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ESSP II Working Paper 44

Spatial Analysis of Livestock Production Patterns in Ethiopia

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Abstract

The livestock sector is a large contributor to the Ethiopian economy as well as a mainstay in the livelihoods of many Ethiopians. It comprised 11 percent of national GDP and 24 percent of agricultural GDP between the years of 1995/96 and 2005/06 (NBE 2005/06). Livestock production and markets vary substantially across space in Ethiopia due to a variety of reasons including topographical variations, market access, water availability, and population characteristics. This study links smallholder livestock population data from the Agricultural Census (2001/02) and data from the annual CSA Agricultural Sample Survey (2005 to 2008) with Geographic Information Systems (GIS) data in order to assess livestock population, market access, and grazing land. We utilize existing studies of travel time (Schmidt and Kedir 2009) to calculate shares of livestock (cattle, sheep and goat) populations within defined travel time thresholds of major markets. In addition, we attempt to provide greater insight of changes in available grazing land given increasing human and livestock population pressure.

1. Introduction

Ethiopia has the largest livestock population in Africa (Hussen et al. 2008; Solomon et al. 2003). The livestock subsector comprised 11 percent of national GDP and 24 percent of agricultural GDP between the years of 1995/96 and 2005/06¹, and is a source of revenue for 60–70 percent of the population (NBE 2005/06; Halderman 2004). According to Negassa and Jabbar (2008), 80 percent of smallholder farmers own cattle, 31–38 percent own sheep, and 21–33 percent own goats. Previous research suggests that the combination of livestock species owned by smallholders varies spatially given availability of feed, human population density, and intended function of livestock species. In highly populated areas, smaller livestock (sheep, goats, etc.) are preferred over large animals that require large expanses of grazing land. In the highlands where crop production requires intensive tillage, draft animals such as oxen or mules are necessary (Jabbar, Negassa, and Gidyew 2007). This spatial variation in livestock population, coupled with other factors such as population density, grazing land availability, and access to markets has implications in grazing land management and livestock markets. Understanding spatial variations within the livestock economy is crucial in order to devise a feasible, more geographically targeted livestock policy.

2. Data and methods

In order to analyze livestock population over time, a database at woreda level was created using data from the Agricultural Census of 2001/02 and the Agricultural Sample Survey (AgSS) from 2005 to 2008 collected by the Ethiopian Central Statistical Agency (CSA 2002, 2006, 2007, 2008a). It is important to note that the AgSS is representative at the zone level; but for purposes of this study, we estimated woreda level figures for 2005–2008 by calculating the woreda share of livestock population for each zone recorded in the 2001/02 census. While we recognize that this method is simplistic in nature and will not capture intra and inter-annual dynamics of livestock population movements and determinants of production, it does provide insight into the importance of livestock production and market linkages in terms of transportation and economic access.

In addition, due to data sampling constraints, livestock population data were not reported for a number of areas. The AgSS collects data in rural sedentary areas of the country. Limited data are collected in urban areas, and given accessibility constraints, only two (of the five) zones in Afar and three (of the nine) zones in Somali region are sampled. Although three zones of Somali region were sampled, limited data were collected from these zones.² An aerial survey was conducted in 2003 in order to survey the remaining zones in Somali region; we discuss these figures separately in order to provide a more comprehensive picture of livestock population throughout the country.

For woredas which are in zones that were not sampled during the annual AgSS, a two percent annual livestock growth rate³ is assumed and production is estimated based on the 2001/02 agricultural census figures. Woredas that were not covered in the census or the AgSS were left out of this analysis. Finally, the census and AgSS data for the study period were evaluated for spatial consistency and coherence over time. Given that the woreda

¹ Behnke (2010) reports that if the value of plowing services is incorporated into the estimate, livestock provided 45 percent of agricultural GDP in 2008/09.

² Two of 6 woredas from Shinile zone were sampled (Shinile and Erer woredas); and 3 of 6 woredas from Jijiga zone were surveyed: Jijiga, Teferi Ber, and Kebri Beyah woredas.

³ Based on previous literature, cattle population growth rate ranges from 1.6 to 3.2 percent (Gebremedhin et al. 2007; Negassa et al. 2011)

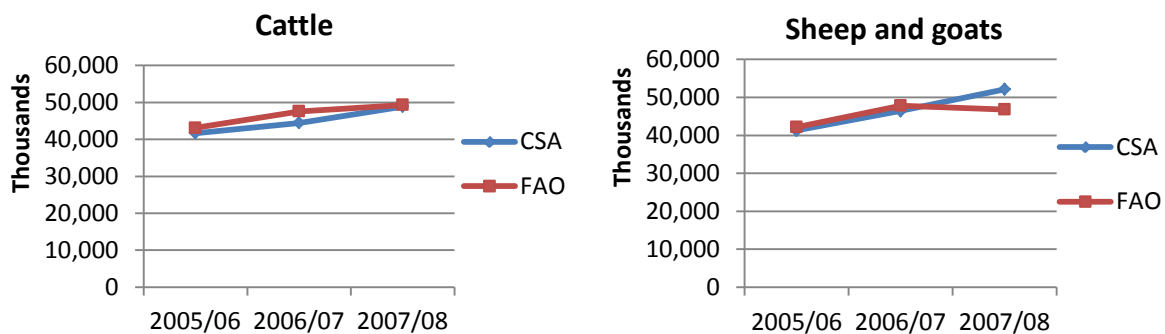
boundaries, names, and codes vary over time, we constructed a spatial database that merged comparable woreda boundary data with a unique spatial identifier following the AgSS codebook.

Finally, several methodologies have been used to estimate livestock populations and patterns at disaggregated levels. A recent example of such work uses the Livelihoods Integration Unit (LIU) data collected between 2006 and 2009 via the Household Economy Approach⁴ (HEA). Unlike the Household Income Consumption Expenditure surveys, which offer nationally representative data, the LIU data (re-estimated using population figures from the 2008 national estimates from the Ethiopia Census) offer stylized facts, which in some cases provide valuable insights into otherwise difficult to survey populations. In addition, we provide livestock population estimates reported by Behnke (2010) whereby the authors adjust CSA annual livestock figures to incorporate all pastoral animals from administrative zones not sampled by CSA⁵.

3. Livestock production in Ethiopia

According to national statistics, livestock population in Ethiopia continues to grow, with the highland regions accounting for the largest share. Both FAO and CSA data report increases in livestock population over the last several years. CSA data suggest a steady incline in population, while FAO reports greater increase initially with slower to declining growth from 2007 to 2008, especially for sheep and goat population (Figure 3.1). Between 2005 and 2008, livestock population (in terms of cattle, sheep, and goats) in Ethiopia grew at 22 percent. In 2007/08, Oromiya region produced the largest share, 38 percent of livestock within Ethiopia, while Amhara and Southern Nations, Nationalities, and Peoples (SNNP) regions produced 26 and 16 percent of livestock shares, respectively (Table 3.1). Approximately 10 percent of overall production is found in the agro-pastoralist regions of Afar and Somali. However, livestock estimates in Ethiopia are based primarily on data collected in sedentary areas, which excludes large pastoral areas of Afar and Somali regions.

Figure 3.1—Cattle, sheep and goat population, 2005–2008



Source: Author's calculations; CSA: Agricultural Sample Survey (2005–2008) and FAO (2005–2008)

⁴ Collected by the Government of Ethiopia Disaster Prevention and Preparedness Agency (DPPA), used to assess livelihoods and how they might respond to environmental and economic shocks.

⁵ We include Behnke (2010) estimates in Appendix D.

Table 3.1—Livestock population by region, 2007/08 (thousands)

Region	Cattle	Goat	Sheep	Region share of total livestock
Tigray	3,119.4	3,005.5	1,388.1	7.4
Afar*	1,627.2	3,398.2	1,799.0	6.8
Amhara	11,757.3	5,468.6	9,469.7	26.4
Oromiya	21,375.7	7,678.4	9,391.1	38.1
Somali*	675.6	1,710.4	1,316.8	3.7
Benishangul Gumuz	363.6	371.5	85.3	0.8
SNNP	9,574.7	2,624.6	4,000.1	16.0
Gambella	212.6	54.6	48.1	0.3
Harari	40.8	41.2	5.0	0.1
Addis Ababa	89.5	19.1	21.8	0.1
Dire Dawa	49.8	154.7	59.6	0.3
Ethiopia	48,886.2	24,526.9	27,584.6	100.0

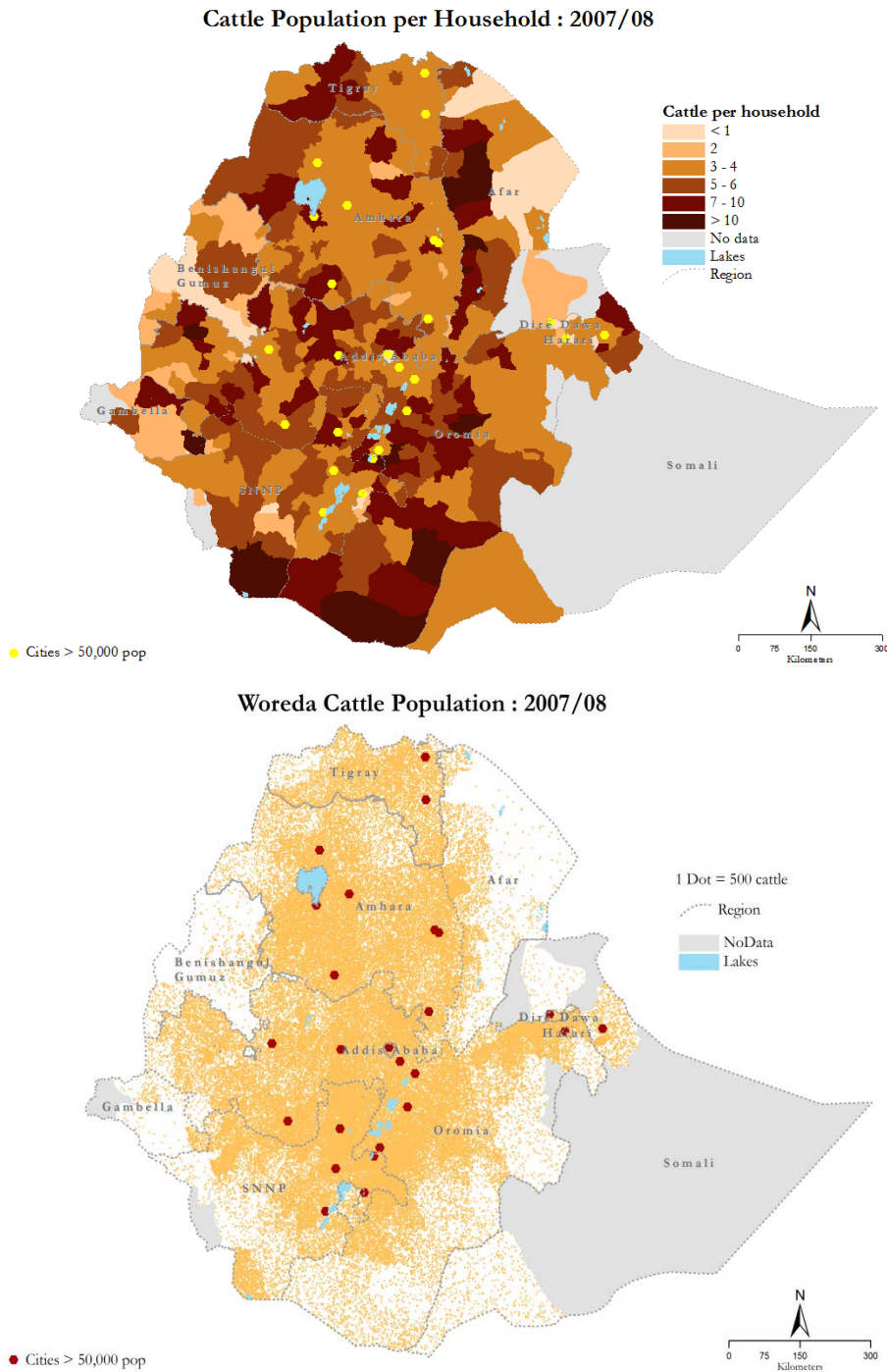
Source: Authors' calculations; Agricultural Sample Survey 2007/08, CSA

Notes: * The CSA annual surveys cover two of the five administrative zones (Zones 1 and 3) in Afar region and three of the nine administrative zones (Jijiga, Liben, and Shinile) in Somali region. SNNP = Southern Nations, Nationalities, and Peoples region

In 2007/08, 87 percent of Ethiopia's cattle were found in Oromiya, Amhara, and SNNP regions, with each region contributing 44, 24, and 20 percent respectively to total cattle population (Figure 3.2 and Appendix A). This trend is similar for previous years of livestock production, whereby Oromiya, Amhara, and SNNP regions combined produced 81 and 80 percent of total livestock in 2005/06 and 2006/07 respectively. While the highland regions are primary producers of cattle, livestock production is often a secondary activity in these areas, used primarily as draught labor as well as insurance against unreliable crop production (Gizaw et al. 2010). Although mixed crop production relies on cattle and oxen to prepare agricultural fields in the highlands, sheep and goat production seems to be growing faster in these areas. This may reflect livestock holders confronting constraints to keeping cattle related to denser human population and grazing land pressure in highly populated areas⁶. In addition, given the more flexible nature of grazing behavior of smaller ruminants, farmers keep sheep and goats for cash and for meat, and as a complement to more expensive cattle production (Tegegne et al. 2009).

⁶ Although the highlands of Ethiopia comprise 45 percent of the total land area, approximately 80 percent of the population lives in these areas (Degefe and Nega 2000). The pastoral areas of Ethiopia cover about 60 percent of the total area, yet only 12–15 percent of the total population lives in these areas (Halderman 2004).

Figure 3.2—Estimated cattle population: cattle population per household and woreda, 2007/08



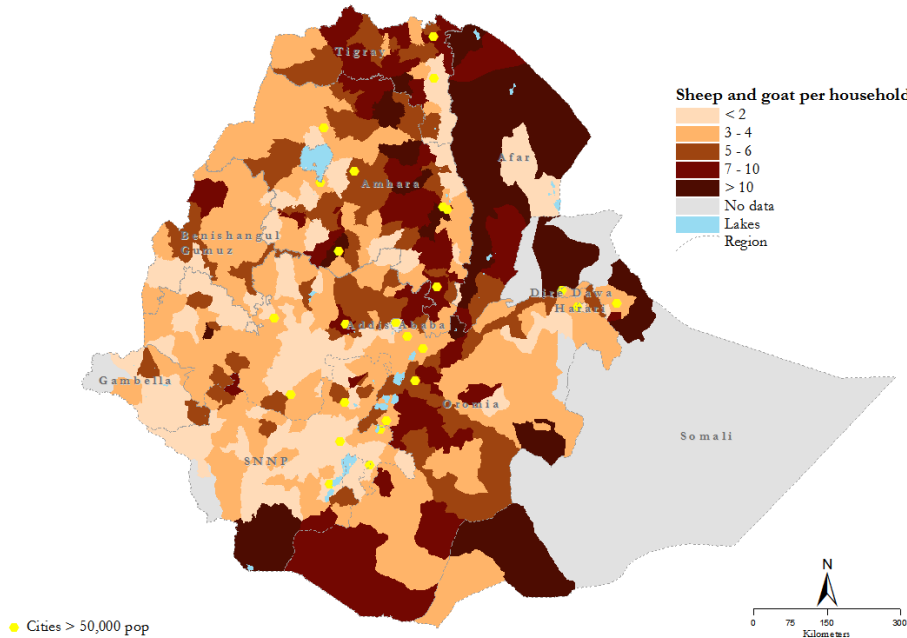
Source: Authors' calculations; CSA AgSS 2007/08, CSA Agricultural Census (2001/02)
 Note: Woreda level livestock numbers are estimated for 2007/08 using the Agricultural Census shares from 2001/02

Sheep and goat population is also highest in Oromiya, Amhara, and SNNP regions (33, 29, and 13 percent, respectively), although more drought prone regions such as Afar, Tigray, and Somali rely more heavily on sheep and goat production compared to cattle (10, 8, and 6 percent respectively in 2007/08). Between 2004/05 and 2007/08 both sheep and goat population doubled in sedentary areas of Somali region, while Tigray region increased sheep population from 814 thousand to almost 1.4 million head between 2005/06 and 2007/08 (Appendix A). This underscores the importance of smaller livestock production in drought

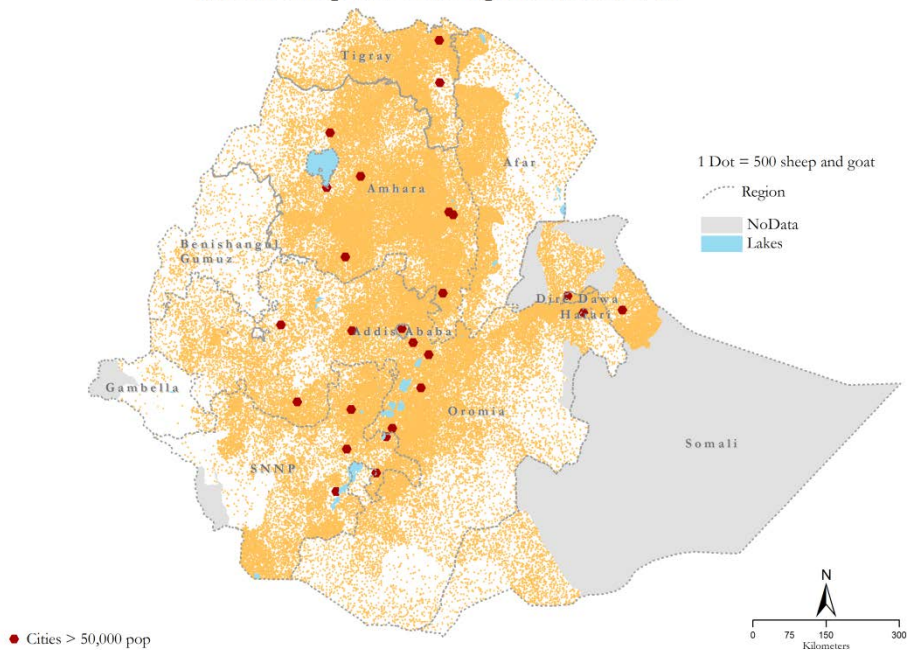
prone and pastoralist areas, that seek to insure against variable climatic conditions. Increases in sheep and goat production are predominant throughout the highlands, as well as in less accessible areas such as southern areas of Oromiya and SNNP region.⁷

Figure 3.3—Estimated sheep and goat population per household and woreda, 2007/08

Sheep and Goat Population per Household : 2007/08



Woreda Sheep and Goat Population : 2007/08



Source: Author's calculations; CSA AgSS 2007/08, CSA Agricultural Census (2001/02)

Note: Woreda level livestock numbers are estimated for 2007/08 using the Agricultural Census shares from 2001/02

A majority of Ethiopia's livestock production is focused in the highlands due to availability of crop residues for feed (Gizaw et al. 2010) and less risk of disease (Knips 2004). However, as these areas are densely populated, cattle per household ratio is low, which can especially

⁷ Population numbers and maps of years previous to 2007/08 can be found in Appendix A and B.

be seen in most parts of Amhara region (Figure 3.2). Whereas a higher cattle per household ratio is observed in less populated areas of southern SNNP and west Oromiya and Tigray regions, sheep and goats per household ratio is high in more densely populated areas of Amhara and pastoral areas of Afar (Figure 3.3). Devereux and Scoones (2008) argue that the livestock to human ratio is important for pastoralists in Somali and Afar regions because trade and remittances provide effective informal social protection against drought and other shocks.

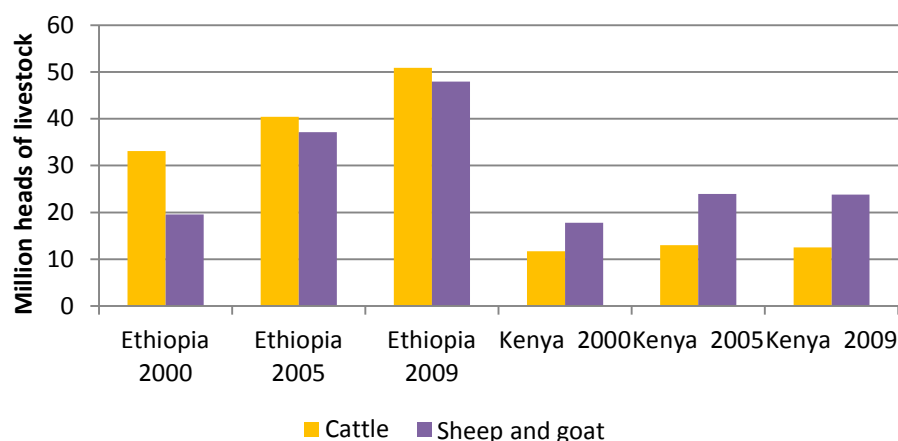
Data comparing herd composition suggest that sheep and goat production is increasing compared to cattle production. In 2001/02 a majority of regions produced more cattle than sheep and goats with the exception of Afar, Somali, and Dire Dawa, which produced more than three times the amount of sheep and goats compared to cattle (Table 3.2). By 2007/08, sheep and goat production dominated in Tigray and Amhara. Compared to other countries in eastern Africa, FAOSTAT (2000, 2005, 2009) data suggest a similar trend whereby in 2009 sheep and goat production increased relative to cattle in the 2000s in Kenya (from 1.52 to 1.90), and Ethiopia (from 0.59 to 0.94), although the difference in magnitudes of such are clear (Figure 3.4). Tegegne et al. (2009) and Moses (2006) suggest that browsing behavior of small ruminants and minimum feed (as compared to cattle) and water requirement induce greater sheep and goat production in the densely populated highlands as well as drought-prone pastoralist areas.

Table 3.2—Sheep and goat to cattle ratio in Ethiopia, 2001–2008

Region	Sheep and goat: Cattle 2001/02	Sheep and goat: Cattle 2005/06	Sheep and goat: Cattle 2006/07	Sheep and goat: Cattle 2007/08
Tigray	0.92	1.22	1.27	1.41
Afar	2.88	3.11	3.05	3.19
Amhara	0.87	1.23	1.28	1.27
Oromiya	0.49	0.74	0.76	0.80
Somali	2.27	2.41	2.90	4.48
Benishangul Gumuz	0.84	1.09	1.33	1.26
SNNP	0.66	0.68	0.78	0.69
Gambella	0.74	0.74	0.74	0.48
Harari	0.73	1.00	1.03	1.13
Addis Ababa	0.46	0.58	0.49	0.46
Dire Dawa	2.31	4.64	4.77	4.30
Ethiopia	0.80	0.99	1.04	1.07

Source: Authors' calculations; CSA: Agricultural Census (2001) and Agricultural Sample Survey (2005–2008)
Note: SNNP = Southern Nations, Nationalities, and Peoples region

Figure 3.4—Number of sheep and goats to cattle in Ethiopia and Kenya, 2000–2009



Source: Food and Agriculture Organization, FAOSTAT (2000, 2005, 2009)

4. Agro-pastoralist and pastoralist regions in Ethiopia

Given the limited data on agro-pastoralist and pastoralist regions in Ethiopia, it is difficult to discern production strategies and trends over time in major areas of Afar and Somali region. Some work has been done to understand production in these areas, although preliminary analysis suggests mixed results. The CSA implemented an aerial survey in 2003 to estimate livestock production in seven zones of Somali region (Somali region has a total of nine zones) that had previously not been surveyed due to inaccessibility.⁸ The 2002/03 aerial data reported similar cattle population data as the figures reported for all nine zones of Somali region from the Agricultural Census (Ethiopian Agricultural Sample Enumeration, EASE) data from 2001/02 (670 and 643 thousand cattle respectively). Aerial data on sheep and goat production for the same seven zones of Somali region (11.94 million), however, is about 8 times greater than reported figures from the Agricultural Census for Somali Region in 2001/02 (1.45 million).⁹ As a check on the consistency, we compared ratios of sheep and goat to cattle production for Somali region from the EASE and aerial data sets with data from the EASE for other geographically contiguous regions with similar agro-ecologies. We find that in the 2001/02 EASE data, the sheep and goat to cattle ratio in Dire Dawa, Afar, and Somali regions is 2.3, 2.9, and 2.3 respectively, while the aerial data suggest a 17:1 ratio (Appendix C). This suggests that the sheep and goat population may be substantially over-estimated in the aerial data.¹⁰

Given the likely overestimate reported in the aerial data, we estimate population figures for the nine administrative zones of Somali region using the figures from the Agricultural Sample Survey 2003/04 for Jijiga and Liben zones, and alternative adjusted estimates of sheep and goat population for the other administrative zones. In Table 4.1, estimate 1 uses the ratio of sheep and goat to cattle for Jijiga and Liben zone calculated from the 2003/04 AgSS (2.71, also similar to the ratio reported from the EASE), to estimate population in the other seven zones of Somali Region. Estimate 2 in Table 4.1 estimates production based on the sheep and goat to cattle ratio (2.27) calculated from the EASE 2001/02 for these seven zones. It is important to note that these are estimates based on limited and varying data. In Appendix D we also report production estimates in Somali region calculated by Behnke (2010).

Table 4.1—Somali region livestock population estimates (thousands)

Zone	Aerial Survey: 2003/04		Estimated 2003/04 livestock population based on EASE 2001/02 and Aerial Survey	
	Cattle	Sheep and goats	Sheep and goats (1) (Ratio AgSS 2.71)	Sheep and goats (2) (Ratio Somali 2.27)
Jijiga	289.9*	556.5*	556.5*	556.5*
Liben	55.9*	382.9*	382.9*	382.9*
Shinile	207.5	1,520.4	563.6	422.0
Afder	166.5	1,875.2	452.2	338.6
Degehabur	51.5	2,117.7	140.0	104.8
Fik	17.1	199.0	46.4	34.7
Gode	165.3	1,503.5	449.0	336.2
Korahe	26.3	1,053.7	71.4	53.5
Warder	36.1	3,666.7	98.2	73.5
Somali Region	1,016.1	11,936.3	2,760.3	2,302.8

Source: CSA Aerial Survey 2003/04; EASE 2001/02; Agricultural Sample Survey data for 2003/04

Notes: * Reported Agricultural Sample Survey data for 2002/03; Sheep and goats (1) estimates sheep and goat production based on the sheep and goat to cattle ratio calculated from Jijiga and Liben data reported from the AgSS; Sheep and goats (2) estimates sheep and goat production based on the sheep and goat to cattle ratio calculated from the EASE 2001/02 for Somali region.

⁸ Liben and Jijiga Zones were excluded, as they had been covered by conventional methods. These zones are reported in the above with the analysis of other regions.

⁹ It is important to note, however, that the data reported from the Agricultural Census as well as the Agricultural Sample Survey (AgSS) are for sedentary areas and cover only three of the nine administrative zones of the region (Jijiga, Liben, and Shinile), which may not accurately represent Somali region as a whole.

¹⁰ Other estimates include the Household Economy Analysis (HEA) results which suggest sheep and goat to cattle ratios of 10.8 in Somali region and 4.4 in Afar region (LIU 2008).

5. Livestock population and market access

In addition to evaluating livestock production in terms of agroecological zones (highland and lowland/pastoralist areas), this study seeks to better understand livestock production within the context of market access. We use a travel time model that calculates the travel time from any point within Ethiopia to major livestock markets, taking into account land cover and walking speed over specific terrain (grassland versus water bodies), slope (if one is walking or driving uphill, travel speed will be less), and transportation infrastructure defined by road maintenance and surface type.¹¹ Schmidt and Kedir (2009) methodology was followed to construct a 1km x 1km resolution friction grid which represents the time required to cross each pixel. Then the cumulative cost to move from any cell to the nearest livestock market is computed. We then merge these data with the livestock figures estimated at woreda level in order to assess production patterns and market proximity. The percentage of woreda livestock population within different travel time is calculated by assigning livestock numbers to the woreda center point.

Recent studies of livestock production and marketing suggest that road infrastructure is important to farmers seeking to sell and buy livestock. On the demand side, data suggest that rural area per capita annual meat consumption is 4.0 kg as compared to 11.5 kg in urban areas (HICES 2004/05). It has been argued that this is due in part to subsistence agriculture practices in the rural areas (in addition to wage differentials between the two areas), as well as poor marketing infrastructure for perishable products (lack of cold chains), and the natural bulk of livestock products which is largely indivisible¹² (Tafere and Worku 2012). At 18.4 kg, the rural annual consumption of dairy products overwhelms the meat consumption, which is only 4.0 kg. The picture is different in urban areas: per capita annual dairy product consumption is 8.5 kg and is less than the average meat consumption of 11.5 kg. The presence of better road infrastructure reportedly enables the highland areas to prevail as primary supplier of livestock for the domestic markets in Ethiopia (FEWS NET 2007). Although the presence of a road decreases travel time, transport costs remain an issue. Studies comparing trekking and trucking costs find mixed preferences depending on a variety of factors including distance to a market, vivacity of market (number of traders), and risk of raids while traveling. Trekking has high indirect costs, in terms of animal mortality and weight loss, trekker time, and environmental and social risk. Although the cost of trucking livestock has higher direct costs (fuel, maintenance, transport fees, etc.) compared to trekking in Ethiopia, research suggests that trucking is largely used to transport animals from the secondary to terminal markets, feedlots, and ports for export, whereas trekking is more common when transporting live animals from the producers to the primary and secondary markets (Dirbaba and Hurrissa 2009). Similarly, Gebremedhin et al. (2007) found that traders and producers prefer trucking fattened animals in order to avoid weight loss.

When evaluating livestock production in terms of market access, data suggest that cattle production is higher within 5 hours of a major livestock market. In 2007/08, more than 75 percent of cattle in the four major highland regions were within 5 hours travel time of a market (Figure 5.1 and 5.3). To illustrate the spatial distribution of high cattle producing woredas in relation to market access, two maps are overlaid: a map depicting travel time to the nearest livestock market and a map that indicates woredas that make up 30 percent of each region's cattle population. In doing so, woredas are ranked in descending order according to livestock populations; those that produce 30 percent of the cumulative regional cattle share are identified and mapped using cross-hatching to show high density population areas (Figure 5.1 and 5.3).

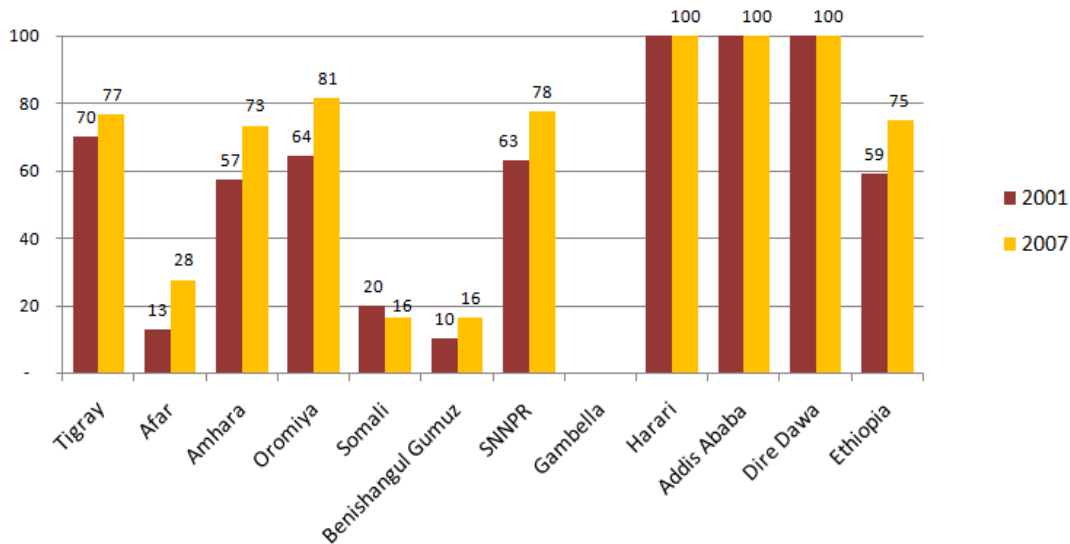
Sheep and goat production seem less dependent on market accessibility, yet a majority of these animals (at least 66 percent) in Oromiya, Amhara, Tigray, and SNNP are located

¹¹ See travel time methodology in Annex 1 of Schmidt and Kedir (2009).

¹² Exceptions are holidays, where traditional sharing of the meat of slaughtered animals eases restrictions imposed on the indivisibility of livestock.

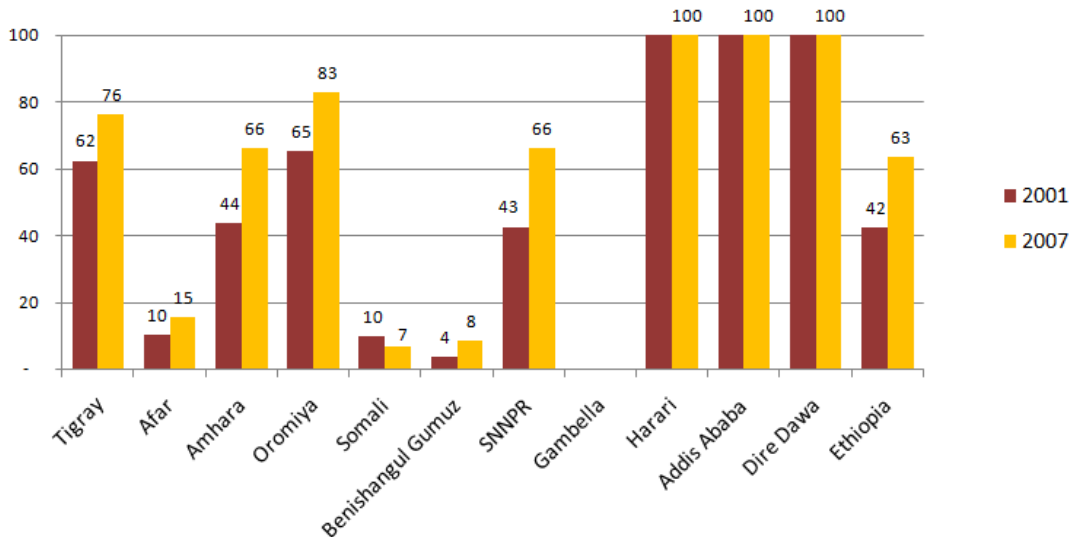
within 5 hours travel time to a market (Figure 5.2 and 5.3). Sheep and goat production within 5 hours travel time to a market increased more than 20 percentage points from 2001 to 2007 in Amhara and SNNP and more than 15 percentage points in Tigray and Oromiya. Overall, in the four major regions, cattle population within 3 hours travel time to a livestock market increased by more than 10 percentage points between 2001 and 2007 (Appendix E).

Figure 5.1—Percent of cattle located within 5 hours of a livestock market, 2001 and 2007



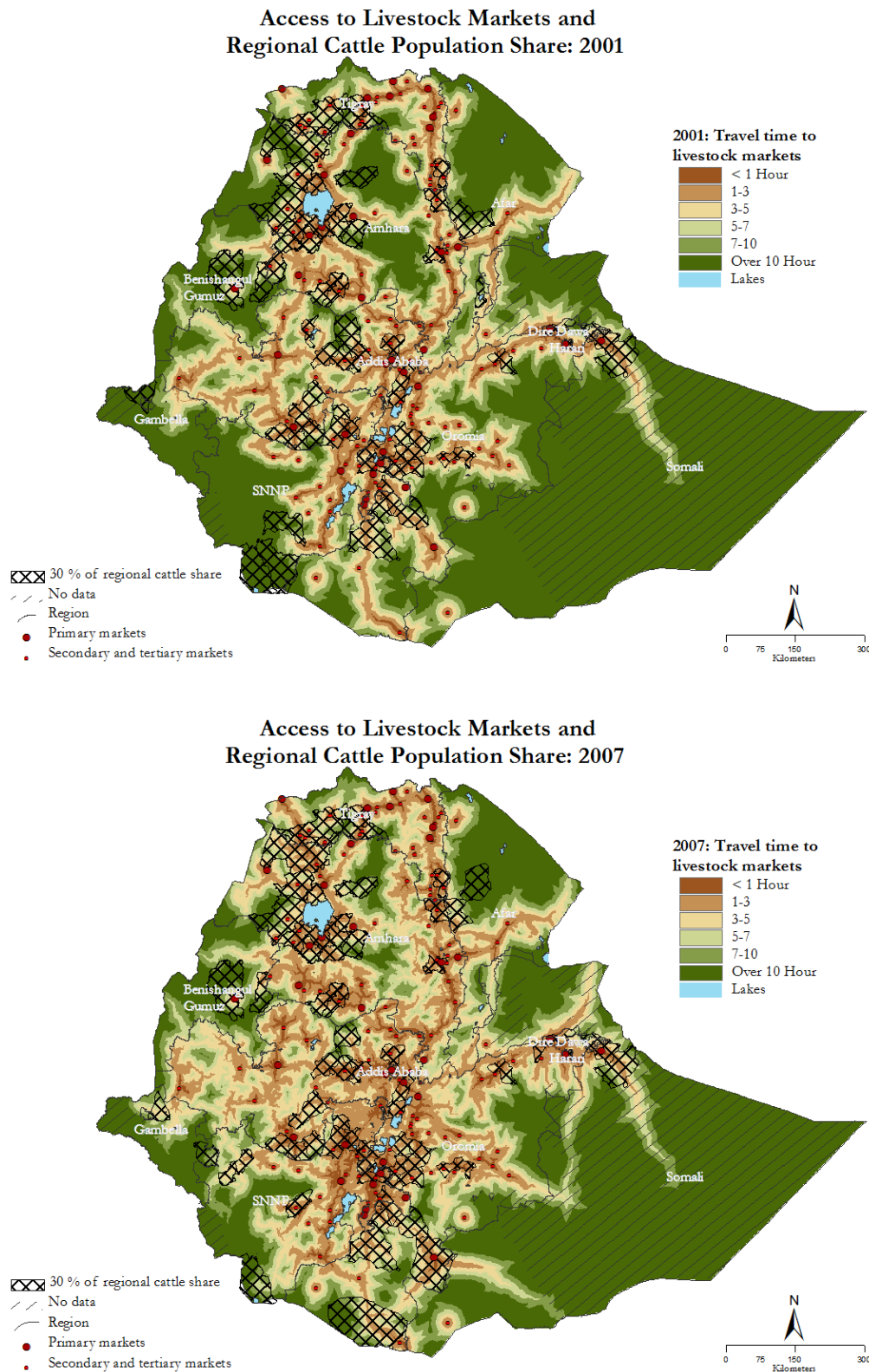
Source: Authors' calculation
 Note: SNNPR = Southern Nations, Nationalities, and Peoples region

Figure 5.2—Percent of sheep and goats located within 5 hours of a livestock market, 2001 and 2007



Source: Authors' calculation
 Note: SNNPR = Southern Nations, Nationalities, and Peoples region

Figure 5.3—Access to livestock markets and regional cattle share, 2001 and 2007



Source: Authors' calculation

Notes: Markets are classified according to Legese et al. (2008). Secondary and tertiary markets consist of 500–1000 head of livestock marketed per day primarily by producers and local assemblers. Primary markets carry over 1000 head per day by local assemblers to big traders to butchers.

6. Change in pressure on grazing land in Ethiopia

Livestock production has not only experienced significant changes in transportation infrastructure over time, but pressure on grazing land is also increasing due to greater population density, larger herd sizes, and relatively fixed grazing land resources. Given that commercial feed production and cultivation of feed has not been adopted in most areas of Ethiopia, natural pasture and crop residues are the major source of livestock feed (Bizuwerk et al. 2005; Desalew 2008; Teklu, Negesse, and Angassa 2010). However, the size of natural pastures is declining due to an annual average human population increase of 2.6 percent (Degefe and Nega 2000; CSA 2008b).

A comprehensive study of land cover has not been completed since the Woody Biomass Inventory and Strategic Planning Project (WBISPP) in 2000.¹³ More targeted analyses of specific areas have assessed grazing pressure, and suggest availability and quality of grazing lands have declined (Benin, Ehui, and Pender 2002). Similarly, Zeleke and Hurni (2001) attempted to analyze land cover change around Dembecha woreda in Amhara region and estimated a decline of forest, bush land, and grassland land cover from 80 percent in 1957 to 11 percent in 1995 (Zeleke and Hurni 2001). According to analyses conducted in Benishangul Gumuz region, clearing of land is a means of obtaining new farmland for 70 percent of farmers (Teklu, Negesse, and Angassa 2011).

In order to provide an approximate measure of livestock density per square kilometer of grazing land, we have paired the land cover data produced by the WBISPP in 2000 with the estimated woreda livestock production figures from 2001 through 2008. We consider grassland, shrub land, cultivated areas, and wood lands as potential grazing lands and assume a constant grazing area over time; we then estimate the change in grazing land pressure given the change in livestock population.¹⁴ We focus on cattle, goat, and sheep production in terms of tropical livestock units (TLU) to estimate density figures. Note that we have disregarded other livestock production (i.e. camel, donkey, chicken etc.).

Compared to other countries in East Africa, Ethiopia has the largest land area but the second densest livestock population after Uganda. Total land area in Ethiopia is approximately 1.1 million km², nearly two times as large as Somalia with 633,000 km² and almost 6 times larger than Uganda with 200,000 km² of total area (Table 6.1).

Table 6.1—Tropical livestock unit per km² of land in East Africa

Country	Cattle (thousands)	Sheep and goat (thousands)	TLU (thousands)	Total km ² (thousands)	TLU per km ²
Ethiopia	41,699	41,291	33,318	1,100	30
Djibouti	289	1,223	325	22	15
Eritrea	1,784	6,309	1,880	18	16
Kenya	10,183	20,743	9,202	546	17
Somalia	5,452	45,026	8,319	633	13
Uganda	11,518	8245	8,887	200	44

Source: Authors' calculations and Cecchi et al. (2010)

Note: TLU = Tropical Livestock Unit (Cattle = 0.7, Goat = 0.1, Sheep = 0.1; see Behnke and Osman (2012) for further detail)

¹³ The Food and Agriculture Organization (FAO) in collaboration with the Central Statistical Agency of Ethiopia (CSA) is currently analysing satellite data on land cover change.

¹⁴ Grazing pressure is defined as the number of livestock, in Tropical Livestock Units, per available grazing land.

When measuring TLU per square kilometer of grazing land as defined in this paper¹⁵, total grazing land in Ethiopia is equivalent to 722,128 km². Within Ethiopia, SNNP, and Amhara regions have the highest tropical livestock units per square kilometer of grazing land since 2001/02 (Table 6.2 and Figure 6.1).¹⁶ As seen in the market access maps above, the Lake Tana region of Amhara, and areas near Hoseana and Shasamene in SNNP region are high livestock producing areas that benefit from access to important trading and market centers with dense settlement patterns. These areas have experienced greater agglomeration economies during the last decade, which continue to bolster activity along important transportation corridors. According to Schmidt and Kedir (2009), urban population increased from 2.2 percent in 1997 to 21 percent in 2007 in SNNP region as new cities and improved roads developed in the northeast area of the region; Amhara's urban population nearly doubled from 3.7 to 7.5 percent over the same period.

Benishangul Gumuz and Gambella remain the regions with the lowest density of livestock, which may be due to a variety of reasons including higher livestock disease and death among cattle, sheep and goats (Figure 6.2). Although livestock death and disease is clearly an issue in Benishangul Gumuz, data suggest that veterinary care is absent in a large part of Ethiopia. CSA reports suggest that approximately 26 percent of cattle and 12 percent of sheep and goats were vaccinated during 2005–2009 (CSA 2006, 2007, 2008a). These reports also highlight that less than half of the sick cattle and 25 to 30 percent of sick sheep and goats were treated by a certified veterinarian. Given limited veterinary services, smallholder farmers that are remote from important livestock centers may be disinclined to make substantive investments in improved livestock breeds.

Table 6.2—Tropical livestock unit per km² of grazing land

Region	Total grazing land* (km ²)	Tropical Livestock Units per km ² grazing land (thousands)			
		2001/02	2005/06	2006/07	2007/08
Tigray	47,431	44	46	51	55
Afar	40,394	57	38	41	41
Amhara	138,085	60	60	63	70
Oromiya	282,026	48	50	54	59
Somali	49,553	12	11	13	16
Benishangul Gumuz	45,807	5	6	6	7
SNNP	97,975	69	63	67	75
Gambella	19,517	5	5	6	8
Harari	355	74	84	85	94
Addis Ababa	308	193	65	71	216
Dire Dawa	677	74	66	68	83
Ethiopia	722,128	74	73	77	87

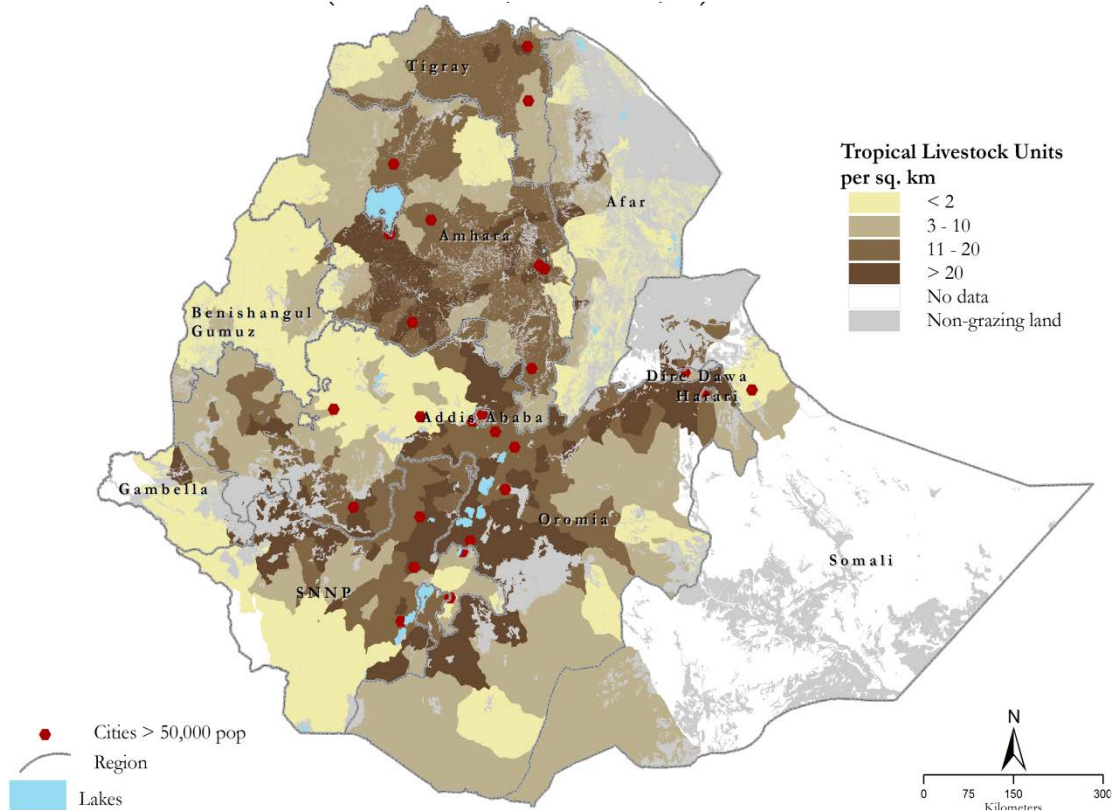
Source: Authors' calculations

Notes: SNNP = Southern Nations, Nationalities, and Peoples region; * Grazing land is defined as grassland, shrub land, cultivated areas, and wood land according to the WBISPP land cover dataset

¹⁵ We define grazing land using the WBISPP land cover data and assume grassland, shrub land, cultivated areas, and wood land comprise the major areas for grazing. This area is then summed and reclassified as grazing land for purposes of this study.

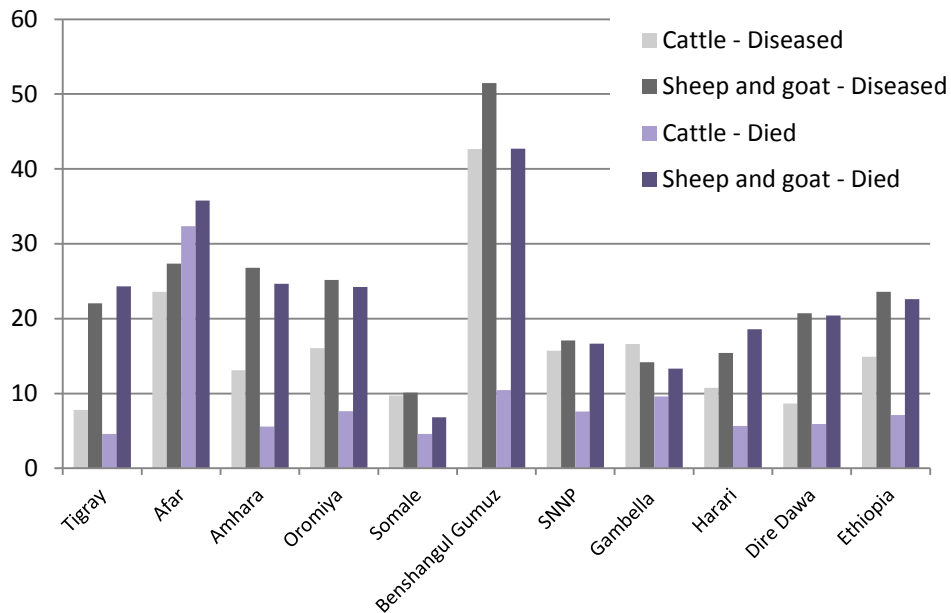
¹⁶ We exclude major urban areas (Addis Ababa, Dire Dawa, and Harari), as these are more centers for trade than production.

Figure 6.1—Change in pressure on grazing land between 2001/02 and 2007/08



Source: Authors' calculation

Figure 6.2—Estimated percent of livestock disease and death* in 2007/08



Source: CSA (2008a)

Notes: SNNP = Southern Nations, Nationalities, and Peoples region; *Death includes livestock that died from disease as well as livestock that died from other causes.

7. Conclusions

Ethiopia is the largest livestock producer in Africa, with Oromiya, Amhara, and SNNP regions producing 87 percent of Ethiopia's cattle and 75 percent of its sheep and goats in 2007/08. Data suggest that livestock production will continue to grow, with the highland regions producing the largest share of cattle, sheep, and goats. Recent analyses suggest that Ethiopia's steady economic growth and urbanization will continue to increase the demand for livestock as animal products become a major source of protein (Seré et al. 2008; Hall et al. 2004; Delgado et al. 1999). Negassa (2009) found that 90 percent of surveyed households expressed willingness to consume more livestock products if they had higher incomes. Currently, this hypothesized increase in demand of livestock products would need to be serviced by the main highland producing regions.

Data on herd composition suggest that sheep and goat population is increasing compared to cattle in most areas of Ethiopia. This is similar for other countries in East Africa such as Kenya. While cattle production is important in the highlands for mixed-crop activities, sheep and goat production continues to increase throughout the country. This increase may be due to grazing land constraints for cattle and the greater flexibility of grazing behavior of sheep and goats.

Market access is important. In 2007/08, more than 75 percent of cattle in the four major highland regions were located within 5 hours travel time of a livestock market. Compared to cattle production, sheep and goat production may be less dependent on market accessibility. Nonetheless, a majority of sheep and goats (more than 66 percent) in Oromiya, Amhara, Tigray, and SNNP were found within 5 hours travel time to a market. Market access continues to improve, and certain regions have experienced major improvements in travel time to markets due to improved road infrastructure. In 2001/02, 57 percent of cattle population in Amhara region was located within 5 hours to a livestock market. This figure reached 73 percent in 2007/08. Similarly, from 2001/02 to 2007/08, the percentage of cattle located within 5 hours of market grew from 64 to 81 and from 63 to 78 in Oromiya and SNNP, respectively.

Finally, pressure on grazing land is also increasing due to greater human population density, larger herd sizes, and relatively fixed grazing land resources. Of East African countries, Ethiopia has the largest land area and the second highest livestock density (in terms of cattle and sheep and goats). Further research on land cover change and livestock growth in the highlands is necessary in order to understand pasture land and environmental viability in coming years. In addition, greater data collection in agro-pastoralist and pastoralist areas will be vital in assessing the livestock sector and its potential for greater growth and future marketability.

Appendix

Appendix A: Livestock production 2005–2008

Table A.1—Regional livestock population, 2005/06 (thousands)

Region	Cattle	Goat	Sheep	Region share
Tigray	2,646.2	2,412.6	814.5	7.1
Afar	1,499.4	3,109.4	1,550.8	7.4
Amhara	10,090.3	4,866.2	7,530.9	27.1
Oromiya	18,252.3	5,415.7	8,056.7	38.2
Somali	562.0	722.0	631.6	2.3
Benishangul Gumuz	350.4	314.3	69.0	0.9
SNNP	8,059.6	2,061.1	3,404.6	16.3
Gambella	136.3	53.0	47.2	0.3
Harari	37.4	32.8	4.5	0.1
Addis Ababa	26.3	4.1	11.1	0.0
Dire Dawa	38.4	124.1	54.2	0.3
Ethiopia	41,698.6	19,115.4	22,175.1	100.0

Source: Authors' calculations; Agricultural Sample Survey 2005/06, CSA

Notes: Data for Somali and Afar regions are limited to accessible, sedentary areas; SNNP = Southern Nations, Nationalities, and Peoples region

Table A.2—Regional livestock population, 2006/07 (thousands)

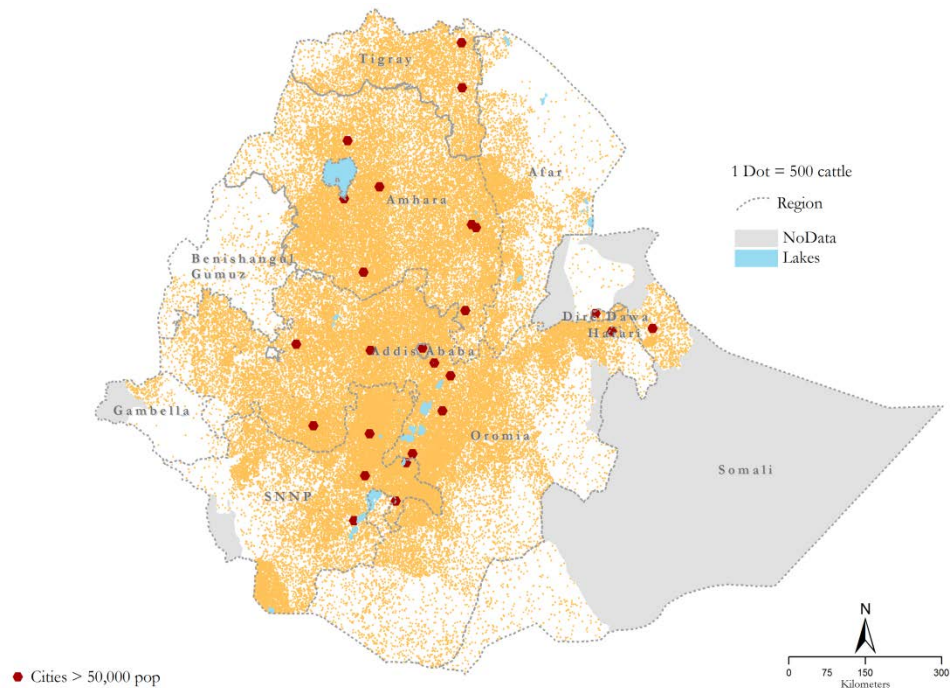
Region	Cattle	Goat	Sheep	Region share
Tigray	2,952.2	2,771.3	973.5	7.4
Afar	1,652.1	3,372.5	1,667.3	7.4
Amhara	10,497.6	5,152.8	8,237.1	26.3
Oromiya	19,648.9	5,800.8	9,203.1	38.1
Somali	659.1	1,123.4	786.1	2.8
Benishangul Gumuz	322.7	339.5	89.1	0.8
SNNP	8,476.0	2,550.0	4,031.7	16.6
Gambella	138.8	54.0	48.1	0.3
Harari	37.5	34.4	4.3	0.1
Addis Ababa	29.2	3.7	10.7	0.0
Dire Dawa	39.0	137.3	48.7	0.2
Ethiopia	44,453.1	21,339.7	25,099.7	100.0

Source: Authors' calculations; Agricultural Sample Survey 2006/07, CSA

Notes: Data for Somali and Afar regions are limited to accessible, sedentary areas; SNNP = Southern Nations, Nationalities, and Peoples region

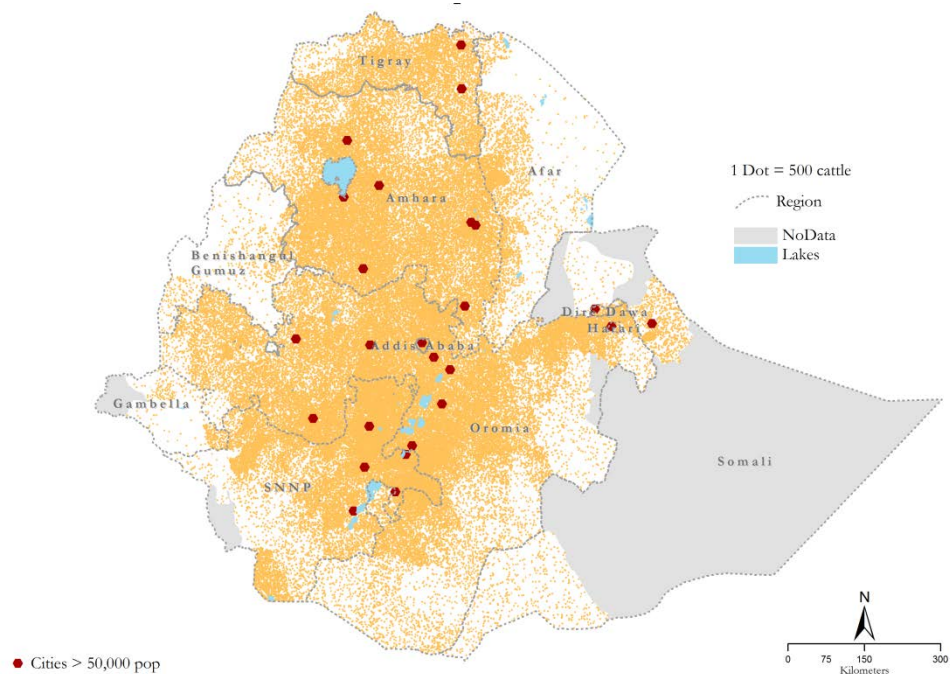
Appendix B: Estimated livestock population by woreda¹⁷

Figure B.1—Estimated cattle population per woreda, 2001/02



Source: Authors' calculation, EASE 2001/02, CSA

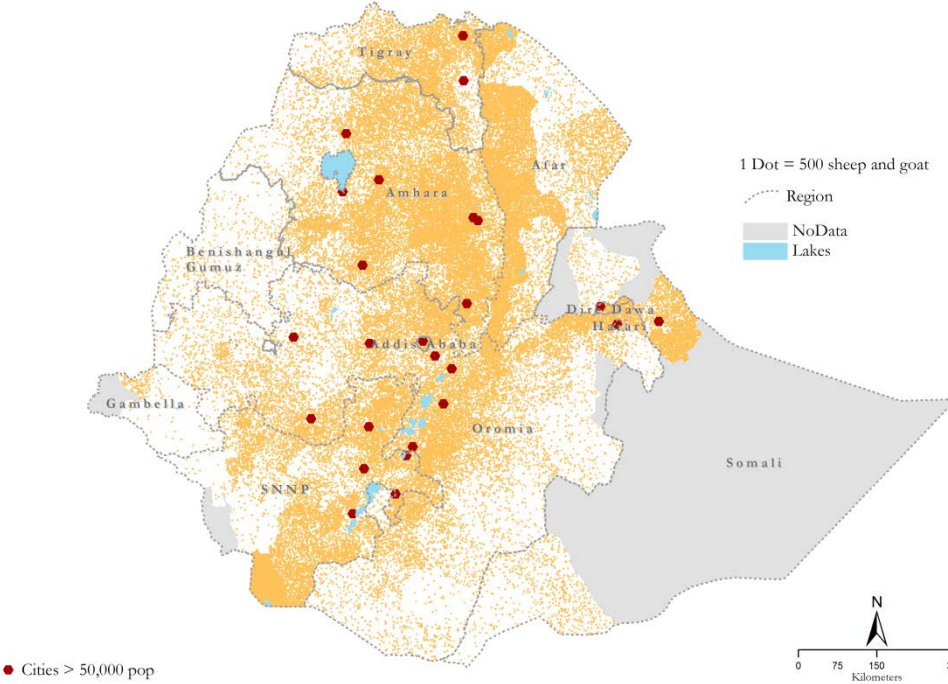
Figure B.2—Estimated cattle population per woreda, 2007/08



Source: Authors' calculation, Agricultural Sample Survey 2006/07, CSA

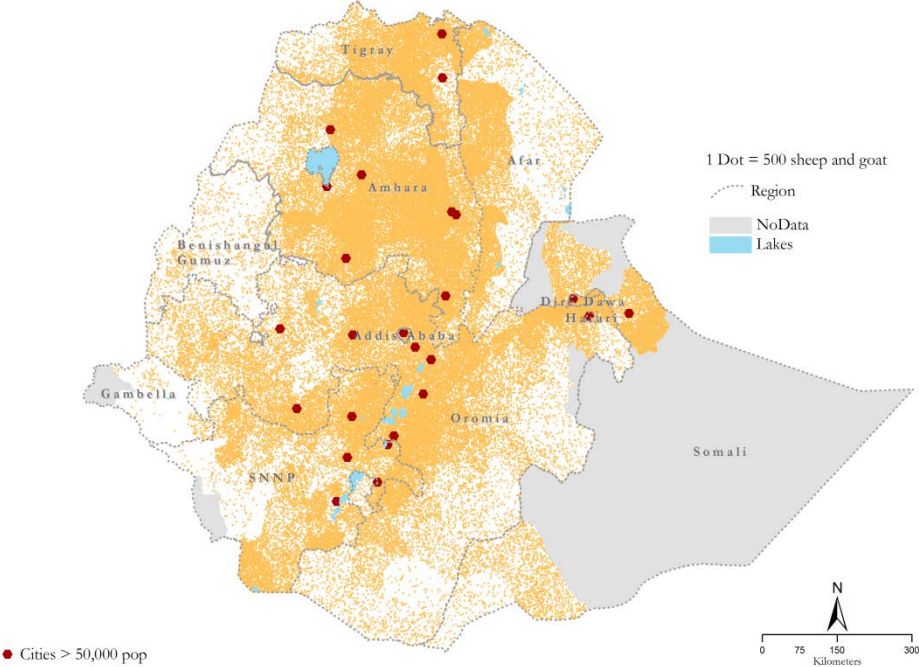
¹⁷ Woreda level numbers are estimated for 2007/08 using the Agricultural Census shares from 2001/02

Figure B.3—Estimated sheep and goat population per woreda, 2001/02



Source: Authors' calculation, EASE 2001/02, CSA

Figure B.4—Estimated sheep and goat population per woreda, 2007/08



Source: Authors' calculation, Agricultural Sample Survey 2007/08, CSA

Appendix C: EASE census livestock count

Table C.1—EASE census livestock count, 2001/02 (thousands)

Region	Cattle	Goat	Sheep	Sheep and goat	Sheep and goat : Cattle
Tigray	2,665.1	1,759.1	686.7	2,445.8	0.92
Afar	2,336.5	4,268.0	2,463.6	6,731.6	2.88
Amhara	10,487.3	3,814.2	5,305.0	9,119.2	0.87
Oromiya	18,035.7	4,175.0	4,685.8	8,860.7	0.49
Somali	642.9	752.1	704.9	1,457.1	2.27
Benishangul Gumuz	309.5	200.5	58.8	259.2	0.84
SNNP	8,831.5	2,651.1	3,169.8	5,820.9	0.66
Gambella	126.2	49.1	43.7	92.8	0.74
Harari	34.0	19.1	5.8	24.9	0.73
Addis Ababa	79.9	17.1	19.5	36.6	0.46
Dire Dawa	54.2	91.0	34.0	125.0	2.31
Ethiopia	43,606.1	17,796.3	17,177.6	34,973.8	0.80

Source: CSA 2002

Note: SNNP = Southern Nations, Nationalities, and Peoples region

Appendix D: Estimated livestock population in Somali Regional State

Table D.1—Estimated livestock populations in Somali Regional State, 2009

	Cattle	Sheep	Goats	Camels
Afder	166,471	1,152,509	722,709	140,454
Degehabur	51,536	1,395,779	721,925	131,106
Fik	17,072	57,561	141,475	25,605
Gode	165,277	517,668	985,869	115,498
Korahe	26,301	362,778	690,891	149,971
Shinile	207,472	670,956	849,451	103,052
Warder	36,146	2,253,550	1,413,143	376,183
Jijiga (2009) CSA*	372,940	852,393	603,098	76,952
Liben (2009) CSA*	228,765	182,100	487,776	149,873
Regional estimated total	1,271,980	7,445,294	6,616,337	1,268,694

Source: Behnke 2010, * CSA AgSS figures 2009

Appendix E: Travel time of livestock production to markets

Table E.1—Travel time of cattle production to livestock markets, 2001/02 (percent)

Region	< 1 hour	1 - 3	3 - 5	5 - 10	>10 hours
Tigray	-	23.13	47.04	29.35	0.48
Afar	-	-	12.95	72.76	14.28
Amhara	-	24.66	32.77	26.27	16.3
Oromiya	1.18	28.93	34.26	31.31	4.32
Somali	-	0.6	19.25	54.89	25.26
Benishangul Gumuz	-	-	10.27	62.55	27.18
SNNP	2.46	33.29	27.29	13.36	23.6
Gambella	-	-	-	23.01	76.99
Harari	-	100	-	-	-
Addis Ababa	7.59	92.41	-	-	-
Dire Dawa	-	-	100	-	-
Ethiopia	1.00	26.31	31.63	28.99	12.07

Source: Authors' calculation

Note: SNNP = Southern Nations, Nationalities, and Peoples region

Table E.2—Travel time of sheep and goat production to livestock markets, 2001/02 (percent)

Region	< 1 hour	1 - 3	3 - 5	5 - 10	>10 hours
Tigray	-	16.57	45.79	36.69	0.96
Afar	-	-	10.04	66.34	23.62
Amhara	-	15.03	28.47	29.83	26.67
Oromiya	1.02	32.05	32.09	29.82	5.02
Somali	-	0.34	9.29	62.18	28.2
Benishangul Gumuz	-	-	3.51	49.5	46.99
SNNP	0.87	25.27	16.43	14.88	42.55
Gambella	-	-	-	15.62	84.38
Harari	-	100	-	-	-
Addis Ababa	10.08	89.92	-	-	-
Dire Dawa	-	-	100	-	-
Ethiopia	0.41	17.58	24.19	36.14	21.67

Source: Authors' calculation

Note: SNNP = Southern Nations, Nationalities, and Peoples region

Table E.3—Travel time of cattle production to livestock markets, 2007/08 (percent)

Region	< 1 hour	1 - 3	3 - 5	5 - 10	>10 hours
Tigray	-	38.28	38.44	22.8	0.48
Afar	-	-	27.53	53.55	18.92
Amhara	-	35.3	38.04	26.27	0.39
Oromiya	1.17	43.1	37.17	17.06	1.5
Somali	-	0.49	15.73	58.41	25.36
Benishangul Gumuz	-	-	16.22	57.66	26.12
SNNP	8.37	49.98	19.37	16.18	6.09
Gambella	-	-	-	40.7	59.3
Harari	-	100	-	-	-
Addis Ababa	46.55	53.45	-	-	-
Dire Dawa	-	100	-	-	-
Ethiopia	2.24	39.76	33.00	21.60	3.41

Source: Authors' calculation

Note: SNNP = Southern Nations, Nationalities, and Peoples region

Table E.4—Travel time of sheep and goat production to livestock markets, 2007/08 (percent)

Region	< 1 hour	1 - 3	3 - 5	5 - 10	>10 hours
Tigray	-	36.36	39.88	22.88	0.88
Afar	-	-	15.39	55.67	28.94
Amhara	-	28.68	37.6	32.33	1.39
Oromiya	1.19	45.19	36.36	15.42	1.84
Somali	-	0.23	6.35	68.85	24.57
Benishangul Gumuz	-	-	8.46	53.57	37.97
SNNP	5.68	44.57	15.8	22.52	11.43
Gambella	-	-	-	41.54	58.46
Harari	-	100	-	-	-
Addis Ababa	55.32	44.68	-	-	-
Dire Dawa	-	100	-	-	-
Ethiopia	1.16	32.30	30.04	29.21	7.29

Source: Authors' calculation

Note: SNNP = Southern Nations, Nationalities, and Peoples region

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