

## **2 Ethiopian Agriculture: A Dynamic Geographic Perspective**

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The opportunities and constraints facing Ethiopian agriculture are strongly influenced by geographical location. Ethiopia's diverse landscape defines certain agricultural production potentials, access to input and output markets, and local population densities, which determine both labor availability and local demand for food. Understanding the geographical expression of Ethiopia's agricultural and rural development options provides greater information for more locally targeted policy options.

These conditions not only vary over space but change over time as well. New and improved roads, greater telecommunications, improved access to electricity, and ongoing urban growth continue to lower transaction costs and improve market access. Evolving production opportunities and technologies continue to provide greater flexibility of livelihood decisions within defined biophysical endowments. As Ethiopia continues to invest in infrastructure and technology, its agricultural landscape continues to be reshaped and redefined into broader areas of opportunity and growth.

The objectives of this chapter are twofold. First we provide an overview of the geographical features that constitute a basic reference for understanding production systems and the geography of agricultural production in rural Ethiopia. This characterization is organized around the economic logic of comparative advantage for a variety of generalized production decisions of relevance in Ethiopia. Second we extend this framework to organize evidence for and discussion of important areas of dynamism in Ethiopia's rural economic landscape, including a discussion of land tenure policy and its effects on the level of investments in the agricultural sector. Thus, this chapter is mainly a descriptive assessment of important production contexts and the manner in which these contexts are evolving.

### **Characterizing Production Contexts**

In large and heterogeneous countries such as Ethiopia, agricultural potential is unevenly distributed over space, and the distribution of production patterns

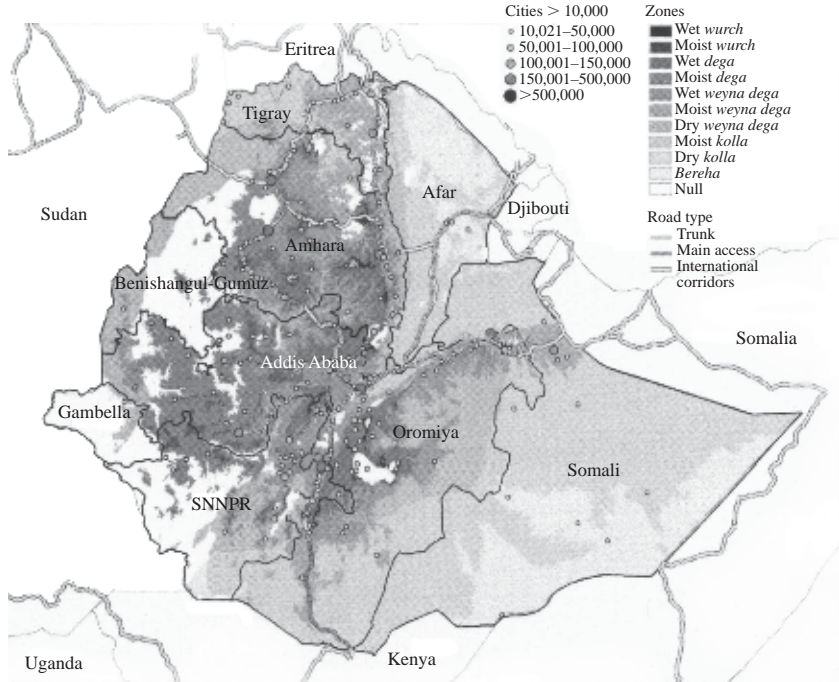
reflects this landscape. Mapped zones of smallholder production systems have long been recognized as important in Ethiopia precisely because of such landscape heterogeneity (for example, Westphal 1975; De Pauw and Bruggeman 1988; Hurni 1998). To provide a useful characterization of agricultural landscapes, geographical perspectives seek a balance between too little information and too much. On the one hand, spatial characterization is motivated by the fact that average national statistics and one-size-fits-all development strategies are insufficient for effective rural planning. On the other hand, a surfeit of detail may render mapped classifications useless for planning on the basis of shared conditions: hundreds of subcategories, whether on a map or in a table, even when they accurately portray local variation, usually contain too much information to be tractable as a planning aid. Thus, characterizations generally seek to reduce complexity by prioritizing characteristics that are most meaningful to the production systems of interest.

Agroecological zones are perhaps the predominant methodology used to understand actual and potential agricultural production across geographic space. Agroecological zonation uses biophysical attributes of soil, terrain, and climate to organize land-use types or production systems into relatively homogenous units (FAO 1978; Hurni 1998). Hurni (1998) implemented a set of agroecological zone definitions for Ethiopia based on traditional zone designations widely used by rural residents. He linked these designations with specific elevation and rainfall parameters, which allowed mappable boundaries to be imposed on agroecological zones (Figure 2.1).

In Ethiopia most agricultural production takes place in the *weyna dega* and *dega* zones (highland areas from 1,500 to 2,300 and from 2,300 to 3,200 meters above sea level), where land productivity has traditionally coincided with the densest rural populations. Figure 2.1 shows these zones in midtone gray, scattered throughout the highlands. Specific crops and livelihood choices within and outside this band are conditioned by moisture and temperature regimes, among other factors. The crops most suited to grow in the *weyna dega* and *dega* zones are also the most commonly produced crops in Ethiopia. Most producers in these zones are smallholders occupying less than a hectare of land per household on average.<sup>1</sup> Smallholder production is dominated by five major cereal crops accounting for almost three quarters of the total cultivated area and about 68 percent of total production. Each of the major cereals—teff, maize, wheat, sorghum, and barley—has its own distribution, defined primarily by bioclimatic ranges (Table 2.1).

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1. Information in this section, unless otherwise cited, is from the *Atlas of the Ethiopian Rural Economy* (Ethiopia, CSA; IFPRI; and EDRI 2006), whose agricultural data are drawn primarily from the 2001/02 Ethiopian Agricultural Sample Enumeration.

**FIGURE 2.1** Characteristics of rainfall and altitude

SOURCE: The agroecological zones depicted here are according to Hurni's (1998) characterization.

### Biophysical Envelopes of Ethiopian Staple Crops

Rural livelihoods are strongly influenced by environment because biophysical conditions and cropping patterns vary widely across Ethiopia (Figure 2.2). Non-biophysical factors, such as access to markets, labor availability, local demand (and markets) for food, and export linkages, may impose additional limitations on locally viable production options. Here we briefly describe some of the major crops—cereals, tubers, and pulses—that make up the Ethiopian agricultural economy, emphasizing the conditions under which they are produced.

Teff (*Eragrostis tef*) is the preferred staple food in much of the highlands. It is grown by nearly half of all farming households (to a greater extent if only highland households are considered) and accounts for 28 percent of all cultivated land, more than any other single crop. Although traditionally grown in the highlands, teff can be grown under a wide variety of agroclimatic conditions, including elevations from zero to 2,800 meters above sea level (masl),

**TABLE 2.1** Traditional ecological zones and altitudinal ranges of selected crops

Meters above sea level	Annual rainfall (mm)		
	<900	900–1,400	>1,400
More than 3,700			High <i>wurch</i> (no crops)
3,700–3,200		Moist <i>wurch</i> (barley)	Wet <i>wurch</i> (barley)
3,200–2,300		Moist <i>dega</i> (barley, wheat, pulses)	Wet <i>dega</i> (barley, wheat, pulses, oilseeds)
2,300–1,500	Dry <i>weyna dega</i> (wheat, teff, maize)	Moist <i>weyna dega</i> (maize, sorghum, teff, wheat, oilseeds, barley, <i>enset</i> )	Wet <i>weyna dega</i> (teff, maize, <i>enset</i> , oilseeds, barley)
1,500–500	Dry <i>kolla</i> (sorghum, teff)	Moist <i>kolla</i> (sorghum, teff, pulses, oilseeds)	
Less than 500	<i>Bereha</i> (only irrigated crops)		

SOURCE: Hurni (1998).

NOTES: Crops in parentheses have restricted distribution within the zone and/or grow under less than ideal conditions in these areas. Blank cells indicate not applicable.

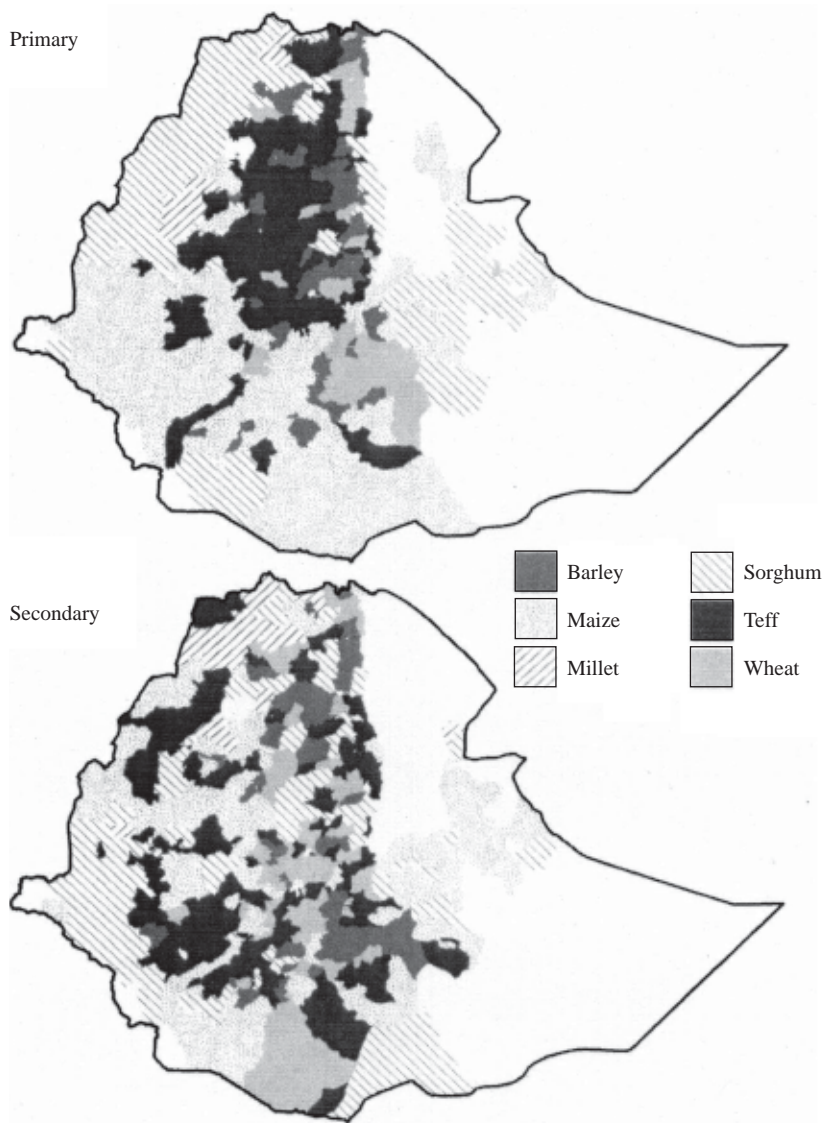
under a similarly wide variety of moisture, temperature, and soil conditions. Its optimal growing conditions coincide with its traditional production areas: an average elevation of 1,800–2,100 masl, average annual rainfall of 750–1,000 millimeters (mm), and average annual temperature of 10–27°C.

Maize is the second most widely cultivated cereal in Ethiopia in terms of area but is produced by more farms than any other crop. It accounts for the largest share of production by volume at 18.8 percent and appears to be increasing throughout Ethiopia. In addition to being a foodgrain, parts of the maize plants are also used as fodder, fencing materials, and cooking fuel.

Although maize is becoming more widely grown, it is less tolerant of cold than teff, barley, and wheat. Teff can grow at elevations up to 2,800 masl; there is only limited maize production above 2,400 meters. In Ethiopia, the highest maize yields require an annual rainfall of 800–1,500 mm. More than 60 percent of maize production comes from Oromiya region, followed by Amhara, with about 20 percent of total production.

Sorghum accounts for about 17 percent of all area planted with cereals and for about 18 percent of production. Relative to other cereals, sorghum is gener-

**FIGURE 2.2** Dominant cereals in Ethiopia



SOURCE: Ethiopia, CACC (2003).

ally drought tolerant and is also accepting of excess water conditions. These characteristics give sorghum a large range of feasible climate regimes, although it grows best in semiarid conditions, especially in comparison to other cereals. For example, sorghum can produce grain in areas too dry for maize (those receiving less than 250 mm average annual rainfall). However, it is sensitive to cold temperatures and is rarely found at higher altitudes (2,500 masl may be considered a ceiling).

Wheat accounts for similar shares of national cereal production as sorghum, with 17 percent of planted area and 19 percent of production. Varieties include Durum, Emmer, and so-called bread wheat. Durum wheat is often grown for domestic pasta fabrication. Emmer (*aja* in Amharic) is grown mainly in eastern Oromiya (Arsi and Bale) and Amhara (Shewa and Wollo). Bread wheat is widely grown throughout the highlands and transitional areas. Ethiopian wheat production typically takes place at altitudes of 1,600–3,200 masl, in areas with average annual rainfall of 400–1,200 mm and average annual temperatures of 15–25°C.

Unlike the other major cereals cultivated in Ethiopia, for which the highest cereal yields are achieved at lower elevations (between 500 and 2,300 masl), barley grows well at high altitudes, and its share of area cultivated generally increases with altitude. At elevations above 2,500 masl it is frequently the only cereal grown. Nationally, barley is grown by about a third of all cereal producers and occupies about 9 percent of cultivated land. Many local varieties of barley are produced in Ethiopia, with a range of production and consumption characteristics such as rate of maturation and size of grain. Ethiopian barley varieties are reported to be relatively quick growing and more drought tolerant than other varieties (NRC 1996).

In addition to the five major cereals grown in Ethiopia, *enset* (*Ensete ventricosum*, sometimes referred to as false banana) is an important staple in large parts of the southern highlands, where it has been estimated that more than 10 million people depend on *enset* for food, fiber, and other uses (Brandt et al. 1997). *Enset*, which is cultivated solely in Ethiopia, is planted at elevations ranging from 1,100 to 3,100 masl, although its optimal range is 2,000–2,750 masl. *Enset* does not tolerate frost, and it is not drought resistant. Thus, optimal growing environments are humid and temperate. Annual rainfall in *enset*-growing areas ranges from 1,100 to 1,500 mm, with average annual temperatures of 10–21°C.

### **Agroecologies and Farming Systems**

Farming systems, encompassing bundled sets of agricultural livelihood choices, including crop type and production technologies, are related to agroecological space because production choices must be viable given the available technology and the physical parameters required for plant growth. To the extent that

the latter are reflected in agroecological zones, the spatial expression of traditional farming systems in Ethiopia is at least partially coincident with agroecological zone maps.

Westphal (1975) identified four major farming systems for Ethiopia: seed farming, *enset* planting, shifting cultivation, and pastoral complexes. The seed-farming complex focuses on the production of grain, particularly cereals, but also pulses and oilseeds. Grain-based, seed-farming production systems are found throughout the central, northern, and eastern highlands and involve the majority of Ethiopian small farmers. Crop choice within the grain-based systems varies widely, with these systems found from *kolla* (lowlands, between 500 and 1,500 masl) to *wurch* (highlands, between 3,200 and 3,700 masl), and in moisture conditions ranging from dry to wet. Similarly, the *enset*-planting complex (in moist and wet *dega* and *weyna dega*) allows for flexibility of production whereby *enset* could be the principal staple, a co-staple with cereals and/or tubers, or a minor component of cereal- or tuber-based systems. Finally, shifting cultivation and pastoral complexes are most common in the western and eastern lowlands, respectively. In the humid western lowlands (primarily moist *kolla*), disease is a limiting factor for livestock. The arid and semiarid lowlands in the eastern part of the country (mostly *bereha*, less than 500 masl) lack available moisture, which limits rainfed crop production. In both areas, population densities are low, reflecting the low carrying capacities of land resources under current technologies.

### Characterization for Policy Guidance

The classification systems described earlier are roughly contoured. They may easily be (and frequently are) further refined on the basis of more detailed environmental data such as soil type, seasonality, terrain, technology specificity, or local production idiosyncrasies. For example, the Ethiopian Institute of Agricultural Research (EIAR) organizes crop management research by 18 major and 49 minor agroecological zones, which are refined from the traditional agroclimatic zones outlined earlier.<sup>2</sup>

For policy guidance, however, more detail may not be what is most required for identifying overarching challenges to the agricultural sector and corresponding investment priorities. Emphasizing the importance of moisture availability for the country's rainfed production systems, the Government of Ethiopia has long framed basic agricultural policy discussions within the

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2. EIAR was called the Ethiopian Agricultural Research Organization (EARO) until 2006. The Food and Agriculture Organization (FAO) was involved in identifying 18 major and 42 minor agroecological zones in the late 1980s, and EIAR has now subdivided some of these zones, with a total of 49 currently. These agroecological zones were developed under an FAO-led project within the Ministry of Agriculture, described by De Pauw (1987).

“Three Ethiopias”: moisture-reliable highlands, drought-prone highlands, and pastoral lowland areas.<sup>3</sup> For many rural experts, these basic regimes of moisture availability and the production systems therein are the critical distinctions when evaluating first-order strategic options for rural development across the country.

However, production choices are a function of not just biophysical endowments but also socioeconomic conditions and the man-made environment. These include the local availability of labor, demand for food, cost of transportation between farms, and presence of input and output markets. Development domains are used in an attempt to build on basic information on agricultural potential by adding economic information within a framework of potential production choices.

### **The Development Domains of Ethiopia**

Development domains were developed out of work by Pender, Wood, and colleagues based on household- and community-level research in Ethiopia, Honduras, and Uganda (Pender, Place, and Ehui 1999; Wood et al. 1999; Pender et al. 2001a, 2001b; Pender, Scherr, and Durón 2001; Nkonya et al. 2004; Pender 2004a, 2004b; Pender et al. 2004; Pender, Ehui, and Place 2006; Pender, Place, and Ehui 2006). Drawing on the theory of comparative advantage and location theory (von Thünen 1826; Chomitz and Gray 1996) and the literature on the evolution of farming systems in tropical agriculture (Boserup 1965; Ruthenberg 1980; Binswanger and McIntire 1987; Pingali, Bigot, and Binswanger 1987; McIntire, Bourzat, and Pingali 1992), we can understand key components of an area’s agricultural development endowment in terms of a relatively reduced set of factors: agricultural potential, access to markets, and population density.

Agricultural potential is determined by crop characteristics, inputs (including seed and fertilizer), and the biophysical environment. The income potential of alternative cropping patterns and livelihoods, however, depends on access to markets and population density, as well as agricultural potential. For example, an area with high and reliable rainfall and good soils may have an absolute advantage in producing high-value perishable vegetables but may have little comparative advantage in this livelihood if it is remote from markets. Population density, by affecting local land–labor ratios, influences the comparative advantage of labor-intensive livelihoods. High land–labor ratios in areas with poor access to markets and low agricultural potential endowments may encourage labor-intensive but low–external input production strategies. All three fac-

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3. This characterization has recently been expanded to “Five Ethiopias” (drought-prone, humid lowland moisture-reliable, moisture-reliable–cereals, moisture-reliable–*enset*, and pastoralist) for the Ethiopian Social Accounting Matrix developed by the Ethiopian Development Research Institute (EDRI).

tors together influence the profitability of different commodities, production technologies, and land management practices.

Implementing development domains means applying this conceptual framework to identify mappable conditions that broadly enable or constrain development options of national importance. This implies that two decisions must be made. First, the scale of strategic planning must be determined. For national strategy formulation, sectorwide perspectives require some level of generalization greater than that typically used in commodity- or technology-specific recommendation domains. A second decision is how best to represent these factors given local conditions and the relevant scope of perspective. In practice, this means identifying the best indicators to represent relative levels of agricultural endowments for rainfed (and irrigated) agriculture, access to market opportunities, and the availability of labor relative to land.

In Ethiopia, Chamberlin, Pender, and Yu (2006) defined development domains by starting with the long-standing moisture regime distinctions featured in policy discussion of the “Three Ethiopias” and further distinguishing between highland and lowland areas of rainfed agriculture. This yielded a total of five basic zones of agricultural potential (moisture-sufficient highlands, moisture-sufficient lowlands, drought-prone highlands, drought-prone lowlands, and pastoralist areas). Socioeconomic characteristics were also included in the characterization: two classes of market access (low and high) and three classes of population density (high, medium, and low). The resulting 25 domains were significant predictors of a range of rural livelihood variables at the *woreda* (district) level.

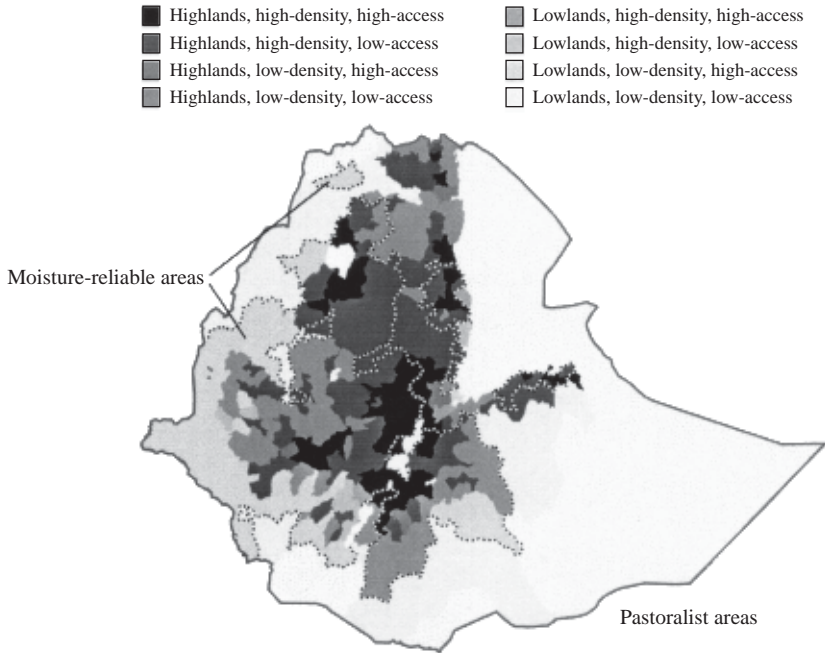
These domains highlight important aspects of the Ethiopian rural context. Of particular note is the predominance of low market access conditions. In 1994, 92 percent of land resources and 69 percent of rural populations were located in areas with low market access, as defined here (Figures 2.3 and 2.4; Tables 2.2 and 2.3). These conditions have improved considerably, with reductions to 79 percent of land and 40 percent of population in 2007, and represent one of the dimensions of greatest change in Ethiopia over the past two decades.<sup>4</sup> Nonetheless, the portion of the country’s land and population resources that may be fairly characterized as remote is still very high. Although high-density areas are becoming even denser (and are accounting for larger shares of total populations), almost half of Ethiopia’s land and people are still in low- and medium-density areas. Many of these areas are also characterized by poor market access.

Although crop choice is heavily influenced by biophysical parameters (at least partially captured in the agricultural potential dimension of the domains),

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4. The domain classification was made on the basis of *woreda* boundaries; we acknowledge that some shifts in categories may simply be artifacts of changing boundaries. Due to this modifiable areal unit problem (Openshaw 1984), we restrict our discussion to broad changes in characteristics rather than shifts between individual domains.

**FIGURE 2.3** Map of *woreda* domain assignments, 1994

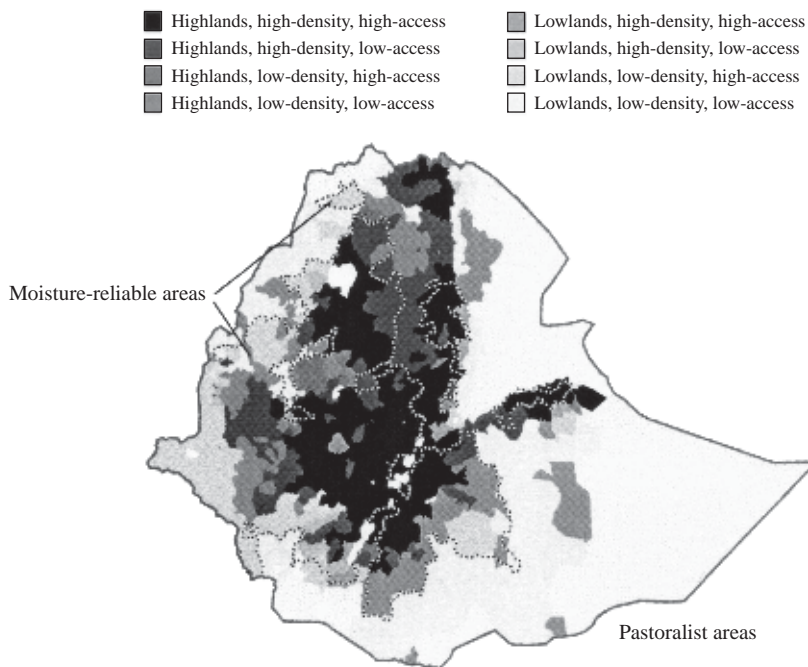


SOURCE: Authors' calculations.

access to markets and land–labor ratios appear to wield considerable influence on production choices and market orientation. Chamberlin, Pender, and Yu (2006) evaluated grain yields (using the Agricultural Census [Ethiopia, CSA 2002]) with regard to the development domains classifications and found that yields (except for those of oilseeds) tend to be higher in high-access and high-density areas, although not strongly or uniformly so. In general, the positive impacts of market access and population density on yields likely reflect the greater availability of inputs and labor in these areas and higher returns to using inputs and labor in areas with better access. However, the relatively small differences in grain yields in high- and low-access areas may suggest that factors other than market access are constraining the use of inputs such as fertilizer. A future agricultural census, with disaggregated crop production data, may be able to highlight these issues when evaluated over time, taking into consideration infrastructure improvements and greater access to markets in certain high-potential areas of the country.

Cereal commercialization is generally greater in moisture-reliable areas as opposed to drought-prone areas, reflecting greater productivity and marketable surplus in these higher-potential areas. However, in moisture-reliable

**FIGURE 2.4** Map of *woreda* domain assignments, 2007



SOURCE: Authors' calculations.

**TABLE 2.2** Domain summary statistics: Share of national totals by domain factor, 1994 and 2007 (percent)

Domain factor	1994		2007	
	Area	Population	Area	Population
<b>Agricultural potential</b>				
Moisture-reliable highlands	25	62	31	67
Moisture-reliable lowlands	12	7	9	4
Drought-prone highlands	10	18	9	17
Drought-prone lowlands	16	5	21	6
Pastoralist	37	9	30	6
<b>Market access</b>				
High	8	31	21	60
Low	92	69	79	40
<b>Population density</b>				
High	6	32	11	47
Low and medium	94	68	89	53

SOURCE: Authors' calculations.

**TABLE 2.3** Domain summary statistics: Domain share of national totals, 1994 and 2007 (percent)

Development domain	1994		2007	
	Area	Population	Area	Population
Moisture-reliable highlands, high-access, high-density	8.7	38.6	2.8	18.2
Moisture-reliable highlands, high-access, low-density	6.3	10.9	2.7	6.5
Moisture-reliable highlands, low-access, high-density	1.1	3.6	2.1	10.4
Moisture-reliable highlands, low-access, low-density	15.2	13.9	17.1	27.4
Moisture-reliable lowlands, high-access, high-density	0.1	0.3	0.0	0.4
Moisture-reliable lowlands, high-access, low-density	0.2	0.3	0.1	0.2
Moisture-reliable lowlands, low-access, high-density	0.0	0.0	0.1	0.5
Moisture-reliable lowlands, low-access, low-density	8.7	3.7	11.5	5.6
Drought-prone highlands, high-access, high-density	0.8	3.2	0.4	1.9
Drought-prone highlands, high-access, low-density	3.1	5.1	1.3	2.5
Drought-prone highlands, low-access, high-density	0.3	1.0	0.3	1.1
Drought-prone highlands, low-access, low-density	5.2	7.3	7.5	12.3
Drought-prone lowlands, high-access, high-density	0.1	0.3	0.0	0.0
Drought-prone lowlands, high-access, low-density	1.2	1.2	0.3	0.6
Drought-prone lowlands, low-access, low-density	19.4	5.1	16.1	4.0
Pastoralist, high-access, low-density	0.4	0.3	0.3	0.4
Pastoralist, low-access, high-density	0.0	0.0	0.0	0.0
Pastoralist, low-access, low-density	29.3	5.2	37.2	8.2
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

SOURCE: Authors' calculations.

areas, the highest commercialization rates are found in areas with low access, whereas the highest commercialization rates in drought-prone areas are in high-access areas. In high-potential areas, cereals are likely less profitable than higher-value commodities such as vegetables in areas with high market access but may have a strong comparative advantage in areas with low market access. In more drought-prone areas, cereals may be the most profitable and/or least risky option for farmers with relatively good market access (but without access to irrigation). Consistent with this explanation, in the drought-prone highlands we find the highest commercialization rates for cereals in areas with favorable market access, whereas in the moisture-reliable lowlands we find the lowest commercialization rate for cereals in areas with high access.

These domains were used to structure a set of tables containing generalized strategic recommendations. It is the purpose of these tables not to narrowly define recommendations for specific locations but rather to help link strategic planning within the agricultural sector (and in other sectors). Identifying conditions that could be associated with specific places may allow for aggregate strategic planning that corresponds with locally meaningful development priorities. Further definition of those local priorities would most appropriately take place at the local level.

Implicit in these recommendations is a choice of scale, the “resolution” of information, and spatial extent. For example, recommendations for a particular variety of maize are more detailed than for all varieties together, and thus the spatial expression of the optimal conditions will also vary. Generally speaking, maize may have a wide and loosely defined envelope of optimal growing conditions. A given variety, on the other hand, may require soil, slope, temperature, and growing season parameters that are more restricted in space and require more detailed data to map. More detailed assessments of this sort, sometimes referred to as technology-specific recommendation domains, may be essential components of addressing specific questions.

### **Ethiopia’s Changing Economic and Biophysical Landscape**

The contexts of rural production outlined earlier have transformed over the last decade given changes in rural infrastructure, expanding urbanization, and the adoption of new technologies. As noted earlier, market access and population density are increasing due to expanded transportation and communication networks, as well as greater urbanization. Because these transformations mirror, in some respects, the components of the development domains’ conceptual framework, we follow our empirical assessment of the change in development domains from 1994 to 2007 with a brief analysis and discussion of the evolving socioeconomic landscape with regard to increased investments in infrastructure and technology and greater urbanization. Finally we review land tenure policy as it pertains to agricultural investment and urbanization.

*Infrastructure Expansion*

Ethiopia's unique geography continues to play a major role in defining not only suitable areas for specific crop production and development domains but also the country's economic transformation on the whole. The development of rural areas and agricultural production is characterized by fragmented and dispersed landholdings (the average plot size is 0.5 hectare [Ethiopia, CSA 2002]), limited irrigation potential in the highlands, and limited infrastructure in peripheral areas of the country.<sup>5</sup> Related to Ethiopia's biophysical geography is the challenge of building and maintaining infrastructure in a mountainous landscape. Not only improving the physical mobility of people, goods, and services via transportation networks but also increasing access to telecommunication systems and electrical grids may open opportunities for improved farming and marketing conditions to better realize agricultural potential. It is important to take into account the multidimensionality of access when viewing change in Ethiopia. For example, information asymmetries are a feature of remoteness and may be mitigated by nonroad investments in such things as liberalized telecommunications and information markets. In addition, a growing literature on land tenure and ownership suggests that Ethiopia's policy of state-owned land remains an obstacle to sustained agricultural growth and rural development, regardless of improved or expanded infrastructure. We will address each of these issues (changes in roads, telecommunications, and electricity in addition to land policy variations) and how improvement over the last several decades has opened up the potential for significant increases in productivity and output.

*Improving Market Access through Improved Transportation Infrastructure*

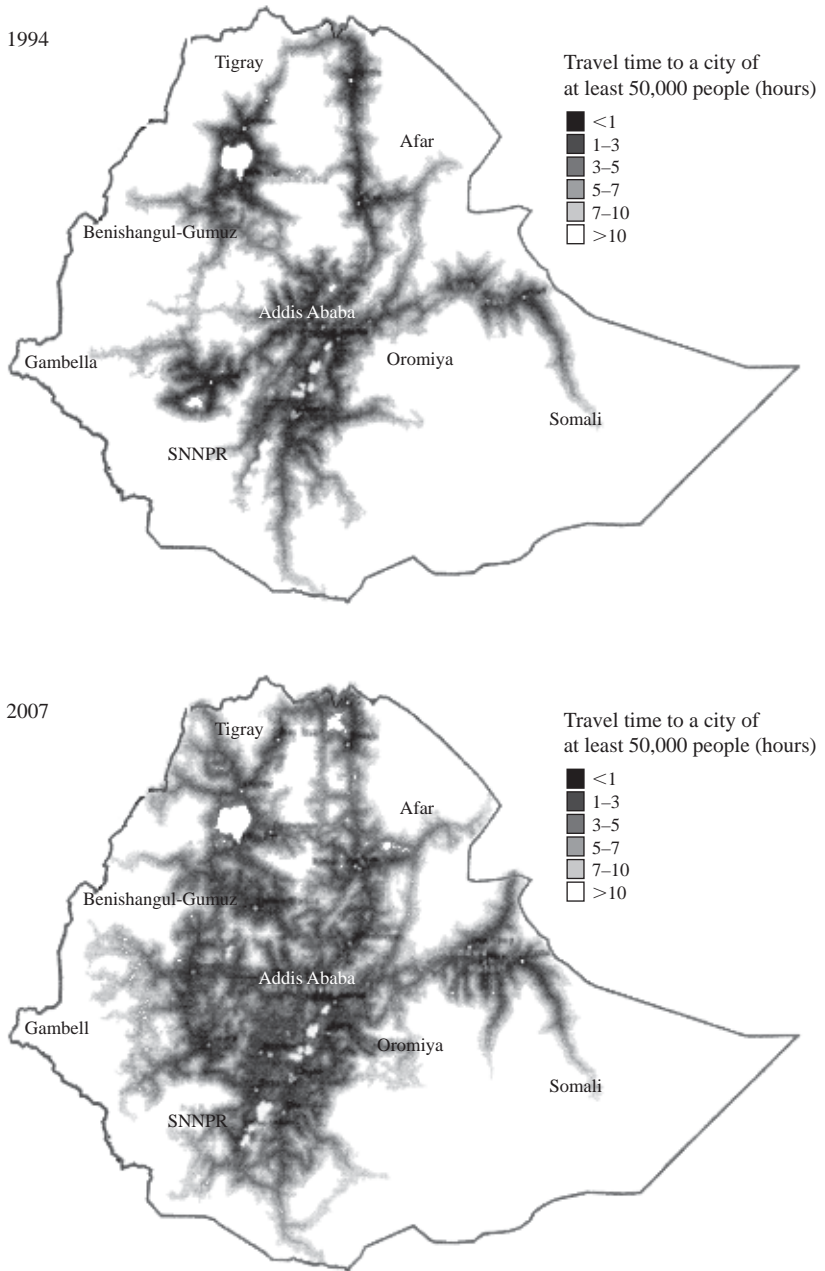
Given the limited infrastructure during the 1980s and early 1990s, the Ethiopian government prioritized transportation infrastructure investment in order to enhance linkages between cities in the highlands. In 2007, almost 62 percent of the country's population was within 5 hours' travel time of a city of at least 50,000 people (Figure 2.5; Table 2.4). This shows a remarkable improvement in market access from 1994, when only 33 percent of the total population was within 5 hours' travel time of a major city.

Currently, only 3.2 percent of the population in Amhara and 4.5 percent in the Southern Nations, Nationalities, and People's Region (SNNPR) are more than 10 hours from a major city. SNNPR showed the most improvement in travel time by connecting 45 percent more people to a city within 3 hours' travel time (Table 2.5). In Tigray and Oromiya, 21 percent of the population improved

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5. Highland systems in Ethiopia tend to have smaller catchments and feed from gravelly rivers in the upper parts of basins. Flash floods are more common and difficult to predict than floods in lowland systems. Command areas are relatively small, defined by fluctuating topography.

**FIGURE 2.5** Travel time to a city, 1994 and 2007



SOURCE: Schmidt and Kedir (2009).

**TABLE 2.4** Percentage of regions' populations connected to a city of at least 50,000 people, by access time, 2007

Region	Access < 1 hour	Access < 3 hours	Access < 5 hours	Access < 10 hours	Access > 10 hours
Tigray	10.89	15.36	12.48	53.71	7.57
Afar	n.a.	n.a.	1.77	9.73	88.49
Amhara	5.05	22.72	37.06	31.98	3.20
Oromiya	9.03	18.06	36.39	27.84	8.68
Somali	7.99	n.a.	n.a.	13.57	78.44
Benishangul-Gumuz	n.a.	n.a.	n.a.	29.15	70.85
SNNPR	12.55	52.65	12.28	18.05	4.47
Gambella	n.a.	n.a.	n.a.	n.a.	100.00
Harari	100.00	n.a.	n.a.	n.a.	n.a.
Addis Ababa	100.00	n.a.	n.a.	n.a.	n.a.
Dire Dawa	100.00	n.a.	n.a.	n.a.	n.a.
Ethiopia	12.48	23.56	25.73	26.03	12.20

SOURCE: Schmidt and Kedir (2009).

NOTE: SNNPR = Southern Nations, Nationalities, and People's Region; n.a. = not available.

**TABLE 2.5** Percentage change in regions' connection to a city of at least 50,000 people, by access time, 1994–2007

Region	Access < 1 hour	Access < 3 hours	Access < 5 hours	Access < 10 hours	Access > 10 hours
Tigray	7.13	12.01	(3.72)	5.98	(21.39)
Afar	n.a.	n.a.	n.a.	4.11	(5.89)
Amhara	2.23	14.68	18.94	(12.49)	(23.35)
Oromiya	3.74	10.40	15.84	(8.88)	(21.10)
Somali	n.a.	n.a.	n.a.	2.62	(2.61)
Benishangul-Gumuz	n.a.	n.a.	n.a.	17.91	(17.91)
SNNPR	9.17	45.37	(14.59)	(21.56)	(18.39)
Gambella	n.a.	n.a.	n.a.	n.a.	n.a.
Harari	n.a.	n.a.	n.a.	n.a.	n.a.
Addis Ababa	n.a.	n.a.	n.a.	n.a.	n.a.
Dire Dawa	n.a.	n.a.	n.a.	n.a.	n.a.
Ethiopia	4.10	17.12	7.54	(9.93)	(18.83)

SOURCE: Schmidt and Kedir (2009).

NOTES: Values in parentheses are negative. SNNPR = Southern Nations, Nationalities, and People's Region; n.a. = not available.

market access from more than 10 hours to between 3 and 10 hours from a city. At present, every region except Gambella has a city of at least 50,000 people, and many of these cities have built key transportation infrastructure in order to harness the potential of economic corridors between cities. Although urban centers are linked to other large cities through improved infrastructure, only 5–13 percent of the population in any region is within 1 hour’s travel time of a city of at least 50,000, except in Addis Ababa, Dire Dawa, and Harari, where 100 percent of the populations are less than 1 hour from a major city.

It is important to note, however, that population densities and the quality or density of transportation infrastructure affect diverse administrative regions in different manners. In Ethiopia, the central and peripheral regions represent two very different economic, geographic, and demographic landscapes. Although in the main central administrative regions (Amhara, Oromiya, SNNPR, and Tigray) higher population densities and a more integrated road network are characteristic of the economic landscape, in the peripheral administrative regions limited road access and dispersed settlements create larger challenges for linking remote populations to the benefits of agglomeration economies. Improving transportation infrastructure along main access roads will benefit those already in densely populated areas, but maintaining and building select rural road infrastructure in areas with economic (agricultural) potential will be critical for poverty reduction and economic growth strategies in the more remote areas.

### *Expanding Electricity Generation*

Large investments in hydroelectric power over the last 30 years have dramatically changed the lives of many individuals living in cities in Ethiopia. In the 1960s, Ethiopia increased its electricity-generating capacity from approximately 65 megawatts to an estimated 1,918 (planned) megawatts at the end of 2011, an increase of 8.9 times on a per capita basis (Table 2.6). The comparison with 1958 is even more striking, because there was essentially no electricity generation in Ethiopia at that time, with the nation having only 2.3 megawatts of diesel-powered capacity. The introduction of hydroelectric power in subsequent decades, and especially the large surge in capacity since 2005, increased the nation’s electricity-generating capacity 834-fold between 1958 and 2011, a 29-fold increase on a per capita basis.

Actual electricity use is generally 35–45 percent of theoretical generating capacity because there is insufficient water behind the hydroelectric power dams for full-scale operation throughout much of the year. Domestic use accounted for 30 percent of total use in 2006/07, whereas commercial and industrial use accounted for 20 and 28 percent, respectively (Dorosh and Schmidt 2010). Overall, electricity use grew at an average rate of 12.5 percent per year from 2002/03 to 2006/07, with the highest growth rate for street lighting (27.1 percent per year).

**TABLE 2.6** Electricity-generating capacity, 1958–2011 (annual averages)

Year	Hydroelectric capacity (megawatts)	Other capacity (megawatts)	Total capacity (megawatts)	Capacity per capita (watts per person)
1958–59	n.a.	2.3	2.3	0.1
1960–69	62.8	2.5	65.4	2.4
1970–79	152.9	3.0	155.9	4.7
1980–89	202.8	4.7	207.5	4.9
1990–99	325.2	9.0	334.2	6.0
2000–04	452.6	25.0	477.6	6.9
2005–09	747.2	50.2	797.4	10.0
2010	1,447.5	50.2	1,497.7	17.4
2011 <sup>a</sup>	1,867.5	50.2	1,917.7	21.7

SOURCE: Dorosh and Schmidt (2010).

NOTES: Figures for 2008–10 based on additional capacity from Tekeze I (300 Mw) in 2009 and Tana Beles (460 Mw) in 2010; n.a. = not available.

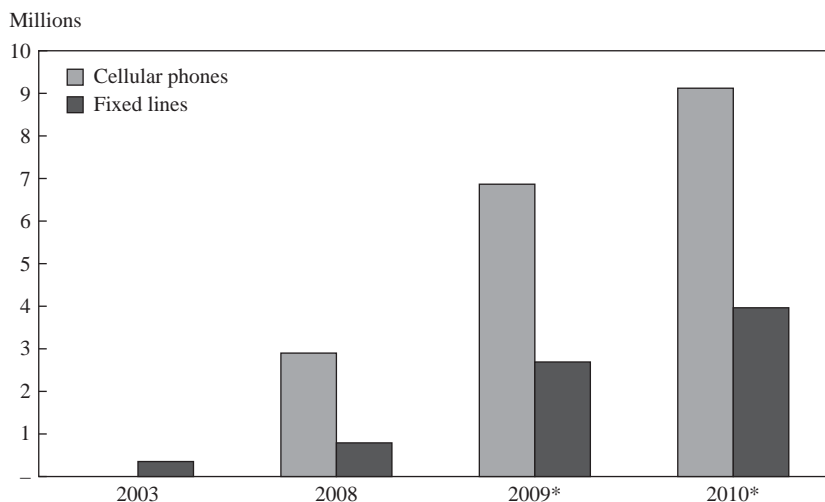
<sup>a</sup>The 2011 figure is the 2010 figure plus that for Gile Gibe II (420 Mw). Gile Gibe II is a hydroelectric power station on the Omo River in Ethiopia for which the tunnel collapsed in December 2009.

Recent research on the productivity effects of electrification suggests that benefits from improved and extended hours of access could be very large, particularly as measured by output per worker. A 2008 survey of small-scale handlooms in Addis Ababa and SNNPR (Ayele et al. 2009) indicates that productivity per worker was about 40 percent higher in electrified versus nonelectrified firms in SNNPR. Workers in nonelectrified rural villages on average worked only 7.2 hours per day, whereas their counterparts in other electrified (but rural) villages worked 10.7 hours per day. This productivity effect is achieved in large part because in towns with electricity access, producers work longer hours and firms share work spaces with electric lights at lower rental costs.

### *Enhancing Telecommunications*

Ethiopia is gradually becoming connected. Individuals who once had to walk hours to gain information about market prices and supply are steadily joining a network of connected individuals who are able to let their fingers do the walking. In 2003, some 405,000 fixed telephone lines were in place and only 51,000 cell phone subscriptions existed throughout the country (Figure 2.6; Table 2.7). By 2008, cell phone subscriptions had catapulted to 3.17 million subscribers and fixed telephone lines had more than doubled. Infrastructure plans reported that cell phone subscriptions might reach as many as 9.9 million users by 2010. It is important to note, however, that only 3.9 percent of the total population had cell phone subscriptions in 2008 (5.3 percent of subscribers were located in connected areas), whereas the share of the population with cellular subscrip-

**FIGURE 2.6** Fixed-line and cellular telephones, 2003, 2008, 2009, and 2010



SOURCE: ITU (2009).

NOTE: Asterisks denote planned coverage.

**TABLE 2.7** Fixed-line and cellular telephones in Ethiopia compared to all of Africa, 2003, 2008, 2009, and 2010

Type of phone, region	2003	2008	2009 <sup>a</sup>	2010 <sup>a</sup>
<b>Main (fixed) telephone lines (thousands)</b>				
Ethiopia	405	909	3,000	4,400
Africa	9,553	10,617	n.a.	n.a.
<b>Mobile cellular subscriptions (thousands)</b>				
Ethiopia	51	3,168	7,500	9,900
Africa	35,251	245,608	n.a.	n.a.
<b>Mobile cellular subscriptions</b>				
Ethiopia (share of total population)	0.1	3.9	9.0	11.5
Ethiopia (share in connected area)	0.1	5.3	n.a.	n.a.
Africa (share in connected area)	3.7	32.5	n.a.	n.a.

SOURCE: Dorosh and Schmidt (2010).

NOTE: n.a. = not available.

<sup>a</sup>Planned coverage.

tions within a connected area in Sub-Saharan Africa reached 32.5 percent of the population. The total number of cell phone subscribers in Africa amounted to 245.6 million people, while a total of approximately 3.17 million Ethiopians benefited from a cellular subscription.

### Urban Growth and Expansion

Ethiopia's recently published 2007 census reports urban population figures at the city level and allows for greater insight into how Ethiopia's demographic landscape has evolved. Schmidt and Kedir (2009) provide an analysis of city growth and expansion using city populations, infrastructure networks, and population density in order to provide a standardized comparison of urban growth over the last three census periods (Table 2.8).

**TABLE 2.8** Agglomeration index: Percentage of people considered urban by region, 1984, 1994, and 2007

Region	1984 <sup>a</sup>		1994		2007	
	Total population (thousands)	Percentage urban	Total population (thousands)	Percentage urban	Total population (thousands)	Percentage urban
Addis Ababa	1,423	61.2	2,113	85.5	2,738	99.3
Afar	780	n.a.	1,061	n.a.	1,411	n.a.
Amhara	10,686	2.0	13,834	3.7	17,214	7.5
Benishangul-Gumuz	351	n.a.	460	n.a.	671	n.a.
Dire Dawa	158	20.3	252	58.2	343	66.3
Gambella	172	n.a.	182	n.a.	307	n.a.
Harari	82	55.2	131	76.2	183	86.0
Oromiya	14,016	1.7	18,733	4.6	27,158	9.2
SNNPR	7,501	n.a.	10,377	2.2	15,043	21.1
Somali	2,006	0.2	3,199	1.6	4,439	1.9
Tigray	2,692	2.0	3,136	3.8	4,314	8.0
Ethiopia	39,869	3.7	53,477	7.1	73,919	14.2

SOURCES: CIESIN, IFPRI, World Bank, and CIAT (2004); Schmidt and Kedir (2009); population estimates based on data from the past three Ethiopian censuses.

NOTES: Population density per square kilometer (derived by GRUMP, the Global Rural–Urban Mapping Project, and LandScan for the year 2000), a major component of the agglomeration index, was projected using a growth rate of 3 percent per annum to adjust for different census years. SNNPR = Southern Nations, Nationalities, and People's Region; n.a. = not available.

<sup>a</sup>Population figures for 1984 were approximated due to changes in administrative boundaries after 1984. In order to maintain consistency across all years, we geographically allocated population to the current regional boundaries.

Urban estimates from the 2007 census are similar to those developed by Schmidt and Kedir (2009) using the agglomeration index methodology, yet when comparing urban growth over time, these estimates show a dramatic difference (Table 2.9). This difference is primarily derived from the definition of an urban area used for the two estimates. The Central Statistical Agency (CSA) measures urban areas as all administrative capitals of regions, zones, and *woredas*, as well as localities with at least 1,000 people who are primarily engaged in nonagricultural activities, and/or areas where the administrative official declares that the locality is urban. In comparison, the agglomeration index provides a measure of the economic strength of urban areas rather than a definition of *urban* based on political status, administrative boundary, or the presence of particular urban services or activities.

Evaluating Ethiopia's urban growth using the agglomeration index methodology shows that urbanization growth rates are much higher (approximately 9 percent on average) than previously calculated by the CSA (on average 4 percent over the last three decades). Although Ethiopia's agglomeration index suggests significant levels of urban clustering and growth over time, when compared with other countries in the region, Ethiopia remains one of the least urbanized nations in East Africa. In 2000, agglomeration in Ethiopia was measured at 11.9 percent, whereas the rates in most other East African countries were between 25 and 32 percent. Overall, Ethiopia's agglomeration index is 10 percentage points below the average agglomeration index for East Africa.

**TABLE 2.9** Alternative urbanization estimates, 1984, 1994, and 2007

Year	Official estimate (percent)	Agglomeration index (percent)
1984	11.40	3.70
1994	13.70	7.10
2007	15.90	14.20
	(Millions of people)	(Millions of people)
1984	4.55	1.48
1994	7.33	3.8
2007	11.72	10.5
	(Growth rate, percent)	(Growth rate, percent)
1984–94	4.90	9.90
1994–2007	3.70	8.10
1984–2007	4.20	8.90

SOURCES: CSA population estimates; Schmidt and Kedir (2009).

Given the overwhelming revenue generated from agricultural activities in Ethiopia, policymakers have focused primarily on ADLI (Agricultural Development–Led Industrialization), but continuous growth of urban centers requires a greater understanding of the dynamic geographic and economic transformations occurring throughout the country. Urban areas facilitate social and economic interactions. These exchanges lead to increased efficiency in flows of goods and services, more efficient matching of workers to jobs, and enhanced information and knowledge spillovers. Increased access to markets also affects development domains, allowing for improved access to new technologies, necessary inputs to boost production and yields, and increased opportunity for cash-crop development for export. Earlier evidence by Chamberlin, Pender, and Yu (2006) suggests that grain yields tend to be higher in high-access and high-density areas. Previous studies on the adoption of technology (such as improved seeds and fertilizer) find clear spatial patterns suggesting that access to main roads and market centers determine the success and pace of adoption (Staal et al. 2002; Croppenstedt, Demeke, and Meschi 2003; Yu et al. 2010). Further investment in connective infrastructure that reduces the distance to areas of greater density and enhances access to information and markets is likely to accelerate adoption. Finally, land tenure policies that ensure land security also play a crucial role in incentivizing investment and promoting labor mobility that allows for greater information exchange and more interactive development between rural and urban areas.

### **Land Tenure Policy**

Land tenure policies have changed dramatically over time in Ethiopia, and there continues to be an ongoing debate on land tenure and privatization. This discourse centers on the trade-offs between state protection and equity versus privatization and increased market efficiency. Given Ethiopia's relatively recent history of land tenure reforms associated with regime change, the current government policy is based on state ownership that ensures free access to land for all peoples of Ethiopia so as to prevent a small number of wealthier landowners from acquiring a majority of land through distress sales and other mechanisms. State ownership of land is thus designed to protect against conditions experienced under the imperial regime, whereby a majority of rural farmers worked under tenancy contracts with exploitative labor agreements (Jemma 2001; Rahmato 2004). However, concerns have been raised that state ownership and limits to land transfers are restricting the development of key land markets, producing negative spillovers in agricultural productivity and off-farm labor (EEA/EEPRI 2002; Deininger et al. 2004). This section briefly outlines land policy in Ethiopia since the imperial regime and provides a synthesis of the ongoing dialogue about land tenure as it relates to agricultural production and development within the country.

*The History of Land Tenure Policy in Ethiopia*

Land tenure policy in Ethiopia can be categorized into three general periods characterized by the past three political regimes. During the imperial regime of Haile Selassie (1929–74), the land tenure system was multitiered, spatially diverse, and one of the most complex systems used in Africa (Joireman 2000). In the north, usufruct land tenure was defined by a *rist*, or communal system that allowed farmers (who were usually politically connected) to claim access to ancestral land, as well as trade land in the rental market, but not to sell or mortgage any land. In the south of Ethiopia, however, land transfers through sales and mortgages were allowed through *gebbar*, or private ownership contracts (Rahmato 1984; Teklu 2004). In addition to communal land allocated by the state (*madeira* or *mengist*), other land was owned by the church (*samon*) or given as grants (*gult*) to individuals. Absentee landlords, insecure tenure due to arbitrary evictions, and exploitative labor agreements were widespread during this period and, some argue, were among the primary reasons that the regime was toppled in 1974 (Jemberre 2000; Adal 2001; Deininger et al. 2003).

The Marxist Derg regime (1974–91) that ruled after the overthrow of Haile Selassie quickly set forth to redefine and reorganize the land tenure laws. The Proclamation to Provide for the Public Ownership of Rural Lands (Proclamation 31/1975) dissolved the previously exploitative landlord–tenant relations by nationalizing all rural land and redistributing land rights to all farmers. The regime constructed peasant associations (PAs) to organize redistribution contingent on proof of permanent physical residence within the PA. This system required each farmer to be a member in the PA, with the leadership of each PA entitled to expropriate land from landholders and redistribute it equally among members. Land transfers were granted only by bequest to an immediate family member, and leases or rentals, exchanges, and mortgages were prohibited. Plot sizes were restricted to a maximum of 10 hectares, and the use of hired agricultural labor was prohibited under Article 5 of the Proclamation (Crewett, Bogale, and Korf 2008).

Given that land distribution was organized around permanent residency and membership in a PA, the option of migration was highly risky, involving the possible loss of not only land but also membership in the PA, the administrative unit that distributed land. Because of this limited migration, however, PAs steadily began to confront land scarcity, while new claimants declared usufruct rights under Proclamation 31/1975. Thus, expropriation and redistribution became frequent in more densely populated areas, and tenure security was undermined by the PA leadership's ability to redistribute land for political reasons, while wealthier farmers used bribery to ensure that they received better-quality or larger land parcels (Ege 1997; Azeze 2002). The scale and frequency of redistribution varied by region and area; while some areas faced frequent

redistributions made in an effort to maintain the egalitarian approach of land access, less pressured PA leadership reallocated land only once during the land reform (Rahmato 1984; Clapham 1988; Holden and Yohannes 2002).

The Ethiopian People's Revolutionary Democratic Front government that took power in 1991 pursued an economic strategy that was, overall, more open than that of the previous socialist Derg regime. Although many groups called for land tenure reform involving privatization of land ownership, the new constitution of 1995 confirmed state ownership of all land in Ethiopia, and few revisions were made to the previous land tenure regime under the Derg (FDRE 1995 [Article 40]; Adal 2001; Belay and Manig 2004). Of the revisions that were enacted, several stand out as important modifications: (1) land redistribution was to be reduced; (2) regional governments were given responsibility to enact laws regarding land rights, transferability, and taxation as long as these laws adhered to national guidelines; and (3) land rental was deemed lawful (Pender and Fafchamps 2006). Although these amendments to the earlier Derg-defined land tenure laws significantly improved farmers' perception of their land security, researchers have found mixed evidence of land or labor market improvement and enhanced off-farm employment incentives in an already dense rural population (studies of land tenure are discussed later).

Since 1995, earlier land tenure laws outlined in the constitution have been primarily modified by regional governments (Crewett, Bogale, and Korf 2008). For example, Tigray region declared an end to all administrative land redistribution; Oromiya region restricted redistribution to only those lands with irrigation potential, whereby farmers would be compensated with reasonable rainfed land (Regional Government of Oromia 2002, Article 14.4; Crewett, Bogale, and Korf 2008). Other regional bylaws have been designed to limit the renting of land: farmers in Oromiya are able to rent out only 50 percent of their total holdings for a maximum of 3 years if using traditional farming methods or 15 years if modern technologies are employed (Deininger et al. 2003). Some argue that although land tenure security has improved under the current government, the imprecise language of the regional regulations, as well as the seemingly non-transparent legal framework used in a variety of regional amendments, may increase the probability of corruption and political interference (Rahmato 2004).

In 2005, the central government issued a revised proclamation designed to increase subjective tenure security within the state-owned land law by emphasizing the importance of land measurement, registration, and certification of land plots (Rural Land Administration and Land Use Proclamation 456/2005). Piloted in Tigray region in 1998, and later in Amhara in 2003 and in Oromiya and SNNPR in 2004, land registration and certification aim to provide farmers with a legal document that outlines their perpetual user rights, along with the right to receive compensation for investments made in the land in case of loss, the right to bestow land on family members, and the right to lease out a defined share of the land for a limited period.

*The Effects of the Current Land Policy on Growth and Investment*

The certification program was organized at the village level through elected land use and administration committees in order to ensure participatory assessments within a short time frame. In addition, the cost of implementing a comprehensive land registration program (approximately \$3.5 per household) was dramatically reduced given the decentralized nature of implementation and was significantly lower than the costs of other similar programs that have been evaluated previously (Deininger et al. 2008; Deininger, Ali, and Alemu 2009). Farmers' favorable evaluations of the process, their willingness to pay for certificates, and the perceived decrease in the risk of land redistribution suggest that the implementation was successful. According to Alemu (1999) and Holden and Yohannes (2002), these certificates have improved land tenure security. A survey conducted by Holden, Deininger, and Ghebru (2009) found that 84 percent of households felt less at risk of being evicted from their land after receiving a certificate.

According to economic theory, tenure security is linked to many positive spillovers, such as decreased land disputes, increased investment in land, more efficient land markets, and hence greater production yields.<sup>6</sup> Several recent studies in Ethiopia suggest that indeed, increased tenure security in the form of registration and certification enhances investment. Deininger, Ali, and Alemu (2009) evaluated the impact of the land certification program implemented in Tigray region on investments in soil and water conservation (SWC) and land productivity using farm-plot panel data. Their findings suggest that the effects of certification on SWC is positive and significant in that certification supports an increase of investment in trees, improved maintenance of soil conservation structures, and enhanced land productivity. Another study by Deininger et al. (2007) drew from a second-round nationwide panel survey of 2,300 households to look at the impact of certification on land investments between 2004 and 2006. The authors found that plots that had been certified at least a year before the second-round survey period were 5 percent more likely to receive new investment. In addition, the amount of new investment was 4.4 percent higher on those plots as compared to noncertified plots receiving investments.

Holden, Deininger, and Ghebru (2011) evaluated certification programs in terms of women's empowerment initiatives in Tigray using a panel dataset from 1997, with follow-up rounds from two, five, and eight years after certification started. Given that traditionally women move into their husband's home upon marriage and that they do not customarily engage in land management, female-headed households tend to rent out much of their land (Ghebru and Holden 2008). Prior to the registration and certification program, female-headed house-

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6. Holden, Deininger, and Ghebru (2009) provide a comprehensive list of such studies in and on a variety of countries and continents.

holds confronted difficulties in staking a claim to their land due to their limited ability to till the land with oxen, which prompted land encroachment by male inlaws and blood relatives. After certification, Ghebru and Holden (2008) found that female-headed households rented out, on average, 1.1–1.6 more *tsimdi* if they had rented out land previously;<sup>7</sup> in addition, women who had not rented out land previously were more inclined to do so after receiving a land certificate. These findings suggest that female-headed households perceive that they have greater land security after certification and, in turn, are able to rent out land without risking the loss of possession.

Although many assessments of the current land policy and registration process suggest that there have been improvements in individuals' perception of their tenure security, other studies point to areas that could be improved or further researched. Teklu (2004) argues that increasing land scarcity, increasing rent costs, and fees incurred for rights to rent are distorting rental land markets. Given that land sale is prohibited in Ethiopia, rental markets pursued through sharecropping and cash rental are becoming increasingly important determinants of access to land. Land-constrained farmers who otherwise have the necessary assets, such as oxen, key inputs, and labor, seek to increase their area of operation through renting agricultural land. Conversely, farmers with large agricultural holdings but insufficient capital to buy farm implements or hire labor (for example, female heads of households) seek to rent out their land in exchange for labor or oxen. Akin to the empirical analysis of Teklu (2004), that of Deininger et al. (2003) suggests that land transfers in Ethiopia follow econometric theory in that large, less efficient producers rent out land to smaller, more efficient farmers, although many farmers who rent out land perceive that they have a higher risk of losing their land in a future redistribution.<sup>8</sup> Similarly, those who engage in off-farm labor have a 10–15 percent greater perception that they are at risk of future land loss. This suggests that the degree of land transaction that could take place in a secure market may be stifled by fears of ongoing tenure insecurity.

Other analyses have looked into the restrictive transferability rights in Ethiopia (no transfers are allowed through sales, exchanges, mortgages, and so on) in terms of off-farm labor development and rural–urban migration. Their hypotheses build on economic theories of property rights (Harris and Todaro 1970; Posner 1973) whereby privatization of land provides the underlying incentive for long-term investment, management, and maintenance in order to increase and sustain productivity, which in turn (given income disparities, among other issues) allows outmigration of less productive farmers to other off-farm and urban sectors of the economy. Current land policy states that the transfer of usufruct land rights is permissible only through bequests to family

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7. A *tsimdi* is equivalent to 0.25 hectare.

8. The analysis of Deininger et al. (2003) was based on the Ethiopian Rural Household Survey of 1999.

members residing in the village who are engaged in or wish to engage in agriculture. This may be inhibiting rural–urban migration, because land cannot be sold to finance outmigration, and seasonal or temporary migrants risk losing access to land in their home village when they return. A recent analysis by Gete et al. (2008) in Amhara region found that most seasonal outmigrants are single young men with no land use rights or dependent family members. In addition, migrants cite lack of sufficient food, shortage of farmland, and lack of employment opportunities in the village as underlying reasons for seasonal migration. Ongoing studies continue to assess how rural–urban migration can help to reallocate labor from the agricultural sector to greater income-earning sectors and provide migrants with alternative income sources. Improving the mobility of rural farmers through transparent land tenure guidelines (and, in the future, possibly the privatization of land) may enhance the network effect of agglomeration economies as discussed previously, as well as reduce the burden of an extra person on the farm and increase household earnings through possible remittance income (De Brauw et al. 2010).

Further research assessing land tenure policy as it relates to land certification and tenure security will be important as Ethiopia continues to urbanize and as additional investments in connective infrastructure redefine the rural landscape. Deininger et al. (2007) outline a series of issues that should be resolved in order to maintain a legitimate certification program. These include the need to identify and promote clear updating procedures (especially in rapidly developing areas) to ensure that old certificates are voided prior to distributing updated documents. In addition, public access to land certification data and information, as well as clear guidelines that identify the varying responsibilities of institutions in registration and updating of documents, is important to secure trust and enhance land security. Finally, well-defined compensation definitions and procedures to use in case of land redistribution should allow farmers to better gauge their risk and investment decisions.

## **Conclusions**

The underlying biophysical features and unique topographic environment of Ethiopia strongly influence but do not strictly determine the success of agricultural production and output in the country. Although natural endowments are significantly linked to agricultural suitability, the changing economic landscape is beginning to blur the boundaries between actual suitable areas and the potentially productive locations. Access to input and output markets, expanding urbanization, and improved technologies are transforming the landscape, as well as the activities and opportunities within previously constrained agro-ecological zones. Understanding the geographical expression of these factors is an important way to make sense of Ethiopia's agricultural and rural development options and to guide the definition of supporting policies.

Investments in connective infrastructure are facilitating the movement of ideas, technologies, goods and services, and labor to areas that demand specific products and distribute other outputs. Improving and restoring primary road infrastructure reinforces secondary and primary market interactions. Maintaining and constructing rural roads that connect agricultural surplus areas with small towns and urban centers also bolster inclusive geographic supply and demand networks. A continuum of population density creates a portfolio of interrelated places, and these places, when functioning properly, will bring about greater economic interaction and ultimately spur development within all spatial spheres.

Clearly, the transformations that have taken place in recent decades with regard to market access, technology investment, and urbanization have facilitated and influenced not only city development and productivity but rural economic growth and potential as well. This growth requires policy decisions that shape the rate of growth and integration between rural and urban areas, as well as a framework for how Ethiopia can best benefit from enhancing the already (actual) agriculturally productive areas while bolstering areas that have significant potential for greater output.

Land tenure policy in Ethiopia continues to be studied and debated as to how to best develop the agricultural sector in an efficient as well as an equitable manner. Recent evaluations of the ongoing land registration and certification programs suggest that farmers perceive that they have greater tenure security after receiving certificates. Although comparative studies argue that land privatization could be an important policy instrument to promote long-term investments and remove a major obstacle to rural–urban migration, such a major move toward a fully functioning land market appears to be unlikely in the current environment.

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