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Synopsis: Agricultural Growth in Ethiopia (2004-2014): Evidence and Drivers

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Ethiopia's agricultural sector has recorded remarkable rapid growth in the last decade. This note documents aspects of this growth process. Over the last decade, there have been significant increases – more than a doubling – in the use of modern inputs, such as chemical fertilizers and improved seeds, explaining part of that growth. However, there was also significant land expansion, increased labor use, and Total Factor Productivity (TFP) growth estimated at 2.3 percent per year. The expansion in modern input use appears to have been driven by high government expenditures on the agricultural sector, including agricultural extension, but also by an improved road network, higher rural education levels, and favorable international and local price incentives.

INTRODUCTION

Ethiopia has been one of the fastest growing economies in the world in the last decade, a remarkable feat for a low-income country that exports relatively little oil and minerals. Ethiopia's growth acceleration since 2004 seems to be explained by three major drivers. First, there has been rapid physical capital accumulation, spearheaded by a substantial expansion of public investment. Second, agricultural modernization has speeded up as reflected by a substantial rise in agricultural productivity. Third, the service sector has seen a surge during this period, exceeding that of the agricultural sector. These drivers, in turn, were supported by a relatively stable political and macroeconomic environment.

The aim of this note is to further explore the second major driver of Ethiopia's growth acceleration: the rapid expansion in agriculture observed since 2004. National official data show that agricultural output has grown on average by 7.6 percent per year over the last decade, and this agricultural growth has been a major contributor to the important poverty reductions observed in the last decade in Ethiopia. This paper contributes to our knowledge in three main ways:

- It reviews evidence on agricultural growth and its sources;
- It assesses evidence of accelerated adoption of improved agricultural technologies; and
- It identifies the main drivers of Ethiopia's agricultural modernization process.

AGRICULTURE AND THE FOOD SECTOR

During the period from 2004/05 to 2013/14, real gross domestic product (GDP) in Ethiopia grew at an average annual rate of 10.7 percent, while real per capita GDP grew at an average annual rate of 7.9 percent. The agricultural sector grew at an average annual rate of 7.6 percent, accounting for 47 percent of real GDP on average over the last decade. Agriculture was the largest contributor to GDP until the services sector took over in 20010/11.

In terms of employment, agriculture engaged the largest proportion of the population of all sectors, employing 80 percent of all Ethiopian workers in 2005 and 77 percent in 2013. Agricultural employment grew at an average annual rate of 2.5 percent between these years.

Similarly, agriculture plays an important role in Ethiopia's commodity exports. Agricultural exports, on average, contributed 81 percent of total commodity exports between 2004/05 and 2013/14. Over the last decade, the real value of total and agricultural exports increased at average annual rates of 11.0 and 9.6 percent, respectively, and the total real value of agricultural exports was twice as high in 2013/14 as in 2004/05.

Coffee is the most important export crop, accounting for, on average, 29 percent of total exports. However, we note increasing export diversification with the relative share of coffee exports declining – but quantities of exports slightly increasing (Minten et al., 2014) – from over 39 percent in 2004/05 to 22 percent in 2013/14. The next most important export item after coffee is oilseed, accounting for an average of 17.4 percent of total exports, followed by chat at 8.7 percent. Two other products in particular showed rapid growth over the last decade. Flower exports comprised one percent of total exports in 2004/05. These increased to 6 percent in 2013/14. Exports of meat products and live animals have also shown rapid growth, from 3 percent in 2004/05 to 8 percent in 2013/14. Although agricultural exports grew considerably in the last decade, the majority of agricultural output is still consumed domestically rather than exported.

AGRICULTURAL GROWTH OVER THE LAST DECADE

Over the period studied, changes have occurred in the area cultivated nationally, in total output, and in yields. To detect these changes, we use data from the government's Central Statistical Agency (CSA) from its annual publications, and specifically concentrate on changes for smallholder farmers in the main *meher* cropping season only.

In 2013/14, the total cultivated area was 27 percent higher relative to 2004/05, with annual growth averaging 2.7 percent during the decade. Grain accounted for about 96 percent of the total cropped area over the period 2004/05 to 2013/14. In particular, nearly three-quarters of the area was covered by the five major cereals – teff, barley, wheat, maize, and sorghum.

With regard to output and yield, smallholder farmers dominate agricultural land use, although the relative importance of commercial farmers is increasing over time. Commercial farms have slightly higher yields than smallholders, but they tend to specialize in particular crops. The most important crops cultivated by commercial farms are sesame (27 percent of their total area), cotton (17 percent), and coffee (12 percent).

According to CSA estimates, total agricultural output during the *meher* season in 2013/14, estimated at 32 million metric tons, was

124 percent higher than output in 2004/05, with annual growth in output averaging 9.4 percent over this period. Growth in output was mainly driven by increases in output from cereals, which grew at 9 percent per year and accounted for 72 percent of the total output on average during the same period. Yields in cereals grew faster relative to other crop groups (Table 1).

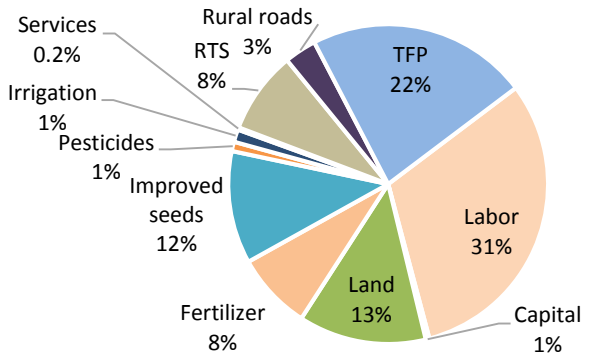
Table 1 – Crop yields (in quintals per hectare)

Crop	2004 /05	2005 /06	2006 /07	2007 /08	2008 /09	2009 /10	2010 /11	2011 /12	2012 /13	2013 /14
Cereals	11.8	12.7	14.4	15.3	16.7	16.9	17.8	20.0	21.6	21.4
Pulses	8.7	8.5	9.5	10.5	12.0	11.8	13.2	13.1	13.7	14.5
Oilseeds	5.4	4.8	5.5	8.2	8.2	7.8	8.6	8.1	8.4	8.7
Vegetables	57	47	43	50	51	54	58	68	64	63
Root crops	98	78	75	86	87	88	97	92	163	151
Fruits	47	86	83	67	67	73	68	79	70	60

Source: Authors' computation using CSA annual reports (2005-2014)

The number of smallholder farmers grew from 11 million in 2004/05 to 15.3 million in 2013/14, an average annual growth rate of 3.8 percent. On average, about 31 percent of agricultural growth over the period 2004-2014 arose from increases in the amount of labor applied to crop production (Figure 1). Similarly, expansion in cultivated land accounted for about 13 percent of the growth in crop production. A further 12 percent of the growth originated from an increase in the use of improved seed, and 8 percent from chemical fertilizer use. Finally, rural roads and returns to scale (RTS) contributed 3 percent and 8 percent, respectively, to overall crop output growth.

Figure 1 – Contributing factors to crop output growth in Ethiopia, 2004/05–2013/14, by percent of contribution to overall growth



Source: Authors calculations based on Agricultural Sample Survey data, CSA.

From the analyses, crop growth resulting from changes in Total Factor Productivity (TFP) – possibly linked to farmers' better management skills because of improved education, or access to better information – was 2.3 percent during the period. Results from these analyses not only indicate the importance of labor and land in output growth recorded in the last decade, but also indicate the rising importance of modern inputs, which have been increasing over time, particularly chemical fertilizers.

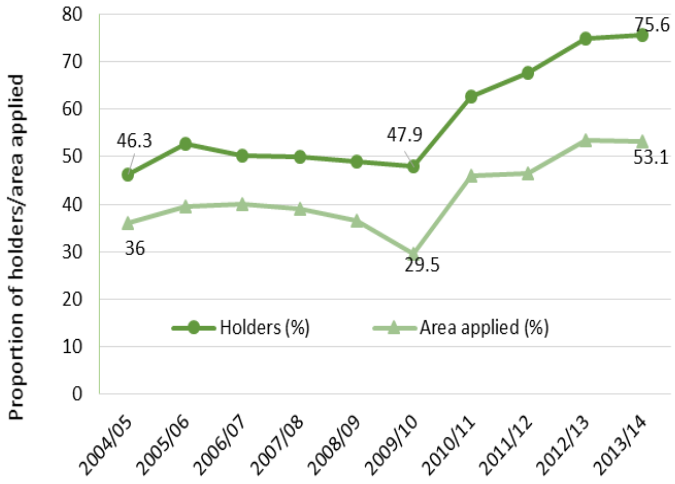
Data from complimentary datasets also were used to assess agricultural growth over the study period. These complementary data similarly illustrate significant yield and production growth, particularly in the cereal sector.

MODERNIZING THE AGRICULTURAL SECTOR

By examining the use of different technologies in agriculture since the early 1990s, we see the effects of different government strategies on the adoption of modern agricultural technologies in Ethiopia. The adoption of chemical fertilizer and improved seed packages has been central to these strategies.

- **Chemical fertilizer** - Ethiopia has some of the most crop nutrient depleted soils in Africa. Despite the introduction of chemical fertilizers in the late 1960s, their application levels have remained low. However, fertilizer imports and their use have dramatically increased over the last two decades. Most fertilizer in Ethiopia is used on cereals, with the cereal area fertilized nearly doubling from 2.7 million hectares in 2004/05 to 5.2 million hectares in 2013/14 (Figure 2). Fertilizer use on other crops has also shown significant increases over the same period.

Figure 2 – Proportion of cereal-growing smallholders using fertilizer and cereal area of fertilizer applied



Source: Authors calculations based on Agricultural Sample Survey data, CSA.

- **Improved seed** - The number of improved seed varieties released to farmers increased rapidly in Ethiopia over the last decade, although from a low base. Improved variety release has been particularly dynamic for wheat – an estimated 54 of the 87 improved wheat varieties available in Ethiopia were developed and released in the period 2001-2011. Varietal release rates are lower for other cereals. While adoption rates of improved seed varieties by farmers are low overall, the proportion of farmers using improved seed, however, has seen significant improvements, with more than a doubling noted over the last decade, from 10 percent of cereal producers using improved seed in 2004/05 to 21 percent in 2013/14. Large increases in the proportion of farmers adopting improved seed are noted for maize producers in particular.
- **Irrigation and pesticides**. Access to irrigation is low and has not changed significantly in the last decade for any crop categories during the major *meher* season. Some increase is seen in the use of pesticides – pesticides were used on 13 percent of the crop area in 2004/05, increasing to 21 percent in 2013/14.

In summary, the analysis shows that the use of chemical fertilizer, improved seeds, and pesticides over the period 2004/05 to 2013/14 has doubled, illustrating modernization and intensification of agriculture in Ethiopia. The analysis also shows that the uptake of these improved agricultural technologies has especially occurred in the second half of the last decade, i.e., between 2009/2010 and 2013/14, with the observed agricultural growth being linked more with greater use of modern inputs in this period. In contrast, land expansion and TFP growth were the major contributing factors to agricultural growth in the period between 2004/05 and 2009/10.

DRIVERS OF CHANGE

To identify the drivers of the increasing adoption of improved technologies in the last decade, two conditions are required. First, these drivers need to be linked to significantly greater adoption of improved practices. Second, they need to have shown major positive changes over the last decade.

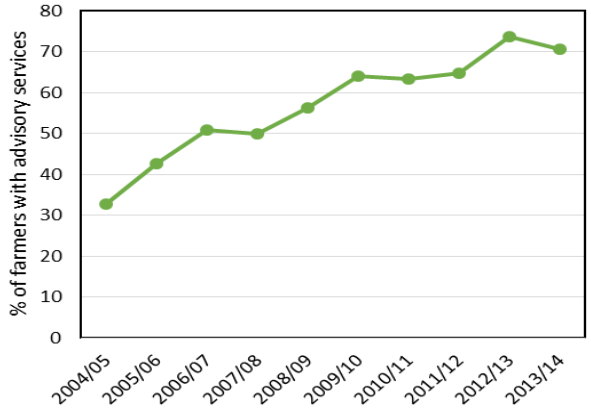
Using data from CSA's Agricultural Sample Survey of 2008/09, we examine different factors potentially associated with the adoption of improved seed or chemical fertilizer for the four main cereals in the country, teff, maize, wheat, and barley. The results show large and significant effects of extension input, remoteness, and education on improved technology adoption. Moreover, the ratio of output over input prices is been shown to be a major incentive for the adoption of fertilizer and other commercial inputs.

The broader context for this improvement in the performance of the agricultural sector is that Ethiopia signed the Comprehensive Africa Agriculture Development Programme (CAADP) agreement in 2003 and was one of the few countries in Africa to attain the target of 10 percent of annual government expenditures going to agriculture. These expenditures have facilitated agricultural performance, including:

Changes in informational efficiency

The government has invested heavily in agricultural extension and the provision of advisory and training services. The number of smallholder farmers who utilized these services increased from 3.6 million in 2004/5 to 10.9 million in 2013/14, or an increase from 33 percent to 71 percent of all farmers (Figure 3).

Figure 3 – The share of smallholders covered through the public extension system, 2004/05-2013/14

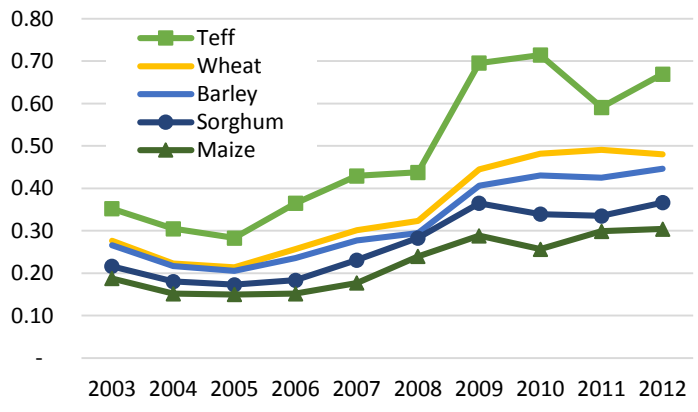


Source: Authors' computations using CSA annual Agricultural Sample Survey household level data (CSA 2004-2014)

Changes in input and output market efficiency

Markets in Ethiopia function better because of improved road infrastructure, lower transaction costs, and improved access to market information. For example, the total length of all-weather surfaced roads in Ethiopia tripled between 2000 and 2013. Significant changes in input and output markets have provided added incentives to farmers to intensify farming with more favorable output price to chemical fertilizer price ratios (Figure 4). The real price of export commodities has also increased significantly over this period, leading to higher investments.

Figure 4—Output – fertilizer price ratio



Source: Berhane et al., forthcoming.

Changes in human capital accumulation and labor markets

Ethiopia made significant strides towards universal primary education coverage over this period, particularly in rural areas. The number of educated farmers has increased as some of these students work in the agricultural sector after studying. Moreover, efforts have been made to make adult education accessible. Growth in the proportion of farmers with higher levels of education over the last decade is significant. The CSA data show that the share of illiterate farmers declined at 1.8 percent per year over this period, while the proportion of farmers with at least grade 9 education increased by 15 percent between 2004 and 2013.

Changes in other factors

- **Good weather** - No major drought occurred during the decade between 2004 and 2013 and rainfall patterns were relatively stable. In the event of such shocks occurring, Ethiopia benefits from a good early warning system in place and also has set up a large safety net program, the Productive Safety Net Programme, to deal with the consequences of drought.
- **Access to credit** – This has shown remarkable growth over the last 2 decades with the establishment of micro-finance institutions and credit cooperatives across the country. However, most of the credit has not been used for agricultural purposes.
- **Managing risk and the effect on technology adoption** – It is plausible that the riskiness of modern technology adoption in agriculture has changed due to a number of factors including: (i) the doubling of output-input price ratios makes much less likely the possibility of negative returns to fertilizer use in the event of bad weather; (ii) there is now a functioning public safety net for many; (iii) a relatively long period of good weather over the period analyzed may make the occurrence of bad weather shocks more muted, thereby changing farmers' expectations of the risk; and (iv) farmers are seemingly richer, have more assets, and are better able to self-insure.
- **Land scale certification program** – This program has allowed for more tenure security for farmers on their land and has become an enabler of investments in the land for increased agricultural production.

CHALLENGES FOR AGRICULTURAL GROWTH AND CONCLUSIONS

Many significant changes in the agricultural sector of Ethiopia have occurred over the last decade. Agricultural output more than doubled, driven in part by area expansion and yield increases. Export earnings from agricultural commodities doubled and average per capita food consumption increased by more than 20 percent.

A number of improved technologies have been adopted at significant scale, notably the use of chemical fertilizer. More improved varieties were released during this period of study than in the previous 30 years. While seed distribution remains an issue, their use doubled during this period.

A number of drivers for the increasing adoption of modern inputs have been identified. Most of these are linked with higher levels of public expenditure, including on agriculture, with major initiatives being:

- The establishment of a large agricultural extension system;
- Significant improvements in access to markets; and
- Improved access to education leading to a decrease in illiteracy in rural areas

A number of other factors have helped as well, including high

international prices of export products, better local incentives for fertilizer use, good weather, better access to micro-finance institutions, and improvements in tenure security.

Despite remarkable agricultural growth, to safeguard this growth in the future, a number of challenges should be addressed:

- Give greater attention to sustainable intensification of land as it becomes constrained in areas of higher population density.
- Provide more appropriate chemical fertilizer packages. The soil mapping project of the government aims to address soil deficiencies for optimal crop production by delivering the right fertilizers for depleted soils. More timely and efficient distribution of chemical fertilizer also is required.
- Encourage higher adoption rate of improved and high performing seeds through better supply, marketing conditions and the provision to farmers of appropriate information on their proper use.
- Greater involvement of the private sector in input markets.

In addition to the challenges outlined above, other considerations include:

- **Climate change.** This is expected to have a significant impact on Ethiopian agriculture in the decades ahead. Shifting rainfall patterns and increasing temperatures will lead to a decrease in crop yields. Incorporating climate change considerations in the design and implementation of agricultural development programs will become increasingly important.
- **Nutritional improvements.** The slow change in nutritional indicators and high child stunting prevalence in the country requires greater attention on how agricultural growth can be enhanced to more effectively address malnutrition and to improve dietary diversity. While there are still a number of unknowns on how this nutritional transformation can be most efficiently achieved, behavioral change communication, sanitation, improved market access, and food crop production diversity, especially in less connected areas, have major roles to play.
- **Changing demands for foods and different consumption baskets.** Along with this, new and different value chains are emerging which will require investments in new technologies to help fulfil demand.
- **Gender issues.** Empowering women in agriculture has proven pay-offs for nutritional and agricultural outcomes.
- **Mechanization.** The transforming agricultural economy has led to higher rural wages, and this provides incentives to innovate by introducing labor-reducing technologies, such as mechanization. Accessing the right machines and spare parts at affordable prices remains however a challenge.

REFERENCES

Refer to ESSP Working Paper 81 for a full list of references used in this study.

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