶

And researchers have begun to probe the effectiveness of biofortified crops—that is, the extent to which farmers and consumers actually adopt or consume them. Effectiveness trials on the pilot distribution of biofortified orange sweet potato to farmers and consumers in Mozambique and



HarvestPlus, Neil Palmer (CIAT)

Some farmers in Rwanda now grow beans bred with high iron content.

Uganda have shown a great level of success, with farmers adopting the beneficial crop and consumers significantly increasing their vitamin A intake. In Uganda, vitamin A status among children improved.²⁷ In Mozambique, biofortification reduced the prevalence of diarrhea in children under age 5 by 11.4 percent and the duration of diarrhea by 10 percent.²⁸ As part of an integrated agriculture and nutrition intervention there, orange sweet potato reduced the prevalence of vitamin A deficiency among children by 15 percent.²⁹ Estimates of the cost-effectiveness of vitamin A–biofortified orange maize in Zambia suggest that it would save US\$24 per DALY (disability-adjusted life year or the number of years lost due to ill-health, disability, or early death), with additional cost savings when biofortification was combined with fortification interventions.³⁰ Whether these successes can be scaled up remains to be seen as HarvestPlus embarks on the third phase of its program.

New Directions in Nutrition and Agriculture: Value Chains

A value chain refers to the path that a food takes from the farm to the table. The journey begins with production—and even the inputs that go into production, such as water, soil, and technologies—and continues through processing, distribution, retailing, promotion, labeling, and finally consumption. As the commodity goes through the various stages of the value chain, it gains value. This value has traditionally been defined in economic terms, but in recent years, nutritionists and development professionals have explored the idea of expanding the concept of value to mean enhancing or retaining the nutritional value of foods, especially micronutrient-rich foods that poor people find difficult to access because of their cost and perishability, such as fruits, vegetables, dairy, meat, and seafood.³¹ A pro-nutrition value chain might find ways to

improve the incentives and coordination among different actors along the chain to make foods more available, affordable, acceptable, nutritious, and safe.

The effectiveness of a value-chain approach to improving nutrition has not yet been studied extensively; research is currently limited to case studies.³² One area where value chains could potentially make a contribution is through school-feeding programs, which have had some small nutrition wins. For example, a review of 18 studies suggests that children in school-feeding interventions in various low-income countries gained an average of 0.39 kilograms more than the control group over an average of 19 months when looking at higher-quality studies, or 0.71 kilograms over 11.3 months when looking at lower-quality studies.³³ Another meta-analysis found similar results: an average weight gain of 0.37 kilograms per school year but no significant effects on height.³⁴ A more integrated approach—home-grown school feeding—uses value chains to connect schools with local farmers and in turn boost the local economy and improve the nutritional status of school-age children and their families. This approach has been used by high- and middle-income countries such as Brazil (see Chapter 11), Chile, and the United Kingdom and is now at various stages of implementation in low-income countries such as Ghana and Nigeria.³⁵ The success of these initiatives will depend on many factors, including the ability to ensure a continuous supply of food throughout the year. If successful, these initiatives would fulfill two different policy objectives—child welfare and pro-poor agricultural development—while potentially increasing farm productivity in some cases, in regions such as Africa south of the Sahara, to effectively meet the demand from schools.³⁶

Lessons Learned

The stories in this chapter highlight a few lessons and challenges. First, long-term impact is a

challenge. While homestead food production, for example, had spillover effects on some indicators of children's and women's health two years after the end of the program, preliminary analyses suggest that it had no impacts on children's anemia or diarrhea, household assets and livestock ownership, dietary diversity, or food security.³⁷ To ensure a long-term impact on nutrition, homestead food production and biofortification programs will need to depend on many local partners around the world to help design, implement, and evaluate programs, to build up local capacity, and to share existing local tools and practices. This can also help ensure that agricultural projects and policies do no harm to people's health and nutritional status or to the environment.

Second, research is key. Enthusiasm for biofortification intensified after research showed that the concept was feasible and effective. Rounds of evaluation of the homestead food production model have underscored the finding that combining agricultural programs with behavior change communication and a focus on gender may have larger impacts than stand-alone home gardening initiatives. In general, the relationship between agriculture and nutrition deserves far more analysis and

research to generate, for example, stronger program designs and in-depth analyses and understanding of program impact pathways.³⁸ Analyses of the cost-effectiveness of different approaches, which have so far been rather scarce, would also be useful for guiding public investment decisions. Large research partnerships such as the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH) and the Leveraging Agriculture for Nutrition in South Asia (LANSA) consortium are making strides in these areas.

The intersection of nutrition and agriculture will certainly continue to yield even greater insights in the years to come. Research advances can be used to make programs and policies more nutrition sensitive and in some cases to overhaul entire food systems. Investments in agriculture have high economic returns compared with other economic investments.³⁹ That 75 percent of the world's poor people live in rural areas—and depend on agriculture⁴⁰—means that integrated agriculture-nutrition interventions have the power to improve not only the nutrition and health, but also the livelihoods and overall well-being, of the poorest and most vulnerable populations living in the world today, a truly exciting prospect.

