Chapter 3

# AGRIFOOD SYSTEMS
## Transformation, Structural Change, and Development

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## Key messages

- Historically, agricultural growth was considered necessary for development in low-income countries, a perspective that contributed to widespread use of supply-side policies to raise agricultural productivity and output.
- Asia's Green Revolution is considered a model of successful transformation that led to increased rural incomes, greater availability and access to food, and unprecedented economic growth.
- Research on Asia's experience offers lessons for other low- and middle-income countries, but the experience of sub-Saharan Africa shows the challenges of replicating the Green Revolution's successes. Evidence from the region highlights how the role of agriculture in structural change and economic development is evolving as low-income countries become more integrated into global markets, and their consumers become more urbanized and consume more diverse diets.
- Research also underscores the need for policymakers to adopt a broader agrifood systems approach as the agriculture sector becomes integrated with the broader agrifood system and the development mandate of agriculture expands.
- This approach will require innovative tools and indicators to build understanding, such as IFPRI's Agricultural Transformation Index, which comparatively assesses a country's level of agricultural transformation and tracks progress over time.

Moving forward, research on development economics should focus on:

- **Informing strategies** for the design and implementation of multifaceted and tailored interventions that address constraints to agricultural and agrifood systems transformation in different environments and contexts.
- **Identifying labor-saving technologies** that can help achieve agricultural productivity and environmental sustainability, as well as ensuring these technologies are suitable and adaptable to local environments and contexts.
- **Supporting a systems approach** to transformation that "looks beyond the farm," including by evaluating how different actors respond to investment incentives and how policies can ensure positive outcomes for both producers and consumers.
- **Building understanding of how to promote better dietary outcomes**, both through economic policies that change the behavior of producers, processors, and consumers and behavioral change policies that address cultural and social drivers of dietary choices.

Historically, agricultural transformation has been critical to improving access to food, reducing poverty, and stimulating economic growth. Over the last 50 years, these contributions helped lead to the widespread use of supply-side agricultural policies to raise agricultural productivity and output. In the modern context, however, the role of agriculture in structural change and economic development is evolving as low-income countries experience socio-demographic changes, characterized by population growth in urban areas and consumption of more diverse diets, as well as economic integration with global markets.

This chapter examines agrifood systems transformation within the broader process of structural change and development. While *agricultural* transformation is often the initial catalyst for economic development, *agrifood systems* transformation is a broader concept that extends beyond farm-level improvements to encompass (1) better integration of the on-farm (primary agriculture) and off-farm (processing and distribution) components of agrifood value chains, (2) market development and expansion of agriproducts (see Barrett et al. 2022), and (3) policy interventions that shape agrifood systems outcomes, such as food security, nutrition, equity, and environmental sustainability (see Ingram and Thornton 2022).

Agricultural productivity growth, rural labor shifts, and evolving food value chains play a major role in economic transitions. This is exemplified by Asia's Green Revolution, which serves as a model of a successful agricultural transformation. This chapter contextualizes these dynamics and explores how lessons from Asia's experience can inform strategies in other regions, particularly sub-Saharan Africa.

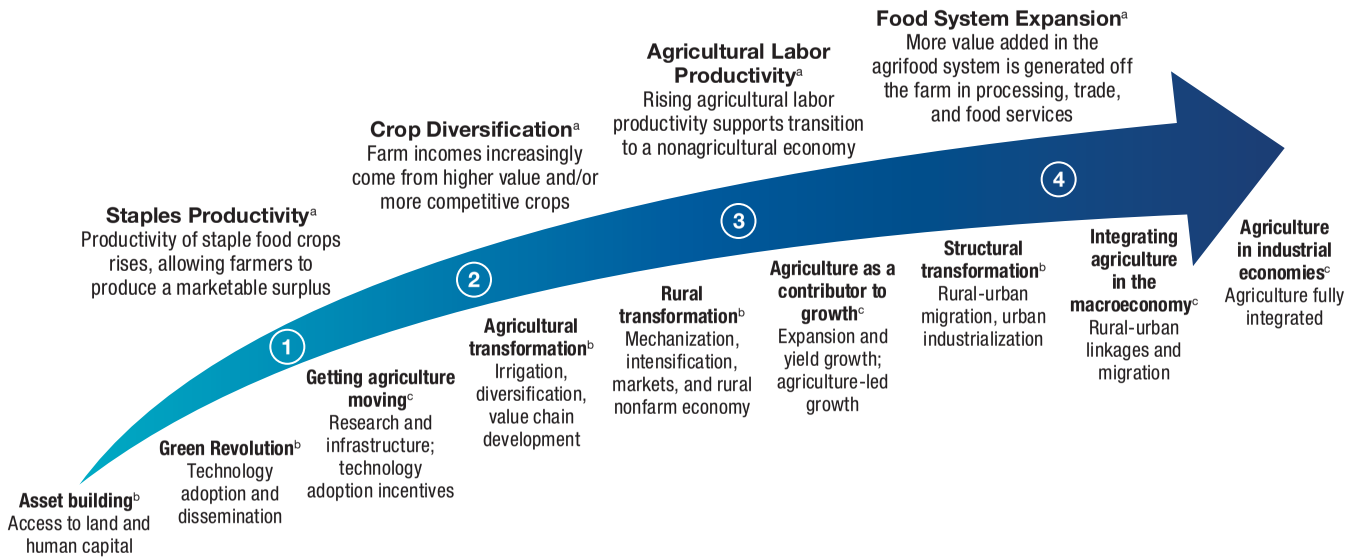
## Evolutions in development economics research

Understanding the drivers, trends, and structural patterns of growth has long been a cornerstone of development economics research, and theories of growth and development have evolved substantially as a result of this work. In the 1950s, growth was understood as a process of labor moving from a "traditional" low-productivity agriculture sector to a "modern" high-productivity manufacturing sector (Lewis 1954), known as structural change. By contrast, the Solow model (Solow 1956) emphasizes the accumulation of human and physical capital and ultimately offers exogenous technological progress as an explanation for long-run growth. Most researchers now tend to view growth as an outcome of both, that is, structural transformation or the movement of labor from low- to high-productivity sectors, as well as productivity growth within sectors (McMillan and Rodrik 2011).

Regardless of the theoretical framework, productivity growth in the agriculture sector is widely acknowledged as a catalyst for broader economic development and a shift toward industrialization (De Janvry and Sadoulet 2019). Such productivity growth is usually associated with the transition that takes place within low-income countries' agriculture sectors as they develop from low-productivity, subsistence-oriented agriculture toward modern, commercially oriented agriculture, a process also called agricultural transformation.

Figure 3.1 depicts the typical phases of this transformation process as it is often described in the literature. The adoption of modern production technologies—such as high-yielding varieties of crops and livestock products, other inputs, and agricultural machinery—leads to growth in agricultural productivity and usually provides the initial impetus for agricultural transformation. Further development and expansion of the sector is fostered by market development and rural infrastructure investments, which facilitate increased diversification and commercialization, both on the farm and, eventually, in the off-farm components of agrifood value chains.

**FIGURE 3.1** Four components of agricultural transformation




**Source:** Adapted from Diao et al. (2024).

**Note:** (a) The top part of the figure shows four stylized components of agricultural transformation as proposed by Diao et al. (2024). A discussion of the Agricultural Transformation Index (ATI) developed by Diao et al. (2024) follows later in the chapter. The ATI is constructed from indicators representing each of the four components of agricultural transformation and can be used to assess the advancement of countries in agricultural transformation. (b) The bottom part of the figure shows how the framework compares to De Janvry and Sadoulet's (2019) five stages of agriculture modernization and (c) Timmer's (1988) four stages of agricultural transformation.

## Agricultural transformation in Asia

Perhaps the most-cited example of successful agricultural transformation is the Green Revolution, which spanned from the mid-1960s throughout the 1990s in Asia. At the start of this period, agriculture sectors in most Asian countries were dominated by smallholder farmers. The high population density and relative scarcity of land necessitated or "induced" the development of land-saving technologies—that is, increasing production per unit of land—to meet demand (Hayami and Ruttan 1985). The period saw a rapid rise in productivity on smallholder farms, partly due to the adoption of high-yielding cereal varieties, especially rice and wheat, many of which were developed and disseminated by CGIAR (Hardin 2010). The effectiveness of new varieties was further enhanced by the increased use of modern inputs, including chemical fertilizers that raised soil fertility; pesticides, herbicides, and fungicides that lowered yield losses from weeds, pests, and crop diseases; the increased integration of livestock production for traction, manure, and transport, and as an off-cycle source of cash to pay for other inputs; and irrigation infrastructure that reduced dependence on seasonal rainfall (see Pingali 2012).

Asia's Green Revolution led to growth in rural incomes and increased availability and access to food in both rural and urban areas. As higher incomes drove demand for more diverse products, the region's agriculture sector gradually became more diversified, and rural nonfarm sectors started to develop as rural households diversified their livelihood strategies. This rural nonfarm development further supported agricultural transformation by reducing the size of the labor force engaged in agriculture, thereby raising output per worker in the sector.

As agricultural and rural development progressed, many East Asian countries adopted manufacturing-led, export-oriented growth strategies to build on the success of agricultural transformation. These strategies provided much-needed foreign exchange, promoted learning and innovation, and accelerated structural change by creating employment outside of agriculture, particularly in manufacturing (Birdsall et al. 1993; Stiglitz 2018). The unprecedented economic growth that followed—dubbed the Asian Miracle—helped close the gap between per capita incomes in East Asian countries and those in more advanced economies in the Western world. The success of the region's growth strategies led development economists to promote manufacturing-led, export-oriented growth strategies as a development pathway for other low-income countries to emulate.

## Can the Asian experience be replicated in sub-Saharan Africa?

Since the start of the Green Revolution more than 50 years ago, total cereal production in low- and middle-income countries has tripled. Remarkably, this growth in output was supported by an increase in agricultural land of less than one-third. During this same period, population size doubled in low- and middle-income countries. The Green Revolution therefore brought about large increases in both agricultural land productivity and the amount of food produced per capita (Pingali 2012).

For low- and middle-income countries in sub-Saharan Africa, however, the experience was vastly different. Although optimism abounded as many of these countries started gaining independence from colonial rule in the 1950s and 1960s, just as the Green Revolution began in Asia, agricultural growth stagnated for several decades. By the turn of the century, most countries in sub-Saharan Africa produced less food per capita than they did in the 1960s (Frankema 2014).

Many theories attempt to explain why sub-Saharan Africa did not experience a Green Revolution of its own during the early postcolonial era (see discussion in Frankema 2014 and Rosenberg 2014). Certainly, climate conditions in the tropics prevented the rice and wheat technologies that were successful in Asia from being readily transferred to sub-Saharan Africa. Even today, agricultural technologies are often highly specific to the ecological characteristics of the countries that led their development (Moscona and Sastry 2025). The food crops introduced instead, such as maize and cassava, were suited to local conditions and crucial for improving food security in the region, but tended to be of lower value, with limited opportunities for off-farm processing and value addition.

Colonial powers further encouraged reliance on a few traditional export crops such as cocoa, coffee, cotton, or tobacco, which were often highly profitable. Although external capital helped finance transport infrastructure, these developments were concentrated in cash crop production zones and sometimes crowded out economic activity in other regions. Furthermore, restrictive trade policies and vertical integration with overseas processing facilities meant products were mostly exported in unprocessed form. As a result, cash crops were associated with limited diversification and agricultural transformation in sub-Saharan African countries (Roessler et al. 2022). On the institutional front, weak bureaucracies in many of the newly independent states led to poor policy coordination and limited support for—or even bias against—agriculture, which, together with a lack of land tenure security for smallholders, poor

infrastructure, and weak markets, resulted in farmers adopting strategies to minimize risk rather than maximize income or productivity.

In the early 2000s, sub-Saharan Africa's fortunes began to change. The region finally experienced its own African Growth Miracle as its economic growth outpaced that of the rest of the world (Diao et al. 2025). During this same period, the structure of sub-Saharan African economies changed as the share of employment in agriculture fell. Although these structural shifts explain most of the region's labor productivity growth in the first two decades of the 21st century, much of the off-farm employment growth was in low-productivity service sectors, while employment growth in the manufacturing sector remained stagnant, reflecting a tendency for relatively productive firms to adopt capital-intensive rather than labor-absorbing manufacturing processes (Diao et al. 2025). This trend is not necessarily unique to sub-Saharan Africa, as evidence shows manufacturing is becoming more skill- and capital-intensive globally (Rodrik 2016). As a result, manufacturing is unlikely to play the same role in income and employment growth in sub-Saharan Africa that it did in South and East Asia following the Green Revolution (AfDB 2024; Rodrik and Stiglitz 2024; Stiglitz 2018).

Within the agriculture sector, output per worker increased due to the rising value of agricultural commodities that accompanied a global surge in commodity prices, along with a decline in the size of the agriculture workforce. However, this recorded growth in labor productivity may simply have been a result of labor shifting from farm to off-farm work due to urbanization. Agricultural land productivity increased modestly in some sub-Saharan African countries, but the pace of growth was slower than the overall increase in agricultural output per worker (see Badiane et al. 2021). Without the land productivity growth seen in Asia during the Green Revolution, agricultural growth in sub-Saharan Africa in the post-2000s was simply not as transformational as it had been in Asia between the 1960s and 1990s.

More recent evidence from farm household surveys conducted in several sub-Saharan African countries paints a more somber picture of declining crop yields and negative total factor productivity growth during the 2008–2019 period (Wollburg et al. 2024), suggesting continued challenges for agricultural transformation in the region. As during the postcolonial era, multiple factors explain these challenges, including credit, insurance, and information constraints; high transaction costs; imperfect land and labor markets; and increased competition in globally integrated product markets. Different combinations of constraints seem to affect different farmers (Suri and Udry 2022), meaning that there is no simple solution to address the myriad

challenges—instead, tailored packages of interventions will be required. In practice, achieving this will be difficult, especially without greater clarity on which elements of multifaceted programs are essential in different contexts or environments.

The stark contrast between the Asian and sub-Saharan African experiences, together with the ongoing challenges facing sub-Saharan Africa in transforming agriculture, has led many development economists to question the feasibility of replicating the Green Revolution. As a result of structural change and urbanization, sub-Saharan African countries are generally less dependent on agriculture today than the economies of South and East Asia were in the 1960s. African consumers are also becoming less dependent on local food supplies as economies become more integrated into global food value chains. These trends increase the attractiveness of non-agricultural policies and investments to promote economic development. But does this mean that agriculture should be deprioritized?

## A broader agrifood systems perspective is imperative

Despite some pessimism about its prospects, the agriculture sector remains vitally important in sub-Saharan Africa. Compared to the rest of the world, the region has the highest share of employment in agriculture, and the sector represents a large share of gross domestic product (GDP) for many of its countries (Gollin 2023; Suri and Udry 2022). Agriculture should therefore remain a key element of development strategies for sub-Saharan African countries and for low-income countries in general (Stiglitz 2018). However, these development strategies should be multifaceted, and primary agriculture cannot be the only focus. In the past, agricultural development policy largely focused on technology adoption on the farm. Though this focus remains important, we now understand that dramatic transformations of entire agrifood value chains occur alongside both agricultural and industrial revolutions (Barret et al. 2022). This new perspective requires agricultural policymakers to look "beyond the farm" and adopt a more holistic agrifood systems approach to transformation that recognizes the importance of supporting the integration of both on-farm and off-farm components of agrifood value chains. An agrifood systems perspective also considers how transformation shapes not only economic outcomes, such as growth and structural change, but also agrifood systems outcomes, such as food security, nutrition, equity, and environmental sustainability.

To elaborate, a broader agrifood systems perspective is imperative for several reasons: first, systemwide investments in agrifood value chains can strengthen linkages and facilitate the transfer of knowledge and skills between their on-farm and off-farm components. While traditional development strategies often regarded on-farm productivity growth as a necessary precondition for developing off-farm components of the agrifood system, innovations in off-farm components often induce the adoption and diffusion of agricultural technologies on the farm (Barrett et al. 2022). For instance, growing demand for workers in rural off-farm activities creates incentives for the adoption of labor-saving technologies on the farm. Thus, transformation cannot be seen as a linear development pathway along which on-farm productivity growth strictly precedes growth beyond the farm.

Second, urbanization, income growth, and higher participation of women in the labor force are contributing to rapid changes in consumer preferences, particularly the increasing demand for higher quality, more processed, and more varied foods (Barret et al. 2022). The consumption baskets of today's African consumers do not contain any commodities that match the importance of rice and wheat for Asian consumers during the Green Revolution (Gollin 2023). This means on-farm investments in one or two staple crops alone are insufficient and must be complemented by investments in a wider range of agricultural products, as well as in food processing capacity and food distribution services to supply changing diets. Food environments—the places and contexts in which consumers access food—also evolve as more consumers rely on supermarkets, restaurants, or fast-food chains instead of their own food production and home cooking.

Facilitating investments in retail markets and restaurants may help formalize and strengthen agrifood value chains so that they are better equipped to respond to consumer demand. For example, contracting arrangements or the use of mobile phone applications can help link farmers, traders, food service providers, and consumers, thus ensuring more efficient production and delivery of food products demanded by consumers. The trade, transport, and food services sectors are all nontradable sectors with potentially large domestic employment and growth multiplier impacts, which, alongside the expansion of agro-processing sectors, can contribute directly to structural change–led growth and employment. Global evidence confirms that the shares of employment and value added in the off-farm components of agrifood systems increase relative to the share of on-farm components as countries transition from low-income to middle- or high-income status (Thurlow et al. 2025).

Third, although the opportunities for low-income countries to adopt export-oriented manufacturing-led growth strategies are now more limited than in the past, there may be scope to expand agro-processing—a subsector within manufacturing—and successfully compete domestically and regionally with food imports. A recent United Nations report finds that the average food trade deficit among least-developed countries is 50 percent, with large trade deficits for processed foods, particularly in sub-Saharan Africa (UN 2024). However, by the time developing nations move above the least-developed-country threshold, their processed food exports exceed imports by 23 percent. Although these statistics mask substantial heterogeneity across countries, they are broadly indicative of the scope for low-income countries to gradually reduce their reliance on processed food imports through development and transformation of their agrifood systems. A starting point could involve investing in small-scale and traditional food processing sectors or foods tailored to local and regional demand, such as fruits and vegetables, meat and dairy, grain milling, or snack food products. Promoting regional trade to substitute for imports of processed foods from outside sub-Saharan Africa can help smaller countries within the region expand their market for processed food products. An expansion in agro-processing capacity will also likely be accompanied and facilitated by what is described as the "quiet revolution" in food value chains, that is, transformation and growth among midstream intermediaries, such as truckers, warehouse owners, millers, cold storage operators, wholesale traders, and rural brokers (Reardon 2015) (see also Chapter 7).

The fourth point relates to the changing role of the agrifood system in contributing to household welfare outcomes. During the early stages of development, investing in primary agriculture is often an effective strategy for reducing poverty because the livelihoods of many of the poor depend on the sector. However, structural change and rural–urban migration cause those agricultural growth–poverty linkages to weaken (Christiaensen et al. 2011; Dorosh and Thurlow 2018). For many low-income households employed outside of agriculture, particularly the rural poor, agricultural productivity growth can still reduce the cost of primary foods that often make up the bulk of their budgets. However, as lifestyles change and processed or prepared foods become relatively cheaper, these low-income households may also undergo a dietary transition, in which case off-farm agrifood systems investments could gradually become more effective at lowering food costs and increasing household income opportunities from employment in off-farm agrifood sectors. An appreciation for these employment and consumption dynamics, as they

pertain to low-income households, can help governments adopt on-farm and off-farm agrifood systems policies that better address development goals, such as poverty reduction.

Last, views on agrifood systems transformation are being shaped by the growing consensus on the importance of promoting sustainability in agrifood systems. These systems should no longer exclusively aim to supply cheap calories to poor consumers but should instead be transformed to promote a wider range of goals, including not only food security, nutrition, human health, and equity but also environmental sustainability (Caron et al. 2018). Put differently, agrifood systems investments must find a balance between making healthy, diverse diets available and affordable to poor consumers and ensuring that foods are produced in an environmentally sustainable way, such that the food security and nutrition of future generations are not compromised (Willett et al. 2019) (see Chapters 5 and 12).

Within this broader context, governments may opt for a wide range of investments across agrifood systems to achieve multiple goals (see Chapter 18). For instance, the underconsumption of plant-based protein sources such as beans and pulses might require traditional on-farm investments in production and marketing channels; the underconsumption of fruits and vegetables in urban markets might best be addressed through off-farm investments in logistics and cold chains; or the underconsumption of milk might require development of dairy processing sectors (see Pauw et al. 2023). On the other hand, the overconsumption of starchy or ultra-refined grains might require reforms to existing staple food subsidy programs to encourage consumption of healthier foods while still ensuring the overall affordability of diets.

## Tracking agrifood systems transformation

Agrifood systems are impacted by multiple external drivers, including biophysical, environmental, political, economic, and demographic ones (Fanzo et al. 2020). The challenge faced by policymakers is to design policies that create incentives to produce enough healthy and affordable food for a growing consumer base in a sustainable manner. Because the global agrifood system is already operating outside of several planetary boundaries (Ruggeri Laderechi et al. 2024), urgent transformation of agrifood systems is required.

Agricultural transformation will remain an important element of broader agrifood systems transformation, even though, as argued in this chapter, future contributions of agriculture to broader structural change and development processes will likely differ from the past. While agricultural productivity

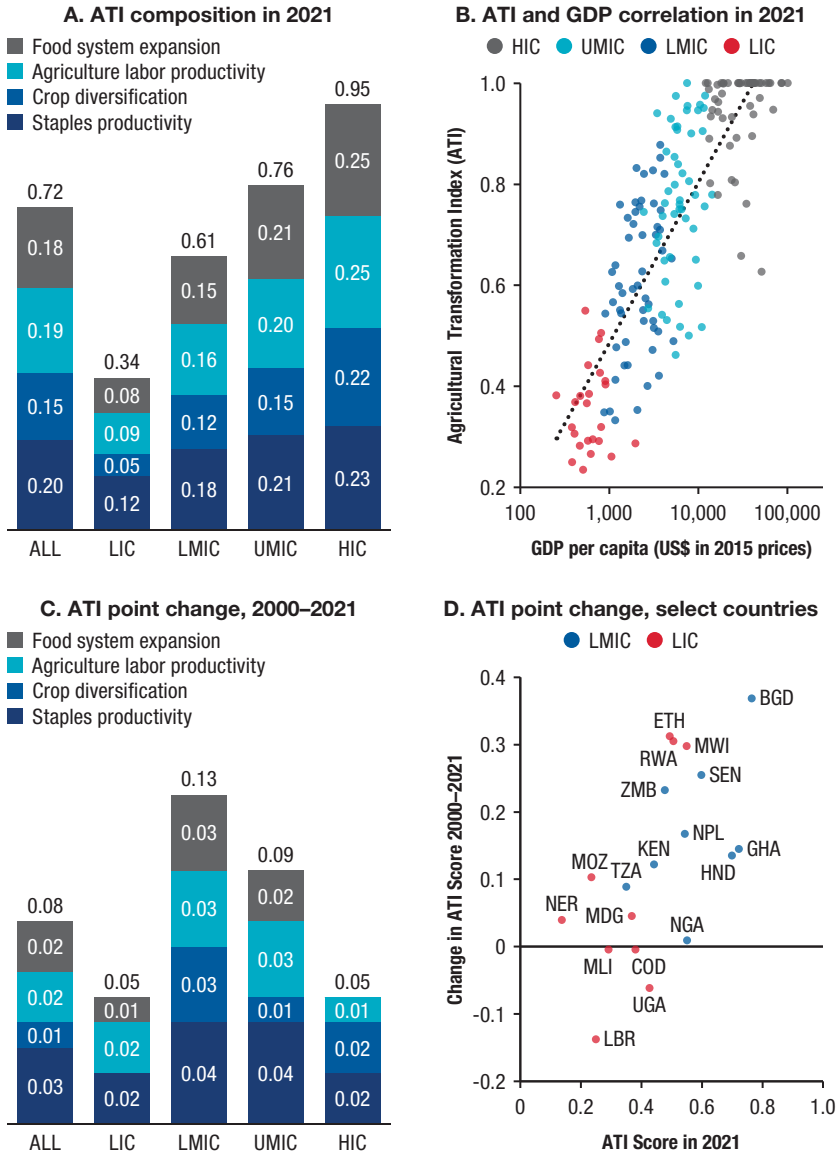
has always been the gold standard for tracking progress within agriculture, new indicators are required to measure and monitor broader transformation of the agrifood system. One such tool is the Agricultural Transformation Index (ATI) proposed by IFPRI researchers (Diao et al. 2024).

The ATI combines indicators for key *economic outcomes* pertaining to agrifood systems transformation into a composite progress score ranging from 0 to 1, with a higher score indicating a greater degree of transformation. It is designed as a practical indicator for tracking the transformational process of agrifood systems within and across all countries around the world, one which can be easily updated using publicly available longitudinal datasets. The ATI is consistent with the framework presented in Figure 3.1 and includes components that measure progress in (1) staples productivity, (2) crop diversification, and (3) agricultural labor productivity. These three indicators all pertain to the on-farm component of the agrifood system. A fourth indicator, (4) food system expansion, measures the share of total value added in the agrifood system that is generated off the farm (for details, see Diao et al. 2024).

Figure 3.2 presents the default ATI scores and changes over time for different country income groups as an illustration of how the indicator can be used to assess progress. Panel A shows that the ATI increases from low- to high-income countries. Although each component contributes roughly equally to the composite score in high-income countries, the contribution of the crop diversification indicator in low-income countries, for instance, is notably small. Panel B confirms the strong positive correlation between countries' ATI scores and their levels of well-being, as measured by GDP per capita, although there is a significant degree of dispersion of ATI values within country income groupings, and especially among lower-middle-income and upper-middle-income countries.

Panel C shows the point changes in the ATI from 2000 to 2021, the range of datapoints currently available. On average, all country groups experienced increases in their ATI scores, with the largest gains in absolute terms in the lower-middle-income (+0.13) and upper-middle-income (+0.09) groups. Agricultural labor productivity growth was the most important contributor to the change in ATI among low-income countries, while staples productivity contributed most to the change in all other country groups, thus supporting the assertion that agricultural transformation is not strictly a linear modernization sequence (Diao et al. 2024). Whereas increased crop diversification had some impact on ATI scores in middle- and high-income countries, this indicator had a negative impact on ATI scores in low-income countries.

**FIGURE 3.2** Agricultural Transformation Index (ATI) composition, correlation, and trends




**Source:** Diao et al. (2024).

**Notes:** LIC = low-income countries; LMIC = lower-middle-income countries; UMIC = upper-middle-income countries; HIC = high-income countries. The countries included in Panel D are selected developing countries including BGD = Bangladesh; COD = Democratic Republic of Congo (DRC); ETH = Ethiopia; GHA = Ghana; HND = Honduras; KEN = Kenya; LBR = Liberia; MDG = Madagascar; MLI = Mali; MOZ = Mozambique; MWI = Malawi; NER = Niger; NGA = Nigeria; NPL = Nepal; RWA = Rwanda; SEN = Senegal; TZA = Tanzania; UGA = Uganda; ZMB = Zambia.

Panel D presents changes in ATI scores for select countries. These countries display both a wide variation in ATI scores—ranging from 0.14 in Niger to 0.76 in Bangladesh—and in changes in ATI scores from 2000 to 2021. The countries with deteriorating scores, such as the Democratic Republic of Congo, Liberia, Mali, and Uganda, are all low-income countries, although Ethiopia, Malawi, and Rwanda, also low-income countries, were some of the best performers. The average improvement across all countries in the figure was +0.12, with slightly smaller improvements among low-income countries (+0.09) than among lower-middle-income countries (+0.17).

Given its focus on economic outcomes, the ATI does not currently incorporate indicators pertaining to *agrifood systems outcomes* such as food security, nutrition, equity, or sustainability. One of the more prominent efforts to measure, assess, and track agrifood systems outcomes at a global scale is the Food Systems Countdown Initiative (FSCI), which focuses on indicators across five thematic areas, namely (1) diets, nutrition, and health, (2) environment, production, and natural resources, (3) livelihoods, poverty, and equity, (4) governance, and (5) resilience (FSCI 2025). Given the complexity of the indicator architecture, the FSCI makes no attempt at forming a composite index or uniquely ranking countries as is done with the ATI. However, with the availability of this comprehensive database, it is worth exploring opportunities for expanding the scope of the ATI in the future to include selected agrifood systems outcomes, particularly those that are collected in a consistent way across countries and deemed comparable.

## Future research

Agriculture's role in structural change and economic development is evolving. Agricultural transformation was historically seen as a necessary precondition for development in low-income countries, a perspective that contributed to widespread use of supply-side agricultural policies to raise agricultural productivity and output. Today, however, low-income countries are more integrated into global markets, and their consumers are more urbanized and consume more diverse diets, an evolution that affects both the supply and demand sides of agrifood systems. Other emerging factors, such as a high burden of noncommunicable disease and global climate and environmental challenges (see Chapters 4, 5, and 12), are also affecting agrifood systems, thereby broadening the development mandate of agriculture (Byerlee et al. 2009). Beyond traditional goals such as improving access to food, reducing poverty, and stimulating growth and structural

change, the agriculture sector is now an integrated part of a broader agrifood system that is also expected to contribute to improved diet quality and health outcomes while remaining within planetary boundaries of sustainable production.

This expanded mandate requires agricultural policymakers to adopt a broader "agrifood systems approach" to promoting transformation and development. This approach is characterized by (1) a recognition of the interdependencies across different parts of agrifood value chains; (2) an appreciation for agrifood systems' dynamic nature and role in development as production or processing technologies and patterns of food demand evolve; and (3) an understanding that the way in which agrifood systems transform has important social and environmental implications, both today and for future generations. Policies designed with this broader agrifood systems perspective can help strengthen integration within agrifood value chains and improve the transfer of knowledge and skills among different components of agrifood systems; enable agrifood systems to better meet changing consumer preferences for higher-quality and more diverse foods; compete with and substitute for food imports; and simultaneously address multiple development challenges, including reducing poverty and food insecurity, improving diet quality and health outcomes, and facilitating the adoption of environmentally sustainable production systems.

Research has an important role to play, first and foremost, in tracking agrifood systems transformation and continuously expanding knowledge and understanding of its drivers. In this regard, indicators such as IFPRI's ATI can provide useful information about a country's level of agricultural transformation in relation to other countries and its progress over time. The ATI can also highlight specific components of transformation that may be lagging, allowing policymakers to prioritize certain interventions over others, especially in contexts where resources are limited. While the ATI focuses on economic outcomes, global databases such as that of the FSCI (2025) create opportunities for expanding the ATI to incorporate agrifood systems outcomes such as food security, nutrition, equity, or sustainability.

Drawing on the wide-ranging discussions in this chapter, we conclude by highlighting select areas for future research where knowledge gaps are most pressing. First, as we have discussed, many constraints to agricultural and agrifood systems transformation have been identified, but since different agrifood systems actors are affected by different combinations of these constraints, multifaceted and tailored programs are required to address them in different environments and contexts. These packages of interventions are complex and

require implementation by capable practitioners, though research can inform their design and implementation strategies.

Second, agricultural land productivity remains low in sub-Saharan Africa, which has encouraged the adoption of expansive agricultural production systems to increase output. However, with high population growth and growing land and water constraints, this aim is becoming harder to achieve. Rapid rural–urban migration further contributes to rural labor shortages, which means the labor-intensive agricultural technologies promoted during Asia's Green Revolution are less attractive and profitable to sub-Saharan African smallholders today. Labor-saving technologies that simultaneously raise agricultural land productivity can offer a win-win strategy by increasing agricultural productivity and environmental sustainability (see Chapter 17). Research can help identify what those technologies look like and ensure their suitability and adaptability to local environments and contexts.

Third, we have argued that an agrifood systems perspective on transformation requires policymakers to look beyond the farm and adopt policies that also support the development of the off-farm components of agrifood value chains (see Chapter 7 ). Market incentives are important drivers for private sector actors to invest in these off-farm components. These actors are also often more diverse than their counterparts in primary agriculture. For instance, they may range from small-scale processors or traders to large-scale investors or multinational food processing companies, which differ not only in size or economic influence, but also in political influence. Research can offer insight into how different actors respond to investment incentives and how policies can ensure outcomes that are equitable for all producers—and, ultimately, that support consumers' health and well-being.

Last, the need to shift consumer preferences toward healthy and sustainably produced foods may be the most challenging aspect of agrifood systems transformation. Poor diet quality is a major contributor to noncommunicable diseases and related deaths, yet the consumption of ultra-processed foods high in sugar and fat is becoming more pervasive. This reflects, to a large extent, the high cost of healthy diets compared to energy-sufficient diets and convenience foods (see Chapter 12) (Herforth et al. 2022). More work is needed to identify which strategies are most effective at lowering the overall cost of food, but, beyond that, research can help us understand how policies can change the behavior of producers, processors, or consumers to ultimately promote better dietary outcomes. For instance, price subsidies or production-side incentives could reduce the relative cost and increase the availability of healthy

foods. However, the extent to which economic policies can change consumer behavior is limited. Therefore, understanding the cultural and social drivers of human diets will also be important to inform the behavioral change policies that are required along with economic policies.

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