CHAPTER

45

Policies for Sustainable Food Systems

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Over the past 50 years, we have seen tremendous progress in poverty reduction and overall economic development across much of the developing world. The incidence of poverty in non-OECD (Organisation for Economic and Co-operation and Development) countries, as measured by the proportion of population living under US$2 a day, has dropped from 47% in 1960 to 14% in 2015. The United Nations reports that developing countries in aggregate have achieved the Millennium Development Goal poverty reduction target. However, there are significant regional differences, with sub-Saharan Africa (SSA) and South Asia lagging behind on poverty, hunger, and other welfare indicators.

Several dozen countries in Asia and Latin America have graduated to middle-income status, some well on their way to becoming developed countries. In most of these countries, agricultural growth has played an important role in "jumpstarting" overall economic development and in moving countries along the structural transformation pathway (Timmer, 2010). Agricultural growth, often associated with the green revolution, focused on enhancing smallholder staple food crop productivity, and has been credited with the high rates of poverty reduction (Hazell, 2010). These emerging economies are well on their way toward achieving agricultural modernization and structural transformation. The challenge for agriculture in these emerging economies is to maintain competitiveness in the face of global integration of food markets and to close the interregional income gap (Pingali, 2010). These countries are also facing negative environmental trade-offs associated with the intensification of agricultural systems, such as long-term soil fertility decline, degradation of water resources, and loss of agricultural biodiversity.

In the low-income countries of SSA, continued high levels of food deficits and reliance on food aid and food imports have reintroduced agriculture as an engine of growth on the policy agenda (Pingali, 2012). Rising population densities and a degrading agricultural resource base have focused attention on the need for a more sustainable approach to

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agricultural development. There is also increasing awareness of the detrimental impacts of climate change on food security, especially for tropical agricultural systems in low-income countries (Byerlee et al., 2009). These countries continue to be plagued by age-old constraints to enhancing productivity, such as the lack of technology, market infrastructure, appropriate institutions, and an enabling policy environment (Binswanger-Mkhize and McCalla, 2010). Political conflicts and civil strife have also contributed to poor growth performance.

A majority of the world's agricultural production takes place on small farms, and currently there are nearly 500 million smallholder farmers around the globe (FAO, 2017). In Asia and SSA, where the problem of hunger and poverty is the most severe, 80% of the food supply comes from smallholders (FAO, 2012). Therefore, assuring the viability of small farms is crucial to enhancing rural incomes, ensuring sustainable food security, and triggering the structural transformation process.

This chapter draws on two publications by its author: Abraham and Pingali (2017) and Pingali et al. (2016). It provides a review of agricultural development and food security and sustainability challenges as economies move along the structural transformation pathway, from their subsistence roots to increased market orientation and commercialization. The challenges of meeting the rising demand for food, including diversity in food, in the context of environmental and climate pressures are described. The first part of the chapter discusses the role of agricultural development in the process of economic growth and structural transformation. It also notes the changes to food and nutrition security and environmental consequences as countries transition from subsistence to modernizing agricultural systems. The second part of this chapter looks broadly at sustainable food systems policies from production to consumption. These policies address sustainable productivity improvement, diversification of food systems, smallholder participation in value chains, nutrition enhancement, gender empowerment, and policies for managing climate risks and reducing environmental trade-offs.

45.1 AGRICULTURAL DEVELOPMENT AND STRUCTURAL TRANSFORMATION

Agricultural development is central to the structural transformation process in all developing countries. Productivity growth in agriculture leads to surplus creation and increased market participation by small farms, resulting in rising household level incomes and welfare gains. This increased engagement with markets is referred to as commercialization (Carletto et al., 2017; Pingali and Rosegrant, 1995). Commercialization is essential for the transfer of surplus in the form of food, labor, and capital from the agrarian sector to the industrial and service sectors to enable structural transformation (Timmer, 1988). The economies of developing countries are at various stages of structural transformation and can be categorized as low-productivity agricultural systems, modernizing agricultural systems, and commercialized agricultural systems (Pingali et al., 2015).

Countries with low per capita incomes and a larger share of agricultural contributions to gross domestic product are referred to as low-productivity agricultural systems. Many of the countries in SSA are classified as such, and in these regions hunger and poverty remain high. Agricultural lands in these economies are also prone to high levels of environmental degradation, as farm productivity growth rates struggle to match population growth rates.

The emerging economies of Latin America, South East Asia, and South Asia are witnessing increasingly market oriented and modernizing agricultural systems. These regions successfully implemented green revolution technologies, gained from the resulting agricultural productivity increases, and have substantially reduced poverty and hunger. In these regions, however, high levels of income inequality and regional disparities in development persist. Their economies are also facing the negative consequences of food policy trade-offs that promoted productivity growth over environmental sustainability. The East Asian economies of Japan, Taiwan, and South Korea, which are dominated by small farms, are referred to as commercialized agricultural systems due to their high per capita incomes, low share of agriculture in gross domestic product, and high market integration of the agriculture sector. Rising values of environmental services have induced policy reforms that have reduced some of the negative environmental trade-offs in many of these countries, for example, the return of tree cover to low productive lands that have been released from agricultural production.

The challenges for sustainable food systems in each of these production systems are different; consequently, by assessing the major characteristics of small farm economies in different stages of structural transformation, we can better understand the economic, nutritional, social, and environmental challenges such systems face.

Low-Productivity Agricultural Systems

Several countries across the globe are beset with low-productivity agricultural systems, and often with low income levels. Most of these countries are in SSA, where the adoption of green revolution technologies in staple grains such as wheat, rice, and maize was low (unlike in Asian and Latin American countries). While 82% of the area under staples in Asia concentrated on modern high-yielding varieties in 1998, SSA had only 27% (Evenson, 2003). While yields in cereals doubled in SSA, they quadrupled in South Asia, Latin America, and Southeast Asia between 1970 and 2010. The difference in productivity primarily stems from the fact that agricultural production in low-productivity agricultural systems is carried out in marginal environments with constraining agroclimatic, socioeconomic, and technological or biophysical conditions, where input intensive green revolution technologies could not be adopted (Pingali et al., 2014). This—coupled as it is with poor access and provision of essential public goods such as research and development (R&D), factors such as seeds and fertilizers, and essential infrastructure such as irrigation, storage, and roads—affects production incentives at the farm level.

Other challenges to adoption are problematic governance, lack of institutional support (like extension services and markets), and the effects of conflicts plaguing several parts of Africa. Factors such as low and inelastic demand for agricultural products have also affected development (Pingali, 2010). In recent years, production increases have taken place in these regions via area expansion and not through yield increases (Binswanger-Mkhize and McCalla, 2010). Also, much of the increase has been in maize rather than in traditional staples, which often have higher nutrient content and are better adapted to agroclimates of SSA, such as millets, cassava, and beans.

Expansion of low-input, low-yield production systems across SSA has contributed to significant land erosion and soil degradation problems. Sanchez (2002) states that African soils over the last 30 years have lost, on average, 22 kg of nitrogen, 2.5 kg of phosphorus, and 15 kg of potassium per hectare of cultivated land—an annual loss equivalent to US$4 billion in fertilizers. Expansion of cultivation into previously uncultivated lands has also caused significant losses in biodiversity (Pingali, 2017).

Finally, in some parts of SSA, frequent incidents of water stress and drought have contributed to high volatility in food outputs and frequent shocks to food security and household welfare. To be effective in moving the needle on agroclimatic risks, investments in irrigation infrastructure ought to be complemented by other measures, such as promotion of drought-tolerant crop varieties and animal breeds, sustainable management of soils, conservation of ecosystem services, information services to empower farmers to anticipate and manage crises, and innovations in agricultural insurance. These measures are crucial for achieving sustainable small farm growth and development in low-productivity agricultural systems.

Modernizing Agricultural Systems in Emerging Economies

Emerging economies face a myriad of challenges that have implications for food system transformation and sustainability. First, rapid growth in incomes, urbanization, and the rise of the middle class led to fast diversification of diets and boost demand for higher value crops and livestock products (Pingali, 2007; Pingali and Khwaja, 2004; Reardon et al., 2009; Reardon and Minten, 2011). Second, despite significant gains in food supply and food access, interregional inequalities in income and nutritional status continue to persist at high levels, especially in the more marginal agroclimatic zones that were bypassed by the green revolution (Pingali, 2012). Third, reversing the negative consequences of the productivity environment trade-offs that were made during the green revolution is a major challenge for emerging economies as they endeavor to transition to a more sustainable food system. A common thread throughout all the above-mentioned issues is the need to reexamine the emphasis given to staple crop production systems in developing countries. Additionally, there is urgency to promote diversity across agroecologies and the food system and to enhance resource conserving technical change.

The green revolution has had an unquestionably positive impact on the calorie and protein consumption of the population due to its direct (access to food) and indirect (through enhanced real incomes) effects. Increased income due to the green revolution led to a rise in demand for nonstaple foods such as vegetables, fruit, meat, and dairy products. This rising demand for diet diversity as countries move along the structural transformation pathway is consistent with Bennett's law. However, the increased demand for nonstaples was not always matched by a corresponding increase in their supply. Hence, high relative prices of nonstaple food persisted. A large number of crops (such as legumes, fruits, and vegetables) whose relative prices compared to staple grains are high are especially rich in micronutrients. This limited the impacts of diet diversification on nutrition outcomes.

Despite the rising demand, policy and structural impediments as well as a weak private sector limited the supply responsiveness for vegetables and other nonstaples. Policies that promoted staple crop production, such as fertilizer and credit subsidies, price supports, and irrigation infrastructure (particularly for rice), tended to crowd out the production of traditional nonstaple crops, such as pulses and legumes in India (Pingali, 2015). The persistence of staple grain fundamentalism in agricultural policy hampers farmer incentives for the diversification of their production systems (Pingali, 2015).

Within emerging economies, regions left behind during the green revolution-led growth process face the dual problem of declining competitiveness with the more agroclimatic favorable zones in the country in terms of staple grain production and limited ability to diversify out of low productive staple grain agriculture. To add to the problem, in many of these regions, traditional crops rich in certain micronutrients, such as millets and pulses, have been crowded out by the push to promote the big three staples—rice, wheat, and maize (Pingali, 2015; Webb, 2009). While closing the interregional productivity gap remains critical, the focus ought to be on crops, livestock, and aquaculture production systems that are relatively more suitable to the marginal environments and enhance access to nutritious food. For marginal environments to respond to changing market demand for higher value crops and other nonstaples in ways that would benefit small farms, infrastructure and support resources are required to enable them to participate in the value chain.

The agricultural productivity-led growth strategy has often resulted in significant negative environmental externalities in terms of land and water resource degradation, agricultural biodiversity loss, and chemical run-off due to excessive fertilizer and pesticide use. The environmental consequences have been exacerbated by the policy environment that promotes injudicious and overuse of inputs and expansion of cultivation into areas that cannot sustain high levels of intensification, such as sloping lands. Output price protection and input subsidies – especially fertilizer, pesticides, and irrigation water—provide distorted incentives at the farm level for adopting practices that would enhance efficiency in input use and thereby contribute to sustaining the agricultural resource base.

45.2 POLICY AGENDA FOR SUSTAINABLE FOOD SYSTEMS

A policy agenda for sustainable food systems strives for simultaneous improvements in economic, social, and environmental welfare of rural ecosystems. It adds to the sustainable intensification principles by incorporating human and social capital dimensions. Pretty et al. (2011) define sustainable intensification as "producing more output from the same area of land while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services." Also important here is agricultural intensification without increasing negative externalities of agricultural production, such as diminishing biodiversity, increased greenhouse gases, and land and water degradation, among others.

In addition, sustainable food systems policies explicitly address the welfare of producers, especially smallholders, the rural poor, and consumers, including considerations of nutrition and food safety.

R&D for Enhancing Food and Nutrition Security

Agricultural research is often cited as the single best investment in terms of increasing productivity and reducing poverty in the developing world (Fan, 2000; Fan et al., 2000; Fan and Pardey, 1997). Among many investments made in agricultural research during the past five decades, South Asia's green revolution—doubling the yields and output of major food staples between 1965 and 1985—is one of the most cited examples of this high payoff (Hazell, 2010; Pingali, 2012). But similar successes have also been achieved in Africa at different scales and with different crops and technologies (Haggblade and Hazell, 2010; Spielman and Pandya-Lorch, 2009). A shared characteristic of many of these high-return investments was the contribution of modern science, particularly plant breeding and cultivar improvement, which was supported by the donor community (Evenson and Gollin, 2003; Raitzer and Kelley, 2008; Renkow and Byerlee, 2010).

Continued high levels of investments are needed for enhancing the productivity of the major staple grains—rice, wheat, and maize—in order to meet their rising demand due to population and income growth. Research into crop breeding and genetics, with a targeted focus on varieties, which will thrive within a specific agroclimatic zone, can substantially influence the productivity of a smallholder and maximize yields. Additionally, productivity gains in traditional staples, such as cassava, millets, barley, and sorghum as well as fruits and vegetables, that were not the focus of the green revolution now need to be emphasized to improve diversity of diets and essential micronutrient availability. High returns have been demonstrated for programs focused on productivity gains for cassava cultivation in SSA (Binswanger-Mkhize and McCalla, 2010).

R&D is also essential for enhancing the efficiency of input use, with a particular focus on soil fertility, water-use efficiency, and pest-resistant cultivars. Modern information and communications technology tools, such as geographic information systems and remote sensing, could contribute significantly to sustainable use of inputs. Research on delivery systems for these intrinsically knowledge-intensive technologies is crucial, especially in developing country smallholder systems. Also essential is policy research for effective means of reducing incentive distortions in the adoption and use of efficiency-enhancing technologies.

Biofortification of staple and nonstaple food can be a sustainable means to reducing immediate concerns of micronutrient deficiency (Bouis et al., 2011). Essential micronutrients such as iron, zinc, and vitamin A can be accessed through biofortified foods and in a cost-efficient way (Asare-Marfo et al., 2013). Vitamin A-biofortified maize and iron-biofortified pearl millets have been successfully adopted in Zambia and Benin, respectively (Cercamondi et al., 2013). Biofortification has also been successfully carried out in nonstaples that can be easily grown and accessed in remote regions where commercially available fortified foods are scarce (Bouis et al., 2011). Examples of this include vitamin A-biofortified cassava in Nigeria and the Democratic Republic of the Congo, and vitamin A-biofortified orange flesh sweet potato in Uganda (Hotz et al., 2012) and Mozambique (Low et al., 2007). These measures may be an effective approach to remedy deficiencies until such time as production of nonstaple micronutrient-rich crops becomes more established.

Promoting Food System Diversification

Despite rising demand, the persistence of green revolution era policies and structural impediments, as well as a weak private sector, limited the supply responsiveness for vegetables, nonstaple food, and other sources of food, including livestock, aquaculture, and neglected or underutilized plant species and breeds. Creating a "level policy playing field" that corrects the historical bias in favor of staple crops would help improve the incentives for diversification of production into nonstaple foods. Agricultural policy of the past was focused on staple crop intensification. The need both today, and well into the future, is for a policy that is "crop neutral," removes distortions, and allows farmers to respond to market signals in making crop production choices (Pingali, 2015).

In addition to leveling the playing field, investments in road and transport infrastructure and cold storage systems are required for developing markets for perishable products. Investments in market information systems and farmer connectivity, especially through cell phones, could significantly cut transactions costs for market participation. Policies promoting food safety should be a priority for upgrading traditional markets and ensuring that human health is safeguarded (Pingali et al., 2015). In addition to reducing instances of foodborne illness and disease, food safety policies can make traditional markets a viable place for procurement by modern retail value chains.

Investments in general literacy and specialized training for farmers in meeting quality and safety standards for high value crops would help integrate smallholders into market value chains. Finally, institutional investments in establishing clear property rights to land and other assets, formalized contractual arrangements that depersonalize market transactions, and access to finance (that is not tied to particular commodities) are essential for diversifying production systems.

Linking Farmers to Modern Fresh Food Value Chains

Linking small producers to fresh food value chains requires particular attention given the rapidly growing urban demand for fruit, vegetables, and livestock products. The rise of supermarkets and their growing reach into rural areas to procure fresh food provides new growth opportunities for small producers. It has been noted that small farms participating in fresh food value chains have both direct and indirect gains (Swinnen and Maertens, 2007). The direct gains accrue through productivity increase, quality improvement, rise in household level incomes, and improved nutrition (Birthal et al., 2009; Dries et al., 2009; Ramaswami et al., 2009). The indirect effects include reduced risks in production, increased access to credit and technology, improved market participation, and the productivity spillovers to other crops (Bellemare, 2012; Swinnen and Maertens, 2007). Therefore, effective linkages to product markets play an important role in incentivizing production, diversification, and intensification in all production systems.

Policy interventions to create infrastructural public goods and mitigating locational disadvantages in low potential areas will help decrease regional disparity in market access. Increased investment by the state to expand storage facilities, cold chains, and improved connectivity is also vital to reduce wastage and increase marketing options for smallholders. These interventions in infrastructure are often needed for a private sector response to engage in markets and enable the successful emergence of vertical coordination where farms can directly connect with retail.

Institutional interventions such as producer organizations and cooperatives have helped provide inputs, reduce transaction costs, and also form market linkages (Barrett et al., 2012; Bellemare, 2012; Boselie et al., 2003; Briones, 2015; Reardon et al., 2009; Schipmann and Qaim, 2010). Promoting these institutions will help smallholders mitigate some of the transaction costs associated with entry into fresh food value chains, as this measure addresses problems associated with economies of scale. These production systems also require an incentive to attract public-private partnerships and collaborate with civil society organizations to enable such linkages.

Growth That is Inclusive of Rural Women

Women are among the largest group of landless laborers and the largest group dispossessed or with restricted access to land (Agarwal, 1994; Deere and Leon, 2001). They also make up two-thirds of the livestock keepers (Thornton et al., 2002) and 30% of labor in fisheries (FAO, 2011). Despite having an important role in production, studies have also shown that women face high costs in accessing capital, engaging in entrepreneurial activities (Fletschner and Carter, 2008), and adopting technological inputs and mechanization (FAO, 2006). Therefore, in many developing countries, woman-headed households have lower yields and incomes due to poor access to markets and productive resources (Croppenstedt et al., 2013), affecting their contributions to agricultural productivity (FAO, 2011). Women also provide nonmarketable goods and services at the household level, such as gathering water and fuel, child health and nutrition, and subsistence food production, which is essential for household welfare (Floro, 1995). Time savings in this context is relevant for reducing women's workloads, income, and household-level welfare.

In low-productivity agricultural systems, women's participation in the agricultural labor force is higher than the global average (Croppenstedt et al., 2013). Therefore, closing the gender gap and addressing gender-specific transaction costs and constraints to agricultural production is crucial to increase agricultural productivity and women's empowerment.

Improving access to the factors of production such as cultivable land and institutional credit is central to providing women with control over productive resources. Better access to tapped water and clean fuel for household use, helps improve women's health, reduce drudgery, and free up labor for more productive activities. Agricultural policies related to natural resource management, input, and technology access and production affect man- and woman-headed households differently and therefore necessitates a more gendered policy focus in agriculture (FAO, 2011). Promotion of women's self-help groups for education, information dissemination, microcredit access, provisions of essential public goods, and supporting production-based activities are essential.

The two major interventions needed to address gender-specific challenges in agriculture are improved access to product markets and labor savings for rural women. With regard to access to product markets, studies have shown that women involved in both traditional and modern crop production and marketing face considerable disadvantages and risks (Cabezas et al., 2007). A more gender-sensitive value chain is required to address access problems in markets (Rubin and Manfre, 2014; Nakazibwe and Pelupessy, 2014; Quisumbing et al., 2015).

Policy initiatives to promote women's organizations and build capacity to make them self-sustaining are important in tackling gender-specific challenges in production and marketing. Gender-sensitive value chains that facilitate women's participation in high value markets are essential. Collaboration with state and civil society organizations is vital for promoting and empowering women's producer organizations and self-help groups.

As women are often involved in agricultural labor and nonmarketed household labor, measures to improve labor efficiency and productivity of women will enable cost savings and free up time. Labor-saving technology through mechanization in agriculture is needed to reduce drudgery. Mechanization, like marketing, is scale sensitive and, again, collective action to enable joint access of labor-reducing machinery is vital. Targeting mechanization in women-dominated activities in agriculture, such as transplanting, harvesting, and postharvest operations, must take precedence in modernizing agricultural systems.

Managing Climate Change Impacts

Mitigating the effects of climate change and the need to increase yield simultaneously pose a major challenge to growth and development of the agricultural sector. This challenge could be particularly important for crops that are important to the poor, such as millets and cassava. Little is known about the long-term climate impacts on crops beyond the major staples. To offset the current impact of climate change, investments in R&D must be made to promote heat- and drought-resistant crop technologies and infrastructure investment like microirrigation systems. Making these technologies easily accessible to smallholders is also crucial. Policy interventions to promote sustainable agricultural intensification are necessary to manage the dual challenge of climate change and productivity growth (Matson et al., 1997; Pretty et al., 2011). For instance, supplementing agricultural productivity programs with agroforestry for carbon sequestration, soil conservation, and watershed management programs to limit land degradation and promote water conservation will prove to be essential in agricultural policy formulation (Lipper et al., 2006; Pretty et al., 2011). Promoting market mechanisms for carbon sequestration through conservation agriculture could contribute to small-farm income improvements while addressing climate mitigation. Finally, insurance systems, disaster relief programs, and safety net programs need to be specifically developed for dealing with the welfare costs associated with increased incidence of extreme events, such as more frequent droughts, floods, and other disasters.

45.3 CONCLUDING REMARKS

Today, the challenges for agricultural development and food security improvement are as formidable as they were 50 years ago. Given the multiple and concurrent threats that food systems face, from unabated growth in food demand to intensification pressures on the agricultural resource base and the growing threat of climate-related risks, the complexity of the task ahead is significantly greater than that faced in the past.

Because of the divergent growth trajectories of developing countries, the future pathways to agricultural growth and food security will differ according to the stage of economic development of each country. A "one-size-fits-all" approach is no longer appropriate in the design of agricultural development programs. While the least-developed countries are still facing chronic conditions of low productivity and high levels of food insecurity, emerging economies are rapidly moving toward market integration and agricultural commercialization. Feeding the cities with a diverse food basket provides new growth opportunities for these economies.

While much of the initial focus of R&D for the green revolution was on the major staples, such as rice, wheat, and maize, the R&D needs for the future are more diverse. This needs to be reflected not only in terms of a diversity of crops and livestock species, but also in terms of the push toward sustainable natural resource management and adaptations related to climate change.

The need today is not just for enhancing the yields of the primary staple grains, but also for addressing the genetic improvement of the so-called "orphan or neglected staples," such as sorghum, millets, and tropical tuber crops, in addition to furthering the diversification of agricultural production by emphasizing the role of livestock and fisheries in our agricultural ecosystem. Such investments could provide new opportunities for growth in the marginal production environments, as well as enhancing the supply and accessibility of micronutrient rich food to the rural poor. There is also an urgent need for R&D investments in making food crops climate resilient, especially in marginal production environments.

Sustainable intensification of food systems can help address multiple societal goals, enhancing food and nutrition security while minimizing the damage to the environment and helping societies deal with climate risks. As in the past, continued and sustained donor support for agricultural development and food security is absolutely crucial, particularly to help the least-developed countries achieve their Sustainable Development Goals.

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