3 Feeding a fast-growing population by 2050 through accelerated agricultural transformation: potential avenues for Ethiopia

Tesfaye Shiferaw Sida, Temesgen Desalegn, Gashaw T. Abate, and Tilahun Amede

1 Introduction

In 2020, Africa's population reached 1.3 billion, and projections show it will rise to 2.5 billion by 2050 (UN-DESA, 2022). Meeting the escalating food demand in the continent while improving nutrition and safeguarding the environment and production resources poses significant challenges. Ethiopia offers a compelling case study to explore potential avenues for feeding a fast-growing population through accelerated agricultural transformation. Ethiopia has grappled with a challenging history marked by food insecurity, culminating in the famine of the 1980s. This severe famine, which unfolded against the backdrop of political and economic instability, brought Ethiopia's food crisis to a climax. This tragic historical chapter prompted an immediate need for humanitarian aid as well as a broader examination of systemic issues contributing to food insecurity. In the decades following the 1980s famine, Ethiopia has made notable strides in addressing food insecurity through various initiatives and international collaborations. The country's resilience and commitment to positive change serve as a testament to its ongoing efforts to overcome the shadows cast by historical challenges and build a more secure and prosperous future (Diriba, 2020).

As of 2023, Ethiopia's estimated population stands at 120 million. Projections indicate an increase to 135 million by 2033 (UN-DESA, 2022). By the middle of the century, the country is expected to become one of the world's top ten most populous countries, with a staggering 213 million inhabitants (CSA, 2020; UN-DESA, 2022). For the timeframe from 1993 to 2021, government statistics show that annual cereal production exhibited a consistent growth rate of 11.9%, increasing from 6 million to 210 million tons per year (FAO, 2023). Despite this remarkable growth, over a quarter of the population still lives below the poverty line, food insecurity persists, 12–16 million people face chronic hunger, and malnutrition is widespread (FAO et al., 2022). According to the Food and Agriculture Organization (FAO) estimates, approximately 20% of the country's population was experiencing acute food insecurity in 2021 (FAO, 2021). Furthermore, the Global Hunger Index (GHI)[1] report (GHI, 2022) assigns Ethiopia a score of 27.6, indicating a serious degree of hunger.

This reeling mismatch presents a substantial strain on the country's agricultural sector, which is already hampered by limited arable land, fragmented farms, suboptimal productivity, and environmental degradation (Yigezu Wendimu, 2021). While Ethiopia has achieved noteworthy successes in increasing agricultural productivity in recent decades (Diriba, 2020), the formidable task of matching this progress with its rapid population expansion has never been easy (Moreland and Smith, 2012). The deleterious effects of climate change and water scarcity further compound the country's food security concerns (Onoja et al., 2019). Increasing urban

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population poses an additional challenge to food security in Ethiopia. By 2050, projections indicate that about 83.3 million inhabitants, more than one-third (39%) of the country's projected population, will live in urban centres (UN-DESA, 2022).

Ethiopia's historic success in improving agriculture production and productivity can be attributed to several key strategies and initiatives (FAO, 2018). Yet, considerable room for improvement in crop productivity remains, as evidenced by the average maize yield of less than 4 tons per hectare, far less than half of what could be achieved (Assefa et al., 2020; Belachew et al., 2022; Van Dijk et al., 2020). Additionally, the country imports approximately US$1 billion worth of wheat annually. This is despite Ethiopia being one of the few African countries with great potential to produce rainfed wheat (Senbeta and Worku, 2023). The Ethiopian government has set a bold target for agricultural development, aiming for a 6.2% annual increase in agricultural output from 2020 baseline over the subsequent decade to sustain past achievements (MOF, 2020). Considering Ethiopia's commendable history of progress in agriculture, achieving this goal appears feasible. However, even if Ethiopia achieves this output target, it will still fall short of attaining complete food and nutrition security (FAOSTAT, 2023). To ensure food security for all its citizens by 2030, Ethiopia's agriculture must grow 13.3% annually, accounting for current deficiencies and the increased demand resulting from additional population (authors' calculation from FAOSTAT, 2023). Achieving such a substantial transformation requires unparalleled excellence and dedication. In this chapter, we explore pathways for accelerated agricultural transformation that can meet the increasing food demands while minimizing the reliance on unsustainable, energy-intensive, and resource-depleting production practices. We suggest moving beyond the traditional agriculture-led structural change pathway to achieve food systems transformation. In addition to structural change, where labour rapidly moves out of agriculture, and intensive agricultural growth, where labour gradually transitions from agriculture to more labour-productive sectors, we propose transformative strategies tailored for Ethiopia and Africa at large.

2 Agricultural development in Ethiopia: exemplary initiatives and lessons

Ethiopia has implemented several strategies and initiatives aimed at transforming its agricultural sector and achieving food security. Noteworthy development strategies and programmes such as the Agricultural Development-Led Industrialization (ADLI) strategy, the Agricultural Growth Program (AGP), and, more recently, the Ten Commodities in Ten Years (10-in-10) and Sustainable and Resilient Food System Transformation (SRFST) programmes have played a crucial role in the country's agricultural progress (UNCTAD, 2022). In this section, we review the impact of these initiatives, highlighting their successes, challenges, and lessons learned.

2.1 Agricultural Development Led Industrialization (ADLI) strategy

The Ethiopian government initiated the ADLI in the early 1990s with the aim of using agriculture as a driver for industrialization and overall economic growth (MOFED, 2010). The strategy drew upon theories from the 1960s that emphasized the development of smallholder agriculture to create demand for industrial goods and inputs (Mellor and Dorosh, 2010). The fundamental assumption underlying the ADLI is that enhancing agricultural productivity in rural areas generates surpluses that can be utilized by urban industries. Consequently, these industries can absorb additional labour, enabling the rural agricultural land to be utilized for even more intensive production. In addition, agricultural productivity growth can lead to higher rural incomes which generate demand for manufactured products. This approach was deemed appropriate because

agriculture represents the largest sector of the economy, employing the majority of the population and contributing substantially to the country's Gross Domestic Product (GDP) and export earnings.

While it is difficult to attribute all achievements to the ADLI, Ethiopia made progress with some of the objectives clearly set in the strategy (Atsbaha and Tessema, 2012). Official reports attribute the sustained annual agricultural growth of 7% over two decades to the ADLI strategy (ATI, 2016). For example, the country's poverty rate declined from around 45% in 1995 to about 23% in 2016 (World Bank, 2015).

Nevertheless, the degree to which the ADLI accomplished its objectives is mixed. While there was a sustained period of agricultural growth, ADLI's success in catalysing industrialization and overall economic development was limited. The ADLI strategy failed to implement several of its key components, which included the introduction of labour-intensive technologies, proper utilization of agricultural land, incorporating indigenous farming technologies, considering agro-climatic zones, integrating agricultural and rural development programmes, building agricultural marketing systems, improving rural finance, encouraging private investments, expanding rural infrastructure, and promoting off-farm activities for people operating in agriculture (Atsbaha and Tessema, 2012).

2.2 Agricultural Growth Programs (AGP I and II)

Drawing from the lessons learned through the ADLI, Ethiopia initiated the implementation of two consecutive five-year plans known as the AGP I and AGP II (MOFED, 2010). AGP I was executed from 2011 to 2015, followed by AGP II, which ran from 2016 to 2020 (National Planning Commission, 2016). Unlike its predecessors, these plans had a broader scope and did not concentrate solely on agriculture. The plans outlined a strategic framework that encompassed multiple sectors, including economic expansion, infrastructure development, agricultural advancement, industrialization, social development, human capital, and instilling good governance (ATI, 2016; Atsbaha and Tessema, 2012; Mellor and Dorosh, 2010; MOFED, 2010; National Planning Commission, 2016). These policies aimed to accelerate economic growth, reduce poverty, and improve living standards (World Bank, 2015).

Both AGPs have made a fair contribution towards the transformation of the country's economy (Osh et al., 2018). According to reports from the Ethiopian government, the remarkable growth in average annual GDP of 10.1% in the first half of the 2010s can be credited to AGP I (National Planning Commission, 2016). During the AGP II period, agricultural value added increased by 6.7% and contributed about 2.5 percentage points to the 10.9% growth of the overall economy, which was only slightly short of the 11.1% target for the period (National Planning Commission, 2018).

Despite the substantial economic expansion observed during the AGP eras, which aimed to achieve swift structural transformation and speedy industrialization by prioritizing the growth of the industry sector over agriculture (Mellor and Dorosh, 2010; MOFED, 2010), the actual shift from agriculture to industry fell short of the intended goals in terms of the economic contributions (National Planning Commission, 2018, 2016). By 2015, the manufacturing sector's share of overall GDP remained below 5% (World Bank, 2015). Additionally, agricultural products struggled to meet the quantity, type, and quality requirements of the export market, as well as the demands of growing industries and domestic consumption (National Planning Commission, 2018, 2016; World Bank, 2015). The economic transformation agenda faced limitations such as restricted agricultural input and output markets, unsustainable land and water management practices, inadequate agricultural research and extension services, insufficient infrastructure,

limited financial access for smallholders, and a general inability of the economy to undergo structural transformation (Sacko and Mayaki, 2020).

2.3 Recent transformation initiatives

Building upon previous efforts that led to notable improvements in agricultural productivity, the Ethiopian government has demonstrated a strong commitment to agricultural transformation. This dedication is exemplified by recent large-scale government initiatives. The Ethiopian government formulated an Agricultural Sector Plan (MOF, 2020), which was reinforced by the introduction of the "10-in-10" initiative in 2021 (Dessie et al., 2022). This initiative serves as the foundation for the National Agricultural Investment Plan (NAIP), and it focuses on ten commodities over ten years from 2020 to 2030. This plan aims to harmonize the country's priorities with the Comprehensive Africa Agriculture Development Program (CAADP) framework and establishment of Comprehensive National Flagship Programs (Sacko and Mayaki, 2020).

Wheat, which is one of the priority commodities in the "10-in-10" initiative, received considerable attention. The government's objective under the National Wheat Flagship Program was to enhance the productivity of both rainfed and irrigated wheat to attain self-sufficiency (Anteneh and Asrat, 2020). The "10-in-10" initiative encompasses the Ethiopian food system transformation[2] and Agricultural Commercialization Clusters (ACC) programmes. Its objective is to achieve significant increases in cereal production (85%), meat production (496%), fish production (356%), chicken meat production (140%), and milk production (127%) by 2030, compared to the levels of 2020 (African Union, 2021). To accomplish these goals, the agriculture sector is expected to grow at an annual rate of 6.2% between 2020 and 2030 (MOF, 2020; National Planning Commission, 2018). Undoubtedly, such a transformative undertaking necessitates not only unwavering commitment but also exceptional implementation capabilities.

Two questions arise. First, can the required resources (both human and material) be mobilized within the given timeframe? Second, even with such a transformation, will the country produce enough food to adequately feed the growing population? The answer to the first question may potentially be affirmative, considering the historical achievements of previous initiatives. In the subsequent sections, we explore potential answers to the second question.

3 The challenges

3.1 The continuing population explosion

Ethiopia's history is 'punctuated by famine.' This culminated in the 1980s with widespread famine and undernutrition, where over half of the country's population consumed less than 2,100 kcal per day (Webb and von Braun, 1994). In 1985, the number of people requiring food aid reached 7 million. Currently, despite a decrease in hunger rates in Ethiopia, for example, as indicated by a significant reduction in child stunting, the proportion and absolute number of individuals experiencing food insecurity remain disturbingly high. By 2022, the number of Ethiopians experiencing severe food insecurity stood at 22 million (FAO et al., 2022; FAO, 2023; IPC, 2019), nearly one-fifth of the country's population. Approximately 10–15 million required food assistance (FAO et al., 2022).

While the causes of famine and hunger are complex and multifaceted, food availability is a crucial factor. Since 1990, agricultural productivity has doubled (Atsbaha and Tessema, 2012; National Planning Commission, 2018; Osh et al., 2018), while total output grew even faster (Figure 3.1a).

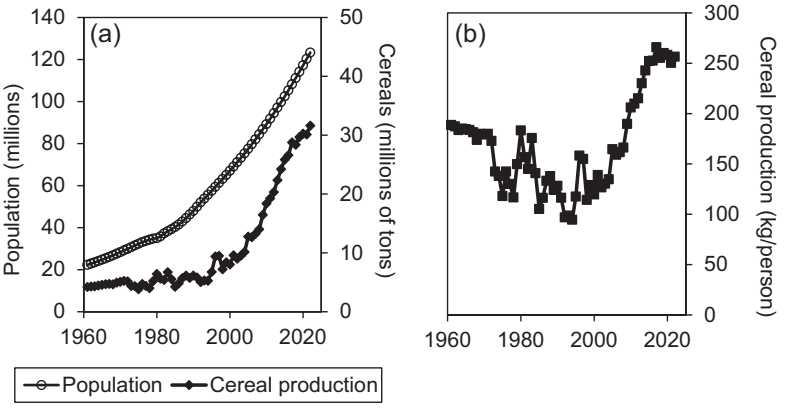

Figure 3.1 Relationship between population growth and change in cereal production between 1961 and 2022 (a) and cereal production per capita (b). Authors' representation (FAO, 2023) for cereal production and (UN-DESA, 2022) for population growth.

Figure 3.1b shows per capita cereal production, which can be categorized into three periods. Prior to the 1970s, the cereal-to-population ratio was relatively stable around 175 kg/person. The ratio declined from the late 1970s to the early 1990s, coinciding with catastrophic famines that hit the country. The third period, from the early 2000s to today, shows a consistent increase in the cereal-to-population ratio, albeit with a slight plateau since 2018. The plateau in recent years could be attributed to ongoing conflicts in the country, the COVID-19 pandemic, and fertilizer shortages following the Ukraine-Russia war. Although cereal production per person has increased since the 1980s, the number and proportion of people experiencing food insecurity have not declined equally fast. This is because food distribution has never been equal among the population, especially as consumption rates among urbanizing communities have been increasing (Mohamed and Weldesilassie, 2021).

3.2 Persistent food insecurity

Despite the positive developments, there are concerns that the projected increase in agricultural production may not be sufficient to meet the demand of the rapidly growing population. Figure 3.2 highlights the potential challenges that lie ahead. In 2022, approximately 20% of the country's population was experiencing acute food insecurity (FAO et al., 2022). According to Ethiopian Public Health Institute and Inner City Fund (EPHI and ICF) (2021), 37% of children under the age of five suffer from stunting, 21% are underweight, and 7% are wasted. About 22% of women aged 15–49 have a body mass index (BMI) below 18.5 (the ideal range being 20–24.9), underscoring their vulnerability to malnutrition.

Cereal production plays a critical role in Ethiopia's food security as it accounts for an average of 68% of the total per capita daily caloric intake (Wolle et al., 2020; Worku et al., 2017). Unfortunately, with the current and targeted trends in agriculture and population growth rates, Ethiopia is unlikely to achieve grain self-sufficiency by 2050. Even with efforts to supplement domestic production with imports, the magnitude of the deficit remains concerning (Figure 3.2). It is anticipated that around 2.5 million individuals, constituting 1.7% of the projected population in 2050, will experience extreme food insecurity (IPC, 2019; WFP, 2023).

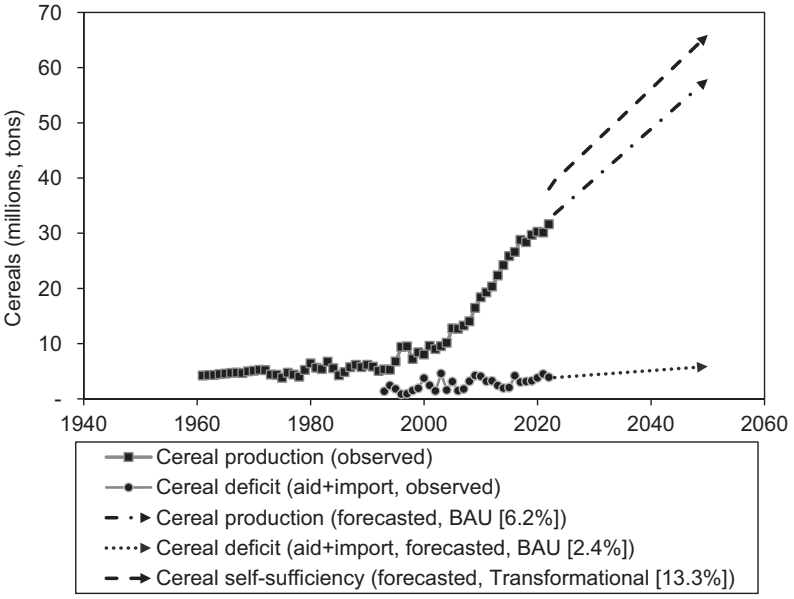

Figure 3.2 Historical and projected cereal production and deficit in Ethiopia (1961–2050). BAU stands for business-as-usual.

Source: Authors' calculation from Central Statistical Agency, Ethiopia (CSA), The World Bank Group (WB), Wold Food Program (WFP), and FAOSTAT and forecast made using the Autoregressive integrated moving average (ARIMA) model.

For Ethiopia to achieve full food self-sufficiency and eliminate the need for imports and food aid, the growth rate in agriculture needs to increase beyond the current target. Figure 3.2 illustrates that Ethiopian agriculture must grow at an annual rate of 13.3% to attain complete independence from food imports and ensure 100% food self-sufficiency through domestic production alone. However, whether domestic production should be considered as the sole path to food self-sufficiency may be debated. Such a significant need for increasing domestic production cannot be accomplished by adhering to business-as-usual practices. Meeting the target growth rate of 13.3% annually calls for a radical shift in the approach to agricultural development. It is a challenging but necessary endeavour to ensure Ethiopia's long-term food security, reduce dependency on imports, and create a sustainable agricultural sector capable of feeding its growing population.

3.3 Fragmented farms, suboptimal yields, and low labour productivity

There is a significant literature that reports an inverse relationship (IR) between land size and productivity (Delvaux et al., 2020), although recent findings suggest that the IR is an artefact of measurement error (Abay et al., 2019; Ayalew et al., 2024; Carletto et al., 2013). Contrastingly, agricultural intensification is constrained by the small sizes of farms and the absence of economic incentives (Giller & Andersson, this volume). Figure 3.3 shows that the IR exists only when we consider small farm sizes, less than 5 ha. These farms represent typical smallholder farm sizes in Ethiopia. Fragmentation of land may impede crop intensification due to numerous factors, including lack of economies of scale, limited access to modern agricultural techniques, low labour productivity, and inadequate resource allocation.

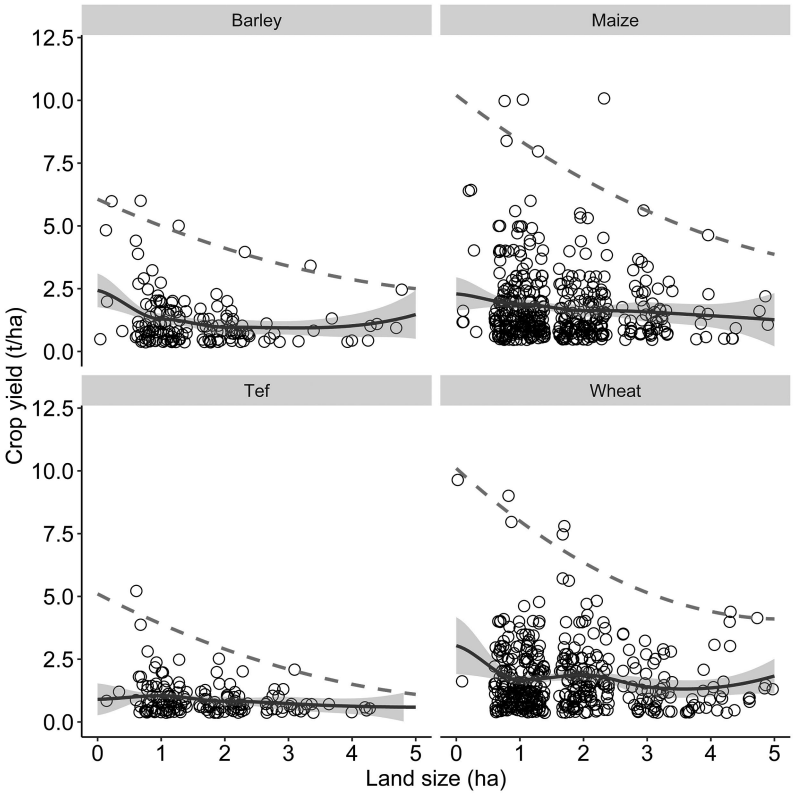

Figure 3.3 Land size per farm and average cereal productivity for non-clustered typical smallholder farms across four crops and from four states in Ethiopia.

Source: Dureti, Tabe-Ojong, and Owusu-Sekyere (2023). Bold lines represent fitted values to the mean, while the broken lines represent values fitted to 99 percentiles.

Upon examining the Agricultural Commercialization Clusters (ACC), an increase in land size for the range of 10–20 ha corresponds to a slight rise in cereal yield (Figure 3.4). The highest cereal productivity appears to be associated with land sizes ranging from 20 to 30 ha. This range potentially allows optimal use of resources, enabling farmers to achieve greater yields per unit of land. Similarly, for land sizes greater than this range, productivity either declines or remains constant, depending on the crop type. Notably, land sizes exceeding 40 ha are associated with a decline in productivity for barley and maize, while productivity remains constant for teff and wheat beyond this range. This suggests that there may be an optimal land holding size for optimizing cereal yield, similar to what is done for other agricultural inputs such as fertilizer. Beyond a certain point, the law of diminishing marginal returns applies, whereby additional land beyond the optimum size may result in reduced efficiency. Data from the ACC initiative indicates that cluster sizes larger than 40 ha do not offer additional productivity benefits. In many instances, clusters larger than this cut-off can actually lead to a decline in productivity. Although the mean land productivity of clustered farms consistently surpasses that of non-clustered farms, it is challenging to solely attribute these gains to land size, given that cluster farms benefit from improved access to inputs and extension advice. In addition, it is important to approach productivity figures resulting from government-led campaigns with caution, as they may require nuanced interpretations.

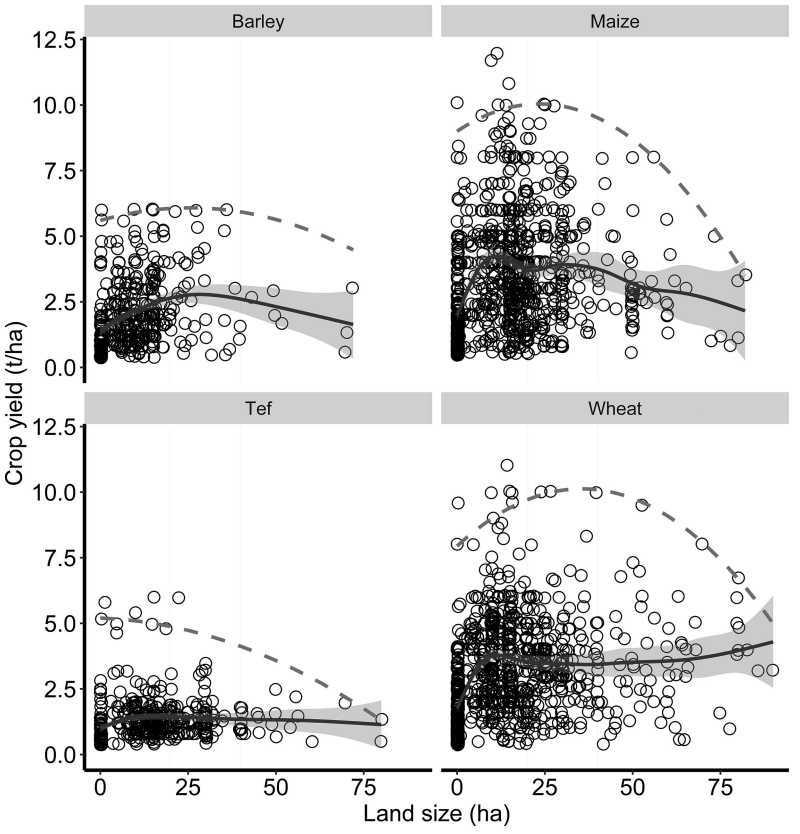

Figure 3.4 Land size per farm and average cereal productivity for clustered farms organized under the Agricultural Commercialization Clusters (ACC) implemented by the Ethiopian government across four crops and in four states in Ethiopia.

Source: Dureti, Tabe-Ojong, and Owusu-Sekyere (2023). Bold lines represent fitted values to the mean, while the broken lines represent values fitted to 99 percentiles.

4 Navigating the future: towards sustained food security for Ethiopia

4.1 Learning and building on past successes

As outlined earlier, Ethiopia has made significant strides in transforming its smallholder agriculture. Nonetheless, two key gaps remain, namely the narrow approach to sectoral change and a lack of implementation capacity (UNCTAD, 2022). In the past, many agricultural transformation efforts focused solely on specific aspects of the sector without considering the broader systemic factors. This often led to disconnected interventions that failed to address the root causes of low agricultural productivity. For example, many initiatives focused solely on boosting productivity by providing farmers with improved seeds or fertilizers without considering other critical factors such as access to credit, markets, infrastructure, or knowledge transfer. By overlooking these interconnected factors, such approaches miss the opportunity to create sustainable agricultural transformation. To overcome this, a more comprehensive approach that involves the entire agricultural value chain, from production to marketing and beyond, is needed. It requires

addressing the complex interactions among farmers, input suppliers, traders, processors, and consumers (see Ingenbleek et al., this volume).

Lack of implementation capacity, especially poor human capacity, was another significant barrier to the success of previous approaches. This includes a shortage of staff with the right mindsets, skills, and expertise, which hampers the design, implementation, monitoring, and evaluation of agricultural development programmes. To address this gap, it is crucial to invest in building human capacity at various levels by providing training and professional development opportunities to agricultural extension workers, researchers, and policymakers. Partnerships between academic institutions, research organizations, and governmental agencies can help bridge the knowledge gap and facilitate knowledge transfer. Capacity-building programmes should focus not solely on technical skills but also on fostering the right attitudes and motivations necessary for innovation, collaboration, and adaptive management.

4.2 Towards land consolidation: institutionalizing cluster farming[3]?

The Ethiopian government is taking proactive steps to initiate land consolidation through cluster farming, which involves grouping of smaller landholdings to form larger, more cohesive farming units while maintaining individual household's ownership rights. While cluster farming shows promise (Dureti et al., 2023; Endalew et al., 2024), there is apprehension regarding the associated expense, particularly with prolonged government involvement. The costs related to infrastructure development, resource allocation, and campaign-style support services may impose significant financial and logistical burdens on the government in the long run. To ensure the success and sustainability of this approach, its institutionalization, thereby facilitating permanent land consolidation, becomes paramount. By implementing targeted measures and efficient collaborations, cluster farming can facilitate achieving economies of scale, improved agricultural practices, efficient resource utilization, and expanded market opportunities. It is worth emphasizing that land-related policies and interventions in Ethiopia have been fiercely debated, largely due to the unsuccessful[4] land collectivization effort implemented by the military government between 1974 and 1984 (Omiti et al., 1999). Smallholders are suspicious of government involvement in land consolidation, fearing it could result in land appropriation, a scenario not uncommon during the Dergue era (Ottaway, 1977). There is a high probability that opinions among Ethiopia's present political and academic elites will sharply vary. Additionally, collective memories of the feudal serfdom system may not have entirely faded away among many smallholder communities in Ethiopia. Due to this delicate nature of land-related concerns, it is essential to consider the following points for cluster farming to thrive.

- Granting user rights on the condition of cluster membership: To encourage active participation and responsibility among farmers within cluster farms, user rights should be contingent upon adherence to cluster farming bylaws, conservation practices, adopting environmentally friendly techniques, and participation in capacity-building programmes. Supportive policies should ensure land tenure security without engaging in the controversial subject of land ownership reform in the country.
- Facilitating input delivery: To support the success of cluster farming, it is crucial to ensure timely and reliable access to and delivery of quality seeds, fertilizers, irrigation equipment, machinery, herbicides, and pesticides. A good strategy is to set up dedicated channels for cluster farms to streamline input distribution and lower costs, ideally with significant private sector involvement.

- Establishing storage, aggregation, and grading mechanisms: To maximize cluster farming benefits, efficient post-harvest handling and market integration are essential. Establishing nearby storage and aggregation centres helps preserve produce, reduce losses, and ensure steady supply. Training and infrastructure for grading and packaging can enhance product quality and market competitiveness.
- Facilitating sustained market access: Creating sustainable market linkages for cluster farms is essential for economic viability. By forming partnerships with market actors like wholesalers, retailers, food processors, and exporters, cluster farms can access markets directly, avoid intermediaries, and secure fair prices.
- Integration with agro-processing industries: In the long term, linking cluster farm products with urban agro-processing industries will benefit both parties. Cluster farms will provide raw materials to industries while accessing larger markets and value addition. Encouraging investment in agro-processing, supporting technology transfer, and incentivizing value addition will boost cluster farms' income and create jobs, strengthening rural-urban connections.
- Creating alternative job opportunities for rural labour: Adopting modern farming technologies in cluster farming may decrease the need for manual labour. The surplus rural labour can be absorbed by diversifying the rural economy through the promotion of industries, entrepreneurship, vocational training, and access to microfinance, thereby ensuring sustainable economic development.

4.3 Inclusive structural change and improved labour productivity

Agriculture-led growth has boosted farm productivity in Ethiopia, yet economic growth has lagged behind rapid population increases. This disparity underscores the necessity for a strategy that accelerates labour migration from agriculture to other sectors, emphasizing the need to address food security and create non-agricultural jobs.

It is important to recognize that the viability and sustainability of these approaches may vary across different regions within Ethiopia. Certain areas, such as the Bale plateau, have already experienced successful agriculture-led economic growth, particularly in wheat production. Conversely, in areas like the Central Rift Valley, where such strategies are less effective, exploring and adopting alternative approaches inclusively are essential.

To quickly transition labour from agriculture, it is essential to develop skills that prepare workers for non-agrarian sectors. For instance, Ethiopia's industrial parks had to employ foreign workers due to the local workforce's lack of necessary skills. Short, targeted technical and vocational training programmes, designed for emerging sectors, are crucial for this transition.

4.4 Revisiting cereal production and value chain

Ethiopian cereal production has been increasing but still falls short of its potential due to significant yield gaps (see Schut & van Ittersum, this volume) and very low fertilizer usage, averaging 36.2 kg/ha, although maize in some areas may receive up to 300 kg/ha. A recent study by Falconnier et al. (2023) revealed that the rate of mineral fertilizer required to maximize benefits greatly exceeds the current application rates in East Africa. The soils in Ethiopia have been highly degraded, depleted of nutrients, and mined for centuries, making external nutrient input a necessity rather than an option if the country is to transform its agriculture in a sustainable manner. Supplying appropriate amounts of fertilizers to replenish the depleted nutrients in the soil will support sustainable agricultural practices and increase productivity.

Another challenge is significant post-harvest loss, which ranges from 15.5% to 27.2% for major grain cereals and averages 23% across all crops (Debebe, 2022). This loss not only represents a waste of valuable resources but also contributes to food insecurity and economic inefficiency. Smallholders tend to produce only enough for their own consumption and rely on spontaneous surplus sales to cover small expenses such as basic consumer goods, school, or emergency medical fees (MOFED, 2010). The seasonality of the grain market has been a common disincentive for smallholders to produce surplus for the market (Negede et al., 2024). The current market value chain does not encourage smallholders to produce with commercial intentions, further limiting their economic opportunities. Addressing this issue requires interventions that provide smallholders with access to stable and profitable markets, incentivizing them to increase production and engage in commercial agriculture.

Grain companies are vital in transforming grain production, yet they are either absent or inefficient in the country. Companies involved across the grain value chain—production to processing and marketing—can be facilitated through public-private partnerships and government support. This approach would ensure fair returns for smallholder farmers, enhance production efficiency, and provide reliable market access, thus transforming Ethiopia's agricultural sector.

4.5 Beyond food self-sufficiency: exploring multiple pathways to food security

Ethiopia has recognized that achieving food self-sufficiency is not just an economic endeavour but also an important national security agenda. The recent wheat initiative serves as clear evidence of Ethiopia's commitment to achieving self-sufficiency and mitigating potential food security crises that could arise due to disruptions in the global supply chain. However, it is important to consider a broader range of strategies beyond self-sufficiency. Ethiopia possesses differentiated competitive advantages in the production of various commodities. The country, for instance, has a strong competitive advantage in boosting wheat production through the intensification of rainfed wheat. By contrast, large-scale irrigated wheat production does not offer the same competitive advantage due to concerns surrounding the large capital investment required to establish irrigation schemes, extended cost of maintaining the infrastructure, and their long-term environmental sustainability. Lowland irrigated wheat production is likely to face major issues of salinity and sodicity unless well-managed. Precision irrigation schemes may reduce these risks and improve water use efficiency, although establishing and maintaining such irrigation infrastructure are extremely expensive for the government. Smallholders may lack the incentives to pursue irrigated lowland production due to these obstacles. To address these challenges, Ethiopia could allocate its potential for irrigation to the cultivation of high-value commodities. Focusing on the production of crops for cooking oil, fruits, and horticultural crops, as well as other commodities such as cotton, tobacco, and sugarcane, would provide a competitive edge. The country needs to analyse whether achieving food self-sufficiency by replacing imports entirely is better than import of commodities through strategic regional and international trade using resources that can be generated from exporting high-value crops.

5 Conclusion: the way forwards

To feed the burgeoning population, Ethiopia needs to transform its agriculture. This endeavour presents a formidable challenge due to the intricate and multifaceted factors involved. If such a transformation is achievable at all, Ethiopia stands as one of the few countries with a genuine potential to accomplish it, mainly because of the country's present commitment and impressive track record. A comprehensive approach to agricultural transformation is realistic,

although challenging. Efforts so far have concentrated narrowly on specific commodities, leading to fragmented interventions and a restricted potential for impact. To overcome this, a holistic perspective that addresses interlinked factors is needed. This involves understanding complex interactions among actors and sectors. Building implementation capacity is vital, including partnerships to facilitate knowledge transfer to bridge existing gaps.

Consolidating fragmented landholdings into cohesive farming units via the institutionalization of cluster farming could significantly accelerate agricultural transformation. This approach promises economies of scale, which can enhance the adoption of productivity-boosting technologies and practices while expanding market opportunities. Optimizing cereal production and value chain management requires careful attention to fertilizer use and minimizing post-harvest losses. Additionally, establishing strong grain producing, marketing and processing companies could improve efficiency and offer smallholders stable market access.

Inclusive structural change is needed to transition the labour force from agriculture and create diverse employment opportunities. This requires investment in education and skills development, promoting technology adoption, improving finance access, developing market linkages, and implementing supportive policies and reforms. Beyond food self-sufficiency, Ethiopia should explore multiple pathways to food security. This includes capitalizing on competitive advantages, intensifying production of commodities where it excels, and considering strategic regional and international trade, the other times.

Notes

1 These GHI calculation scores are made on a 100-point scale, using combination of indicators that include standardized undernourishment, child stunting, child wasting, and child mortality rates, where 0 GHI value is the best score (no hunger) and 100 is the worst. In practice, neither of these extremes is reached. A value of 100 would signify that a country's undernourishment, child wasting, child stunting, and child mortality levels each exactly meets the thresholds set slightly above the highest levels observed worldwide in recent decades. A value of 0 would mean that a country had no undernourished people in the population, no children younger than five who were wasted or stunted, and no children who died before their fifth birthday (GHI, 2022). Ethiopia ranks 101 in the world for the GHI in 2023.
2 The Ethiopia's Food Systems transformation initiative focuses on five action areas that include ensuring access to safe and nutritious food for all, shifting to sustainable consumption patterns, boosting nature-positive production, promoting advanced, equitable livelihoods, and building resilience to vulnerabilities and shocks (Federal Democratic Republic of Ethiopia, 2021). These action areas are designed to align with United Nations Forum on Sustainability Standards Action Tracks.
3 Cluster farming is an agricultural practice that aims to optimize resources and enhance productivity by strategically grouping smallholder farmers within a defined geographical area. The method leverages the proximity of farm plots to foster collaboration, share resources, and achieve economies of scale.
4 With the exceptional case of the Arsi-Bale plateau, where collective farming from the Dergue period succeeded and is still viable.

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