

Structural Transformation of the Agricultural Sector: A Primer

Raian Divanbeigi, Nina Paustian, and Norman Loayza

From agriculture to agribusiness: Agriculture in developing countries is experiencing a remarkable transformation, with improved productivity, changing production composition, and integration with domestic and international markets

Trends and Driving Forces

“Structural transformation” is a term used to describe the process of change in the production structure of an economy. One such transformation was the Industrial Revolution of the 1700s in England and 1800s in continental Europe and North America, which marked the change from an agrarian society to an industrial one, and from artisanal manufacturing to mass production (Clark 1951). As economies grew and urbanized, services from commerce, finance, and the state also became increasingly important (figure 1, panel a).

In developing countries, structural transformation started much later, mostly in the 1900s. The process occurred less gradually, even abruptly and dissimilarly in some cases. The general trend was, however, broadly similar: from mostly agrarian to a mix of agrarian, industrial, and service economies (figure 1, panel b).

Along with this general trend, two basic features evolved (Kuznets 1957). The first was a process of human and labor migration from rural to urban areas. The second was a gain in total factor productivity associated with a shift from traditional to modern forms of production.

A less obvious, though no less important, structural transformation has occurred within the agricultural sector itself (Timmer 1988). It shares certain features with the overall structural transformation: modernization in the mode of production and in market transactions, and integration in its relationship with the other economic sectors and even other countries (WDR 2008).

The structural transformation of the agricultural sector has been characterized by the relative decline of basic agriculture; the rising importance of agribusiness, which includes the value added for agro-related industries and for agricultural trade and distribution services (figure 2); as well as the growing share of high-value agricultural products in international trade with respect to traditional exports (figure 3).

Agricultural structural transformation has been shaped by three interrelated processes.

Improvements in productivity

Higher yields and lower costs from existing and new farming lands have increased agricultural productivity. From 1960 to the present, agricultural output per hectare has expanded by over 250 percent (Alston,

Babcock, and Pardey 2010). In some cases, this expansion has been led by developing countries. Cereal yields in East Asia have risen by an impressive 2.8 percent per year, much more than the 1.8 percent growth in industrial countries. Likewise, in low- and middle-income countries the shares of arable and cultivated land have risen by 29 percent and 36 percent, respectively, since 1960, while in high-income countries they have not increased, on average.

Change in composition in production

The types of agricultural products have changed, from subsistence to cash crops, from food staples to intermediate inputs, and from low-value/low-risk to high-value/high-risk varieties. This change is reflected in the evolution of agricultural commodities in global markets. Whereas traditional exports have grown at an average of 2.5 percent per year in the last 50 years, cereals and fruits have grown by over 5 percent per year, and livestock has grown by more than 7 percent per year. Naturally, this evolution has differed across regions and countries, given their heterogeneous geographic and climatic endowments.

Change in mode of commercialization

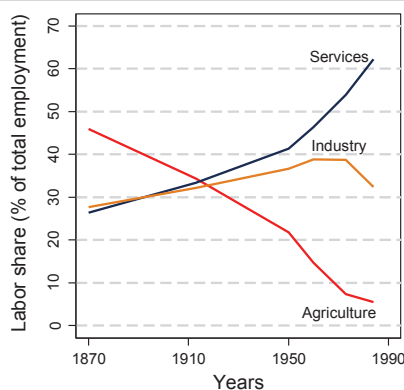
Agricultural market transactions have become more integrated with the rest of the economy, more dependent on finance, and more oriented to international trade. Fueled by food industries and services, agribusiness has expanded in most developing countries, despite the decline in the share of agriculture in GDP (figure 2). The percentage of adults in rural areas who have an account at a financial institution increased sharply from 2011 to 2014, in both low-income countries (by over 15 percent) and in middle-income countries (over 44 percent) (FINDEX 2016). In the last 50 years, exports of agricultural commodities from developing countries have increased eight-fold (figure 3). The expansion of manufactured exports based on agricultural inputs has been at least as remarkable (figure 4).

The three processes that characterize agricultural structural transformation have, in turn, been driven by several forces. They can be grouped into three categories.

- **Technological progress:** The use of more efficient irrigation, the adoption of modern technologies and mechanization, and new and improved inputs (seeds, fertilizers, and pesticides).

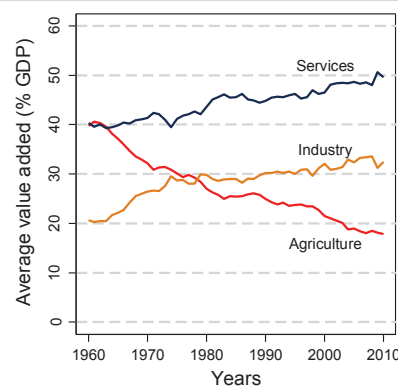
Figure 1. Historical and modern structural transformations have been marked by a shift away from agrarian societies to a mix of agriculture, manufacturing, and services

a. Developed countries, sectoral shares of employment, 1870–1984



Source: Maddison (1987).
Note: Shares are averages for France, Germany, Japan, Netherlands, United Kingdom, and United States.

b. Low- and middle-income countries, sectoral shares of value added, 1960–2010



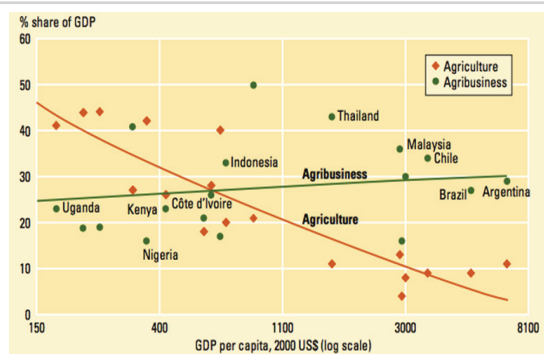
Source: World Bank World Development Indicators (WDI), March 2016.
Note: Data are based on a sample of 39 low- and middle-income countries with almost complete information during the period 1960–2010.

Affiliation: Divanbeigi and Paustian: Global Indicators Group, the World Bank. Loayza: Development Research Group, the World Bank.

Acknowledgement: Greg Larson, Fabian Mendez-Ramos, Nancy Morrison, and Federica Saliola contributed to this Note.

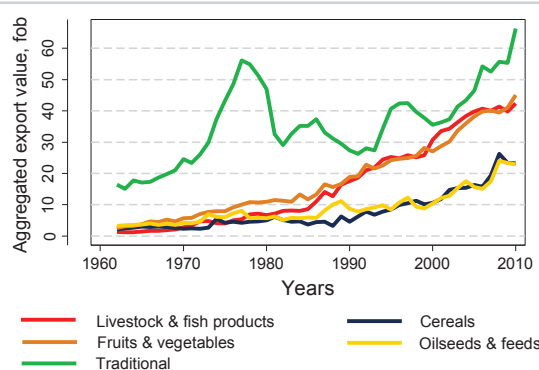
Objective and disclaimer: Research & Policy Briefs attempt to synthesize existing research and data to shed light on a useful and interesting question for policy debate. Research & Policy Briefs carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions are entirely those of the authors. They do not necessarily represent the views of the World Bank Group, its Executive Directors, or the governments they represent.

Figure 2. The relative GDP shares of agriculture and agribusiness change as incomes rise



Source: Reproduced from World Bank World Development Report (WDR) 2008. Note: Agribusiness includes the value added for agro-related industries and for agricultural trade and distribution services. Data are for Argentina, Brazil, Cameroon, Chile, Côte d'Ivoire, Ghana, India, Indonesia, Kenya, Malaysia, Mexico, Nigeria, Republic of Korea, South Africa, Tanzania, Thailand, Uganda, and Zimbabwe.

Figure 3. High-value exports of agricultural commodities are expanding rapidly in developing countries



Source: COMTRADE AND WDI. Note: Low- and middle-income countries. Traditional exports include cocoa, tea, coffee, rubber, tobacco, sugar, cotton, and spices. Units are billions of constant 2005 U.S. dollars. fob = free on board.

- **Public goods:** Government-provided institutions and infrastructure. Land and water property rights are crucial, as well as the regulatory system that governs them. Regarding infrastructure, irrigation, transportation, and conservation deserve special attention.
- **Market access:** Access to both trade and finance. Trade involves markets for agricultural goods nationally and internationally, as well as for inputs and machinery. Finance comprises the ability to tap resources from the financial sector through credit, equity, and insurance.

The rest of the policy note discusses how each of these driving forces have affected the interrelated processes of agricultural structural transformation.

Technological Progress

The growth in productivity of food crops in the developing world has been extraordinary in the past 50 years. Although populations have more than doubled, the production of cereal crops has tripled during this period, with only a 30 percent increase in land area cultivated (Wik, Pingali, and Broca 2008). Much of the success has been generated by the combination of high rates of investment in crop research, infrastructure and market development, and appropriate policy support that took place during the Green Revolution (1966 to 1985) and the two decades that followed (Pingali 2012). The fundamental strategy for the growth in productivity in food crops was that spillovers from existing advanced technologies could be captured across political and agro-climatic boundaries. As neither private firms nor national governments had sufficient incentive to invest in all of the research and development of such international public goods, great focus was put on promoting appropriate institutional mechanisms (Hazell 2010). The Consultative Group on International Agricultural Research (CGIAR) was established specifically to generate technological spillovers for countries that underinvest in agricultural research.

Change in productivity

The rapid increase in agricultural output resulting from the Green Revolution came from an impressive increase in yields per hectare. Between 1960 and 2000, yields for all developing countries tripled for wheat, more than doubled for rice and maize, and increased by 78 percent for potatoes, and 36 percent for cassava (Evenson and Gollin 2003; FAO 2004). Global total factor productivity for agriculture nearly doubled from the 1970–89 period (0.87 percent) to 1.56 percent for the 1990–2006 period (Fuglie 2010). The decrease in time to maturity allowed for an increase in cropping intensity, which explained the rapid spread of the rice–wheat system in the plains of the Indus and Ganges Rivers (Pingali and Shah 1998). Other improved inputs, including fertilizers, irrigation, and—to a certain extent—pesticides, were critical components of the Green Revolution.

While many regions have improved their agricultural technologies over the last three decades, a number of countries worldwide still make very little use of modern inputs (figure 5). Sub-Saharan African countries register the lowest levels of modern input use, as well as fertilizer use and irrigation (WDR 2008).

Change in composition

Access to technology influences choices in crop allocation. Modern

production depends on purchased inputs; thus effective input supply systems are essential. Inadequate formal seed supply systems have slowed, or even precluded, the diffusion of new crop varieties (Tripp 2001). Fertilizer use has long been hindered by difficulties in providing the right fertilizer types and in affordable pack sizes (Omamo and Mose 2001).

Change in commercialization

Market-oriented production requires modernization of systems, which depends heavily on the adoption of new technology and farm mechanization (Omiti and others 2006). Lack of access to modern technology, as well as quality inputs such as fertilizers and improved seed varieties, lowers farmers' ability to produce surpluses for the market (Olwande and Mathenge 2012).

Extension services promote the adoption of available technology by farmers and support their shift from traditional to modern and market-oriented agriculture. For instance, the expansion of agricultural extension services significantly increased the intensity of input use, agricultural productivity, and market participation of smallholders in Ethiopia (Gebremedhin, Jaleta, and Hoekstra 2009). Extension services are improving rapidly, thanks to the diffusion of information and communications technology (ICT). Mobile applications support commercial farmers by providing them with information on prices, good farming practices, soil fertility, pest or disease outbreaks, and extreme weather (World Bank 2012). In Zimbabwe, access to extension services, as well as ownership of basic ICT technology, increased farmers' participation in the soybean market (Zamasiya and others 2012).

Public Goods

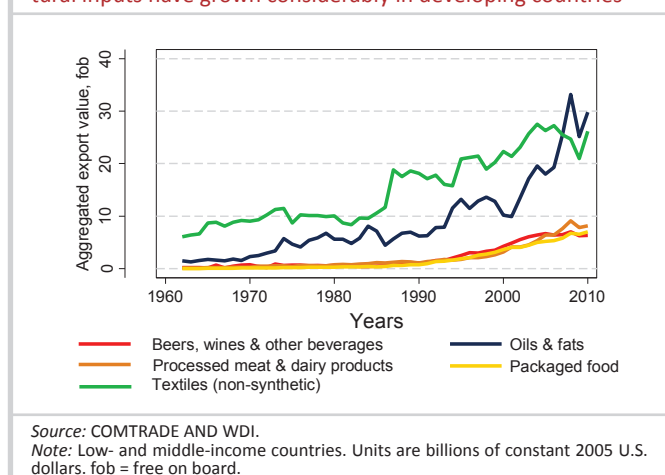
By providing and regulating public goods, governments influence the cost of production as well as the distribution of agricultural goods, and thus determine the degree to which the private sector can benefit from specialization, investment, and trade (Engerman and Sokoloff 2011). By setting the right institutional and regulatory framework, governments can help increase the competitiveness of farmers, enabling them to integrate in regional and global markets.

Change in productivity

Secure and clearly defined property rights enforced by efficient institutions enable farmers to reap the benefits of their work, and thus provide incentive for them to invest in their land and manage it in a more sustainable way (Besley 1995; de Soto 2000). In Ghana, insecure land tenure is associated with greatly reduced investment in land fertility (Goldstein and Udry 2008). Equally important, the transferability of land rights promotes efficiency gains by allowing land to be reallocated to more efficient users via land markets (Deininger and Jin 2005). The resulting consolidation of plots increases productivity through economies of scale (Barrett 1996; Adamopoulos and Restuccia 2014).

The regulation and enforcement of water rights has a significant impact on productivity by influencing decisions on investment and cropping patterns. In India, the redistribution of water rights of the Krishna River led to productivity gains of the downstream state—which were more than offset by the productivity losses of the two upstream states (Das 2012).

Figure 4. Exports of manufactured products based on agricultural inputs have grown considerably in developing countries



Infrastructure increases agricultural productivity by reducing transaction costs, protecting against shocks, and providing vital inputs. High costs due to low density or low quality of transport infrastructure alter investment decisions and represent a major obstacle to agricultural growth. In particular, roads that link farmers to markets significantly affect the use of inputs and crop choices. In Ethiopia, improvement in road quality increased the likelihood of purchasing crop inputs by 29–34 percent (Dercon and others 2009).

Public investment in irrigation systems can significantly reduce the dependency on rain and therefore the vulnerability to shocks such as droughts. The productivity of irrigated land is significantly higher than rain-fed land (Lipton, Litchfield, and Faurès 2005). While 20 percent of the world's cultivated land is irrigated, it contributes about 40 percent to the world's total crop production (FAO 2016). However, there are huge regional differences: in Sub-Saharan Africa, only 4 percent of the arable land is irrigated, compared to 34 percent in Asia (WDR 2008).

Efficient storage and conservation technologies increase productivity by reducing post-harvest losses through better preservation, leading to increased yield and profitability. Losses of fruits and vegetables after harvest in India are equal to a year's consumption in the United Kingdom (WDR 2008).

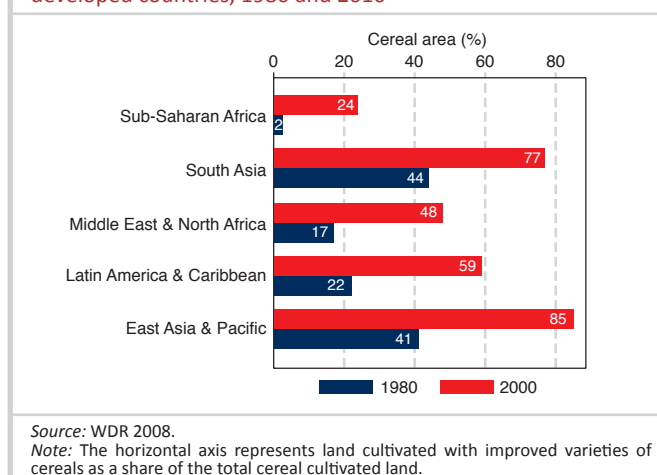
Change in composition

Many factors influence a farmer's decision on the composition of production. Larger plots may promote higher degrees of specialization, leading to economies of scale. A land reform in Vietnam led to an increase in the proportion of land devoted to multiyear crops by 7.5 percentage points (Do and Iyer 2008). Furthermore, secure land rights as well as effectively regulated water rights reduce uncertainty, and promote the production of crops with higher returns despite higher risk.

Adequate infrastructure enables access to input and product markets, shifting farmers' production toward producing goods for more distant markets, and away from an exclusive focus on goods for local consumption. Transport costs can make up one-third of the farmgate price in some Sub-Saharan African countries (WDR 2008) and therefore significantly affects crop choice, up to the point where they prevent farmers from specializing in the goods where they have a competitive advantage (Gollin and Rogerson 2010). In Kenya, high transport costs shifted farmers' production from cash crops that could bring higher gross income to lower yield food crops (Omano 1998). Also, higher price variability in isolated areas leads to a focus on low-risk and less productive crops to be less dependent on input prices (Rosenzweig and Binswanger 1993; Barrett 1999).

Irrigation reduces the variability of prices and incomes because it reduces the impact of climatic shocks. Like more secure water rights, access to adequate irrigation systems can shift farmers' focus to products that require more water but have a higher export value. When they are less dependent on rainfall, farmers can address new target markets with different demands throughout the year. Increased access to irrigation systems also contributes to price stability, facilitating access to inputs and creating incentives to produce "riskier" crops. In India, for example, rice farmers shifted from drought-resistant varieties that do well in bad years to less drought-resistant seeds that bring higher returns (Mobarak and Rosenzweig 2013).

Figure 5. Use of improved varieties of cereal has increased in developed countries, 1980 and 2010



Without proper storage and conservation facilities, farmers are forced to sell what they harvested immediately. This also impacts the choice of crops. By contrast, having access to storage facilities makes farmers move from heartier storable goods with lower yields, such as staples, to perishable goods with higher profits (von Thunen 1966). Adequate storage facilities and technologies promote the integration into global markets and the development of agribusiness industries, especially those that specialize in highly perishable agricultural products.

Change in commercialization

The provision of public goods to strengthen farmers' competitiveness and create a favorable investment climate is key to integrate farmers into value chains and international markets, especially more demanding ones. For example, obtaining access to the horticultural global value chain requires a sound regulatory sanitary and enforced phytosanitary standards (SPS) framework, access to conservation and cold-storage facilities, as well as testing and certification centers to comply with quality standards and ensure a consistent supply of quality products (Jouanjean 2013). In Peru, the SPS authority (SENASA) supports farmers in two main ways: it consolidates and negotiates market opportunities and has developed a strong regulatory framework assuring quality standards. As a result, asparagus exports increased from \$6.4 million in 1993 to \$286 million in 2011 (Schuster and Maertens 2015).

Consolidation of land plots promotes specialization, which in turn leads to an increase in farmers' export orientation and the formation of agribusinesses. Access to credit is key to enable farmers to invest and grow their businesses: for example, to purchase quality inputs such as high-yield seeds and chemical fertilizers. Therefore, the provision of a sound (physical and/or virtual) financial infrastructure and a corresponding enabling regulatory framework—allowing land and non-traditional assets as collateral, for example—is crucial to promote agricultural growth. Beyond credit, crop insurance systems can have a significant impact on making farmers more willing to invest in their land and take up higher-return projects (Dercon and Christiaensen 2011).

In order to monitor progress and benchmark across countries, public goods and regulations should be regularly assessed. On the latter, one example is the World Bank's project *Enabling the Business of Agriculture*.

Market Access

Sustained trade liberalization over the past five decades has greatly boosted global agricultural trade and expanded opportunities for exporters of agricultural products. In the last 50 years, exports of agricultural products from developing countries have multiplied eight-fold while those of agriculture-based manufactured products increased ten-fold (figures 3 and 4; COMTRADE 2016). The positive trend has continued recently: largely thanks to an increase in prices, export value of agricultural products nearly tripled between 2000 and 2012, while increased by around 60 per cent in terms of volume (WTO 2013).

Change in productivity

Easier access to domestic and international markets generates important productivity gains. Better market access facilitates specialization and exchange transactions in rural areas, allowing producers to allocate their land to higher value crops. Moreover, as the costs of trading agricultural

products decline, farmers raise their productivity by using inputs more intensively (Freeman and Silim 2002). In Kenya, improvements in market access increased aggregate agricultural productivity by 1.7 percent through direct specialization effects and by 7.5 percent through indirect input intensification effects (Kamara 2004).

Change in composition

Greater market integration allows countries to diversify their trade patterns. In the past 50 years, the share of raw traditional agricultural exports in global agricultural exports has declined significantly, while the weight of high value-added agricultural trade has increased. Until the mid-1980s, raw traditional agricultural products represented around 40 percent of total trade in agricultural goods. In the following decade, the share dropped sharply by over 10 percentage points. Processed agricultural products (which include processed traditional export products) now represent over 60 per cent of total exports of agricultural goods (WTO 2013).

Livestock as well as beer and wine are good examples. Over the last 50 years, developing countries' exports of these products have grown by more than 7 percent per year. Traditional exports, on the other hand, have grown by 2.5 percent per year in developing countries, confirming their overall shift away from commodities towards processed and higher value agricultural products (COMTRADE/WDI 2016).

Access to markets affects trade composition, as obstacles to trade can be more relevant to certain product types. Nontariff trade barriers—such as sanitary, phytosanitary, and technical standards—are extremely diffused in horticulture, given its perishable nature. These measures can drastically limit market access, making it harder for countries to trade in high-value agricultural products. For example, Zambia's estimated tariff equivalents for nontariff trade barriers were estimated to be 55 percent for imports of fresh peas to the Netherlands, and 98 percent to the United Kingdom (Nimenya, Frahan and Ndimira, 2012).

Change in commercialization

In recent decades, developing countries' agricultural trade as a share of domestic agricultural production and consumption has increased. The

average annual volume growth in agricultural trade between 1950 and 2010 was about 4 percent—twice as high as the annual growth in global agricultural production of 2 percent (Cheong and Jansen 2013; Cheong, Jansen, and Peters 2013). This reflects an increased integration of the agricultural sector into global markets. For many developing countries, revenue from agricultural exports is a major source of income. In Latin America, excluding Mexico, the share of agricultural export revenue in total merchandise export revenue is 30 percent (Cheong, Jansen, and Peters 2013). In some Sub-Saharan African countries and several other low-income countries, agricultural products account for almost half of merchandise export revenue (WTO 2013).

Agricultural commercialization involves the transition from subsistence farming to increased market-oriented production. Marketing costs are an important determinant of the extent to which smallholders participate in the market. Proximity to markets and roads, ownership of means of transport or access to affordable transport services, reduce marketing costs, and thus encourage market participation by farmers (Gebremedhin and Jaleta 2012).

Recent increase in agricultural trade has been accompanied by a shift toward nontraditional products. High-value crops such as fruits and vegetables are usually associated with higher levels of market participation than staple crops. For instance in Bangladesh, farmers on average sell 96 percent of their vegetable products, but only 19 percent of their cereal output (Weinberger and Genova 2005).

Concluding Remarks

Far from becoming unimportant, agriculture in developing countries is experiencing a remarkable structural transformation, characterized by an increase in productivity, a change in production composition, and a renovation in its mode of commercialization. This transformation is supported on technological, governmental, and commercial pillars. Agriculture is becoming agribusiness, in the good sense of market integration and entrepreneurship.

A question remains for future work. Agriculture has consistently alleviated poverty across developing countries. Will agribusiness continue to do so? And will the conditions that facilitate the transformation also be necessary to benefit the poor?

References

- Adamopoulos, T., and D. Restuccia. 2014. "The Size Distribution of Farms and International Productivity Differences." *American Economic Review* 104 (6): 1667–97.
- Alston, J. M., B. A. Babcock, and P. G. Pardey, eds. 2010. *The Shifting Patterns of Agricultural Production and Productivity Worldwide*. CARD-MATRIC Electronic Book.
- Barrett, C. B. 1996. "On Price Risk and the Inverse Farm Size-Productivity Relationship." *Journal of Development Economics* 51: 193–215.
- , 1999. "Stochastic Food Prices and Slash and Burn Agriculture." *Environment and Development Economics* 4: 161–76.
- Besley, T. 1995. "Property Rights and Investment Incentives: Theory and Evidence from Ghana." *Journal of Political Economy* 103 (5): 903–37.
- Binswanger, H. P., and M. R. Rosenzweig. 1993. "Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments." *Economic Journal* 103 (416): 56–78.
- Cheong, D. and M. Jansen. 2013. "Employment, Productivity, and Trade in Developing-Country Agriculture." In *Shared Harvests: Agriculture, Trade, and Employment*. ILO and UNCTAD.
- Cheong, D., M. Jansen, and R. Peters. 2013. *Shared Harvests: Agriculture, Trade and Employment*. ILO and UNCTAD.
- Clark, C. 1951. *The Conditions of Economic Progress*. London: McMillan.
- Das, S. 2012. "State Rights over Water and Agricultural Productivity: Evidence from the Krishna Basin." Working Paper 12-03, Department of Economics, University of Wisconsin–Whitewater.
- Deininger, K., and S. Jin. 2005. "Tenure Security and Land-Related Investment: Evidence from Ethiopia." *European Economic Review* 50: 1245–77.
- De Soto, H. 2000. *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else*. Basic Books.
- Dercon, S., and L. Christiaensen. 2011. "Consumption Risk, Technology Adoption and Poverty Traps: Evidence from Ethiopia." *Journal of Development Economics* 96: 159–73.
- Dercon, S., D. O. Gilligan, J. Hoddinott, and T. Woldehanna. 2009. "The Impact of Agricultural Extension and Roads on Poverty and Consumption Growth in Fifteen Ethiopian Villages." *American Journal of Agricultural Economics* 91 (4): 1007–1021.
- Do, Q-T, and L. Iyer. 2008. "Land Titling and Rural Transition in Vietnam." *Economic Development and Cultural Change* 56: 531–579.
- Engerman, S. L., and K. L. Sokoloff. 2011. "Institutional and Non-Institutional Explanations of Economic Development." In *Economic Development in the Americas since 1500: Endowments and Institutions*, 315–340. National Bureau of Economic Research.
- Evenson, R. E., and D. Gollin. 2003. "Assessing the Impact of the Green Revolution, 1960 to 2000." *Science* 300 (5620): 758–62.
- FAO (Food and Agriculture Organization). 2004. *The State of Food and Agriculture 2003–2004*.
-----, 2016. *AQUASTAT Main Database*. Accessed March 20, 2016.
- Freeman, A., and S. Silim. 2002. "Commercialisation of Smallholder Irrigation: The Case of Horticultural Crops in Semiarid Areas of Eastern Kenya." In *Private Irrigation in Sub-Saharan Africa*, 185–92. Proceedings of the Regional Seminar on Private Sector Participation and Irrigation Expansion in Sub-Saharan Africa.
- Fuglie, K. 2010. "Total Factor Productivity in the Global Agricultural Economy: Evidence from FAO Data." In *The Shifting Patterns of Agricultural Production and Productivity Worldwide*. Midwest Agribusiness Trade Research and Information Center, Iowa State University.
- Gebremedhin, B., and M. Jaleta. 2012. "Market Orientation and Market Participation of Smallholders in Ethiopia: Implications for Commercial Transformation." Paper presented at the International Association of Agricultural Economists (IAAE), August 18–24.
- Gebremedhin, B., M. Jaleta, and D. Hoekstra. 2009. "Smallholders, Institutional Services and Commercial Transformation in Ethiopia." *Agricultural Economics* 40(5): 773–87.
- Goldstein, M., and C. Udry. 2008. "The Profits of Power: Land Rights and Agricultural Investment in Ghana." *Journal of Political Economy* 116 (6): 981–1022.
- Gollin, D., and R. Rogerson. 2010. "Agriculture, Roads, and Economic Development in Uganda." In *African Successes: Sustainable Growth*. National Bureau of Economic Research.
- Hazell, P. 2010. "An Assessment of the Impact of Agricultural Research in South Asia since the Green Revolution." In *Handbook of Agricultural Economics*, vol. 4, 3469–3530. Elsevier BV.
- Jouanjean, M. A. 2013. *Targeting Infrastructure Development to Foster Agricultural Trade and Market Integration in Developing Countries: An Analytical Review*. Overseas Development Institute Report.
- Kamara, A. 2004. "The Impact of Market Access on Input Use and Agricultural Productivity: Evidence from Machakos District, Kenya." *Agrekon* 43 (2): 202–17.
- Kuznets, S. 1957. "Quantitative Aspects of the Economic Growth of Nations: II. Industrial Distribution of National Product and Labor Force." *Economic Development and Cultural Change*: 1–111.
- Lipton, M., J. Litchfield and J-M Faurès. 2005. "The Effects of Irrigation on Poverty: A Framework for Analysis." *Journal of Water Policy* 5: 413–27.
- Mobarak, A. M., and M. Rosenzweig. 2013. "Informal Risk Sharing, Index Insurance and Risk-Taking in Developing Countries." *American Economic Review* 103 (3): 375–80.
- Nimenya, N., B. H. de Frahan, and P-F Ndimira. 2012. "Tariff Equivalents of Nontariff Measures: The Case of European Horticultural and Fish Imports from African Countries." *Agricultural Economics* 43 (6): 635–53.
- Olwande, J., and M. Mathenge. 2012. "Market Participation among Poor Rural Households in Kenya." Paper presented at the International Association of Agricultural Economists, August 18–24.
- Omamo, S. W. 1998. "Farm-to-Market Transaction Cost and Specialisation in Small-scale Agriculture: Explorations with a Non-separable Household Model." *Journal of Development Studies* 35: 152–63.
- Omamo, S. W., and L. Mose. 2001. "Fertilizer Trade under Market Liberalization: Preliminary Evidence from Kenya." *Food Policy* 26: 1–10.
- Omiti, J., E. Mccullough, D. Otieno, M. Madelon, T. Nyanamba, and A. Murange. 2006. "Participatory Prioritization of Issues in Smallholder Agricultural Commercialization in Kenya." Discussion Paper 64, Kenya Institute for Public Policy Research and Analysis.
- Pingali, P. 2012. "Green Revolution: Impacts, Limits, and the Path Ahead." *Proceedings of the National Academy of Sciences (PNAS)* 109 (31): 12302–08.
- Pingali, P., and M. Shah. 1998. "Sustaining Rice-Wheat Production Systems: Socio-Economic and Policy Issues." Rice-Wheat Consortium, New Delhi, 1–12.
- Schuster, M., and M. Maertens. 2015. "The Impact of Private Food Standards on Developing Countries' Export Performance: An Analysis of Asparagus Firms in Peru." *World Development* 66: 208–21.
- Timmer, C. P. 1988. "The Agricultural Transformation." *Handbook of Development Economics* 1. Part II: 276–331.
- Tripp, R. 2001. *Seed Provision and Agricultural Development: The Institutions of Rural Change*. Overseas Development Institute and James Currey Ltd.
- UN (United Nations). 2016. *COMTRADE*.
- von Thünen, J. H. 1966. *Isolated State*. Pergamon Press.
- Weinberger, K., and C. Genova. 2005. "Vegetable Production in Bangladesh: Commercialization and Rural Livelihoods." Technical Bulletin No. 33, AVRDC–The World Vegetable Center, Shanhua, Taiwan, China.
- Wik M., P. Pingali, and S. Broca. 2008. "Global Agricultural Performance: Past Trends and Future Prospects." Background Paper for the *World Development Report 2008*. World Bank.
- World Bank. 2007. *World Development Report 2008: Agriculture for Development*.
-----, 2012. *Agricultural Innovation Systems: An Investment Sourcebook*.
-----, 2016. *FINDEX*.
-----, 2016. *World Development Indicators*.
- WTO (World Trade Organization). 2013. *World Trade Report 2014. Trade and Development: Recent Trends and the Role of the WTO*.
- Zamasija, B., N. Mango, K. Nyikahadzo, and S. Siziba. 2012. "Determinants of Soybean Market Participation by Smallholder Farmers in Zimbabwe." *Journal of Development and Agricultural Economics* 6 (2): 49–58.