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A Spatial Assessment of Livestock Production and Market Access

Summary of ESSP Working Paper 44, "Spatial Analysis of Livestock Production Patterns in Ethiopia"

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This study links smallholder livestock production data from the Agricultural Census (2001/02) and annual CSA agricultural sample survey with Geographic Information Systems (GIS) data on land cover, city population, and road networks in order to assess the relationship between livestock population, market access, and grazing land. We use existing studies of travel time to calculate shares of livestock populations within defined travel time thresholds of major markets. In addition, we attempt to provide greater insight into changes in available grazing land given Ethiopia's increasing human and livestock population pressure.

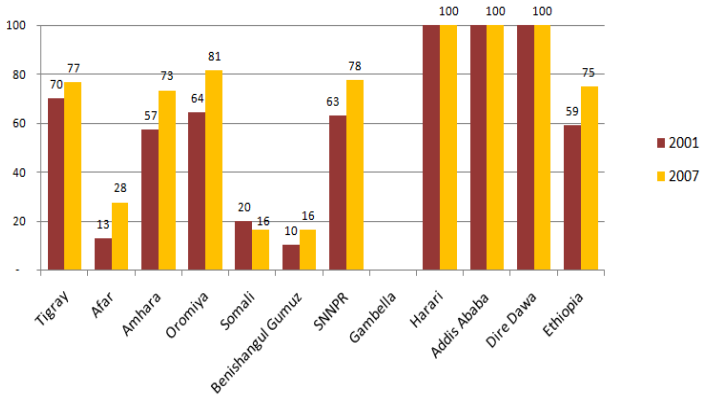
The livestock sector is a large contributor to the Ethiopian economy as well as a mainstay in the livelihoods of many Ethiopians. Livestock production and markets vary substantially across space in Ethiopia for a variety of reasons, including topographical variation, market access, water availability, and population characteristics. This study links smallholder livestock production data from the Agricultural Census (2001/02) and the annual CSA agricultural sample survey with Geographic Information Systems (GIS) data on land cover, city population, and road networks in order to assess the relationship between livestock population, market access, and grazing land. We use 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 livestock markets. In addition, we attempt to provide greater insight into changes in available grazing land given Ethiopia's increasing human and livestock population pressure.

Livestock production and market access

When evaluating livestock production in terms of market access, analysis suggests that cattle production is greater within 5 hours of a major livestock market. In 2007/08, more than 75 percent of cattle production in the four major highland regions occurred within 5 hours travel time of a market. 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 within 5 hours travel time to a market.

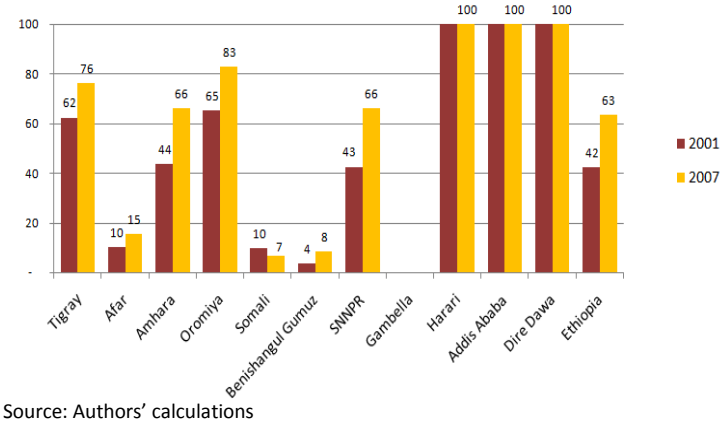
Improvements in road infrastructure between 2001 and 2007 resulted in many more sheep and goat producers being located within 5 hours travel time to a market. Sheep and goat production within 5 hours travel time to a market increased more than 20 percentage points from 2001 to 2007 in Amhara and SNNP and more than 15 percentage points in Tigray and Oromiya. Improved transportation networks increased by more than 10 percentage points the proportion of the cattle population in the four major regions being within 3 hours travel time to the nearest market (Figure 1 and 2).

Figure 1—Percent of cattle located within 5 hours of a livestock market, 2001 and 2007



Source: Authors' calculations

Figure 2—Percent of sheep and goats located within 5 hours of a livestock market, 2001 and 2007



Source: Authors' calculations

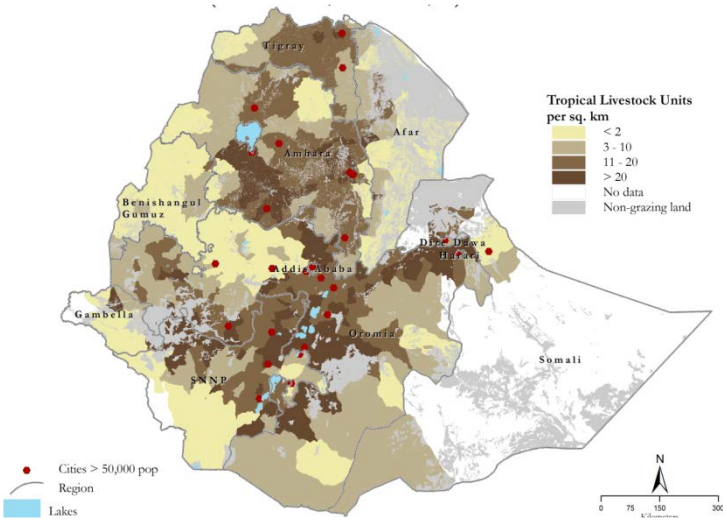
Change in pressure on grazing land in Ethiopia

Livestock production has benefitted from the 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. In order to provide an approximate measure of livestock density per square kilometer of grazing land, we paired the land cover data produced by the Woody Biomass Inventory and Strategic Planning Project (WBISP) in 2000 with the

estimated woreda livestock production figures from 2000 through 2007. We consider grasslands, shrub lands, cultivated areas, and wood lands as potential grazing lands. We then estimate the change in grazing land pressure in relation with change in number of cattle, goat, and sheep population over the study period. Grazing pressure is defined as the number of livestock, in tropical livestock units, per square kilometer of available grazing land. It is important to note that grazing land, as defined above, remains constant over the study period due to lack of recent data on land cover (however, CSA in collaboration with FAO is currently producing a more recent land cover dataset that should be available in the future). More targeted analyses of specific areas in the country have assessed grazing pressure and suggest that the availability and quality of grazing lands have declined since 2000 (Benin et al. 2002).

We find that Amhara, Oromiya and Tigray experience 17, 23, and 25 percent greater pressure between the years 2000/01–2007/08 respectively, ranging from 55 to 70 tropical livestock units (TLU) per square kilometer. In the central highlands of Ethiopia where there are both high human and livestock populations, larger pressure on grazing land is observed (Figure 3). Similar patterns can also be recognized in a substantial part of northern SNNPR and the eastern part of Oromiya bordering Somali region.

Figure 3—Increase in pressure on grazing land between 2001/02 and 2007/08



Source: Authors' calculations

When comparing to other countries in East Africa, Ethiopia has the largest land area (1.1 million square kilometers), and the second highest livestock density with 30 TLU's per square kilometer (in terms of cattle, sheep, and goats). In comparison, Uganda possesses 200,000 square kilometers of land area, and has on average 44 TLUs per square kilometer (Table 1).

Table 1—Tropical Livestock Units in East Africa

Country	Cattle (thousands)	Sheep & Goats (thousands)	TLU (thousands)	Total land (km^2) (thousands)	TLU/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	118	16
Kenya	10,183	20,743	9,202	546	17
Somalia	5,452	45,026	8,319	633	13
Uganda	11,518	8,245	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)

This analysis suggests that further research on land cover change and livestock growth in the highlands is necessary in order to understand pasture land dynamics and environmental viability in coming years.

Conclusion

Improvements in road infrastructure have facilitated access to livestock markets throughout Ethiopia. A majority of cattle production in the highlands—comprising 87 percent of total cattle production—occurs within 5 hours of a livestock market. Sheep and goat production is also highest in the highlands, although more remote and drought prone regions such as Afar and Somali rely more heavily on sheep and goat production compared to cattle (10 and 6 percent, respectively, in 2007/08).

Data suggests that grazing pressure in Ethiopia is also increasing. Among the East African countries, Ethiopia has the largest land area and the second highest livestock density (in terms of cattle and sheep and goats). Previous research suggests that livestock pressure may reach a threshold whereby land degradation risks decreasing both the quality and the quantity of production. As more recent land cover data become available, it will be important to measure change over time to understand grazing pressure in terms of economic and agricultural activity and plan accordingly to ensure sustainable livestock growth and production.

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