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ESSP II Working Paper 16

Crop Production in Ethiopia: Regional Patterns and Trends

Alemayehu Seyoum Taffesse, Paul Dorosh and Sinafikeh Asrat

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Ethiopia Strategy Support Program II (ESSP II)

ESSP II Working Paper No. 0016

March 2011

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1. Introduction

Ethiopia's crop agriculture is complex, involving substantial variation in crops grown across the country's different regions and ecologies. Five major cereals (teff, wheat, maize, sorghum and barley) are the core of Ethiopia's agriculture and food economy, accounting for about three-quarters of total area cultivated, 29 percent of agricultural GDP in 2005/06 (14 percent of total GDP) and 64 percent of calories consumed.¹ There has been substantial growth in cereals, in terms of area cultivated, yields and production since 2000, but yields are low by international standards and overall production is highly susceptible to weather shocks, particularly droughts. Thus, both raising production levels and reducing its variability are essential aspects of improving food security in Ethiopia, both to help ensure adequate food availability, as well as to increase household incomes.

Ethiopia's crop agriculture in general, and the cereals sub-sector in particular, face serious challenges. We show in this paper that much of the increase in production in the past decade has been due to increases in area cultivated. However, little suitable uncultivated land remains in the highlands, apart from pasture land. Soil degradation from erosion and soil compaction also threatens crop yields (Hamza and Anderson 2005; Tadesse 2001). Furthermore, uncertain rainfall and very low levels of irrigation make intensive cultivation with improved seeds and fertilizer risky (McCann 1995).

This paper presents an overview of crop agriculture, focusing mainly on cereal production. The next section describes area and production levels of the main agricultural crops, distribution of cultivated area by farm size and the importance of seasonal differentiation. Section three presents area, yield, production, growth and variability for cereals in general as well as for each major cereal crop separately. The results of a decomposition analysis of cereal production changes are discussed in section four. An overview of production of other major agricultural crops, including enset, oilseeds, pulses and export crops (coffee and chat) is presented in section five. Section six discusses major constraints to increasing agricultural production, providing some international productivity data to compare with Ethiopia's agricultural productivity. Section seven summarizes the chapter and presents concluding observations.

2. Overview of agricultural crop area and production

2.1. Importance of crop categories

Cultivated crop area (13 million hectares in 2007/08) accounts for a relatively small share of the total area of Ethiopia as most land is not suited for cultivation. Table 2.1 shows average area and production levels of the main crops cultivated for the period 2004/05-2007/08. Cereals dominate Ethiopian crop production. Cereals were grown on 73.4 percent of the total area cultivated, by a total of 11.2 million farmers. Together, these holders produce a yearly

¹ Source: Food Balance Sheets database at <http://faostat.fao.org/>.

average of 12 million ton of cereals, which is 68 percent of total agricultural production. The five major cereals are teff, wheat, maize, sorghum and barley. Teff accounts for 28 percent of total cereal area, while maize stands for 27 percent of total annual cereal production.

Table 2.1. Crop area and production (Smallholder farms, Meher season), 2004/05-2007/08²

Crop	Number of holders	Average – 2004/2005 – 2007/08			
		Area Cultivated in hectares		Production in quintals	
		Level	Share in total area cultivated (%)	Level	Share in total production (%)
Grain	11,519,148	10,382,365	92.7	140,902,733	79.8
Cereals	11,156,837	8,230,211	73.4	120,629,724	68.3
Teff	5,462,782	2,337,850	20.9	24,079,480	13.6
Barley	3,842,462	1,024,390	9.1	13,264,217	7.5
Wheat	4,118,164	1,439,098	12.8	22,933,077	13
Maize	7,287,931	1,595,238	14.2	33,142,865	18.8
Sorghum	4,253,534	1,429,886	12.8	22,161,808	12.5
Pulses	6,377,027	1,384,499	12.4	14,955,466	8.5
Oilseeds	3,127,131	767,655	6.9	5,317,543	3.0
Vegetables	4,936,741	106,585	1.0	4,248,252	2.4
Root crops	4,757,733	174,826	1.6	14,732,919	8.3
Fruit crops	2,658,415	51,078	0.5	4,034,590	2.3
Chat	2,068,262	141,881	1.3	1,264,269	0.7
Coffee	3,049,120	305,940	2.7	2,106,711	1.2
Hops	1,685,422	23,457	0.2	263,111	0.1

Source: Author's computation using CSA data

After cereals, the second most important crop group (in terms of acreage) is pulses. In 2004/05-2007/08 6.4 million holders grew pulses on 12.4 percent of total area cultivated. Total pulse production averaged 1.5 million tons per year, which is 8.5 percent of total crop production. Oilseeds form the third most important crop group. It is cultivated on 6.9 percent of total area cultivated, by 3.1 million holders. They produce an average of 0.5 million ton of oilseeds yearly, i.e. 3 percent of total annual production. Coffee is a major cash crop, accounting for 3.8 percent of GDP (and 19 and 35 percent of the quantity and value of exports respectively in that period), but occupying only 2.7 percent of total area cultivated (i.e. 306 thousand hectares). Chat, another stimulant crop, is cultivated by 2 million farmers

² CSA defines a *holder* as:

"... a person who exercises management control over the operation of the agricultural holding and makes the major decision regarding the utilization of the available resources. He/she has primary technical and economic responsibility for the holding. He/she may operate the holding directly as an owner or a manager. Under conditions of traditional agricultural holding the holder may be regarded as the person, who with or without the help of others, operates land and/or raises livestock in his/ her own right, i.e. the person who decides on which, where, when, and how to grow crops or raise livestock or both and has the right to determine the utilization of the products."

on 1.3 percent of total area cultivated, and accounts for 5 percent of total export earnings. Vegetables and root crops together are cultivated on 281 thousand hectares, 2.6 percent of total area cultivated.

2.2. Distribution of cultivated land by farm size

The Central Statistical Agency (CSA) classifies Ethiopian farms into two major groups: smallholder “peasant” farms and large commercial farms. Smallholders and larger farms are defined as those that cultivate less and more than 25.2 hectares respectively. The majority of farmers in Ethiopia are smallholder farms. These farms, though small, are often fragmented, produce mostly for own consumption and generate only a small marketed surplus. Large farms (averaging 323 hectares per farm) can be state property or private and they sell agricultural products at local markets and/or abroad. These larger farms usually use more modern farm management practices and inputs than smaller farms do (e.g. machinery, irrigation, fertilizers, pesticides and improved seeds). Large farms are not widely spread in Ethiopia and the contribution of these farms to total agricultural output is limited. It is estimated that they make up less than 4% of total production in the country (CSA January 2009, report 443).

Table 2.2 shows area cultivated by farm size for the smallholder farms only. Each farm size interval contains 20 percent of Ethiopia’s smallholder farms. Sixty percent of smallholders (called “small farms” further on) in Ethiopia cultivate less than 0.90 hectares of land. While 40 percent of the farmers cultivate less than 0.52 hectares, they manage only 11 percent of total area cultivated. On the other hand, medium-size farms, defined as those cultivating 0.90 hectares or more, account for 75 percent of the total land cultivated.

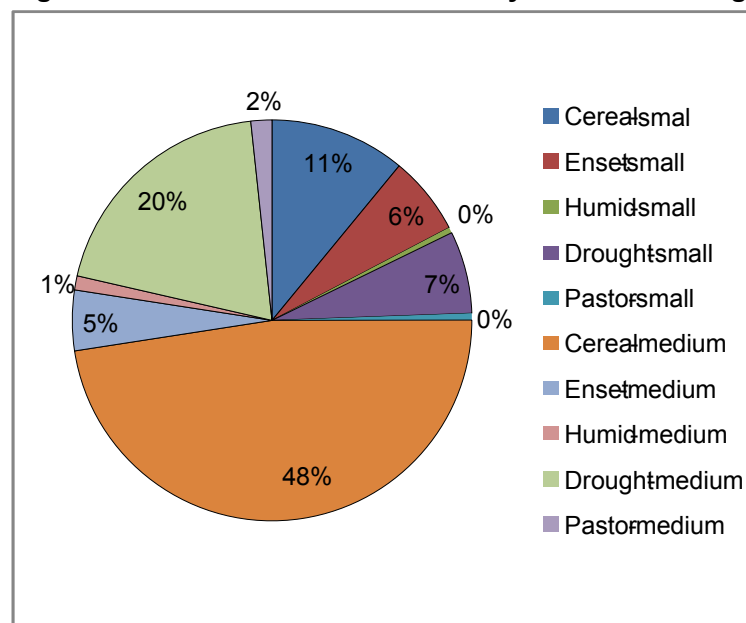
Table 2.2 further shows how agricultural production is spread over different agro-ecological regions. We distinguish five categories, i.e. moisture reliable cereals, moisture reliable *enset*, humid lowlands, drought prone highlands, and pastoralist in the Table. Most smallholder farms are located in the moisture reliable cereal-based highlands, which accounts for 59 percent of all farm area (i.e. 48 percent cultivated by medium-size farmers and 11 percent by small farmers). Farm area in the drought-prone highlands is good for 27 percent of total area cultivated (i.e. 20 percent medium-size farm area and 7 percent small farm area) (Table 2.2, Figure 2.1).

Table 2.2. Ethiopia: Total area cultivated by farm size and agro-ecology

Farm size (hectares)	Moisture Reliable Cereal	Moisture Reliable Enset	Humid Lowland	Drought prone	Pastoralist	Total
	(thousand hectares)					
0.0 - 0.25	111.7	133.2	6.5	76.9	6.8	335.1
0.25 - 0.52	364.3	298.7	17.1	271.2	22.1	973.4
0.52 - 0.90	884	355.7	31	474.3	39.4	1784.4
0.90 - 1.52	1739.5	330	47	824.8	70.5	3011.8
1.52 - 25.20	4153.2	272.4	94.4	1617.8	140.3	6278.1
Total	7252.7	1390	196	3265	279.1	12382.8
	(percentage of national total)					
0.0 - 0.25	0.9	1.1	0.1	0.6	0.1	2.7
0.25 - 0.52	2.9	2.4	0.1	2.2	0.2	7.9
0.52 - 0.90	7.1	2.9	0.3	3.8	0.3	14.4
0.90 - 1.52	14.0	2.7	0.4	6.7	0.6	24.3
1.52 - 25.20	33.5	2.2	0.8	13.1	1.1	50.7
Total	58.6	11.2	1.6	26.4	2.3	100.0

Note: Each farm size interval (quintile) contains 20 percent of Ethiopia's small farms, approximately 2.57 million farms.
Source: Calculations from the Agriculture Sample Survey of 2007/08, Central Statistical Agency (CSA)

Figure 2.1. Shares of area cultivated by farm size and agro-ecology, 2007/08



Note: small = small farms (having a size less than 0.90 hectares; i.e. 60% of all farms), medium = medium-size farms (having a size of 0.90 or more hectares, i.e. 40% of all farms)

Reliable access to water is an important condition to achieve good agricultural productivity. However, in the moisture-reliable enset-based highlands (11 percent of total farm area, i.e. 5 percent medium-size and 6 percent small farms), population pressure has diminished farm

size to such an extent that out-migration has become a major pathway out of poverty. The farmers in the two other areas (humid lowlands and pastoralists) are relatively less important as they count for only 3.9% of all smallholders in Ethiopia.

2.3. Crop area and production by farm size

Table 2.3 and 2.4 show the level of crop area and crop production by farm size for the year 2007/08 (CSA data). In this year, smallholder farmers (12.8 million farmers) cultivated together 12 million hectares of land or 96.3 percent of the total area cultivated. A total of 461,000 hectares was cultivated by large commercial farms. Smallholder farms generated 95 percent of total production for the main crops (cereals, pulses, oilseeds, vegetables, root crops, fruits and cash crops). In contrast, large farms contributed to only 5 percent of total production of these main crops, and to only 2.6 percent of cereal production in particular.

However, large farms account for a much larger share of sugar cane, cotton and other industrial crops (16.3 percent of total production). Coffee, fruit and vegetable production of large farms accounted for 19.1 percent, 19.4 percent and 23.7 percent of total production respectively. Even higher shares were reported for sesame and sugar cane: 42.6 percent and 78.1 percent, respectively, of total production come from large farms. Cotton was only produced on large farms.

Table 2.3. Crop area by season and size of farm, 2007/08

	Small holder		Large (<i>'000 has</i>)	Total (<i>'000 has</i>)	Total (share)	Small holder		Large (share of crop)	Total (share of crop)
	Meher (<i>'000 has</i>)	Belg (<i>'000 has</i>)				Meher (share of crop)	Belg (share of crop)		
Cereals	8,730	865	158	9,753	72.4%	89.5%	8.9%	1.6%	100.0%
<i>Teff</i>	2,565	69	5	2,639	19.6%	97.2%	2.6%	0.2%	100.0%
<i>Barley</i>	985	142	1	1,127	8.4%	87.4%	12.6%	0.1%	100.0%
<i>Wheat</i>	1,425	65	33	1,523	11.3%	93.6%	4.2%	2.2%	100.0%
<i>Maize</i>	1,767	512	54	2,334	17.3%	75.7%	22.0%	2.3%	100.0%
<i>Sorghum</i>	1,534	61	66	1,660	12.3%	92.4%	3.7%	3.9%	100.0%
Pulses	1,518	188	20	1,725	12.8%	88.0%	10.9%	1.2%	100.0%
Oilseeds	707	12	122	841	6.2%	84.1%	1.5%	14.5%	100.0%
<i>Sesame</i>	186	6	118	309	2.3%	60.1%	1.9%	38.0%	100.0%
Subtotal	10,955	1,065	300	12,319	91.5%	88.9%	8.6%	2.4%	100.0%
Vegetables	119	-	11	130	1.0%	91.7%	0.0%	8.3%	100.0%
Root crops	184	-	8	192	1.4%	95.9%	0.0%	4.1%	100.0%
Other temporary crops	-	-	7	7	0.0%	0.0%	0.0%	100.0%	100.0%
Fruit crops	63	-	5	68	0.5%	92.2%	0.0%	7.8%	100.0%
Cash crops	596	-	59	655	4.9%	91.0%	0.0%	9.0%	100.0%
<i>Coffee</i>	407	-	54	461	3.4%	88.2%	0.0%	11.8%	100.0%
Sugar Cane	21	-	23	45	0.3%	47.8%	0.0%	52.2%	100.0%
Cotton	-	-	42	42	0.3%	0.0%	0.0%	100.0%	100.0%
<i>Other</i>	-	-	-	-	-	-	-	-	-
Permanent crops	-	-	5	5	0.0%	0.0%	0.0%	100.0%	100.0%
Total*	11,938	1,065	461	13,463	100.0%	88.7%	7.9%	3.4%	100.0%

Source: Calculated from CSA area data.

Table 2.4. Crop production by season and size of farm, 2007/08

	Smallholder		Large	Total	Smallholder		Large	Total
	Meher	Belg			Meher	Belg		
	('000 tons)	('000 tons)	('000 tons)	('000 tons)	(% of Prod.)	(% of Prod.)	(% of Prod.)	(% of Prod.)
Cereals	13,717	668	381	14,766	92.9%	4.5%	2.6%	100.0%
<i>Teff</i>	2,993	33	8	3,033	98.7%	1.1%	0.3%	100.0%
<i>Barley</i>	1,355	112	1	1,468	92.3%	7.6%	0.1%	100.0%
<i>Wheat</i>	2,314	67	66	2,448	94.6%	2.7%	2.7%	100.0%
<i>Maize</i>	3,750	412	191	4,353	86.1%	9.5%	4.4%	100.0%
<i>Sorghum</i>	2,659	26	115	2,800	95.0%	0.9%	4.1%	100.0%
Pulses	1,783	87	26	1,896	94.0%	4.6%	1.4%	100.0%
Oilseeds	617	0	142	760	81.2%	0.1%	18.7%	100.0%
<i>Sesame</i>	187	-	139	326	57.4%	0.0%	42.6%	100.0%
Subtotal	16,117	755	550	17,421	92.5%	4.3%	3.2%	100.0%
Vegetables	472	-	146	618	76.3%	0.0%	23.7%	100.0%
Root crops	1,531	-	154	1,685	90.9%	0.0%	9.1%	100.0%
Other temporary crops	-	-	99	99	0.0%	0.0%	100.0%	100.0%
Fruit crops	462	-	112	574	80.6%	0.0%	19.4%	100.0%
Cash crops	443	-	74	517	85.7%	0.0%	14.3%	100.0%
<i>Coffee</i>	273	-	64	338	80.9%	0.0%	19.1%	100.0%
Sugar Cane	782	-	2,782	3,564	21.9%	0.0%	78.1%	100.0%
Cotton	-	-	82	82	0.0%	0.0%	100.0%	100.0%

Source: Calculated from CSA data.

As yields are usually higher on large farms, their share in production is often higher than in acreage. For example, sugar cane cultivated on large farms accounted for 52.2 percent of total sugar cane acreage, though it accounted for 78.1 percent of total sugar cane production. The yields are three times as high on large farms, i.e. 119 tons/ha, compared to the smallholders, i.e. 37 ton/ha (Table 2.5). Other large differences between area and production shares, driven by significant yield gaps, are seen for coffee (large farms: 11.8 percent of total coffee acreage, 19.1 percent of total coffee production) and maize (large farms: 2.3 percent of total maize acreage, 4.4 percent of total maize production).

Table 2.5. Crop yields by season and size of farm, 2007/08

	Smallholder Meher (tons/ha)	Smallholder Belg (tons/ha)	Large Meher (tons/ha)	Yield Total (tons/ha)	Yield Meher Large/Small
Cereals	1.57	0.77	2.41	1.51	1.53
<i>Teff</i>	1.17	0.47	1.66	1.15	1.43
<i>Barley</i>	1.38	0.79	1.87	1.30	1.36
<i>Wheat</i>	1.62	1.04	1.97	1.61	1.22
<i>Maize</i>	2.12	0.80	3.55	1.87	1.67
<i>Sorghum</i>	1.73	0.42	1.76	1.69	1.01
Pulses	1.17	0.46	1.29	1.10	1.10
Oilseeds	0.87	0.04	1.17	0.90	1.34
<i>Sesame</i>	1.00	--	1.18	1.05	1.17
Subtotal	1.47	0.71	1.83	1.41	1.25
Vegetables	3.96	--	13.49	4.76	3.40
Root crops	8.31	--	19.66	8.77	2.37
Other temporary crops	--	--	15.14	15.14	--
Fruit crops	7.37	--	20.90	8.43	2.84
Cash crops	0.74	--	1.26	0.79	1.69
Coffee	0.67	--	1.19	0.73	1.77
Sugar Cane	36.39	--	118.57	79.29	3.26
Cotton	--	--	1.96	1.96	--

Source: Calculated from CSA data

2.4. Seasonal variation

In the main agricultural regions in Ethiopia there are two rainy seasons, the Meher and the Belg, and consequently there are two crop seasons. Meher is the main crop season. It encompasses crops harvested between Meskerem (September) and Yeaktit (February). Crops harvested between Megabit (March) and Nehase (August) are considered part of the Belg season crop. Table 2.3, 2.4 and 2.5 present data on crop area, production and yield by season, for 2007/08 (CSA data). There are three important insights from these tables. First, only smallholder farmers cultivate crops during the Belg season, as large farms concentrate their production entirely on the more productive Meher season. Second, the Meher season is overwhelmingly important. Area cultivated and crop production in the Meher season

accounted for 92.1 percent of total area cultivated and 96.9 percent of total crop production. Third, crop yields were always smaller in the Belg season than in the Meher season.

Smallholder cereal production in the Meher season dominates cereal production in Ethiopia and accounted for 93 percent of national cereal production in 2007/08. While 8.9 percent of total cereal area was cultivated during Belg season, only 4.5 percent of national cereal production was produced in the Belg season, a reflection of the significantly lower yields in the Belg season. The most important contribution of the Belg season to total production is found for the maize crop: 22.0 percent of total maize area was cultivated in the Belg season and this resulted in 9.5 percent of total maize production.

3. Cereal production trends

3.1. Trends in total cereal production

Data on national cereal production levels and trends are controversial. Changes in government and methodologies have coincided with distinct breaks in the data, making it difficult to distinguish between actual changes and statistical artefacts. Moreover, beginning in 1981/82, there have been two alternative data sources for each year, one from the Ministry of Agriculture and Rural Development (or its predecessors) and one from the Central Statistical Authority (CSA). We present the descriptive statistics of agricultural production and areas based on both sources in Table 3.1.

Data from the Food and Agricultural Organization (FAO), generally derived from the Ministry of Agriculture and Rural Development or its predecessors, indicate a steady but slow 1.9 percent average growth in cereal production in the 1960s, due almost equally to modest area (1.1 percent per year) and yield (0.8 percent per year) increases (Table 3.1). Given a population growth rate estimated at 2.3 percent per year in this period, it is estimated that per capita production declined by an average of 0.4 percent per year. Due to the poor state of infrastructure and weak statistical capacity in the country in the 1960s, the degree of uncertainty in this data is rather high, however.

Cereal production showed high variability in the beginning of the 1970s. Cereal production decreased from 5.17 million tons in 1972/73, to 4.37 and 4.35 million tons in 1973/74 and 1974/75, respectively, before falling even more dramatically to only 3.81 million tons in 1975/76, i.e. 31 percent below the level of three years earlier. Food aid and other net imports of cereals increased more than ten-fold between 1972/73 and 1974/75, from 8 to 112 thousand tons, but they were nonetheless far too small to offset the decline in production. As a result, per capita availability of food³ fell from 138 kg/person/year in 1972/73 to only 113 kg/person/year in 1973/74 and 1974/75, and then plummeted to only 96 kg/person/year in 1975/76 (see Figure 3.1).⁴

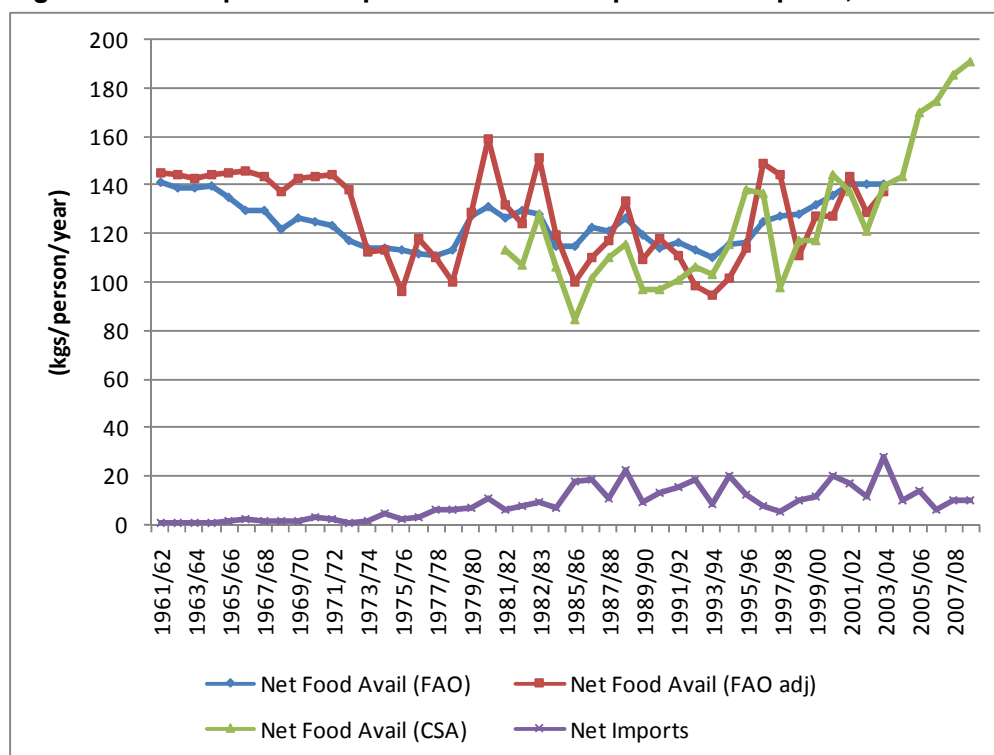
³ The figure for availability of food includes an adjustment for post-harvest production losses of about 5 percent, as well as feed, seed and other non-food uses.

⁴ Data in the FAO Food Balance Sheets show almost no decline in food availability per capita in this period (from 116.7 kgs/person/year in 1972/73 to 113.3 kgs/person/year in 1975/76), due to very large changes in stocks. From 1961/62 through 1972/73, stocks rise each year with a cumulative build up of 4.46 million tons. Thus, per capita food availability for these years is reduced accordingly. The FAO data then show a drawdown of stocks of 50,000 tons per year in 1973/74 and

The major cause of the reported production decline between 1972/73 and 1975/76 was a steep 31 percent decline in area cultivated of cereals, a decline equal to the decline in production. Two factors may have contributed to the change in cultivated area in that period: the revolution of 1973 (i.e. the fall of the imperial regime of Haile Selassie) and the subsequent land reform, and regulation of cereal prices beginning in 1975 that may have reduced incentives for production (or even led to major incentives to under-report production). However, some of the decline in reported cultivated area may also be due to differences in methodology and in the implementation of production surveys under the Derg regime.

There were wide fluctuations in production and net availability in the second half of the 1970s and the 1980s, but overall, cereal production stagnated in this period (Figure 3.1 and Table 3.1). The average growth rate of production from 1979/80 to 1989/90 was -0.3 percent according to the FAO data; CSA data for 1981/82 to 1989/90 indicate a growth rate of 0.6 percent. In the 1990s, growth in cereal production accelerated to about 5 percent per year (according to both FAO and CSA data). The rise was entirely due to increases in area cultivated (by almost 6 percent per year), while yields continued to decline by 0.5 – 0.7 percent per year according.

Figure 3.1. Ethiopia: Per capita cereal consumption and imports, 1961/62 to 2008/09



Source: FAO Food Balance Sheets.

1974/75, followed by a drawdown of 650,000 tons in 1975/76, thus raising per capita food availability in these years (See Figure 3.1).

Table 3.1. Ethiopia: Cereal area, yield and production, decade averages and growth rates

	FAO			CSA		
	Area (mn has)	Yield (tons/ha)	Production (mn tons)	Area (mn has)	Yield (tons/ha)	Production (mn tons)
1961/62-1969/70	6.23	0.73	4.53	--	--	--
1970/71-1979/80	5.25	0.90	4.63	--	--	--
1980/81-1989/90	4.89	1.15	5.63	4.30	1.14	4.89
1990/91-1999/00	5.87	1.18	6.88	5.60	1.20	6.67
2000/01-2008/09	8.24	1.30	10.68	7.72	1.41	10.94
Average Growth Rates (from logarithmic regressions)						
1961/62-1969/70	1.1%	0.8%	1.9%	--	--	--
1970/71-1979/80	-4.9%	3.7%	-1.4%	--	--	--
1980/81-1989/90	0.5%	-0.8%	-0.3%	2.4%	-1.7%	0.6%
1990/91-1999/00	5.9%	-0.7%	5.1%	5.8%	-0.5%	5.2%
2000/01-2008/09	2.7%	3.6%	6.5%	3.1%	3.5%	7.0%

Source: Note: FAO data is for 2000/01 to 2007/08 (2000 to 2007). CSA 1980/81-1989/90 data is 1981/82 to 1989/90. CSA levels and growth rates are based on interpolated data (constant logarithmic growth rates). FAO denotes 2007/08 as 2007.
Note: n.a. indicates *not available*. CSA data is small holder meher season only.

According to CSA data, growth in cereal production accelerated further to 7.0 percent per year from 1999/2000 to 2008/09. Average cereal production increased to 10.94 million ton per year during this time period. Though growth in area cultivated slowed to 3.1 percent per year, yields increased by 3.5 percent per year. Cereal production and yield growth was particularly rapid from 2004/05 to 2008/09 (12.2 and 6.2 percent, respectively), while cereal acreage recorded an annual growth rate of only 4.8 percent (Table 3.2). During the same time period, cereal production on average involved 11 million holders. Cereal acreage and cereal output averaged 8.2 million hectares and 12.1 million tonnes, respectively.

Table 3.2. Cereal production by crop, 2004/05-2007/08 (1997-2000 E.C.)

Crop	Number of holders	Average - 2004/2005 - 2007/08					
		Production (quintals)		Area Cultivated (hectares)		Yield (quintals per hectare)	
		Level	Annual growth rate (%)	Level	Annual growth rate (%)	Level	Annual growth rate (%)
Grain	11,519,148	140,902,733	11.8	10,382,365	3.9		
Cereals	11,156,837	120,629,724	12.2	8,230,211	4.8	14	6.2
Teff	5,462,782	24,079,480	15.9	2,337,850	6.7	10.2	7.7
Barley	3,842,462	13,264,217	0.7	1,024,390	-3.4	13	4.5
Wheat	4,118,164	22,933,077	2.1	1,439,098	0.6	15.9	1.5
Maize	7,287,931	33,142,865	18.9	1,595,238	9	20.6	7.8
Sorghum	4,253,534	22,161,808	18.3	1,429,886	7.4	15.4	8.9

Source: Author's computation using CSA data (CSA (July 2006), CSA (July 2007), and CSA (June 2008)).

Note: Cereal yield is calculated as acreage-share weighted average of the yields of the five major cereals listed in the table – they account for more than 95 percent of cereal acreage and cereal output.

3.2. Trends in the production of the major cereals

Since the start of the collection of national agricultural statistics in the 1960s, teff has always accounted for the largest share of cereal area cultivated (Table 3.3). However, over the past five decades the share of teff has declined gradually (a decrease by 5.8 percentage points from the 1960s to the first decade of the 2000s), while the share of maize has increased by 7.8 percentage points. Compared to teff and maize, the share of other cereals stayed relatively stable over time.

Table 3.3. Ethiopia: Cereal area cultivated, decade averages

	<u>Teff</u>	<u>Wheat</u>	<u>Maize</u>	<u>Sorghum</u>	<u>Barley</u>	<u>Other</u>	<u>Total</u>
	(million hectares)						
1961/62-1969/70	2.11	0.97	0.80	1.09	0.96	0.30	6.23
1970/71-1979/80	1.67	0.78	0.83	0.87	0.84	0.27	5.25
1980/81-1989/90	1.23	0.52	0.84	0.71	0.86	0.15	4.30
1990/91-1999/00	1.76	0.75	1.12	0.95	0.73	0.29	5.60
2000/01-2008/09	2.17	1.27	1.59	1.35	0.96	0.38	7.72
	(Shares of Total Cereal Area Cultivated)						
1961/62-1969/70	33.9%	15.6%	12.8%	17.4%	15.4%	4.9%	100.0%
1970/71-1979/80	31.8%	14.8%	15.7%	16.6%	15.9%	5.1%	100.0%
1980/81-1989/90	28.7%	12.0%	19.5%	16.4%	19.9%	3.4%	100.0%
1990/91-1999/00	31.3%	13.4%	20.0%	17.0%	13.1%	5.2%	100.0%
2000/01-2008/09	28.1%	16.5%	20.6%	17.5%	12.5%	4.9%	100.0%

Source: 1961/62-1979/80 data are from FAO. 1980/81 – 2008/09 data are from CSA Agricultural Sample Surveys.

During the first decade of the 2000s, production of all the major cereals increased, with teff (8.9 percent), sorghum (8.6 percent) and wheat (8.3 percent) having the fastest annual growth rates. Growth in maize production, 6.8 percent per year in the 1980s and 5.5 percent per year in the 1990s, slowed to 4.2 percent in the early 2000s. This reduced growth figure was caused in part by a collapse in domestic maize prices inducing slow adoption, or even dis-adoption, of hybrid maize technology.

Compared to the 1990s, wheat and sorghum area cultivated grew fastest (by 4.9 and 4.6 percent per year, respectively) during 2000/01–2008/09, while maize area cultivated increased by only 1.6 percent per year. Yields of all five major cereals increased rapidly in the first decade of the 2000s, with growth rates averaging from 2.9 and 3.0 percent per year for maize and wheat, and 4.3 and 4.8 percent per year for sorghum and teff.

As total cereal production growth was particularly rapid from 2004/05 to 2008/09, it is worth examining the growth rate for the five cereals separately in this period (Table 3.2). The speed of growth was somewhat varied across crops. Average annual growth in output was fastest in maize production (18.9 percent), closely followed by sorghum production (18.3 percent). Teff production rose by 15.9 percent per year. The slowest output growth was recorded in barley production (0.7 percent), due to a decline in barley acreage. It is interesting to note that, for the main cereals, yield growth was faster than acreage expansion during the period,

so the increased production rates were more the result of increased yields than of increased acreages. An exception to this was maize, a crop considered to have the highest potential for yield increases. Over this four year period, yield increased by 7.8% while area grew by 9%.

4. Decomposition Analysis of Cereal Production

4.1. Methodology

Agro-ecology and market infrastructure, the key components of the development domains, are important determinants of crop production/output and revenue. In this section, we decompose changes in cereal output into changes in area and yield across various development domains and across time periods. We also examine changes in gross crop revenues by total output and price.

The quantity of output of crop i (Q_i^t) is the product of yield (y_i^t) and acreage allocated to its production (A_i^t). Decomposition can thus take the following approximate form:

$$dQ_i \cong A_i dy_i + y_i dA_i$$

The decomposition reveals the relative contribution of changes in acreage and changes in yield to the overall change in the quantity of output. This is a policy-relevant issue to the extent that acreage, and to a certain degree, yield, reflect government interventions in agriculture and the wider economy, and are not simply determined by variations in weather and severity of pest attacks.

A more informative decomposition involves crop revenues. Such decomposition can highlight, in addition to the relative contributions of changes in acreage and yield as quantity decomposition, those of changes in prices and the pattern of allocation of acreage. Changes in prices in part reflect market development, while patterns of acreage allocation are partly driven by differences in returns to the cultivation of alternative crops. Both are relevant to policy decisions.

The total revenue from cereal cultivation (R) is given by the sum of revenues from each cereal type i :

$$R = \sum_{i=1}^n p_i Q_i = \sum_{i=1}^n p_i (A_i y_i)$$

where p_i = price of cereal i and the rest are as defined above. Defining total cereal acreage

as $A = \sum_{i=1}^n A_i$ and the share of each cereal in total acreage as $a_i = \frac{A_i}{A}$, cereal revenue can

be computed as:

$$R = \sum_{i=1}^n p_i (a_i A y_i) = A \left(\sum_{i=1}^n p_i a_i y_i \right)$$

The expression shows that there are four potential sources of growth – changes in total acreage, changes in the shares of crops in total acreage, changes in crop yields, and changes in crop prices. Thus, approximately:⁵

$$dR \approx \left(\sum_{i=1}^n a_i y_i p_i \right) dA + A \sum_{i=1}^n a_i y_i dp_i + A \sum_{i=1}^n a_i p_i dy_i + \sum_{i=1}^n y_i p_i da_i$$

The first term on the right-hand side of equation denotes the change in the gross crop income due to changes in total cropped area; the second term gives the effect of changes in real prices; the third term captures the effect of change in crop yields; and the fourth term describes the change in gross crop income associated with changes in the area composition of crops over time. If the fourth term is positive, this indicates a reallocation of cropland from lower-value crops to higher-value crops, so this term represents the effect of crop diversification on gross crop income. Dividing both sides of the last equation by the overall change in gross crop income (dR) gives the proportional contribution of each component in the growth.

4.2. Decomposition of changes in total cereal revenue

Tables 4.1 and 4.2 show the results of a decomposition of changes in cereal output and cereal revenue across various development domains for the four main administrative regions – Amhara, Oromiya, SNNPR, and Tigray. The data used in this analysis are derived from CSA Agricultural Sample Survey data at the administrative zone level for the period 1996/97-2007/08 (1989-2000 E.C.). Four development domains are considered: Low Market Access (LMA) with Low Agricultural Potential (LAP), LMA with High Agricultural Potential (HAP), High Market Access (HMA) with LAP, and HMA with HAP.

For cereal production, the broad story is very clear (Table 4.1). During the study period, acreage expansion was the more important source of growth in output for four of the five major cereals (the exception is teff) in almost all development domains. Out of the sixty crop-domain-period specific pairs of yield and acreage contribution shares, in only twelve the share of yield was higher. Moreover, no statistically significant correlation can be detected between acreage share of a crop and the significance of yield changes as a source of growth in that crop's output. Moreover, the relative contributions of acreage and yield changes to output growth were not statistically significantly different across development domains as well as time periods, except for sorghum (see Taffesse 2009).

⁵ For a single crop, the expression reduces to:

$$dR_i \cong y_i p_i dA_i + y_i A dp_i + p_i A dy_i$$

A more detailed description of the decomposition approach and its application can be found in Taffesse (2010).

Table 4.1. Median contributions to changes in quantity of cereal output by crop and year, 1998/99 – 2007/08

Year	Barley		Maize		Sorghum		Teff		Wheat	
	Change in crop area (%)	Change in crop yield (%)	Change in crop area (%)	Change in crop yield (%)	Change in crop area (%)	Change in crop yield (%)	Change in crop area (%)	Change in crop yield (%)	Change in crop area (%)	Change in crop yield (%)
1998/99 - 2000/01	72.6	35.1	74.5	34.2	69.8	32.7	56.0	49.1	71.7	42.4
2001/02 - 2004/05	73.3	28.7	49.8	45.2	57.3	39.6	54.8	47.8	67.2	35.7
2005/06 - 2007/08	58.6	39.3	64.4	39.7	67.5	39.1	55.6	49.1	67.3	48.7
1998/99	59.3	49.2	78.6	36.8	51	53.2	61.1	48.6	77.6	30.5
1999/2000	95	8.1	74.8	25.7	72.5	19.2	64.5	39.2	78	39.9
2000/01	63.4	48	70	40	85.9	25.6	42.5	59.5	59.6	56.8
2001/02	57.9	37.1	62.6	31.1	67.4	26.9	68.4	25.3	71.1	33.1
2003/04	99.1	-0.3	60.7	29.6	55.6	36.7	56.2	38.8	76.8	21.9
2004/05	62.8	49.2	26.2	75	48.8	55.1	39.7	79.4	53.6	52.1
2005/06	32.2	57.1	44.6	67.4	69	48.9	37.4	60.7	37.9	60.1
2006/07	85.2	19.2	84.3	21.4	79.9	26.6	86.8	16.8	92.7	42.9
2007/08	58.4	41.5	64.3	30.3	53.7	41.9	42.5	69.7	71.3	43.2

Source: Calculated from CSA data, Taffesse (2009).

Similarly, the average picture for decomposition of cereal revenues across development domains is relatively simple (Table 4.2). For all cereals, acreage expansion was the top source of revenue change. This is to be expected since acreage increase generated the bulk of output growth during the period. Increases in yield made the second largest contributor to revenue growth in the case of maize, sorghum and wheat. In contrast, real price rises stood second to acreage expansion as the origin of growth in barley and teff revenue (in fact, price and acreage contributed equally to teff revenue growth).

Table 4.2. Median contributions to changes in cereal revenue by crop and development domain, all periods, 1998/99 – 2007/08

Development Domain	Crop	Change in crop area	Change in crop yield	Change in crop price	Actual Change minus Estimated Change
LMA, LAP	Barley	54.6	14.7	20.5	10.2
	Maize	47.2	14.1	24.9	13.9
	Sorghum	30.6	29.9	26.7	12.8
	Teff	51.8	25.2	15.7	7.3
	Wheat	55.7	38.7	7.5	-1.9
LMA, HAP	Barley	38.4	13.1	37.6	10.9
	Maize	51.7	35	17.1	-3.9
	Sorghum	48	14.6	15.2	22.2
	Teff	38.4	9.3	73.8	-21.5
	Wheat	47.5	30.7	35.3	-13.5
HMA, LAP	Barley	54.6	21.3	28.5	-4.4
	Maize	41.8	50.7	-3.9	11.5
	Sorghum	42.4	33	28.6	-4
	Teff	27.7	29.4	42.1	0.8
	Wheat	50.2	32.7	23	-6
HMA, HAP	Barley	53.7	17.2	25.4	3.7
	Maize	53.5	15.6	13.5	17.4
	Sorghum	60.5	19.4	11.3	8.7
	Teff	41.8	21	27.9	9.3
	Wheat	41.5	26.8	17.2	14.4
Average	Barley	50.3	16.6	28	5.1
	Maize	48.6	28.9	12.9	9.7
	Sorghum	45.4	24.2	20.5	9.9
	Teff	39.9	21.2	39.9	-1
	Wheat	48.7	32.2	20.8	-1.8

Source: Authors' computation using CSA data.

Note: HMA = 'High Market Access'; LMA = 'Low Market Access'; HAP = 'High Agricultural Potential'; LAP = 'Low Agricultural Potential'.

This general picture holds across development domains and across periods. As in the case of output change, it was not possible to detect statistically significant differences across development domains in the pattern of contributions to the growth of each crop's revenue

(with the exception of teff).⁶ In contrast, differences across periods are statistically significant (with the exceptions of yield contributions to the growth in barley revenue, sorghum revenue and wheat revenue). A closer look at these time differences revealed the following. During the first period (1999/2000-2001/02), acreage expansion was the dominant source of change in cereal revenue, followed by yield (Table 4.3). Price increases became the top contributor to revenue growth in the second period, with acreage change taking second place. Yield improvements played a limited role during this period. The third period was characterised by more mixed outcomes. Increases in acreage generated the largest contribution to revenue growth in the case of barley, maize, sorghum, and teff, while yield change did so for wheat revenue. Crop prices also made significant contributions to revenue growth in this third period.

Table 4.3. Median contributions to changes in cereal revenue by crop and period

Crop Revenue	Source of Revenue Growth	Period		
		1998/99-2000/01	2001/02-2004/05	2005/06-2007/08
Barley Revenue	Change in crop area	75.89	31.21	43.08
	Change in crop yield	20.99	6.39	24.61
	Change in crop price	7.94	55.66	35.99
Maize Revenue	Change in crop area	72.54	24.99	49.2
	Change in crop yield	29.38	0.48	31.17
	Change in crop price	6.37	53.09	13.23
Sorghum Revenue	Change in crop area	69.65	28.22	40.09
	Change in crop yield	25.06	10.49	34.39
	Change in crop price	5.76	41.3	25.27
Teff Revenue	Change in crop area	58.92	28.04	43.5
	Change in crop yield	42.9	5.69	21.4
	Change in crop price	14.02	47.74	37
Wheat Revenue	Change in crop area	64.6	26.35	32.62
	Change in crop yield	41.47	16.29	43.01
	Change in crop price	6.13	53.29	25.79
Total Cereal Revenue	Change in crop total cereal area	60.62	27.98	18.59
	Change in crop yield	19.58	-1.28	34.58
	Change in acreage shares	3.27	0.08	-0.22
	Change in crop price	15.31	64	44.62

Source: Authors' computation using CSA data.

Note: The annual Agricultural Sample Survey for 2002/03 was not implemented. Thus 2002/03 is not included - i.e., the period 2001/02-2004/05 includes 2001/02, 2003/04, and 2004/05.

Total cereal revenue is calculated as the sum of the value of output of the five cereals covered by the study. As noted above, CPI-deflated real prices are used in computing the value of crop output. Aggregation across crops leads to a fourth source of revenue growth, namely, the share of each crop in total cereal acreage. In other words, change in a specific crop's acreage has two components – one due to change in total acreage and another due to change in its share in total acreage.

⁶ Note that there are five significant differences (out of possible fifteen) with levels of significance falling between 5% and 10%. These are: yield contributions in the case of sorghum, wheat, and teff; and area and price contributions in the case of teff.

The results of the decomposition exercise are reported in Table 4.3 (bottom four rows for periods 1998/99 – 2000/01, 2001/02 – 2004/05, and 2005/06 – 2007/08) and Table 4.4. Consistent with previous results, change in total cereal acreage was a primary source of growth in total cereal revenue. That price changes were a competing source in this case is an interesting variation. Change in allocation of cereal acreage was rather limited and thus did contribute very little to revenue expansion. Its role is likely to be more prominent when a more inclusive set of crops is considered (if pulses and oil seeds are added, for example).

Table 4.4. Median contributions to changes in cereal revenue by development domain and period, 1998/99 – 2007/08

Development Domain	Period	Change in total area under cereals	Change in cereal yields	Change in the allocation of total area under cereals	Change in the price of cereals	Actual Change minus Estimated Change
HMA, HAP	1998/99-2000/01	58.98	34.39	2.3	22.44	-18.12
	2001/02-2004/05	29.59	0.1	0.94	53.14	16.24
	2005/06-2007/08	17.15	32.71	-0.39	45.68	4.85
HMA, LAP	1998/99-2000/01	61.12	36.45	0.58	-28.55	30.4
	2001/02-2004/05	34.77	-22.94	-0.25	87.15	1.26
	2005/06-2007/08	-0.81	20.64	-1.26	56.56	24.87
LMA, HAP	1998/99-2000/01	56.19	9.86	5.75	26.43	1.77
	2001/02-2004/05	26.54	-12.64	-0.07	87.46	-1.3
	2005/06-2007/08	18.67	34.39	0.14	74.31	-27.51
LMA, LAP	1998/99-2000/01	69.04	18.68	4.29	8.5	-0.51
	2001/02-2004/05	25.96	7.77	-0.09	59.45	6.91
	2005/06-2007/08	19.92	39.03	-0.17	36.95	4.27

Source: Authors' computation using CSA data.

Note: The annual Agricultural Sample Survey for 2002/03 was not implemented. Thus 2002/03 is not included - i.e., the period 2001/02-2004/05 includes 2001/02, 2003/04, and 2004/05.

HMA: High Market Access, LMA: Low Market Access, HAP: High Agricultural Potential, LAP: Low Agricultural Potential

As before, a statistically significant difference in the pattern of contributions to revenue growth could not be ascertained across development domains. The opposite is true across time periods, however (Table 4.3 and 4.4). A clear dominance of acreage expansions is found during the first period (1998/99-2000/01), while a considerable rise in the contribution of price changes was found during 2001/02-2004/05. In a reversal of outcomes, changes in yield were a positive and considerable, though second to price changes, source of revenue growth in the last period (2005/06-2007/08).

5. Other crop agriculture

Although the production of cereals is by far the most important sector in Ethiopian agriculture, it is important to also discuss the other crops, since area cultivated of other crops is growing fast, even faster than the increase in cereal area. The other main crops discussed here are: pulses, oilseeds, coffee and enset. Table 5.1 presents the area cultivated of these crops in the periods 1994/95-2000/01 and 2003/04-2008/09, giving also the acreage growth rates within each of these two periods.⁷

5.1. Pulses

In the periods 1994/95-2000/01 and 2003/04-2008/09 pulse acreage was 12 percent and 12.4 percent, respectively, of the total area cultivated. Annual production averaged 1.5 million ton; this represents 8.5 percent of total yearly production (in the period 2004/05-2007/08, Table 2.1). The share of area cultivated of pulses is increasing; in the period 2003/04-2008/09 this was with 6.6 percent per year, which is a faster growth compared to the yearly cereal area growth (4.6 percent). The main legumes are horse bean (*Vicia faba* var. *minor*), field pea (*Pisum arvense*), haricot bean (*Phaseolus vulgaris*) and chickpea (*Cicer arietinum*). They form an important basis of non-meat national dishes and are a principal protein source.

5.2. Oilseeds

The main oilseeds are neug (also known as noug or niger seed; *Guizotia abyssinica*), linseed (also known as flax; *Linum usitatissimum*) and sesame (*Sesamum indicum*), with an increasing importance of sesame over time. The cultivation of neug is found mostly in the northern and central highlands at elevations between 1800 and 2500 meters. Linseed is cultivated in the same areas as niger seed. Sesame grows at elevations from sea level to about 1500 meters. Oilseeds are the third crop according to acreage: 5.4 percent and 6.8 percent of the total area cultivated was occupied by oilseeds in the periods 1994/95-2000/01 and 2003/04-2008/09, respectively (Table 5.1). The area growth rate was 5.6 percent per year in the first period, though declined to 4.3 percent per year in the second period. This slower growth is mainly because of a negative yearly growth rate in neug and linseed area. This is balanced by a fast growth in sesame area. Sesame has grown from essentially zero in 1994/95 to 288 thousand hectares in 2008/09, with an impressive growth of 33.1 percent per year in the first half of that period and a growth of 20.5 percent per year in 2003/04 to 2008/09.

⁷ Note that no data at the administrative zone level are available for either 2001/02 or 2002/03.

Table 5.1. Ethiopia: Area cultivated of all crops (smallholder meher season), 1994/95 to 2008/09

	1994/95-2000/01			2003/04-2008/09		
	('000 ha's)	(share)	(growth rate)	('000 ha's)	(share)	(growth rate)
Cereals	6,545	82.6%	3.2%	8,115	73.5%	4.6%
Pulses	954	12.0%	4.7%	1,370	12.4%	6.6%
<i>Horse Beans</i>	336	4.2%	2.4%	470	4.2%	6.1%
<i>Field Peas</i>	159	2.0%	1.4%	227	2.1%	-0.5%
<i>Haricot Beans</i>	122	1.5%	15.9%	219	2.0%	5.9%
<i>Chickpeas</i>	172	2.2%	4.3%	197	1.8%	8.9%
<i>Other</i>	165	2.1%	5.9%	257	2.3%	13.7%
Oilseeds	426	5.4%	5.6%	749	6.8%	4.3%
<i>Neug</i>	240	3.0%	6.4%	303	2.8%	-0.8%
<i>Linseed</i>	115	1.5%	-3.0%	186	1.7%	-1.5%
<i>Sesame</i>	23	0.3%	^b 33.1%	185	1.6%	20.5%
<i>Other</i>	48	0.6%	7.8%	75	0.7%	7.2%
Subtotal	7,926	100.0%	3.5%	10,235	92.7%	4.8%
Vegetables	--	--	--	112	1.0%	11.7%
Root crops	--	--	--	167	1.5%	0.5%
Fruit crops	--	--	--	49	0.4%	4.1%
Cash crops	--	--	--	485	4.4%	9.8%
<i>Chat</i>	--	--	--	136	1.2%	6.1%
<i>Coffee</i>	--	--	--	308	2.8%	12.3%
<i>Hops</i>	--	--	--	23	0.2%	3.7%
<i>Sugar Cane</i>	--	--	--	18	0.2%	2.3%
Total^a	7,926	100.0%	100.0%	11,048	100.0%	5.1%

Source: CSA production data.

Note: ^a Data on vegetables, root crops, fruit crops and cash crops were not available for 1994/95 to 2000/01. Thus, the figure for "Total" in 1994/95-2000/01 is not comparable to the "Total" for 2003/04 to 2008/09.

^b Sesame area growth rate is 1995/96 - 2000/01.

In 2007/08, a total of 760 thousand ton of oilseeds was produced; this is three percent of total annual production. Smallholder farms produced 81.3 percent of total oilseed production, while large farms produced 18.7 percent of it. However, large farms produced 42.6 percent of total sesame output. Sesame seed has the highest value per ton of Ethiopian oilseeds, more than twice the value of linseed.⁸ According to market value oilseeds are much more important than pulses.

5.3. Coffee

In 2003/04-2008/09 coffee was cultivated by three million farmers on a total of 308,000 ha, which is only 2.8 percent of total cultivated area. However, the share of area cultivated for coffee increased by 12.3 percent per year from 2003/04 to 2008/09. In 2008/09 337 thousand ton was produced, this is 1.3 percent of total production; 19 percent of total coffee output was produced by large farms. Coffee is Ethiopia's major export product, and Ethiopia is the world's fifth producer of coffee.

⁸ Ethiopia is the fifth world producer of linseed and the sixth of sesame seed; it is the third world exporter of sesame seed and an important exporter of neug (niger seed).

5.4. Enset

Enset (*Ensete ventricosum*) is commonly known as “false banana” for its close resemblance to the domesticated banana plant, but its fruit is not edible. Enset grows best at altitudes above 1600 meters above sea level, not because it cannot withstand heat, but because it needs adequate soil moisture. It can survive seasonal rainfall shortages, but succumbs to prolonged droughts.⁹

Enset was cultivated on 279 thousand hectares in 2008/09, 2.5 percent of total cultivated area. As many as 7 million people consume the carbohydrate-rich, but low-protein enset products as a staple or co-staple food. For many households it forms an important food security reserve against other crop failures. Besides its use as a staple food, enset is also used for animal fodder, fibre production, construction materials and for its medicinal values.

5.5. Other crops

Only one percent of total area cultivated is used to grow vegetables, the equivalent of 112,000 hectares. However, the importance of vegetables is growing, as there is an 11.7 percent per year growth in acreage from 2003/04 to 2008/09 (Table 5.1). This increase in growth rate is comparable to that of coffee (12.3 percent). Vegetables, together with sesame and coffee, are the crops with the largest acreage increase in the recent years.

Chat is an important cash crop and its significance is increasing. Only 1.2 percent of total area cultivated is used for chat production, however, its share in area cultivated grew with 6.1 percent per year in 2003/04-2008/09 (Table 5.1).

⁹ Each plant takes four to seven years to mature. The plant is cut before flowering and the pseudostem (stalk or base) and leaf midribs are scraped to collect the pulpy white juice. The pulp is then fermented for 10-25 days in the soil, followed by another 20 days of sun-drying. Finally, enset-based food, in the form of a steam-baked flat-bread or a kind of porridge, can be prepared.

6. Constraints and opportunities in crop agriculture

Much of the increase in crop production in the past decade has been due to increases in area cultivated. To what extent the area cultivated can continue to expand remains an important question. It seems that in the highland areas, expansion of cultivated area will have to come almost exclusively from reduction in pasture land. In most instances, this land is likely to be less fertile than existing crop land. Increased use of inter-cropping or double-cropping may allow some expansion of area cultivated as well. Expansion of area cultivated outside of the highland regions will require major investments in infrastructure and might involve reductions in forest areas, with important negative environmental implications. As a consequence, it seems that obtaining higher yield rates is *the* challenge of Ethiopia's agricultural system.

Numerous constraints to yield and productivity growth have been identified, including relatively low levels of input use (fertiliser, pesticide, improved seeds), low levels of irrigation, soil degradation and soil erosion, inadequate agricultural research and extension, and constraints in market development.

The limited use of modern inputs is a major characteristic of crop production in Ethiopia and it seems to be a major explanation for its current low productivity. Table 6.1 shows that in 2007/08 only about 40 percent of cereal acreage benefited from chemical fertilisers, with the highest application in wheat areas. It is remarkable that the share of fertiliser-applied area in cereal cultivation declined from 2001/02 to 2007/08, after an increase in 2001/02 compared to 1997/98. The opposite is seen when the amount of fertiliser per hectare of fertiliser-applied cereal area is considered. In that case, the levels used in 2001/02 were lower than in 1997/98, but an increase was noted in 2007/08 compared to 2001/02. In general, the intensity of fertiliser use is relatively low when estimated as quantity of fertiliser per hectare of total cereal acreage. However, it is broadly comparable to intensity in Asia when measured as quantity of fertiliser per hectare of fertiliser-applied cereal area (Agwe et al. 2007).

Table 6.1. Fertilizer application by crop, private holdings; 1997/98, 2001/02, 2007/08

Crop	Fertilizer Applied area (share in total area cultivated - %)			Fertilizer application (total quintals/ total hectares)			Fertilizer application (quintals per hectare of fertilizer applied area)		
	1997/98	2001/02	2007/08	1997/98	2001/02	2007/08	1997/98	2001/02	2007/08
Cereals	32.3	42.8	39	0.37	0.3	0.45	1.15	1	1.16
Teff	44.9	49.9	54.3	0.5	0.4	0.52	1.11	0.91	0.95
Barley	34.4	39.6	30.5	0.33	0.2	0.3	0.97	0.79	0.99
Wheat	57	56.7	62.1	0.75	0.56	0.85	1.32	1.12	1.36
Maize	18	45.7	32.8	0.25	0.28	0.54	1.39	1.33	1.63
Sorghum	2.9	16.9	3.1	0.04	0.01	0.03	1.26	0.54	1.05

Source: Authors' computation using CSA data (CSA (September 1998), CSA (July 2003b), and CSA (August 2008)).

Though increasing, the use of other modern inputs is even more limited (Table 6.2). In 2007/08, improved seeds were applied over about 5 percent of cereal acreage. The highest rate was in maize production (19.5 percent) with negligible rates in the production of other

cereals. Irrigation techniques are even less applied. Only one percent of cereal acreage was irrigated in 2007/08. Pesticides were applied in 20.8 percent of total cereal acreage in 2007/08. Furthermore, the use of improved seeds, pesticides and irrigation is increasing only slowly in the last decade. The constraints related to cereal production are similar to the ones associated with crop production more broadly.

Table 6.2. Area under improved farm management practices by crop, private holdings, 1997/98, 2001/02, 2007/08

Crop	Share of crop area (%)									Extension package covered crop area
	Improved seed applied crop area			Pesticide applied crop area			Irrigated crop area			
	1997/98	2001/02	2007/08	1997/98	2001/02	2007/08	1997/98	2001/02	2007/08	
Cereals	2.4	3.5	4.7	12	10.8	20.8	0.64	1.3	1.1	14.5
Teff	1.7	0.6	0.7	17.7	16.6	30.5	0.66	0.7	0.7	13.8
Barley	0.1	0.4	0.6	9.6	9.07	20.7	0.62	0.8	1.2	11
Wheat	5.6	2	2.9	31.3	28.11	43.6	0.32	0.4	0.5	21.9
Maize	5.2	12.5	19.5	1.3	1.93	2.9	1.1	3.2	2.2	21.3
Sorghum	0.2	0.4	0.1	3.1	1.69	5.4	0.39	1.1	1.2	1.4

Source: Authors' computation using CSA data (CSA (September 1998), CSA (July 2003b), and CSA (August 2008)).

Several policy initiatives have been taken to stimulate productivity. In the nineties, the Ethiopian government tried to improve Ethiopian agriculture through a range of measures. In 1993, the Sasakawa Global 2000 Program (SG 2000), an international non-governmental organization for assisting small-scale farmers in sub-Saharan African countries to increase staple food crop production, began work in Ethiopia in partnership with the government.¹⁰ In 1994/1995 the government introduced PADETES (Participatory Demonstration and Training Extension System) with SG 2000 principles as a model.¹¹

However, there are concerns that these state-led cereal intensification programmes are not consistently generating the desired effects (Spielman 2008). For example, distribution of improved maize seeds is a main focus, but adoption of improved seeds has generally been disappointing. Shortfalls in supply, decreasing seed quality and delayed deliveries may explain this. Similarly, there is evidence suggesting that many farmers have dis-adopted the seed-fertiliser inputs over time due to poor extension service, cost, unavailability of preferred varieties and other inputs from suppliers, a preference for local varieties, or other such factors (Bonger et al. 2004; EEA/EEPRI 2006; Spielman 2008).

To illustrate the international position of Ethiopia and to indicate potential growth, Table 6.3 presents cereal yields of different countries in Eastern Africa for the period 2006-2008.

¹⁰ Sasakawa Global 2000 defends high-external-input technologies. The program provided credit, inputs (fertiliser and improved maize seeds) and extension assistance to participants willing to establish half-hectare demonstration plots on their own land. Data from the SG 2000 demonstration plots revealed that the use of improved seeds and fertiliser is strongly associated with higher yields, but medium-input levels were as profitable or more profitable as high-input levels. Additionally, other factors affecting yields were: soil type, frequency of ploughing, planting time, plant spacing and weeding (Howard et al. 2003). However, the authors found no evidence of a successful expansion of the pilot programme. Two factors playing a plausible role are: (1) scaling up takes the program into areas with less favourable production and/or market conditions and (2) scaling up requires local organisations to take over from the special authorities.

¹¹ PADETES reached to about 40 percent of the smallholder farms over a 10-year period. Initially, the program generated positive impacts in Ethiopia.

Based on FAOSTAT data, it is shown that Ethiopia has similar cereal yields levels as Uganda; Kenya and Malawi have higher cereal yields; and Tanzania, Rwanda and Sudan have much lower yield levels. While Ethiopia achieves a higher cereal yield rate than the average for Eastern Africa, it has however a lower yield level than the Least Developed Countries average. Looking more into detail per crop (Table 6.4) we find that Ethiopia, compared to the other countries in the region, has higher yields for maize and sorghum, but smaller yields for wheat.

Table 6.3. Cereal yield by country and by year, 2006-2008

Country	Cereal Yield (Kg/Ha)				Average as a percentage of Ethiopia's average yield (%)
	2006	2007	2008	avg	
Ethiopia	1651.9	1391.9	1421.7	1489	100
Kenya	1646.5	1773.3	1416.6	1612	108.3
Malawi	1444.6	2467	1598.6	1837	123.4
Rwanda	1117.7	1126.1	1126.1	1123	75.5
Sudan	644.7	729.4	567.1	647	43.5
Tanzania	1147.6	1238.4	1224	1203	80.8
Uganda	1522.9	1525.2	1534.4	1528	102.6
Eastern Africa	1393.9	1389.4	1302.1	1362	91.5
Least Developed Countries	1744.2	1780.3	1768.4	1764	118.5
World	3284.1	3381.9	3539.3	3402	228.5

Source: FAO data

Table 6.4. Yields (Kg/Ha) of maize, wheat and sorghum by country and by year, 2006-2008

Country	Maize			Wheat			Sorghum		
	2006	2007	2008	2006	2007	2008	2006	2007	2008
Ethiopia	2640.4	1969.1	2136.7	1904	1505.5	1728.8	1575.5	1484.3	1510.2
Kenya	1719.7	1813.1	1392.4	2187.5	3093.9	2271.5	800.5	947.3	522
Malawi	1481.4	2654.7	1649.8	1207.1	2296.7	1613.2	768.7	859.2	831.4
Rwanda	799.5	818.1	818.1	850.9	869.5	869.5	1100.3	1098.2	1098.2
Sudan	1046.3	1909	2021.3	3831.9	2825.8	1945.7	667.1	766.3	584.5
Tanzania	1141	1180.3	1180.3	2750	2760	939.1	799.5	1000	1000
Uganda	1536	1495.2	1468.6	1800	1727.2	1727.2	1428.5	1452.2	1485.9
Eastern Africa	1423.5	1480.9	1518.7	1701.8	1820.1	1614.4	768.8	792.4	750.9
Least Developed Countries	1414.1	1461	1300.5	2005	1691.4	1747.6	1002.2	1077.3	1068.8
World	4752.8	4968.9	5109.4	2856.5	2857	3086.1	1327.7	1403.3	1459.1

Source: FAO data.

7. Summary and Conclusions

Ethiopia's crop agriculture continues to be dominated by the country's numerous small farms that cultivate mainly cereals for both own-consumption and sales: smallholders account for 96 percent of total area cultivated. The five major cereals (teff, wheat, maize, sorghum and barley) occupy almost three-quarters of total area cultivated, and represent almost 70 percent of total value added in recent years. Moreover, cereal acreage is still increasing, though not as fast as area planted to other crops such as sesame, coffee, chat, vegetables and pulses.

During the 1990s, most of the increase in cereal production came from increases in area. However, in the 2000s, area and yield increases each accounted for about half of production growth and we thus see an initial start of increasing intensification. With little suitable land available for expansion of crop cultivation available, especially in the highlands, future cereal production growth will need to come increasingly from yield improvements. Current improved inputs use is relatively low, suggesting substantial scope for raising productivity through the increasing adoption of improved seeds and chemical and organic fertilizer, i.e. at least in the rainfall sufficient ecologies (and on irrigated farms). However, it seems that growth in agricultural real incomes will also require more diversification and a shift to higher-value crops, as to respond to changing consumption baskets driven by the increasing per capita income growth in the country.

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