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# The Economywide Effects of Teff, Wheat, and Maize Production Increases in Ethiopia

Results of Economywide Modeling

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## INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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The study of the economywide effects of cereal production increases in Ethiopia was done to provide evidence to the Ethiopian Agricultural Transformation Agency (ATA) to guide investments and program interventions that it and its partner institutions make in the cereals subsector in the country. While we benefited from the engagement and interest in this work shown by several ATA technical analysts, in particular we thank Nicky Goulimis and Dawit Mulugeta, both of the ATA Markets Program, for working with us to define the production and program scenarios that were modeled.

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## ABSTRACT

The government of Ethiopia is investing significant public resources to increase overall national production of teff, wheat, and maize. To better understand the likely economywide effects of increases of between 12 and 14 percent in the national production of these cereals, a set of production increase scenarios for each crop were run using a computable general equilibrium model of the Ethiopian economy. The analyses were extended to also consider the effects of several international wheat price and wheat import scenarios, a wheat subsidy program, and maize exports. Among the effects considered are changes in economic growth, prices, total household consumption, cereal and calorie consumption levels, and poverty measures.

The model estimates that the Ethiopian economy would be 1.4 percent larger if the desired production increases for all three cereals were jointly achieved. However, the cereal production increases do not bring about much change in the structure of the economy of Ethiopia. While the agriculture sector expands by 3.1 percent, there is virtually no increase in the size of the nonagricultural sector as a result of increased cereal production. The impact of these cereal initiatives on the consumption and welfare of various household groups in the country are uniformly positive—higher consumption and reduced poverty. However, different household groups benefit depending on which cereal sees its production levels rise. Teff production increases will provide greatest benefits for urban consumers, particularly poor urban households, while the economic benefits of increases in maize production will principally flow to rural households, both poor maize consumers and maize producers. The benefits of increased wheat production are more evenly shared.

Turning to the economic effects of the crop-specific policies or programs evaluated using the model, the analyses of wheat imports demonstrate that Ethiopia's reliance on international sources for about one-fifth of the wheat that it consumes exposes it to volatility in international wheat markets. However, we also found that with a drop in wheat imports, Ethiopian wheat producers can be expected to produce about 80 percent of the reduction in imports. The analysis of the wheat subsidy program showed that this urban-targeted program results in lower welfare for rural households, as the increased income for wheat producers resulting from the increased demand associated with the subsidy program is smaller than the aggregate cost of the higher wheat prices that result, which unsubsidized rural wheat consumers must face. Finally, the results of the maize export scenarios were not unexpected—higher maize prices and reductions in maize consumption affecting the poor more than the nonpoor—while maize producers realize benefits to their welfare.



**Keywords: Ethiopia, cereal sector, economywide modeling**

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ATA | Agricultural Transformation Agency |
| CGE | Computable General Equilibrium economywide model |
| CSA | Central Statistics Agency |
| FAO | Food and Agriculture Organization of the United Nations |
| GDP | gross domestic product |
| GTP | Growth and Transformation Plan |
| HICES | Household Income, Consumption, and Expenditure Survey |
| IFPRI | International Food Policy Research Institute |
| SAM | social accounting matrix |

# 1. INTRODUCTION

The sufficient consumption of cereals is central to the well-being of virtually all Ethiopian households. Almost two-thirds of all calories consumed come from cereal grains, while more than 40 percent of the value of the average household food basket in Ethiopia is made up of cereals (Table 1.1). The diverse cropping systems of the country provide a range of cereals, with teff (*Eragrostis tef*), wheat, maize, barley, and sorghum each being locally important in specific areas for food security. Nationally, teff, wheat, and maize in particular are at the center of the increasingly vibrant agricultural output markets of Ethiopia (Minten, Stifel, and Tamru 2014). The level of annual production of these cereals is central to Ethiopia's national food security.

**Table 1.1 Cereals in Ethiopia, 2004/2005: Share of total calories consumed and share of household food expenditures, in percentages**

| | National | | Rural | | Urban | |
|---|---|---|---|---|---|---|
| **Food item** | **Calories** | **Food expenditures** | **Calories** | **Food expenditures** | **Calories** | **Food expenditures** |
| **All cereals** | **64** | **41** | **64** | **43** | **64** | **27** |
| ***Teff*** | ***11*** | ***9*** | ***8*** | ***8*** | ***30*** | ***17*** |
| ***Wheat*** | ***13*** | ***9*** | ***13*** | ***10*** | ***10*** | ***5*** |
| ***Maize*** | ***17*** | ***9*** | ***18*** | ***10*** | ***5*** | ***2*** |
| ***Other cereals*** | ***24*** | ***14*** | ***24*** | ***15*** | ***18*** | ***3*** |
| Other foods | **36** | **59** | **36** | **57** | **37** | **73** |
| Total | **100** | **100** | **100** | **100** | **100** | **100** |

Source: Berhane et al. (2012).

Given the centrality of teff, wheat, and maize to the food economy of Ethiopia, increased domestic production of the cereals can be expected to benefit both producers and consumers of the crop and lead to positive wider economic effects. Higher productivity potentially will provide higher incomes for farmers, improving the welfare of their households and enabling them to increase their assets. Increased supply of grain will lower prices for cereal consumers, increasing their overall consumption and allowing them to productively reallocate economic resources that they previously devoted to food. Increased supply of domestically produced wheat, in particular, should reduce the level of wheat imported into Ethiopia, freeing up foreign exchange for other developmental purposes. More generally, increased productivity should result in increased capital investment in agriculture or in other sectors of the Ethiopian economy, propelling broader economic growth.

This report presents an analysis of some of the wider economic effects that are anticipated to result from a significant increase in Ethiopia in the production of teff, wheat, and maize, both separately and jointly. This is done through the use of a computable general equilibrium (CGE) model of the Ethiopian economy. The modeled economic outcomes of significant crop production increases are compared against those that result from a baseline, business-as-usual scenario in which the dynamics in the production levels of these cereals during the past several years is maintained in the running of the model. After reporting on the economic impact of these cereal production increases, the economic effects of several crop-specific policies or programs are evaluated using the model—three for wheat and one for maize. The results from this modeling exercise can serve as one component of the evidence used to design economic and agricultural development strategies and programs in Ethiopia.

## Cereal Productivity Interventions of the Ethiopian Agricultural Transformation Agency (ATA)

The government of Ethiopia, through its Agricultural Growth Program, the agricultural-sector program for the Growth and Transformation Plan (GTP) of the country, seeks to sustainably improve crop production and productivity through increased use by farmers of best agronomic practices and increasing the availability and adoption of improved inputs, particularly seed and fertilizer. Cereals are at the center of most of these efforts. The overall target of GTP is at least 8.1 percent annual agricultural growth during the period of GTP implementation from 2011 to 2015. Among the subsectoral targets is a more than doubling of the production of key crops during this five-year period.

In consequence, the Ethiopian ATA, the government agency established in 2010 to catalyze agricultural transformation in the country, instituted in 2012 and 2013 crop-specific initiatives for teff, wheat, and maize in a focused effort to advance toward the productivity targets of GTP. Under each initiative, ATA, working through the regional bureaus of agriculture, makes available to farmers in the *woredas*—the district-level administrative units—targeted by the initiatives improved access to inputs, agricultural advisory services, output markets, and in some cases, agricultural financing. These packages of improved access to agricultural inputs and services are expected to lead to significant sustained increases in the amount of each cereal produced in the target *woredas*. When program rollout is complete, the Teff Initiative, if implemented as designed, is to be operating in 209 *woredas*, the Wheat Initiative in 95 *woredas*, and the Maize Initiative in 132 *woredas*. These target *woredas* are located in high-potential areas in the Tigray, Amhara, Oromia, and Southern Nations, Nationalities, and Peoples regions.

ATA managers responsible for the three initiatives sought to gain additional insights into the likely effects that a sustained increase in productivity of the cereals would have on a range of economic and welfare outcomes. As the International Food Policy Research Institute (IFPRI) has a project under which it provides analytical support to ATA, the Research for Ethiopia's Agriculture Policy project, ATA staff asked IFPRI whether it could explore the broader impact that the initiatives would have. As IFPRI researchers, working with Ethiopian policy research institutions, have during the past decade developed a detailed CGE model of the Ethiopian economy, it was proposed that this model be used to obtain a clearer idea of the likely broader economic effects of the significant increases in the production of teff, wheat, and maize that ATA envisions. Thereafter, an iterative process was engaged in between IFPRI researchers and ATA staff to develop various scenarios related to the ATA Teff, Wheat, and Maize Initiatives or associated policies and programs that could be run in the CGE model.

The ATA cereal initiatives are not implemented solely for agricultural development but also have the objective of advancing Ethiopia further along the pathway of economic and broad social development laid out in GTP, the master development framework for the country. Consequently, the use of a CGE model to consider the likely economywide impacts of the initiatives is appropriate. Strong interlinkages occur across agricultural subsector and between agriculture and the rest of the Ethiopian economy, particularly between rural net producers and urban net consumers. The model is based on a detailed social accounting matrix (SAM) for the Ethiopian economy that has highly disaggregated information about subsector and agroecological regions within the agricultural sector. The CGE model of Ethiopia provides a tool to better understand these linkages and how agricultural growth can contribute to the broader development goals of the country. The model provides an integrated analytical framework by which we can examine how different growth projections among different agricultural commodities or subsector might reinforce or work at cross-purposes to each other and thereby evaluate their combined effects on economic growth and poverty reduction in Ethiopia.

## 2. THE ECONOMYWIDE MODEL FOR ETHIOPIA

To assess the economic growth, price, consumption, and distributional impacts of increased teff, wheat, and maize productivity and selected crop-specific policies and programs, we used a CGE model that differentiates agricultural production in different regions of Ethiopia and a microsimulation module that captures the heterogeneity of Ethiopian households' incomes and expenditures. The model was developed to capture tradeoffs and synergies from accelerating growth in various subsectors of agriculture, the economic interlinkages between agriculture and the rest of the economy, and the effects of different sources of growth on household incomes and poverty. The model is recursive dynamic and is run using annual time-steps during the 10-year period from 2006 to 2015. As such, the model is solved as a series of equilibriums with economic actors optimizing their behavior within each time-step period; that is, there is no intertemporal or long-run optimization.

The model identifies 69 subsectors, 24 of which are in agriculture (Table 2.1). Agricultural crops fall into five broad groups, including cereals. The cereals group is further separated into teff, barley, wheat, maize, sorghum, and millet. Most of the agricultural commodities captured by the model not only are consumed by households or exported but also are used as inputs into various processing activities in the manufacturing sector. Similarly, the agricultural subsectors in the model also use inputs from nonagricultural sectors. The model is constructed to incorporate these linkages between agriculture and other segments of the wider economy.

**Table 2.1 Subsectors in the computable general equilibrium model of the Ethiopian economy**

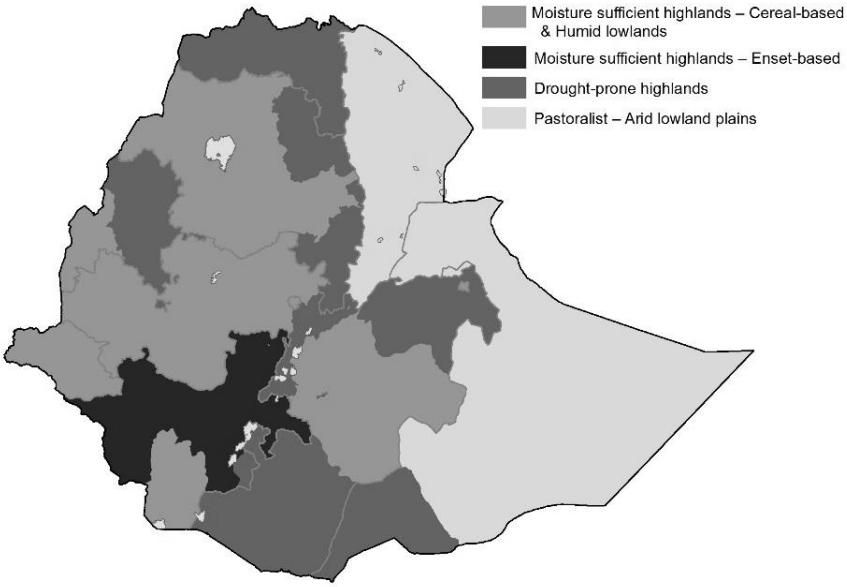
| Sectors or groups within sectors | Subsectors |
|---|---|
| Cereals | teff, wheat, maize, barley, sorghum |
| Pulses and oilseeds | pulses, oilseeds |
| Horticulture | vegetables, fruits, enset |
| Export crops | cotton, sugarcane, tea, tobacco, coffee, cut flowers |
| Other crops | chat, other crops |
| Livestock | cattle, milk, poultry, animal products |
| Other agriculture | fisheries, forestry |
| Agroprocessing | meat, dairy, vegetable products, grain milling, milling services, sugar refining, tea processing, other food processing, beverages, tobacco processing |
| Other manufacturing | textiles, yarn, fibers, lint, clothing, leather products, wood products, paper and publishing, petroleum, fertilizer, chemicals, nonmetallic minerals, metals, metal products, machinery, vehicles and transport equipment, electronic equipment, other manufacturing |
| Other industry | coal, natural gas, other mining, electricity, water, construction |
| Services | wholesale and retail trade, hotels and catering, transport, communications, financial services, business services, real estate, other private services, public administration, education, health |

Source: Dorosh and Thurlow (2012).

The model captures regional heterogeneity within the agricultural sector of Ethiopia's economy. Farm production is disaggregated across four rural zones, as shown in Figure 2.1. These zones reflect different agroecological and climatic conditions across the country. The CGE model is calibrated to observed cropping patterns in each of the four zones. Representative farmers in each zone respond to changes in production technology, commodity demand, and prices by reallocating their land across different crops to maximize incomes. These farmers also reallocate their labor and capital between farm and nonfarm activities, including livestock and fishing, wage employment, and diversification into nonagricultural sectors, such as transport, trade, and construction. By capturing production information

across subnational regions, the CGE model is useful for capturing the growth linkages and income and price effects resulting from changes in productivity for teff, wheat, and maize and changes in policies and programs related to those cereals.

**Figure 2.1 Spatial disaggregation of the computable general equilibrium model of the Ethiopian economy**




Source: Adapted from Dorosh and Thurlow (2012).

The model endogenously estimates the impact of changes in cereal productivity and changes in policies and programs on the value of household consumption, poverty, and per capita calorie consumption. There are 12 representative household groups in the model, disaggregated by the four rural zones and small or large urban centers and by their poor or nonpoor status. The poor are defined here as including all households falling into the bottom two consumption quintiles (that is, the poorest 40 percent of the population).

The Ethiopia CGE model has a microsimulation component whereby each sample household from the 2004/2005 Household Income, Consumption, and Expenditure Survey (HICES) is directly linked to a corresponding representative household in the model. Changes in representative households' consumption expenditure and prices in the CGE model component are passed down to their corresponding households in the survey, where the values of total expenditures as captured in the survey data for each sample household are recalculated. This new level of per capita expenditure for each survey household is compared to the separate poverty lines for rural and urban areas, and standard poverty measures are recalculated. Similarly, changes in food consumption patterns of sample households can be computed to determine changes in daily per capita calorie consumption associated with various scenarios run in the CGE model.

The model makes a number of assumptions about how the economy maintains macroeconomic balance. For the current account, a flexible exchange rate maintains a fixed level of foreign savings. This means that the government cannot increase foreign debt to pay for new investments and that export earnings are needed to pay for any additional imports. For the government account, tax rates are fixed, and recurrent expenditure grows at a fixed rate. The fiscal deficit therefore adjusts to ensure that public expenditures equal receipts—as such any new or expanded government program will require additional revenue to finance. Investment and private consumption are also fixed shares of absorption, with private savings adjusting to ensure that savings equals investment in equilibrium.

The core dataset used to create the CGE model is the 2005/2006 SAM, which captures the economic structure of the Ethiopian economy. The SAM provides a balanced accounting of all economic transactions that take place within the economy, drawing on data from household surveys, national accounts, and a broad range of other data on production and consumption in Ethiopia. This SAM was originally developed by the Ethiopian Development Research Institute (Tebekew et al. 2009) and was updated to use the most recent data available. This SAM disaggregates information on the agricultural sector by the four rural zones and includes a detailed disaggregation of household groups by those zones. Zonal-level agricultural production and area data taken from the 2005/2006 Agricultural Sample Survey were used to disaggregate production in the SAM to the subnational rural zones. The CGE model for Ethiopia therefore is consistent with recent agricultural production levels and yields at the level of these zones.

While most of the parameters in the CGE model are derived from the SAM, there are a number of behavioral elasticities that govern how changes in relative prices affect domestic production, foreign trade, and household consumption patterns. Household income elasticities determine how households choose to spend any additional income. Income elasticities in the model were based on econometric estimates from the 2004/2005 HICES (see Diao et al. 2012, 137). Trade elasticities determine how readily producers respond to relative price changes in supplying domestic or export markets. Similarly, they determine the willingness and ease with which consumers switch between consuming domestically produced or imported commodities. In the absence of Ethiopia-specific estimates of trade elasticities, we use the global cross-country elasticities reported in Dimaranan (2006).

## 3. BASELINE PERFORMANCE OF THE ECONOMYWIDE MODEL FOR ETHIOPIA

The cereal production and cereal-related policy and program scenarios that were run through the CGE model involve altering parameters of the model so that it no longer reflects the economic relationships observed in the 2005/2006 SAM but the changed relationships that are defined by the scenarios of interest. As will be discussed in more detail below, depending on the scenario modeled, the changes in the model parameters include changes in cereal productivity levels, wheat import levels and the price of wheat imported from international markets, subsidies on the price selected consumers face in purchasing wheat, and imposing a sharp shift in demand for maize to exports from household consumption.

As the model is run, changes in production result in changes in supply, leading to changes in prices and in demand, while changes in imports or prices lead to shifts in supply and demand. These initial effects then prompt a range of further changes in the economy, including reallocations of land and labor from less to more economically rewarding crops, changes in crop production levels, reallocation of labor across both farm and nonfarm activities as economic actors seek to maximize returns to their labor, changes in household expenditures and food consumption, changes in import levels, and changes in both agricultural-sector and economywide growth, among other changes. The complexity of the underlying SAM for the Ethiopia CGE model results in such a large array of modeled output that management of that output to draw insights is in itself a challenge in employing the model for policy analysis.

For the purposes of evaluating the economic impact of the ATA initiatives for teff, wheat, and maize and selected cereal policies and programs, a standard set of output indicators were extracted from the results of each model run. Relative to baseline, business-as-usual conditions without the modeled interventions, these consist of

- changes in crop supply and demand, where relevant;
- changes in *real* prices for all three cereals;
- economic growth or changes in national gross domestic product (GDP) over time, where relevant—overall; for the agricultural sector, both nationally and for the four rural zones; and for the nonagriculture sectors in aggregate;
- changes in household welfare for all households and disaggregated by poor/nonpoor and rural/urban;
- changes in the poverty head count and in the depth of poverty for all households and for rural or urban households;
- changes in cereal consumption, where relevant; and
- changes in per capita daily calorie consumption.

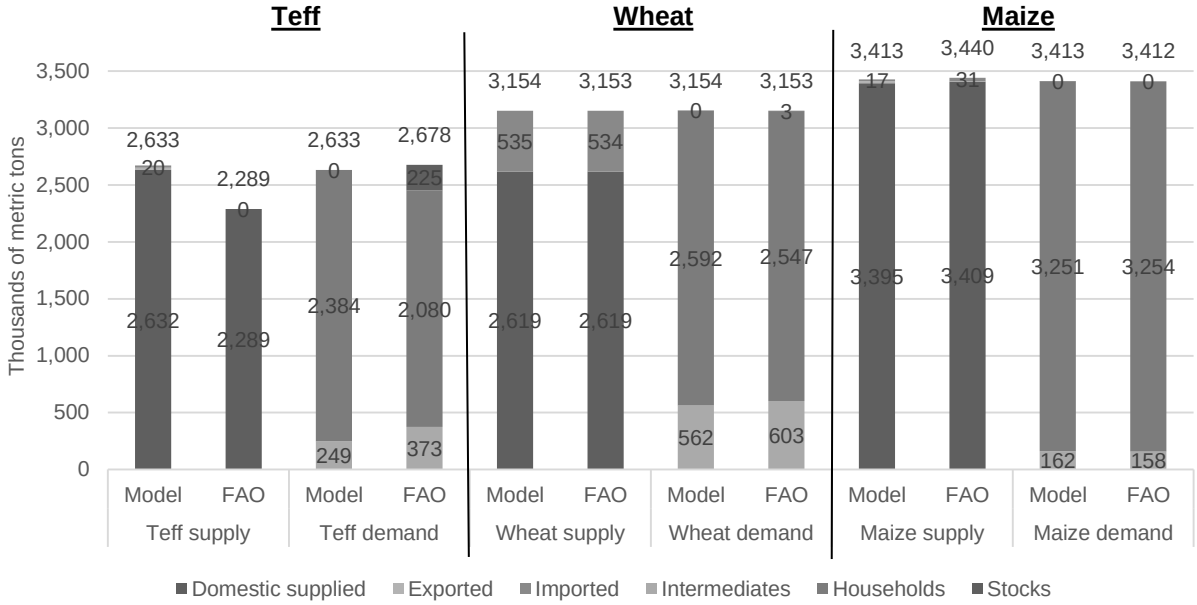
However, in this report not all of the listed outputs are presented for each scenario modeled.

To ensure that the CGE model of the Ethiopian economy is suitable for examining the broader economic impacts of the cereal production increases and policy and program changes considered, the model is run during the 10-year period from 2006 until 2015 starting from the initial conditions established with the 2005/2006 SAM. Our interest in doing this is to assess whether the economic conditions that the model predicts for the most recent year for which we have observations are reasonably close to those observations—that is, the model is predicting relatively accurately how the economy of Ethiopia is evolving. To establish the business-as-usual conditions for the economy as modeled, the economic relationships observed in the 2005/2006 SAM are maintained, and no alterations are made to any elements of the model.

The supply of and demand for teff, wheat, and maize in Ethiopia, both modeled and observed, at the start of the model run at the base year of 2006 are presented in Figure 3.1. What we see is that the model reflects quite closely the observed national supply and demand conditions for these three cereals for 2006 as reported in the annual Food Balance Sheets for Ethiopia as computed by the Food and Agriculture Organization of the United Nations (2014). The only significant difference between the

modeled and observed conditions is for teff supply, where the model estimates supply that is about 15 percent higher than the observed.

**Figure 3.1 Baseline teff, wheat, and maize supply and demand conditions of the Ethiopia CGE model compared to FAO estimates of crop supply and demand estimates for 2006**

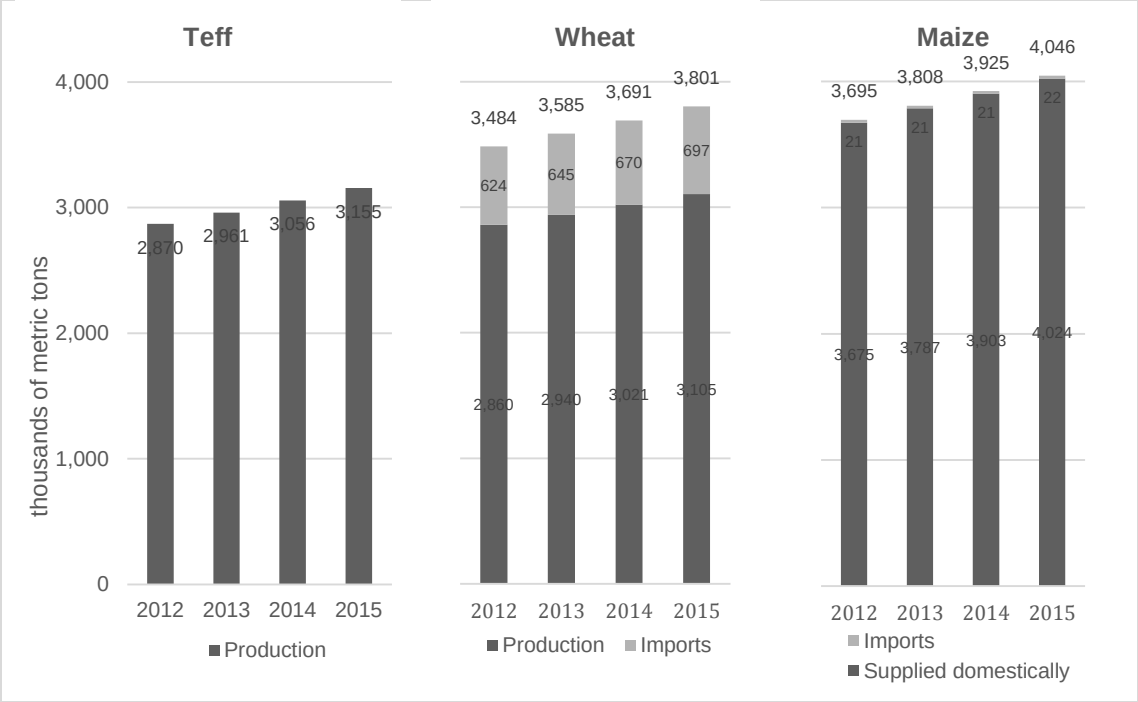



Source: Authors computations using the Ethiopia computable general equilibrium model and FAOSTAT Food Balance Sheet data (FAO 2014).

The model is first run without any modification to historical trends to generate a baseline or business-as-usual scenario for the period 2006 to 2015. The supply of teff, wheat, and maize in the baseline for the period 2012 to 2015 is as shown in Figure 3.2. The modeled year-on-year increase in supply for teff is about 3.2 percent; for wheat, about 3.0 percent; and for maize, about 3.1 percent. The supply of teff is wholly from production, as there is virtually no international trade in the cereal. That of wheat is made up of both domestic production and imports, with imports making up about 18 percent of total wheat supply.[1] Maize is primarily made up of domestic production, but the model does impose some small quantities of maize imports and exports to allow us to consider model scenarios that would involve international trade in maize—the "supplied domestically" category is the net of domestic production minus the exports imposed in the model. The total domestic maize production in 2015 predicted by the model is 4,042,000 metric tons (mt), with 22,000 mt of maize imports and 18,000 mt of maize exports.

[1] For the all-model scenarios discussed in this report that involve wheat, it is assumed that there is no difference in quality between domestic and imported wheat that would lead to differentiation between the two types of wheat in Ethiopian markets or among Ethiopian consumers. This likely is not the case, as imported wheat may well be better or less suited for commercial bakeries and other industrial processing than domestic wheat or may have taste and other consumption characteristics that may make it either less or more preferred for home processing and consumption. However, the computable general equilibrium model for Ethiopia does not take into account any such differences.

**Figure 3.2 National supply of teff, wheat, and maize under business-as-usual conditions between 2012 and 2015, Ethiopia computable general equilibrium model results**




Source: Ethiopia computable general equilibrium model.

Although not presented here, similar baseline conditions are estimated by the Ethiopia CGE model for the full range of output indicators listed earlier that we will use to assess the economic effects of the various scenarios modeled—economic growth, prices, consumption, poverty measures, and so on. The baseline conditions for 2015 for these variables as predicted by the model are the values against which the economic effects of the modeled scenarios will be assessed.

# 4. DEFINING THE SCENARIOS AND EXPLORING THE RESULTS OF EACH

The CGE modeling exercise reported here was initiated to provide ATA with a clearer understanding of the likely impact of the envisioned cereal production increases of the ATA Teff, Wheat, and Maize Initiatives on the economy of Ethiopia and on Ethiopian households. Only after some basic understanding was achieved of those initiatives did attention turn to several wheat-related policy and program changes and a maize export scenario. In presenting the results of the modeling of these scenarios in this section of the report, we will first consider in detail the impact of the three ATA initiatives before later turning to the results from modeling the economic effects of the other commodity-specific policy and program changes.

## Teff, Wheat, and Maize Production Increases

ATA established the initiatives for teff, wheat, and maize to bring about a sharp increase in the production of the three cereals. As was noted earlier, ATA, working through the regional bureaus of agriculture, makes available to farmers in the *woredas* targeted by the initiatives a package of improved access to inputs, agricultural advisory services, output markets, and in some cases, agricultural financing. Particularly for teff, the initiative also involved the introduction to farmers of promising new production techniques. These packages of inputs and services are expected to lead to significant sustained increases in the amount of each cereal produced in the target *woredas* and should also result in the diffusion of the new technologies to other areas of the country where the cereals are produced.

The Teff Initiative began in 2012 in 158 *woredas*, with expansions to the initiative planned in 2013 and 2014 to a total of 209 target *woredas*. The Wheat Initiative began in 2013 in 40 *woredas* and was to be completed in 2014 with an additional 55 *woredas* added. The Maize Initiative was to be launched only in the 2014 season with a three-year rollout to reach 132 target *woredas* by the final year. Although the initiatives were initiated in a staggered fashion, in our analysis here we model the three initiatives as being rolled out at the same time in parallel starting in 2013 with full implementation completed for all three by 2015.

In the design of the three initiatives, ATA did not establish specific production increase targets in each of the target *woredas*. Consequently, in the initial set of scenarios for the cereal initiatives run with the Ethiopia CGE model, three separate targets were evaluated—10, 25, and 50 percent production increases for each target *woreda*. However, thereafter, the CGE analysis focused only on the 25 percent production increase, and that is what is done in the model analyses for which the results are reported here.

## Production Increase Scenarios for the Model

To determine the economywide effects of the ATA Teff, Wheat, and Maize Initiatives using the CGE model, we had to determine what a 25 percent production increase for each of the three cereals in each of the target *woredas* would correspond to in terms of production increases for each cereal across each of the four rural zones of the CGE model. To do this, we used *woreda*-level teff, wheat, and maize production data from the last detailed, nationally representative, *woreda*-level agricultural production survey that was done for Ethiopia, the Ethiopian Agricultural Sample Enumeration, implemented by the Central Statistical Agency (CSA) between February 2001 and February 2002 (1994 Ethiopian Calendar) (CSA 2006). These data were used to determine what share of the production of each cereal in each of the administrative zones for the Ethiopian Agricultural Sample Enumeration survey year came from the target *woredas* for the ATA initiatives. These shares of administrative zone production were then applied to the most recent crop production information that had been estimated at administrative zone level, the Agricultural Sample Survey of 2010/11 (2003 Ethiopian Calendar), to determine the recent production of the cereals in those administrative zones that was accounted for by the target *woredas* of the three initiatives (CSA 2011). These results were then aggregated to determine changes in teff, wheat, and maize production of the four CGE rural zones (although the pastoralist zone has no target *woredas* for the ATA initiatives) and the

country as a whole that would be attributable to 25 percent production increases for those crops in the target *woredas* of the three ATA initiatives.

As shown in Table 4.1, we determined that the 25 percent increases in teff production in the Teff Initiative target *woredas* would correspond to a national increase in production of 18.1 percent after the initiative is fully implemented. For wheat, the corresponding figure is 11.7 percent, while for maize it is 13.5 percent. Given the dynamic nature of the Ethiopian CGE model, we used the year-on-year production increases for each cereal presented in Table 4.1, disaggregated by rural zone, as the shock that we imposed on the model for two or three model years, starting with the 2013 model year. This was done by increasing the productivity levels of the three cereal sectors in each of the subnational regions. Note that the production increases are in addition to those that already occur in the baseline scenario, that is, a scenario that does not include the three cereal initiatives of ATA.

**Table 4.1 Estimated national production increase for teff, wheat, and maize associated with a 25 percent production increase in the target *woredas* of the three ATA cereal initiatives, relative to 2011 production levels**

| 25 percent increase in production in target *woredas* of the ATA cereals initiatives | Teff | | Wheat | | Maize | |
|---|---|---|---|---|---|---|
| | Year-on-year national production increase, % | *Target woredas, number* | Year-on-year national production increase, % | *Target woredas, number* | Year-on-year national production increase, % | *Target woredas, number* |
| Year 1 (2013) | 15.4 | *158* | 6.6 | *40* | 8.9 | *69* |
| Year 2 | 1.9 | *31* | 5.1 | *55* | 3.1 | *40* |
| Year 3 | 0.8 | *20* | — | — | 1.5 | *23* |
| Total | 18.1 | *209* | 11.7 | *95* | 13.5 | *132* |

Source: Authors' calculations using CSA (2006, 2011).

Note: ATA = Agricultural Transformation Agency. Dashes indicate no cases and no increase.

The scale of the Teff Initiative, with 209 target *woredas*, is considerably larger than that of the Wheat and Maize Initiatives, with 95 and 132 target *woredas*, respectively. However, given the lower yields of teff relative to wheat and maize, as will be seen, the impact in terms of the total increase in cereal produced under each initiative will not be so different—CSA (2011) reports that the national average on-farm yields of teff are 1,260 kilograms per hectare (kg/ha), 1,840 kg/ha for wheat, and 2,540 kg/ha for maize.

### *Results for the Production Increase Scenarios*

The model was run for each of the three cereal production increases individually and for all jointly. While the initial production shocks were applied to the 2013 model year, the various economic effects of the three initiatives are considered three years later at the end of the 2015 model year after all of the initiatives as planned will have been fully implemented. Given this lag, the model results reflect some second-round reallocation of land, labor, and capital due to the first-round economic effects arising from the cereal production increases. As such, the results presented here reflect not only the immediate economic effects of increases in production of the three cereals but also how actors in the Ethiopian economy will seek to exploit new economic opportunities that arise in consequence of those production increases and the changes in supply, demand, and prices that the increases bring about.

The modeled changes in national production of the three cereals and in wheat imports due to the 25 percent increase in production in the target *woredas* of the three ATA initiatives are presented in Table 4.2. With the second-round economic effects of the production increases, the increases for teff and maize when considered individually are somewhat lower after three years of the implementation of the programs than was envisioned—for example, teff production nationally is up by 14.0 percent, rather than the 18.1 percent that was estimated from a 25 percent increase in production in the target *woredas* (Table 4.1). In other words, the increase in cereal productivity allows farmers to diversify into other higher-value crops—a transition that is also encouraged by declining real prices for cereals relative to other crops (Figure 4.1). The case of wheat is more complicated because increased production displaces significant imports. Overall domestic wheat production increases by 14.0 percent, but the total wheat available increases by only 7.2 percent since imports drop by 22.8 percent in response to domestic wheat becoming relatively cheaper than imported wheat. When the joint implementation of the three initiatives is modeled, cereal production overall increases by 13.5 percent nationally. In the joint implementation scenario, wheat imports decline relative to baseline conditions by slightly more than they do in the individual Wheat Initiative scenario, reflecting additional displacement of those imports from the increased production of the other cereals, which are partial substitutes for wheat. Note that the absolute increases in grain production across the three cereals are quite similar—between 430,000 and 495,000 mt—even though the Teff Initiative is significantly larger in scale than the other two.

**Table 4.2 Modeled changes due to ATA cereal initiatives in national production of teff, wheat, and maize and in wheat imports, from the baseline scenario for 2015, in thousands of metric tons**

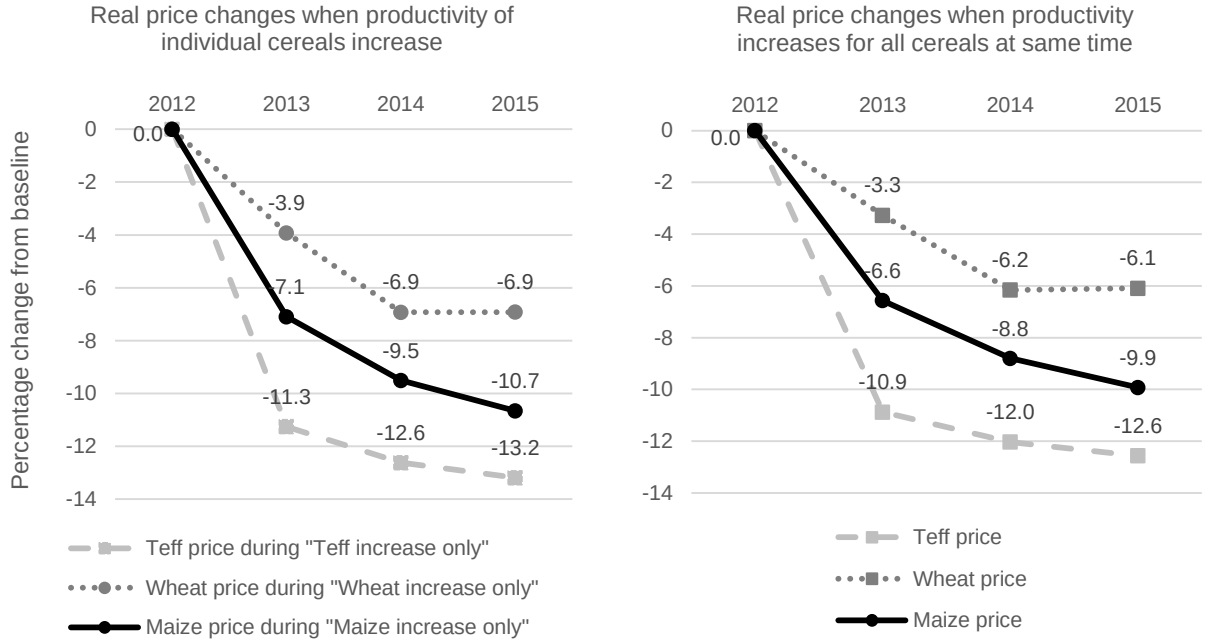
| | | Change in cereal production and imports relative to baseline by 2015 | | | |
|---|---|---|---|---|---|
| **Cereal** | **Baseline** | **Teff increase only** | **Wheat increase only** | **Maize increase only** | **All cereal increases together** |
| **Production, all** | 10,302 | 466 | 436 | 488 | 1,394 |
| | | *(4.5%)* | *(4.2%)* | *(4.7%)* | *(13.5%)* |
| Teff | 3,155 | 440 | 1 | 5 | 447 |
| | | *(14.0%)* | *(0.0%)* | *(0.2%)* | *(14.2%)* |
| Wheat | 3,105 | 14 | 434 | 7 | 456 |
| | | *(0.4%)* | *(14.0%)* | *(0.2%)* | *(14.7%)* |
| *Wheat imports* | *697* | *–5* | *–159* | *–2* | *–165* |
| | | *(–0.8%)* | *(–22.8%)* | *(–0.3%)* | *(–23.6%)* |
| Maize | 4,042 | 12 | 1 | 476 | 491 |
| | | *(0.3%)* | *(0.0%)* | *(11.8%)* | *(12.1%)* |

Source: Ethiopia computable general equilibrium model.

Note: ATA = Agricultural Transformation Agency.

Figure 4.1 shows how the real price of the three cereals changes over the three years of implementation of the Teff and Maize Initiatives and the two years of implementation of the Wheat Initiative. The price shifts are somewhat larger when the initiatives are considered in isolation in the left panel. When the initiatives are considered jointly (right panel), the price changes are somewhat attenuated. This is partly accounted for by the higher crop incomes for producers arising from the broad increases in cereal production generating additional demand. This additional demand reduces the declines in prices of the cereals associated with their increased supply.

**Figure 4.1 Modeled changes in real prices for teff, wheat, and maize, from the baseline scenario for 2015, in percentages**




Source: Ethiopia computable general equilibrium model.

The impacts of the cereal productivity increases on the size of the Ethiopian economy are shown in Table 4.3. Several patterns are observed:

- Jointly the increase in cereal production leads to a 1.36 percent increase in GDP for Ethiopia and a 3.07 percent increase in the size of the agricultural sector of the economy. However, there is virtually no net growth realized in the nonagricultural sectors of the economy as a consequence of these increases in cereal productivity. This is partly a result of there being relatively little grain processing linked to domestic production that is classified as "manufacturing" in Ethiopia's national accounts. This implies that most of the milling that does take place—mainly by households themselves—is subsumed as a component of agricultural GDP. Moreover, increases in agricultural productivity encourage farmers to allocate more of their labor to farm rather than nonfarm activities, such that any increase in downstream processing associated with enhanced cereal production is offset by falling nonfarm labor supplies.
- Across the rural zones modeled, greatest growth is seen in the cereal-based highlands, as would be expected. However, increases in teff production also provide particular benefit to the drought-prone highlands. Maize production increases, while most important for economic growth in the cereal-based highlands, are the most significant of the three cereals in contributing to economic growth in the enset-based highlands, an area agroecologically better suited for maize production than for wheat and teff. The pastoralist zone—although no increase in cereal production was modeled in the zone—benefits from increased teff and maize production, likely through increased consumption made possible through reduction in the real prices of these cereals. However, production increases in wheat do not generate these positive economic effects in the pastoralist zone.
- Comparing the cereals, their individual impacts on economic growth primarily will be due to the production increases achieved for each and the value of that production. Although teff

yields per unit area are significantly lower than those for wheat and maize, the Teff Initiative is the largest in scale of the three initiatives. Moreover, the per-unit value of teff is significantly higher than that of the other two crops—the average ratio of their prices in the Addis Ababa market between 2001 and 2011 was 2.47 for teff : maize and 1.47 for teff : wheat (Minten, Stifel, and Tamru 2012, Figure 5.1). In consequence, the Teff Initiative has the largest impact on economic growth, even though the overall production increases due to each initiative are quite similar (Table 4.2).

**Table 4.3 Modeled changes in annual economic growth due to production increases in teff, wheat, and maize, from the baseline scenario for 2015, in percentages**

| Economic sector | Share of baseline GDP in 2015 (%) | Change in GDP relative to baseline by 2015 (%) | | | |
|---|---|---|---|---|---|
| | | Teff increase only | Wheat increase only | Maize increase only | All cereal increases together |
| **Overall** | **100.0** | **0.58** | **0.31** | **0.46** | **1.36** |
| Agriculture sector | 44.5 | 1.31 | 0.70 | 1.05 | 3.07 |
| *Cereal-based highlands and humid lowlands* | *19.4* | *1.83* | *1.10* | *1.43* | *4.37* |
| *Enset-based highlands* | *5.9* | *0.72* | *0.35* | *1.25* | *2.32* |
| *Drought-prone highlands* | *11.4* | *1.59* | *0.69* | *0.96* | *3.25* |
| *Pastoralist—arid lowlands* | *3.0* | *0.20* | *–0.03* | *0.24* | *0.42* |
| Nonagriculture | 55.5 | –0.01 | 0.01 | –0.01 | –0.01 |

Source: Ethiopia computable general equilibrium model.

Note: GDP = gross domestic product.

The impact of the three cereal initiatives on household welfare and poverty are considered in Table 4.4 and Table 4.5. Household welfare is measured using the per capita real value of consumption in the CGE model. Under the ATA initiatives, consumption increases for all households. The joint effect of the three initiatives shows that poor households in urban areas see the largest increase in their welfare, benefiting from lower cereal prices in the urban markets. Poor households in rural areas see the second highest welfare benefits, which flow both from higher incomes for cereal producers whose production levels increase and, for net rural cereal consumers, from lower prices for the cereals that they consume. The urban nonpoor see the lowest welfare benefits in relative terms.

**Table 4.4 Modeled changes in household welfare (per capita real consumption) due to production increases in teff, wheat, and maize, from the baseline scenario for 2015, in percentages**

| Household type | Teff increase only | Wheat increase only | Maize increase only | All cereal increases together |
|---|---|---|---|---|
| **All households** | 0.57 | 0.21 | 0.35 | 1.13 |
| Rural poor | 0.64 | 0.28 | 0.53 | 1.45 |
| Rural nonpoor | 0.46 | 0.22 | 0.37 | 1.05 |
| Urban poor | 1.25 | 0.18 | 0.19 | 1.63 |
| Urban nonpoor | 0.62 | 0.10 | 0.07 | 0.79 |

Source: Ethiopia computable general equilibrium model.

**Table 4.5 Modeled changes in poverty due to production increases in teff, wheat, and maize, from the baseline scenario for 2015**

| Poverty measure | Teff increase only | Wheat increase only | Maize increase only | All cereal increases together |
|---|---|---|---|---|
| **Poverty headcount, percentage change** | | | | |
| **All households** | **–0.77** | **–0.50** | **–0.84** | **–2.00** |
| Rural | –0.78 | –0.53 | –0.97 | –2.22 |
| Urban | –0.73 | –0.31 | –0.23 | –0.93 |
| **Number of poor individuals** | **–646,000** | **–418,000** | **–708,000** | **–1,687,000** |
| **Depth of poverty, percentage change** | | | | |
| **All households** | **–0.29** | **–0.15** | **–0.28** | **–0.70** |
| Rural | –0.26 | –0.16 | –0.31 | –0.71 |
| Urban | –0.42 | –0.10 | –0.12 | –0.64 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

However, this pattern of the joint effect of the three initiatives on household welfare is not seen when the three cereal initiatives are considered separately. The increases in teff production provide greatest relative welfare benefits to urban households, maize production increases provide greatest benefits to rural households, and wheat production increases provide similar, but lower, levels of relative welfare benefits to households in both rural and urban areas.

By linking the results of the CGE model to information about the characteristics of sample households of the 2004/2005 HICES, the microsimulation module of the Ethiopian CGE model is used to estimate changes in the poverty measures for the Ethiopian population. Using a poverty line that is initially set at the 40th percentile of per capita consumption of households in the 2004/2005 HICES, Table 4.5 provides insights into what the cereal production increases will mean for the poverty status of households in Ethiopia. The poverty headcount measure—that is, the share of the population whose consumption is below the poverty line—drops in all cereal production increase scenarios. The cereal initiatives improve the consumption of some households sufficiently, such that their new level of consumption is above the poverty line. Across the three cereals, increased maize production has the greatest impact on the incidence of poverty in rural areas, while in urban areas, teff is the most important cereal in this regard.

Changes in the depth of poverty measure give insight into how the cereal initiatives affect the welfare of all of the poor, as the measure reflects the mean consumption shortfall relative to the poverty line across the whole population. Here too we see that the three initiatives reduce the depth of poverty in the country. However, when comparing the impact of the different cereals, we see that production increases of teff seem not to be as efficacious in reducing the depth of poverty in rural areas as they are for reducing the rural poverty headcount. This may reflect specific elements in the patterns of both teff production and teff consumption across the distribution of consumption in the rural population of Ethiopia—the poorest rural households may neither produce nor consume much teff. For maize, we see that production increases of the cereal do not reduce the depth of poverty in urban areas to the same degree as in rural areas. However, in contrast to the relatively high impact of increased teff production on the rural poverty headcount, maize production increases lead to only a limited change in the poverty headcount in urban areas. The relative impact of wheat production increases on poverty measures in rural and urban areas is consistent across the two areas but lower than for the other two cereals.

The impact of the three cereal initiatives on household cereal consumption is considered in Table 4.6. The impact of the Wheat Initiative on consumption is significantly lower than the impacts of the Teff and Maize Initiatives. However, as the production increases achieved by the three initiatives are comparable (Table 4.2), the reason for the lower impact of the Wheat Initiative on overall household consumption is that much of the increased production of wheat serves to displace wheat imports.

**Table 4.6 Modeled changes in household cereal consumption due to production increases in teff, wheat, and maize, from the baseline scenario for 2015, in thousands of metric tons**

| Household type | Baseline | Teff increase only | Wheat increase only | Maize increase only | All cereal increases together |
|---|---|---|---|---|---|
| **All households** | 9,757 | 423<br>(4.3%) | 220<br>(2.3%) | 444<br>(4.5%) | 1,090<br>(11.2%) |
| Rural poor | 3,277 | 123<br>(3.7%) | 77<br>(2.3%) | 171<br>(5.2%) | 372<br>(11.4%) |
| Rural nonpoor | 5,257 | 190<br>(3.6%) | 123<br>(2.3%) | 257<br>(4.9%) | 572<br>(10.9%) |
| Urban poor | 499 | 44<br>(8.8%) | 9<br>(1.8%) | 9<br>(1.8%) | 62<br>(12.5%) |
| Urban nonpoor | 724 | 66<br>(9.1%) | 11<br>(1.5%) | 6<br>(0.9%) | 83<br>(11.5%) |

Source: Ethiopia computable general equilibrium model.

Considering the impact of each initiative on cereal consumption, on a percentage basis we see that the Teff Initiative increases consumption in urban centers by considerably more than it does in rural areas. For maize, as we saw earlier, the opposite is the case with a greater impact on the consumption of rural households. For wheat, a more balanced impact on consumption is seen across the rural/urban and poor/nonpoor groups. The urban nonpoor see the greatest increase in consumption with higher production of teff, while it is the rural poor who see in relative terms their consumption increase the most with higher production of maize. However, when the initiatives are considered jointly, it is the urban poor who see the largest increase in cereal consumption in relative terms, followed by the urban nonpoor and rural poor. The rural nonpoor see the lowest relative increase in consumption in the joint initiatives scenario.

Using the microsimulation module of the Ethiopian CGE model, changes in per capita calorie consumption of Ethiopian households resulting from the ATA cereal initiatives can be estimated. These are presented in Table 4.7. These changes do not simply reflect the impact of the increased calories made available through an increase in cereal production but also reflect changes in the composition of household food consumption baskets as a consequence of relative food price shifts that these production increases will bring about. Here we again see that the Teff Initiative is most important for the urban population, while the Maize Initiative is the most important for the rural population. When the initiatives are considered jointly, the relative impact on calorie consumption across the rural/urban and poor/nonpoor groups is similar to that seen in Table 4.6 on changes in cereal consumption levels—the greatest increase in calorie consumption is found among the urban poor and the lowest increase among the rural nonpoor.

**Table 4.7 Modeled changes in per capita daily calorie consumption due to production increases in teff, wheat, and maize, from the baseline scenario for 2015, in percentages**

| Household type | *Calorie consumption, baseline* | Teff increase only | Wheat increase only | Maize increase only | All cereal increases together |
|---|---|---|---|---|---|
| **All households** | 2,163 | 1.89 | 0.86 | 2.42 | 5.18 |
| Rural poor | 1,374 | 1.64 | 0.79 | 2.97 | 5.42 |
| Rural nonpoor | 2,353 | 1.53 | 0.89 | 2.65 | 5.10 |
| Urban poor | 1,293 | 3.80 | 0.81 | 1.53 | 6.17 |
| Urban nonpoor | 2,140 | 3.79 | 0.69 | 0.87 | 5.38 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

### *Discussion of the Production Increase Scenarios*

As estimated through the use of the CGE model of the Ethiopian economy, the impact of the cereal production increases envisioned by the Teff, Wheat, and Maize Initiatives of ATA on the size of the economy of Ethiopia are important, if not significantly transformative. If each initiative prompts a 25 percent increase in production of the cereals in question in the target *woredas* in which the initiatives are being implemented, this will result in a national expansion in the production of each cereal of between 430,000 and 495,000 mt. The increased production for each cereal alone will lead to somewhere between a 0.3 and 0.6 percent increase in the size of the country's economy relative to the baseline, while the increased joint production of the three cereals increases the size of total GDP by 1.4 percent (Table 4.3). While it is difficult to assign a monetary value to this expansion, it is possible to provide a broad estimate of the overall economic gain. For example, Ethiopia's economy was estimated to be $41.7 billion in size in 2012. As such, the 1.4 percent expansion in total GDP in the joint cereal production scenario adds about $580 million to the Ethiopian economy. However, note that we have not considered the costs of achieving these gains in productivity, which, if internalized, might offset some of the economywide gains; for example, raising taxes to pay for the cereal initiatives could reduce growth in other sectors.

The cereal production increases do not bring about much change in the structure of the economy of Ethiopia. Almost all of the economic growth associated with the production increases comes from the agricultural sector of the economy. The increased joint production of the three cereals results in an agricultural sector that is 3.1 percent larger (measured in GDP). However, in the nonagricultural sectors of the economy, these sharp increases in cereal production will lead to virtually no net growth. The figures presented in Table 4.3 show a slight contraction in the nonagricultural sectors as a consequence of the increased cereal production, likely resulting from a flow in factors of production out of manufacturing and services to agriculture as the economic returns in agriculture become more attractive for reasons related to the increased cereal production. The poor linkages between the agricultural and nonagricultural sectors observed here principally reflect the limited industrial processing and other industrial use of the cereals in Ethiopia. In and of itself the successful implementation of the ATA initiatives for teff, wheat, and maize will not bring about much change in the structure of the Ethiopian economy.

With regard to the initiatives' impact on consumption and welfare, the CGE analysis shows that the ATA initiatives for teff, wheat, and maize are expected to have quite different impacts across rural and urban households and poor and nonpoor households. The broad insights from the modeling exercise are that significant increases in teff production will provide greatest benefits for urban consumers, particularly poor urban households, while the economic benefits of increases in maize production will principally flow to rural households, both poor maize consumers and maize producers. The benefits of increases in wheat production are more evenly shared across all households. The reasons for this variation in impact of the production increases of the different cereals across household groups are found in differences in the food baskets of the various groups, in relative cereal prices, and in the price elasticities of supply and demand for the cereals. Cultural factors also explain some of these patterns—teff is viewed

as a superior good, its consumption associated among many Ethiopians with a better quality of life. Table 1.1 shows that while urban households proportionally consume very little maize, their teff consumption is much higher than is seen in rural households. Wheat, in contrast, is consumed in almost equal proportions by rural and urban households.

While all three cereals have their role in the economy of Ethiopia and in the food baskets of Ethiopian households, from which cereal does society derive the greatest return? Using the CGE model and the data at hand, we cannot confidently and completely answer this question. However, the analysis here provides some insights into the merits of public investments in the three cereals relative to each other. It was noted that the average ratio of the prices of the cereals in the Addis Ababa market between 2001 and 2011 was 2.47 for teff : maize and 1.47 for teff : wheat (Minten, Stifel, and Tamru 2012, Figure 5.1). Similarly, the national average on-farm yields of teff are 1,260 kg/ha, 1,840 kg/ha for wheat and 2,540 kg/ha for maize (CSA 2011)—using the average maize yield as the denominator, these correspond to ratios of the yields of the cereals nationally as 0.497 for teff : maize and 0.724 for teff : wheat. The relative market value of production per hectare (ha)for teff and wheat relative to maize can be calculated as the product of these two ratios: for teff, this is 1.23, while for wheat, it is 1.06. These results indicate that farmers who can choose between maize and the other two cereals and achieve the national average yield levels would do better to produce teff or wheat, rather than maize, if the market value of that production is the principal criterion guiding their decision. Moreover, if recent increases in the average yields of teff and wheat can be sustained and exceed any increases in maize yields, these cereals will become even more financially attractive for farmers relative to maize.

However, the decision is more complicated than this analysis would suggest at both farm and national policy levels. The significantly higher land productivity of maize will make maize a more reasonable production choice than wheat or teff for smallholders on small plots, particularly if production for own consumption is important. At a policy level, that maize provides more production on less land means that investments in increasing maize productivity will be strategic in the sense that some of the economic objectives of Ethiopia, such as food security, can be achieved on a smaller land base with maize than would be the case with other crops, making available more land to other economic uses. Given the agroecological diversity of Ethiopia, a mix of cereals makes sense for agronomic reasons alone. However, there also are good economic reasons for maintaining a mix in cereals, both high value, like teff, and lower value, like maize.

### Cereal-specific Scenarios

The economic impact on Ethiopia of the four cereal-specific scenarios that were run in the Ethiopian CGE model are presented in this subsection of the report:

1. Changes in the international price of the wheat that is imported into the country
2. Changes in the amount of wheat imported into Ethiopia
3. Changes in the design of an existing wheat price subsidy program for urban consumers
4. Permitting maize exports at two aggregate levels

The impetus for the CGE analysis of cereal production and marketing in Ethiopia stemmed from the design and implementation of the Teff, Wheat, and Maize Initiatives of ATA. The agency initially sought to gain a better understanding of the broader economic impact of the initiatives and whether there would be any adverse first- or second-round effects arising from the investments in increased cereal production that they were coordinating. The results of the initial analyses, described in the previous subsection of this report, raised new issues. These led to a number of commodity-specific queries from ATA staff members to enable them to better understand how Ethiopian cereal markets and Ethiopian households might respond to or benefit from various policy initiatives. In particular, wheat, given the significant quantities that are imported into Ethiopia, was seen as requiring more investigation using the economywide model.

As with the examination of the economic impact of the ATA cereal initiatives, baseline conditions for 2015 as predicted by the model for the variables used to assess economic impact are compared with those that the model generates for the modeled scenarios. The impacts considered include changes in cereal supply and demand, prices, household welfare levels, poverty measures, and cereal and calorie consumption.

### *Changes in International Wheat Prices*

As 18.3 percent of all wheat consumed in Ethiopia is imported, wheat prices on international markets are an important consideration for national food security planners and for agricultural policy analysts who seek a better understanding of how Ethiopia can become more self-sufficient in wheat through an increase in domestic production. The international wheat price changes we consider are drops of 30 and 10 percent and increases of 10, 30, and 70 percent. To run this set of analyses, for each price change we alter in the 2013 model year the real price for international wheat from its baseline level by the price change being investigated and then run the model for three model years at that price to allow the model of the Ethiopian economy to adjust to the change in the price of imported wheat, to adjustments in Ethiopia's foreign exchange position that the changes in the costs of wheat imports will bring about, and to changes in domestic wheat production and consumption levels. The impact of the price change is then assessed in the 2015 model year.

The broad pattern of the effect of changes in international wheat prices is that higher prices will reduce the amount of wheat available for Ethiopian consumers, while lower prices increase wheat supply. As expected, higher international prices will reduce wheat imports, but while Ethiopian wheat farmers will increase their production of wheat to cover part of the import supply deficit, they will not supply sufficient domestic wheat to make up the full reduction in wheat imports (Table 4.8). Similarly, lower international wheat prices will result in Ethiopian farmers' reducing their production of wheat. For example, if international prices drop by 30 percent, the model estimates that more than 47 percent of the wheat supplied to Ethiopian consumers will come from imports. On the demand side, lower international prices will work through the model to increase consumption, while higher international prices will result in reduced wheat demand.

**Table 4.8 Modeled changes in national supply and demand for wheat due to changes in the world wheat price, from the baseline scenario for 2015, in thousands of metric tons**

| | | Change in world wheat price from baseline price | | | | |
|---|---|---|---|---|---|---|
| **Supply/Demand** | **Baseline** | **–30%** | **–10%** | **+10%** | **+30%** | **+70%** |
| **Total supply** | **3,801** | **218** | **46** | **–32** | **–70** | **–103** |
| Production | 3,105 | –996 | –224 | 157 | 346 | 494 |
| Imports | 697 | 1,213 | 270 | –189 | –416 | –597 |
| **Total demand** | **3,801** | **218** | **46** | **–32** | **–70** | **–103** |
| For food | 3,071 | 297 | 66 | –48 | –108 | –163 |
| For other uses | 730 | –79 | –21 | 16 | 38 | 59 |

Source: Ethiopia computable general equilibrium model.

The effect of imported wheat on domestic wheat prices is where we find much of the story about changes in wheat supply and demand. Shown in Table 4.9 are the effects on domestic wheat prices, as well as on teff and maize prices, of the changes in international wheat prices. Cheaper international wheat results in lower consumer prices for wheat in Ethiopia, and vice versa. There also is some spillover in lower or higher domestic wheat prices to the prices of teff and wheat. Lower wheat prices can be expected to reduce demand for the other two cereals as consumers substitute wheat for teff and maize, leading to reductions in demand and, consequently, in their prices, if of a much smaller magnitude than for wheat. With higher international wheat prices, teff and maize prices will also rise as consumers increase their demand for those cereals to substitute for the now relatively expensive wheat.

**Table 4.9 Modeled changes in real prices for wheat, maize, and teff due to changes in the world wheat price, from the baseline scenario for 2015, in percentages**

| | Change in world wheat price from baseline price | | | | |
|---|---|---|---|---|---|
| **Cereal** | **–30%** | **–10%** | **+10%** | **+30%** | **+70%** |
| **Wheat** | **–8.74** | **–2.09** | **1.55** | **3.59** | **5.48** |
| Maize | –0.28 | –0.08 | 0.06 | 0.15 | 0.25 |
| Teff | –0.30 | –0.08 | 0.07 | 0.17 | 0.26 |

Source: Ethiopia computable general equilibrium model.

The urban poor is the group whose welfare is most affected by variability in international wheat prices. As shown in Table 4.10, lower international prices lead to important gains in the consumption levels of the urban poor, while higher prices depress their consumption. Of the four rural/urban and poor/nonpoor groups, the model suggests that the welfare of the rural nonpoor is the least affected by changes in international wheat prices.

**Table 4.10 Modeled changes in household welfare (per capita real consumption) due to changes in the world wheat price, from the baseline scenario for 2015, in percentages**

| | Change in world wheat price from baseline price | | | | |
|---|---|---|---|---|---|
| **Household type** | **–30%** | **–10%** | **+10%** | **+30%** | **+70%** |
| **All households** | **0.60** | **0.14** | **–0.10** | **–0.23** | **–0.34** |
| Rural poor | 0.77 | 0.17 | –0.13 | –0.29 | –0.44 |
| Rural nonpoor | 0.47 | 0.10 | –0.07 | –0.16 | –0.24 |
| Urban poor | 1.26 | 0.31 | –0.23 | –0.54 | –0.84 |
| Urban nonpoor | 0.59 | 0.14 | –0.11 | –0.25 | –0.38 |

Source: Ethiopia computable general equilibrium model.

The patterns seen in overall household welfare in Table 4.10 are replicated in Table 4.11 in which poverty changes are examined. Urban poverty levels generally are most affected by changes in the international prices for wheat. Moreover, with significant falls in international wheat prices, there does not seem to be an adverse income effect on rural households. In spite of the lower wheat prices rural producers will obtain under such conditions, the reduction in the poverty headcount is higher in rural areas than in urban areas with the larger drop in international wheat prices. However, this pattern is not seen in the depth of poverty measure, with the urban poor benefiting more.

**Table 4.11 Modeled changes in poverty due to changes in the world wheat price, from the baseline scenario for 2015**

| | Change in world wheat price from baseline price | | | | |
|---|---|---|---|---|---|
| **Poverty measure** | **–30%** | **–10%** | **+10%** | **+30%** | **+70%** |
| **Poverty headcount, percentage change** | | | | | |
| **All households** | **–0.66** | **–0.11** | **0.15** | **0.25** | **0.34** |
| Rural | –0.68 | –0.08 | 0.13 | 0.22 | 0.28 |
| Urban | –0.57 | –0.23 | 0.24 | 0.41 | 0.60 |
| **Number of poor individuals** | **–557,000** | **–91,000** | **128,000** | **209,000** | **284,000** |
| **Depth of poverty, percentage change** | | | | | |
| **All households** | **–0.23** | **–0.05** | **0.04** | **0.09** | **0.14** |
| Rural | –0.20 | –0.05 | 0.03 | 0.08 | 0.12 |
| Urban | –0.35 | –0.09 | 0.07 | 0.15 | 0.24 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

Table 4.12 examines wheat consumption levels with changes in the international wheat price. The poor see the largest changes in their consumption with these price changes, with the consumption of the urban poor being somewhat more affected by the price changes than that of the rural poor. However, urban households, both poor and nonpoor, see larger shifts in their calorie consumption with changing international wheat prices than do rural households (Table 4.13). The calorie consumption of urban households rises more with lower international wheat prices than does the calorie consumption of rural households, and it rises relatively higher with higher prices. A closer understanding of the makeup of the average food basket of households in each of the rural/urban and poor/nonpoor groups would be needed to understand what underlies these patterns.

**Table 4.12 Modeled changes in household wheat consumption due to changes in the world wheat price, from the baseline scenario for 2015, in thousands of metric tons**

| | | Change in world wheat price from baseline price | | | | |
|---|---|---|---|---|---|---|
| **Household type** | **Baseline** | **–30%** | **–10%** | **+10%** | **+30%** | **+70%** |
| **All households** | **3,071** | **297** ***(9.7%)*** | **66** ***(2.2%)*** | **–48** ***(–1.6%)*** | **–108** ***(–3.5%)*** | **–163** ***(–5.3%)*** |
| Rural poor | 1,041 | 103 *(9.9%)* | 23 *(2.2%)* | –17 *(–1.6%)* | –38 *(–3.6%)* | –56 *(–5.4%)* |
| Rural nonpoor | 1,732 | 165 *(9.5%)* | 37 *(2.1%)* | –26 *(–1.5%)* | –60 *(–3.5%)* | –90 *(–5.2%)* |
| Urban poor | 130 | 13 *(10.3%)* | 3 *(2.3%)* | –2 *(–1.7%)* | –5 *(–3.8%)* | –7 *(–5.7%)* |
| Urban nonpoor | 169 | 16 *(9.2%)* | 3 *(2.1%)* | –3 *(–1.5%)* | –6 *(–3.4%)* | –9 *(–5.1%)* |

Source: Ethiopia computable general equilibrium model.

**Table 4.13 Modeled changes in per capita daily calorie consumption due to changes in the world wheat price, from the baseline scenario for 2015, in percentages**

| | ***Calorie consumption,*** | Change in world wheat price from baseline price | | | | |
|---|---|---|---|---|---|---|
| **Household type** | ***baseline*** | **–30%** | **–10%** | **+10%** | **+30%** | **+70%** |
| **All households** | **2,163** | **2.00** | **0.48** | **–0.35** | **–0.82** | **–1.26** |
| Rural poor | 1,374 | 1.77 | 0.42 | –0.31 | –0.73 | –1.12 |
| Rural nonpoor | 2,353 | 1.99 | 0.47 | –0.35 | –0.81 | –1.24 |
| Urban poor | 1,293 | 2.52 | 0.61 | –0.46 | –1.07 | –1.65 |
| Urban nonpoor | 2,140 | 2.13 | 0.52 | –0.39 | –0.90 | –1.39 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

What we have seen in the international wheat price change scenarios is that the Ethiopian wheat market is quite closely linked to the international wheat market. Changes in international prices lead to changes in wheat supply and wheat and calorie consumption levels of both rural and urban households in Ethiopia. With higher international prices, households will pay more for any wheat that they purchase, regardless of whether it is imported or domestically produced. Rural wheat producers will benefit from the higher domestic wheat prices that result from the more restricted supply of wheat imports with higher international wheat prices. Overall, urban households are affected more than rural households by changes in international wheat prices, as they are entirely net consumers of the cereal and derive no benefits from higher wheat prices. Moreover, poorer households, as they generally spend a larger share of their income on food, are less able than nonpoor household to moderate the impact of the changes in international wheat prices on their consumption and well-being.

### *Changes in the Level of Wheat Imports*

The second wheat-specific set of scenarios that we model are changes in the amount of wheat Ethiopia imports, assuming a fixed international wheat price. As wheat imports for the country are managed closely by a government parastatal institution, the Ethiopian Grain Trade Enterprise, the government can act to closely regulate what quantity of imports is used to help meet Ethiopia's wheat needs. In the scenarios modeled here, the import levels examined are not defined by market forces but are exogenously imposed on the model. The economic effects of those import levels are examined. To run this set of scenarios, the wheat import level in 2012 for the baseline run of the CGE model, 624,000 mt, is changed to reflect three wheat import scenarios:

1. A doubling of imports to 1.2 million mt
2. A halving of imports to 300,000 mt
3. An elimination of virtually all imports—the "zero" case (1,000 mt of wheat imports are left in the model to enable it to run properly)

We then run the model for three model years from the 2013 model year at each wheat import level to allow the model of the Ethiopian economy to adjust to the change in the quantity of imported wheat, to adjustments in Ethiopia's foreign exchange position that the changes in wheat import costs will bring about, and to changes in domestic wheat production and consumption levels. The impact of the change in the amount of wheat imported is then assessed in the 2015 model year. As such, the impact of the change in wheat import levels described in the tables below likely is not as sharp as will be experienced in the initial year following a change in wheat import levels by, notably, urban poor households, the household group most susceptible to changes in consumption and welfare arising due to changes in wheat import levels. To examine the economic impact of changes in wheat imports, we examine the same impacts that were considered in the set of scenarios on changes in the international wheat price.

A significant increase in wheat imports from current levels does not lead to a significant change in the total supply of wheat available to Ethiopian consumers. The CGE model estimates that adding 503,000 mt of wheat imports will result in only an 86,000 metric ton increase in the total supply of wheat (Table 4.14). Wheat producers will find that the significantly lower wheat prices resulting from the large amount of imported wheat provide a poor incentive to continue producing wheat. Domestic wheat production will drop by more than 13 percent. If wheat imports are reduced, here too we find a significant effect on wheat producers. A drop in wheat imports by 397,000 mt will result in a drop in total supply of only 67,000 mt, as 83 percent of the drop in imports will be made up in the medium term (three-year time horizon) through a more than 10 percent increase in domestic wheat production. Eliminating all wheat imports will result in a drop in total supply of 127,000 mt. On the demand side, as wheat supplies decline with reduced imports, there is increased demand for wheat grain as an input into domestic wheat farming (for example, for seed). This is reflected in the larger proportion and absolute quantity of wheat going to "other uses" as imports decline, as seen in Table 4.14.

**Table 4.14 Modeled changes in national supply and demand for wheat due to changes in wheat import levels, from the baseline scenario for 2015, in thousands of metric tons**

| Supply/Demand | Baseline | Double—1,200,000 metric tons | Halve—300,000 metric tons | Zero—1,000 metric tons |
|---|---|---|---|---|
| **Total supply** | **3,801** | **86** | **–67** | **–127** |
| Production | 3,105 | –416 | 330 | 569 |
| Imports | 697 | 503 | –397 | –696 |
| **Total demand** | **3,801** | **86** | **–67** | **–127** |
| For food | 3,071 | 123 | –103 | –204 |
| For other uses | 730 | –37 | 36 | 77 |

Source: Ethiopia computable general equilibrium model.

Considering the price of cereals in the context of changes in the quantities of wheat imported into Ethiopia (Table 4.15), doubling imports increases supply, leading to lower prices. The prices of maize and teff fall as well, as some of the existing demand for those cereals will be satisfied through consuming the now relatively cheaper wheat. Conversely, reducing wheat imports causes real wheat prices to rise significantly, while prices of maize and teff also rise, if much less so.

**Table 4.15 Modeled changes in real prices for wheat, maize, and teff due to changes in wheat import levels, from the baseline scenario for 2015, in percentages**

| Cereal | Double—1,200,000 metric tons | Halve—300,000 metric tons | Zero—1,000 metric tons |
|---|---|---|---|
| **Wheat** | **–3.81** | **3.41** | **6.96** |
| Maize | –0.14 | 0.15 | 0.32 |
| Teff | –0.15 | 0.16 | 0.34 |

Source: Ethiopia computable general equilibrium model.

With regard to the effect of changing levels of wheat imports on household welfare, it is the urban poor who are most affected, seeing both the greatest improvements in welfare with increased imports and the greatest loss in welfare with lower imports (Table 4.16). The rural nonpoor, who are likely the most significant wheat producers, see the lowest declines in welfare with reductions in imports and the lowest increases in welfare with higher import levels.

**Table 4.16 Modeled changes in household welfare (per capita real consumption) due to changes in wheat import levels, from the baseline scenario for 2015, in percentages**

| Household type | Double—1,200,000 metric tons | Halve—300,000 metric tons | Zero—1,000 metric tons |
|---|---|---|---|
| **All households** | **0.25** | **–0.22** | **–0.43** |
| Rural poor | 0.32 | –0.28 | –0.55 |
| Rural nonpoor | 0.19 | –0.15 | –0.30 |
| Urban poor | 0.56 | –0.52 | –1.07 |
| Urban nonpoor | 0.26 | –0.23 | –0.47 |

Source: Ethiopia computable general equilibrium model.

Examining the poverty effects of these changes in wheat import levels, the results in Table 4.17 are consistent with those in Table 4.16, showing that urban poverty levels are most affected by wheat import levels. A greater proportion of the urban population than the rural population falls into poverty with lower wheat import levels. Higher wheat imports see the consumption levels of more urban poor households rise above the poverty line. These patterns are apparent when considering both the poverty headcount and the depth of poverty measures.

**Table 4.17 Modeled changes in poverty due to changes in wheat import levels, from the baseline scenario for 2015**

| Poverty measure | Double—1,200,000 metric tons | Halve—300,000 metric tons | Zero—1,000 metric tons |
|---|---|---|---|
| **Poverty headcount, percentage change** | | | |
| **All households** | **–0.25** | **0.23** | **0.43** |
| Rural | –0.23 | 0.20 | 0.37 |
| Urban | –0.36 | 0.41 | 0.70 |
| **Number of poor individuals** | **–214,000** | **195,000** | **361,000** |
| **Depth of poverty, percentage change** | | | |
| **All households** | **–0.10** | **0.09** | **0.17** |
| Rural | –0.09 | 0.07 | 0.15 |
| Urban | –0.15 | 0.14 | 0.30 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

Focusing on wheat consumption (Table 4.18), the urban poor see the greatest relative changes in consumption of the cereal with changes in wheat import levels, followed by the rural poor. Many rural poor households can be expected to be net wheat consumers, so they will benefit from the lower prices accompanying higher wheat import levels and scale back their wheat consumption when wheat prices rise due to reduced imports and more limited supplies of wheat overall. The urban nonpoor see the lowest changes in their wheat consumption with changes in wheat import levels.

**Table 4.18 Modeled changes in household wheat consumption due to changes in wheat import levels, from the baseline scenario for 2015, in thousands of metric tons**

| Household type | Baseline | Double—1,200,000 metric tons | Halve—300,000 metric tons | Zero—1,000 metric tons |
|---|---|---|---|---|
| **All households** | **3,071** | **123 (4.0%)** | **–103 (–3.4%)** | **–204 (–6.7%)** |
| Rural poor | 1,041 | 43 (4.1%) | –36 (–3.4%) | –71 (–6.8%) |
| Rural nonpoor | 1,732 | 68 (3.9%) | –57 (–3.3%) | –113 (–6.5%) |
| Urban poor | 130 | 6 (4.3%) | –5 (–3.6%) | –9 (–7.2%) |
| Urban nonpoor | 169 | 6 (3.8%) | –5 (–3.2%) | –11 (–6.4%) |

Source: Ethiopia computable general equilibrium model.

The relative pattern of wheat consumption across rural/urban and poor/nonpoor groups shown in Table 4.18 is not fully replicated when calorie consumption is considered (Table 4.19). While the urban poor still are most affected both positively and negatively by increases and decreases, respectively, in

wheat import levels, thereafter it is the urban nonpoor whose calorie consumption levels are then most affected. Moreover, it is the rural poor who see their calorie consumption shift the least relative to the other groups with changes in wheat import levels. Why this should be the case will be linked to the composition of the typical food baskets of these household groups and the importance of wheat as a source of calories for members of poor households in rural areas.

**Table 4.19 Modeled changes in per capita daily calorie consumption due to changes in wheat import levels, from the baseline scenario for 2015, in percentages**

| Household type | *Calorie consumption, baseline* | Double—1,200,000 metric tons | Halve—300,000 metric tons | Zero—1,000 metric tons |
|---|---|---|---|---|
| **All households** | *2,163* | 0.87 | –0.78 | –1.60 |
| Rural poor | *1,374* | 0.77 | –0.69 | –1.42 |
| Rural nonpoor | *2,353* | 0.86 | –0.77 | –1.58 |
| Urban poor | *1,293* | 1.11 | –1.02 | –2.11 |
| Urban nonpoor | *2,140* | 0.94 | –0.86 | –1.77 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

In summary, a doubling of the quantity of wheat imports reduces cereal prices and increases consumption of wheat. Rural households consume most of the increased imports, but we cannot track in the model whether households are consuming domestic or imported wheat—rural households either consume imports directly or, more likely, increase their consumption of domestic wheat once urban households switch to the now cheaper imported wheat. Reducing wheat imports has the opposite effect. The wheat consumption of rural households falls as urban consumers switch from imported to domestic wheat, paying a higher price for the increased quantities of domestic wheat that they consume. Wheat producers respond to these price signals with greater production of domestic wheat after some time.

### *Changes in Wheat Price Subsidy for Urban Consumers*

During the past several years, a significant amount of the wheat that has been imported by the Ethiopian Grain Trade Enterprise, the parastatal institution responsible for organizing bulk wheat imports into the country, has been used for a wheat subsidy program to benefit poor urban consumers. The subsidy program operates by offering wheat at lower than cost to industrial millers and bakers at one subsidy level and directly to urban consumers through *kebele* shops at a slightly lower subsidized price (higher subsidy).[2] The aggregate value of the subsidy in 2013 was US$102 per mt of wheat on a cost of US$391 per mt, for a subsidy of 26.1 percent on the cost of the wheat. ATA wished to explore the likely economic effects of an expansion in the urban wheat consumer subsidy program so asked that the CGE model be employed for this purpose.

As the subsidy program was not explicitly captured in the 2005/2006 SAM for the CGE model when it was constructed, the initial scenario for this analysis of the subsidy program was to introduce the subsidy into the model. This involved providing all urban households in the model with a consumer price for wheat that that was 26.1 percent less than the price of wheat in consumer markets as established by the model baseline run.

[2] *Kebele* shops were established in poorer areas in towns and cities of Ethiopia under the Derg regime in the 1970s to distribute subsidized food items, such as wheat, cooking oil, and sugar, to urban residents. While they are not as common now as they once were, they still are an important mechanism for distributing subsidized food by the government (Woldu et al. 2013).

Thereafter, the subsidy program scenario was changed to create two additional scenarios.

1. The size of the subsidy offered for urban wheat consumers was doubled—that is, the model was run with urban households receiving a 52.2 percent subsidy on the wheat that they obtained from local shops or the commercially processed flour or bread that they obtained from urban industrial millers or bakers—a subsidy of US$204 per mt.
2. The current urban subsidy program was expanded to offer the 26.1 percent subsidy on wheat to all households in the country, both to the existing urban beneficiaries and to new rural beneficiaries.

The subsidy was applied to the CGE model run in model year 2013. We then run the model under each subsidy design scenario for three model years to allow the model of the Ethiopian economy to adjust to the change in the consumer price wheat for beneficiary households and to consequent changes in domestic wheat production and wheat consumption levels. The impact of the wheat subsidy is then assessed in the 2015 model year. The economic impacts of the three designs for the wheat subsidy program that we examine are changes in levels of domestic wheat supply and demand, cereal prices, household welfare and poverty, wheat consumption, and calorie consumption.

When examined in the context of national wheat demand, the current design of the subsidy program is relatively small, raising demand by about 2.4 percent (Table 4.20). This additional wheat is supplied from increased domestic production and imports, with somewhat more coming from imports than the share of wheat supplied by imports in the baseline model run. About 21 percent of the increased demand due to the subsidy program will come from imports, in contrast to the 18.3 percent of wheat coming from imports in the baseline, and this pattern holds across all three subsidy program designs considered. When the subsidy targeted only for urban households is doubled to 52.2 percent of the cost of the wheat, the model estimates that the increase in national wheat consumption will triple, as the lower price for wheat for urban consumers increases demand significantly. When the subsidy is made universal by extending it to rural households, the scale of the program and its economic effects expand substantially. Supplies of wheat will need to increase from baseline conditions by more than 25 percent to meet the additional demand for wheat under this broadest design for the subsidy program. It is unclear, however, whether Ethiopian wheat producers would be quite as responsive as the model would indicate, as there may be some production constraints that would limit such a large response in wheat production to meet the demand of the universal consumer subsidy on wheat.

**Table 4.20 Modeled changes in national supply and demand for wheat due to changes in wheat price subsidy program, from the baseline scenario for 2015, in thousands of metric tons**

| Supply/Demand | Baseline | Current—26.1% | Double—52.2% | Extend—rural/urban |
|---|---|---|---|---|
| **Total supply** | **3,801** | **90** | **277** | **984** |
| Production | 3,105 | 71 | 219 | 773 |
| Imports | 697 | 19 | 58 | 211 |
| **Total demand** | **3,801** | **90** | **277** | **984** |
| For food | 3,071 | 82 | 253 | 901 |
| For other uses | 730 | 8 | 24 | 83 |

Source: Ethiopia computable general equilibrium model.

A consumer subsidy is designed to reduce the price that consumers will pay for the commodity being subsidized. The price information presented in Table 4.21 shows that average real wheat prices decline with the subsidy program, with greater reductions in price being seen as the program expands. Real maize and teff prices rise slightly, reflecting changes in relative producer prices across the three cereals. The increased demand for wheat emanating from the subsidy program raises the price producers

receive for their wheat relative to maize and teff, leading to increased wheat and lower maize and teff production. With lower supplies of teff and maize, their prices rise slightly.

**Table 4.21 Modeled changes in real prices for wheat, maize, and teff due to changes in wheat price subsidy program, from the baseline scenario for 2015, in percentages**

| Cereal | Current—26.1% | Double—52.2% | Extend—rural/urban |
|---|---|---|---|
| **Wheat[a]** | **–3.15** | **–8.77** | **–25.71** |
| Maize | 0.08 | 0.24 | 0.86 |
| Teff | 0.07 | 0.22 | 0.82 |

Source: Ethiopia computable general equilibrium model.
Note: [a]. The wheat price examined here is the weighted average of the real prices Ethiopian households face for both subsidized and unsubsidized wheat.

The different levels of impact of the wheat consumer subsidy on the welfare of Ethiopian households is shown in Table 4.22. As one would expect, the urban poor see the greatest welfare benefits from the urban-targeted subsidy designs, although the urban nonpoor also benefit. Doubling the size of the subsidy received results in more than a doubling of the welfare benefits these urban households receive from the wheat subsidy program. Rural households see declines in welfare when the subsidy is not extended to rural households. Under the urban subsidy program designs, the rural poor see a somewhat greater decline in welfare than do the rural nonpoor, possibly reflecting some income benefits associated with the subsidy program for nonpoor wheat-producing households in rural areas, as the subsidy program can be expected to increase demand for domestic wheat and, hence, raise the prices producers receive.

**Table 4.22 Modeled changes in household welfare (per capita real consumption) due to changes in wheat price subsidy program, from the baseline scenario for 2015, in percentages**

| Household type | Current–26.1% | Double–52.2% | Extend–rural/urban |
|---|---|---|---|
| **All households** | **0.02** | **0.07** | **0.23** |
| Rural poor | –0.14 | –0.42 | 0.59 |
| Rural nonpoor | –0.10 | –0.30 | 0.56 |
| Urban poor | 1.09 | 3.23 | –0.47 |
| Urban nonpoor | 0.31 | 0.88 | –0.96 |

Source: Ethiopia computable general equilibrium model.

However, when the wheat subsidy is extended to rural consumers, the flow of welfare benefits between rural and urban reverses. Rural households see an improvement in per capita real consumption, with both poor and nonpoor households seeing quite similar relative gains. However, urban households see a decline in their welfare under the universal, extended subsidy program, with the urban nonpoor seeing the greatest drop in this welfare measure on average. This results from the increased tax burden that urban nonpoor households primarily will bear to fund the large extended subsidy program. As was noted in the description of the CGE model earlier in this report, the sum of all public expenditures in the model must equal the sum of all public revenues. As such, any new or expanded government program, such as a universal consumer subsidy on wheat, will require additional revenue to finance, and this must be reflected in the model. In part, this additional revenue will come from higher taxes that erode some of the benefits of the wheat subsidy for urban households, particularly nonpoor households.

The reversal in benefits from urban to rural households with the expansion of the wheat subsidy program to rural households is also seen in the poverty measures (Table 4.23). The urban-focused designs result in drops in the poverty headcount and depth of poverty in the urban population, while increasing both among rural households. However, when the program is extended universally, poverty measures for the rural population drop, although the depth of poverty measure for the rural population does not budge by much. Note that for the country as a whole, a decline in the numbers of poor, even if modest, is seen only under the most expansive subsidy program. The urban-focused subsidy designs both result in a small increase in the number of poor nationally.

**Table 4.23 Modeled changes in poverty due to changes in wheat price subsidy program, from the baseline scenario for 2015**

| Poverty measure | Current—26.1% | Double—52.2% | Extend—rural/urban |
|---|---|---|---|
| **Poverty headcount, percentage change** | | | |
| **All households** | **0.08** | **0.03** | **–0.28** |
| Rural | 0.17 | 0.36 | –0.44 |
| Urban | –0.34 | –1.57 | 0.51 |
| **Number of poor individuals** | **70,000** | **28,000** | **–236,000** |
| **Depth of poverty, percentage change** | | | |
| **All households** | **–0.01** | **–0.01** | **–0.01** |
| Rural | 0.05 | 0.15 | –0.04 |
| Urban | –0.29 | –0.82 | 0.14 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

The consumer subsidy on wheat leads to notable changes in wheat consumption among beneficiary households (Table 4.24). With the current subsidy, wheat consumption among urban households is estimated to increase by about 30 percent. A doubling in the value of the urban subsidy will lead to about a 90 percent increase in wheat consumption for urban households over baseline conditions. Rural households see very little change in their wheat consumption under the urban subsidy designs. However, when the subsidy program is extended to rural households, increases in wheat consumption of about 30 percent are seen among rural beneficiaries, in line with the consumption increases urban households realize under the current design of the program. In absolute terms, the current urban program will raise national wheat consumption by under 3 percent. Extending the same level of subsidy to rural consumers, given their large numbers, will raise national wheat consumption by more than 29 percent.

**Table 4.24 Modeled changes in household wheat consumption due to changes in wheat price subsidy program, from the baseline scenario for 2015, in thousands of metric tons**

| Household type | Baseline | Current—26.1% | Double—52.2% | Extend—rural/urban |
|---|---|---|---|---|
| **All households** | **3,071** | **82 (2.7%)** | **253 (8.2%)** | **901 (29.3%)** |
| Rural poor | 1,041 | –2 (–0.2%) | –6 (–0.6%) | 313 (30.0%) |
| Rural nonpoor | 1,732 | –3 (–0.2%) | –9 (–0.5%) | 509 (29.4%) |
| Urban poor | 130 | 40 (31.1%) | 124 (95.5%) | 36 (28.1%) |
| Urban nonpoor | 169 | 47 (27.8%) | 144 (85.5%) | 43 (25.2%) |

Source: Ethiopia computable general equilibrium model.

Examining the estimated changes in calorie consumption associated with the three wheat subsidy designs (Table 4.25), subsidy beneficiaries see increases in calorie consumption, whereas nonbeneficiaries see slight declines. This pattern is seen in the extended, universal subsidy design wherein even though urban households see some loss in welfare, they nonetheless see a net increase in calorie consumption.

**Table 4.25 Modeled changes in per capita daily calorie consumption due to changes in wheat price subsidy program, from the baseline scenario for 2015, in percentages**

| Household type | *Calorie consumption, baseline* | Current—26.1% | Double—52.2% | Extend—rural/urban |
|---|---|---|---|---|
| **All households** | **2,163** | **0.25** | **0.76** | **1.71** |
| Rural poor | 1,374 | –0.19 | –0.58 | 1.23 |
| Rural nonpoor | 2,353 | –0.17 | –0.51 | 1.96 |
| Urban poor | 1,293 | 3.01 | 9.16 | 0.95 |
| Urban nonpoor | 2,140 | 2.49 | 7.62 | 0.72 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

To summarize the findings from running the three wheat subsidy scenarios with the Ethiopia CGE model, we find that when subsidies benefit only urban households, the reduction in urban consumer prices for wheat will lead to an increase in total demand for wheat. This drives up wheat prices for unsubsidized rural consumers, so rural consumption of wheat will fall while urban consumption rises. As their total consumption rises, urban households benefit overall from an urban-targeted consumer subsidy on wheat, even though they also are the households that primarily must pay higher income taxes to pay for the wheat subsidy. In contrast, when subsidies are extended to all households, both urban and rural, the consumption of rural households will now rise due to the lower wheat prices that they face as consumers. However, urban households will be worse off with the extended subsidy program because they have to pay higher taxes to cover the costs to government of the expanded subsidy program that more than offset the benefits that they derive from lower wheat prices. Through their increase in tax payments, the net result is that the urban households will be subsidizing increased rural wheat consumption when the wheat subsidy program is extended to rural households.

### *Maize Exports*

The last cereal-specific scenario that we investigated using the Ethiopia CGE model was the export of 300,000 and 600,000 mt of maize, about 7.4 and 14.8 percent of total maize production in Ethiopia, respectively. The government of Ethiopia does not now allow exports of substantial amounts of cereal. However, with recent concerted efforts to increase the production of cereals—notably the Teff, Wheat, and Maize Initiatives of ATA—it is foreseen that Ethiopia should soon be in a position where it will be able to reliably satisfy its domestic grain requirements for several cereals and produce a surplus that can be exported for some. Of the cereals whose production is soon likely to exceed domestic demand requirements, maize is the commodity that will most easily find an export market to supply. In view of this prospect, ATA asked that the CGE model be used to examine the likely economic effects of withdrawing significant amounts of maize from the domestic market for export.

To run this scenario in the CGE model for Ethiopia first required inserting a maize export component into the model. The 2006 SAM that was used to develop the model reported no maize exports or imports for the country in 2006. Consequently, for this analysis, a small maize export and import component of 18,000 mt each was added to SAM so that a baseline scenario could be run that would include maize exports. Since these fictitious maize trade components balanced each other, the net impact on maize demand and supply in the baseline run of the model effectively was zero. However, their

addition to the model allowed the imposition on the model of 282,000 and 582,000 mt of additional maize exports in the 2013, 2014, and 2015 model years to examine the economic effects of 300,000 and 600,000 mt of maize exports in total. These exports are imposed arbitrarily on the model—that is, they do not arise from a change in the comparative advantage of Ethiopia with regard to international maize markets. Simply, those quantities of maize were removed from the local supply of maize for the country and instead directed toward export markets. The economic effects of this sharp drop in domestic maize supply (and increase in exports) were examined in model year 2015, three years after the exports began.

As shown in Table 4.26, these exports of maize will results in some increase in the total amount of maize supplied by domestic producers—by 1.6 percent for the lower export amount and 3.3 percent for the higher level of exports. However, most of the maize exported will be sourced out of sharp drops in the amount of maize that households consume. Demand for maize for use as food will drop by 5.8 and 11.6 percent under the two export levels.

**Table 4.26 Modeled changes in national supply and demand for maize due to changes in levels of maize exports, from the baseline scenario for 2015, in thousands of metric tons**

| Supply/Demand | Baseline | Exports of 300,000 metric tons | Exports of 600,000 metric tons |
|---|---|---|---|
| **Total supply** | **4,064** | **73** | **149** |
| Production | 4,042 | 66 | 133 |
| Imports | 22 | 7 | 16 |
| **Total demand** | **4,046** | **73** | **149** |
| Export | 18 | 294 | 590 |
| For food | 3,846 | –223 | –445 |
| For other uses | 199 | 2 | 4 |

Source: Ethiopia computable general equilibrium model.

The withdrawal from the domestic market of these quantities of maize will restrict domestic supply and lead to large increases in maize prices. In nominal terms, the price of wheat and teff may rise, with the maize exports expanding demand for those cereals. However, Table 4.27 shows that in real terms, the prices of these cereals fall relative to the overall consumer price index, which faces strong upward pressure resulting from the sharp increase in maize prices. In other words, nominal wheat and teff prices do not rise by as much as the overall consumer price index, and therefore, the prices for these cereals fall in real terms.

**Table 4.27 Modeled changes in real prices for wheat, maize, and teff due to changes in levels of maize exports, from the baseline scenario for 2015, in percentages**

| Cereal | Exports of 300,000 metric tons | Exports of 600,000 metric tons |
|---|---|---|
| **Maize** | **6.82** | **14.59** |
| Wheat | –0.33 | –0.71 |
| Teff | –0.21 | –0.45 |

Source: Ethiopia computable general equilibrium model.

Considering the effect of these maize exports on the welfare of Ethiopian households, although the impact is relatively small for all groups, the rural nonpoor benefit the most (Table 4.28). This is likely due to a large proportion of the maize-producing households in this group being net producers and able to derive some income benefits from the higher prices that result from the export of maize. In contrast, it is

the rural poor who see the largest drop in welfare. The urban poor see a small decline in welfare under both export scenarios, while the urban nonpoor experience practically no change in their welfare levels with maize exports.

**Table 4.28 Modeled changes in household welfare (per capita real consumption) due to changes in levels of maize exports, from the baseline scenario for 2015, in percentages**

| Household type | Exports of 300,000 metric tons | Exports of 600,000 metric tons |
|---|---|---|
| **All households** | **–0.03** | **–0.02** |
| Rural poor | –0.21 | –0.37 |
| Rural nonpoor | 0.04 | 0.12 |
| Urban poor | –0.15 | –0.03 |
| Urban nonpoor | 0.03 | –0.01 |

Source: Ethiopia computable general equilibrium model.

The changes in poverty measures resulting from the maize exports are small (Table 4.29). All poverty measures go up with maize exports, except for the poverty headcount for the rural population under the higher level of exports, possibly reflecting the movement of poor net maize producers out of poverty as they increase production of now higher-value maize. However, the depth of poverty measure increases for rural households slightly more than it does for those in urban centers, reflecting the adverse impact of higher maize prices on the overall consumption of poorer rural households.

**Table 4.29 Modeled changes in poverty due to changes in levels of maize exports, from the baseline scenario for 2015**

| Poverty measure | Exports of 300,000 metric tons | Exports of 600,000 metric tons |
|---|---|---|
| **Poverty headcount, percentage change** | | |
| **All households** | **0.06** | **0.01** |
| Rural | 0.05 | –0.01 |
| Urban | 0.06 | 0.09 |
| **Number of poor individuals** | **47,000** | **7,000** |
| **Depth of poverty, percentage change** | | |
| **All households** | **0.07** | **0.14** |
| Rural | 0.08 | 0.14 |
| Urban | 0.06 | 0.11 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

The drop in household maize consumption was noted in Table 4.26. Exports totaling 300,000 mt will result in a drop in food consumption of 223,000 mt or almost 75 percent of the amount exported. Exports of 600,000 mt result in a similar proportional drop in household consumption relative to the quantity of maize exported. More detail about the relative drop in consumption across household groups is shown in Table 4.30. Poor households see slightly larger reductions in maize consumption than do nonpoor households, with rural poor households seeing the largest drop in maize consumption. The urban nonpoor see their maize consumption drop the least.

**Table 4.30 Modeled changes in household maize consumption due to changes in levels of maize exports, from the baseline scenario for 2015, in thousands of metric tons**

| Household type | Baseline | Exports of 300,000 metric tons | Exports of 600,000 metric tons |
|---|---|---|---|
| **All households** | **3,846** | **–223 (–5.8%)** | **–445 (–11.6%)** |
| Rural poor | 1,453 | –87 (–6.0%) | –174 (–11.9%) |
| Rural nonpoor | 2,269 | –129 (–5.7%) | –257 (–11.3%) |
| Urban poor | 72 | –4 (–5.9%) | –9 (–11.8%) |
| Urban nonpoor | 53 | –3 (–5.3%) | –6 (–10.6%) |

Source: Ethiopia computable general equilibrium model.

The pattern seen in Table 4.30 on overall maize consumption is replicated when considering changes in levels of calorie consumption (Table 4.31). Rough linear trends are apparent in the table, with a doubling in maize exports leading to a doubling in the reduction of calories consumed.

**Table 4.31 Modeled changes in per capita daily calorie consumption due to changes in levels of maize exports, from the baseline scenario for 2015, in percentages**

| Household type | *Calorie consumption, baseline* | Exports of 300,000 metric tons | Exports of 600,000 metric tons |
|---|---|---|---|
| **All households** | ***2,163*** | **–1.03** | **–2.03** |
| Rural poor | *1,374* | –1.37 | –2.71 |
| Rural nonpoor | *2,353* | –1.10 | –2.16 |
| Urban poor | *1,293* | –0.83 | –1.65 |
| Urban nonpoor | *2,140* | –0.45 | –0.91 |

Source: Ethiopia computable general equilibrium model with microsimulation module.

To summarize the economic effects of maize exports, overall maize production increases with maize exports as farmers respond to higher maize prices. However, the amount of maize consumed by Ethiopian households falls quite sharply—in total, by about three-quarters of the amount of maize exported. Consuming households will face higher maize prices. This has adverse effects on the welfare of poorer households that are net purchasers of maize, while net producers of maize may realize improved incomes and higher consumption levels. When considered at the national scale, the net effect of maize exports on poverty is small. However, more significant changes in various economic parameters might be seen more locally in areas of Ethiopia where maize is the dominant cereal produced.

It should be noted that the approach to modeling the maize exports here is somewhat simplistic in that we constrained any subsequent increase in maize production to cover the shortfall in domestic supplies. In reality, withdrawing large amounts of maize from domestic markets is expected to result in higher maize prices, as we saw, and thereafter subsequent reallocations of land and agricultural labor from other crops to maize as farmers seek to maximize returns to their land and labor. One would expect significant reorganization of production patterns under such export levels in those agroecologies of Ethiopia where maize is well-suited. However, in the CGE scenarios considered here, the analysis is not extended to consider these broader second-round resource reallocation effects that may lead to quite different patterns of economic growth and poverty reduction than what our modeled scenarios suggest.

# 5. BROADER IMPLICATIONS FOR CEREAL POLICY IN ETHIOPIA

We have seen through the use of the CGE model of the Ethiopian economy that the impact on the economy of Ethiopia of increasing the national production of teff, wheat, and maize as envisioned by the Teff, Wheat, and Maize Initiatives of ATA is important. Increases in the national production of each cereal of between 12 and 14 percent, corresponding to increases of between 430,000 and 495,000 mt, jointly will result in economic growth estimated at about 1.4 percent, adding more than $580 million to the size of the Ethiopian economy. However, the scenarios run in the model also demonstrate that these increases in cereal production will not lead to much change in the structure of the Ethiopian economy. Almost all of the economic growth that will result from this increase in cereal production will be within the agricultural sector. As there are only weak linkages between agriculture and other sectors of the Ethiopian economy, these cereal production increases do not propel increased growth elsewhere in the economy.

The CGE analysis also showed that production increases for teff, wheat, and maize can be expected to have quite different impacts across rural and urban households and poor and nonpoor households. Significant increases in teff production will provide the greatest benefits for urban consumers, particularly poor urban households, while the economic benefits of increases in maize production will principally flow to rural households, both poor maize consumers and maize producers. The benefits of increases in wheat production are more evenly shared across all households. Overall, the impact of these cereal production increases on household welfare, household cereal consumption, calorie consumption, and national poverty levels are uniformly positive.

The CGE analyses of the economic impact of varying international wheat prices and quantities of wheat imported annually demonstrate that Ethiopia's reliance on international sources for about one-fifth of the wheat that it consumes leaves its economy and its wheat consumers, in particular, exposed to volatility in international wheat markets. However, these analyses demonstrate that Ethiopian wheat producers should be expected to be quite responsive to changing market conditions for wheat. With a drop in wheat imports, while domestic producers will not replace all of the drop in wheat imports, several scenarios run for these analyses show that they should be expected to produce about 80 percent of the reduction in imports. As such, public investments in increasing domestic wheat production do make sense. With the inducement of higher prices for their wheat, Ethiopian farmers will supply the market with most of the wheat Ethiopian consumers demand, resulting in reduced exposure for Ethiopian wheat consumers and the government of Ethiopia, as the importer of wheat into the country, to adverse volatility in international wheat markets.

Urban households are the principal beneficiaries of wheat imported into Ethiopia. A consumer subsidy program based on imported wheat is in place in Addis Ababa. The CGE model was used to assess the economic effects of changes in its design. The results obtained are not unexpected—subsidizing the consumer price of wheat leads to increased demand. The model showed again that Ethiopian farmers will supply much but not all of the increased demand. However, the urban subsidy program does result in lower welfare for rural households, as the increased income for wheat producers is smaller than the aggregate cost of the higher wheat prices that result for rural wheat consumers. When the subsidy program is made universal, demand for wheat soars, and a very sharp increase is seen in both domestic supply and imports in the model. It is unclear whether Ethiopian wheat producers would be quite as responsive as the model would indicate, however, as there may be some production constraints that would limit such a large response in wheat production. Nonetheless, the question of whether it is a good idea for the wheat consumer subsidy program to be maintained or expanded likely cannot be answered solely based on the insights gained from the CGE analysis. It is clear that domestic producers of wheat can provide most of current demand for wheat without recourse to imports, but that is a separate issue from whether the subsidy program should be maintained. A wider set of political considerations than the agricultural production and trade issues we consider here will be called on to determine whether the subsidy will be eliminated, remain in place, or be expanded.

The last cereal-specific scenario examined using the CGE model for Ethiopia was that of maize exports. As there are virtually no cereal exports from Ethiopia, the scenario that was used in the model was necessarily quite simple, involving simply the removal of 300,000 and 600,000 mt of maize from the supply for the country. The results obtained were not unexpected, with higher maize prices and sharp reductions in maize consumption affecting the poor more than the nonpoor, while maize producers realize welfare benefits. However, these are not the only economic effects that maize exports will produce. The foreign exchange the exports earn may provide important macro-economic buttressing for Ethiopia to the extent that these wider benefits are judged to outweigh the adverse effects of the maize exports on the consumption of certain household groups. The analysis here was not extended sufficiently to provide evidence to guide such considerations.

In summary, the cereal subsector of Ethiopia's agricultural economy offers considerable scope for contributing to the economic transformation of the country. The Teff, Wheat, and Maize Initiatives of ATA are an appropriate approach to realizing some of the potential the sector has to contribute to such a transformation. Current cereal productivity levels in Ethiopia are below potential—the average wheat yields of 1,840 kg/ha are only 57.9 percent of average wheat yields (3,175 kg/ha) in the United States for 2013, while the average maize yield of 2,540 kg/ha is only 25.5 percent of average maize yields (9,970 kg/ha) of US farmers (United States Department of Agriculture 2014). While this comparison is not wholly fair, it does demonstrate that the agronomic productivity potential of these two cereals is far from realized in Ethiopia. While judging its on-farm potential is more difficult, likely a similar story applies to teff. Ethiopian farmers can become much more productive, benefiting their own households and the country as a whole.

However, policymakers should be sensitive to the possibility that there might be alternative public investments, whether in the agricultural sector or in other sectors, that would provide similar levels of economic growth, poverty reduction, and increased household consumption more efficiently at less cost. The analyses here provide no insights into this possibility.

Keeping this caveat in mind, nonetheless it would appear that increasing public investments to improve productivity levels and increase overall production of cereals has considerable potential for bringing about strong economic growth in the country, particularly in the agricultural sector and across the rural economy. While the results here do not provide any evidence of structural transformation of the economy with the level of production increases modeled here, it should be expected that as the agricultural sector grows through increased productivity, increasingly positive spillovers into the other sectors of the economy and strengthened linkages between those sectors and the agricultural sector will be observed. As such, as Ethiopia seeks continued strong economic growth and broad poverty reduction, continued investment in raising production of cereals should be one of the principal strategies it uses to attain these objectives.

# REFERENCES


Berhane, G., L. McBride, K. T. Hirfrfot, and S. Tamiru. 2012. "Patterns in Foodgrain Consumption and Calorie Intake." In *Food and Agriculture in Ethiopia: Progress and Policy Challenges*, edited by P. Dorosh and S. Rashid, 190–216. Philadelphia: University of Pennsylvania Press.

CSA (Central Statistical Agency). 2006. "Results at Zonal Level, Statistical Report on Socio-economic Characteristics of the Population in Agricultural Households, Land Use, and Area and Production of Crops," In *Ethiopian Agricultural Sample Enumeration, 2001/02 (1994 Ethiopian Calendar)* Multiple region-specific volumes. Addis Ababa, Ethiopia.

———. 2011. Agricultural Sample Survey 2010/2011 (2003 Ethiopian Calendar) (September–December 2010), vol. 1, Report on Area and Production of Major Crops (Private Peasant Holdings, Meher Season). Addis Ababa, Ethiopia.

Diao, X., A. S. Taffesse, P. Dorosh, J. Thurlow, A. Nin Pratt, and B. Yu. 2012. "Ethiopia." In *Strategies and Priorities for African Agriculture: Economywide Perspectives from Country Studies*, edited by X. Diao, J. Thurlow, S. Benin, and S. Fan. Washington, DC: International Food Policy Research Institute.

Dimaranan, B., ed. 2006. Global Trade, Assistance, and Production: The GTAP 6 Database. West Lafayette, IN, US: Center for Global Trade Analysis, Purdue University.

Dorosh, P., and J. Thurlow. 2012. "Implications of Accelerated Agricultural Growth for Household Incomes and Poverty in Ethiopia: A General Equilibrium Analysis." In *Food and Agriculture in Ethiopia: Progress and Policy Challenges*, edited by P. Dorosh and S. Rashid, 219–255. Philadelphia: University of Pennsylvania Press.

FAO (Food and Agriculture Organization of the United Nations). 2014. FAOSTAT database. Accessed April 15, 2014. http://faostat3.fao.org/faostat-gateway/go/to/download/FB/*/E.

Minten, B., D. Stifel, and S. Tamru. 2012. *Structural Transformation in Ethiopia: Evidence from Cereal Markets*. Ethiopia Strategy Support Program II Working Paper 39. Addis Ababa, Ethiopia: International Food Policy Research Institute.

———. 2014. "Structural Transformation of Cereal Markets in Ethiopia." *Journal of Development* Studies 50 (5): 611–629.

Tebekew, T., A. Amoge, B. Teferra, Z. Seyoum, M. Amha, H. Beyene, E. Fisseha, E. Tsehaye, H. A. Ahmed, S. Robinson, D. Willenbockel, P. Dorosh, and S. McDonald. 2009. Ethiopia: Input Output Table and Social Accounting Matrix. Addis Ababa: Ethiopian Development Research Institute.

United States Department of Agriculture. 2014. *Crop Production: 2013 Summary*. Washington, DC: United States Department of Agriculture, National Agricultural Statistics Service.

Woldu, T., G. Abebe, I. Lamoot, and B. Minten. 2013. *Urban Food Retail in Africa: The Case of Addis Ababa, Ethiopia.* Ethiopia Strategy Support Program II Working Paper 50. Addis Ababa, Ethiopia: International Food Policy Research Institute.

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