Global Livestock CRSP

Are Cattle Die-Offs Predictable on the Borana Plateau?

D. Layne Coppock, Getachew Gebru, and Solomon Desta, Utah State University; Sintayehu Mesele, OARI; Seyoum Tezerra, PARIMA Project
Pastoral Risk Management Project

Research Brief O8-O2-PARIMA December 2OO8

Drought regularly affects rangelands and contributes to high death rates for livestock and poverty for pastoralists. But do livestock losses occur randomly simply when rainfall is low, or are they cyclical and predictable? Previously, PARIMA researchers proposed that high stocking rates—combined with low rainfall—trigger livestock die-offs on the Borana Plateau. It takes about six years for animal numbers to recover, setting the stage for another die-off when a dry year occurs. This "boom-and-bust" cycle is based on observed herd crashes in 1983-5, 1991-3, and 1998-9. Researchers predicted in 2002 that the next major die-off would occur during 2004-06, and one goal of this brief is to report on recent observations. Team members also examined ecological change in relation to livestock patterns. Results confirm that a major crash occurred during 2005, verifying the prediction. The rangelands have been degraded by decades of heavy livestock grazing, resulting in bush encroachment and top-soil erosion. Will the next livestock crash occur "on schedule" around 2011? Probably not—it is expected sooner. Researchers speculate that the production system is rapidly changing, a view shared by local pastoralists. Livestock carrying capacity is reportedly declining and animal die-offs may become more frequent and irregular.

Background

Drought routinely affects pastoral areas. Ellis and Swift (1988), after working in arid Turkana District, Kenya, proposed that some East African pastoral systems have vegetation and livestock populations that are largely controlled by rainfall. If rainfall is high, livestock and vegetation are more productive. If rainfall is low, livestock may die of starvation and vegetation is unproductive. This implies that livestock numbers in such systems change mostly in response to annual rainfall variation and are unpredictable. Because such systems are rainfall controlled, livestock only have a minor role in affecting the composition and productivity of vegetation and condition of soils.

For the semi-arid Borana Plateau, however, PARIMA researchers proposed an alternative to that of Ellis and Swift. Desta and Coppock (2002) noted that livestock crashes in Borana appeared predictable due to interactions between livestock population density and forage resources. When stocking rates exceed a threshold size (over 30 head of cattle per square kilometer, for example), a major die-off becomes more likely when the annual rainfall happens to be low (for example, less than 400 millimeters per year). Previous crashes, when over 40 percent of cattle died, have been documented on the Borana Plateau in 1983-5, 1991-3, and 1998-9. This remarkable pattern led team members to think that the time between crashes was related to the time needed for herds to recover their numbers following drought to once again become vulnerable to a sudden lack of forage during a dry year. Desta and Coppock (2002) thus predicted that the next cattle crash in Borana after 1999 would occur during 2004-06. Researchers had also made observations of plants and soils in the region and speculated that overgrazing by livestock was exerting major negative effects on rangeland productivity.

The first objective of the work reported here was to verify the herd crash prediction. A second objective was to determine whether long-term soil and land-cover changes have occurred on the Borana Plateau. A third objective was to determine how the pastoralists view the livestock population and other ecological patterns in the rangelands. If the herd crash was confirmed, ecological degradation demonstrated, and pastoralists shared PARIMA researchers' view of what was happening, then researchers felt they would have a solid example of a rangeland ecosystem controlled by livestock in combination with rainfall, and quite unlike the situation proposed by Ellis and Swift (1988.)

Unlike previous work (Desta and Coppock, 2002), the researchers were no longer able to maintain a network of enumerators to provide cattle herd data after 2003. The team thus tracked regional herd dynamics from 2003 to 2007 via their own casual observations as well as by reviewing independent reports generated by governmental and non-governmental organizations. To examine the long-term pattern of herd crashes in relation to rainfall, The authors obtained annual rainfall data for four representative sites on the central plateau (Yabelo, Arero, Negele, and Mega) for 27 years (1980 to 2007). These data came from the Ethiopian Meteorological Organization (EMO) and the Southern Rangelands Development Unit (SORDU). The researchers compared and contrasted annual rainfall patterns with the occurrence of livestock crashes on a qualitative (presence/absence) basis. The assessment of rangeland soils and land cover was conducted for the 400-km^2 Yabelo District by Mesele (2006) for four land types: (1) grassland; (2) bushed grassland; (3) bushland; and (4) cropland. Soil sampling was stratified with three samples per site type taken to a depth of 20 cm. Samples were analyzed for standard physical and chemical properties. Land cover change was quantified using LandSat images for 1973, 1986, and 2003. Pastoralists' perceptions about livestock production trends and ecosystem change were assessed in 2008 using five focus groups with 10 members each from several districts across the study area. Male elders dominated these recruits, but women and people from all wealth classes participated. The Focus Group Discussions (FGD) centered on seven questions. Discussions averaged 2.5 hours in length.

> **"Today many of us could not afford to purchase grain because of the ever-increasing price of grain and on the other hand, the ever-declining price of livestock other than mature male cattle, which only the very few wealthy can own. The other livestock species and age classes are getting cheaper in the market. Also, emaciated animals cannot reach the market. Most of us are forced to sell at low prices and procure grain to survive at the expense of few productive animals."**

Findings

Figure 1 illustrates the pattern of annual rainfall and livestock crashes over the past 27 years. Indeed, a major crash occurred in 2005 with 40-60% of livestock reportedly dying, consistent with the prediction (Gebru, 2007.) For the seven years when a herd crash occurred, the mean (±SE) for annual rainfall was 511±51 mm, while that for the other 20 years was 710±38 mm. The net rainfall decline in the crash years was 22% below the long-term mean of 660 mm. While the crashes tended to occur in drier years, not all of the drier years had crashes (Figure 1.) When the livestock population is recovering from a crash, it is very unlikely that another die–off will occur despite annual rainfall that is often comparable to that of years when crashes occur. PARIMA researchers interpret this as indirect evidence of the interaction between the density of the cattle population and annual rainfall.

Percent change in land cover for Yabelo District is shown in Table 1. The area covered by grassland declined by about 149 km^2 over 30 years, while that for bushland, bushed grasslands, and croplands (maize) increased. The district has been transformed by heavy livestock use from a grass-dominated system—useful for grazing livestock like cattle—to a system dominated by shrubs and trees. Soil texture data (not illustrated) indicated that the topsoil of bushed and bushed-grassland sites were sandier than those of the grasslands or croplands. Bushed sites had significantly higher values (P<0.05) for soil bulk density and soil compaction.

Table 2 illustrates chemical properties of the soils. Of particular note is the decline in organic matter (OM) in the topsoil of bushlands and bushed-grasslands relative to that of other sites. Croplands exhibited higher values for soil phosphorus (P) and OM that reflect their landscape position in drainages. Croplands are former dry-season grazing sites that have deep soils and residual soil characteristics of

Figure 1. Average annual rainfall across four meteorological stations on the north-central Borana Plateau, 1980-2007. Black bars denote years when a cattle crash occurred.

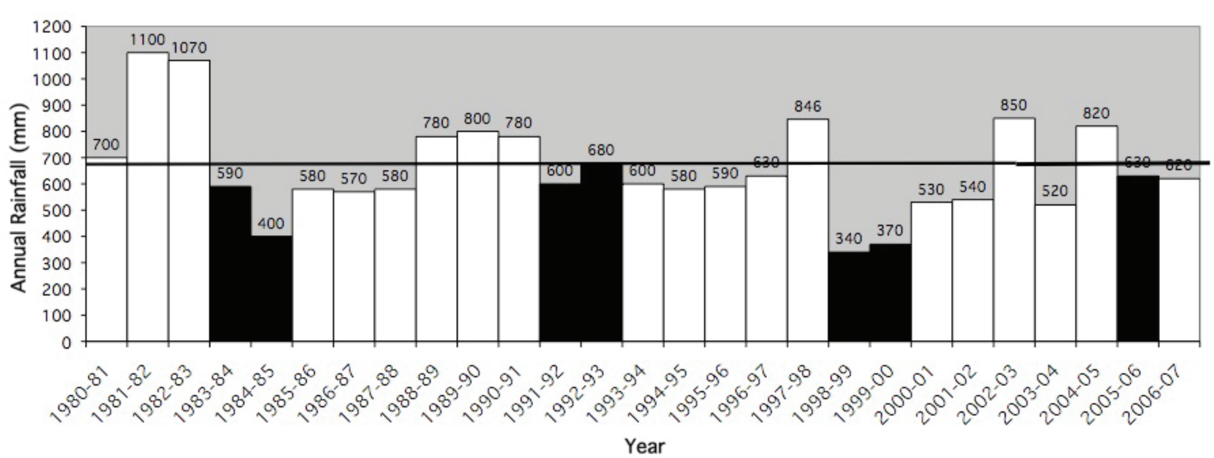

Table 1. Percent change in land cover for Yabelo District between 1973 and 2003 as interpreted from LandSat images. Source: Mesele (2006).

Land cover class	Area in 1973		Percent change in Land Cover		
	km^2	%	1973-1986	1986-2003	1973-2003
Bushlands	80	20.0	+25.0	+15.0	+43.8
Bushed- grasslands	134	33.5	+20.1	+23.0	+47.8
Grasslands	173	43.3	-38.7	-77.4	-86.1
Croplands	13	3.3	+153.8	+84.8	+384.6

Table 2. Mean values of soil chemical properties as affected by land cover. Means within columns followed by same letters are not significantly different at p=0.05. EC=Electrical conductivity; OM=Organic Matter; AvP=Available P (Olsen); ppm=parts per million; LSD=Least significant difference; SEM=Standard Error. Source: Mesele (2006).

Land use type*	pH (H2O)	EC (dS m-1)	OM (%)	AvP (ppm)
Grasslands	6.40ab	0.07a	3.44c	0.78
Bushed- grasslands	6.40ab	0.08a	2.16b	2.37
Bushlands	5.70a	0.08a	1.36a	0.66
Croplands	7.00b	0.17b	2.85bc	13.85
LSD (0.05)	1.13	0.08	0.79	16.40
SEM (±)	0.46	0.03	0.32	6.70

productive, perennial grasses such as *Pennisetum spp.* Soil transformations that accompany change from grasslands to bushlands are detrimental to the productivity of grasses.

The focus group results from mid-2008 clearly supported the following concepts:

1. The "boom and bust" pattern for the livestock population has long been recognized, but pastoralists see the frequency and severity of die-offs as increasing. The terms in the local language (Oromifa) for the cycle include *midame*, *chabe*, and *duwahafe*;
2. Many factors affect herd dynamics, including an increasing frequency of dry years, changes in land use, increased conflict over resources, fragmentation and degradation of natural resources, and growth in the human and livestock populations;
3. The next big livestock die-off is imminent—not in 2011, but right on the doorstep;
4. Livestock markets are uncertain and often unprofitable. Grain for human consumption is becoming more expensive;
5. Overall, the future for pastoralism is perceived as very negative. The possible ways to mitigate problems lie more in the realm of livelihood diversification, increased livestock marketing, and restoring herd mobility.

A focus-group member portrays the situation for the people: "Today many of us could not afford to purchase grain because of the ever-increasing price of grain and on the other hand, the ever-declining price of livestock other than mature male cattle, which only the very few wealthy people can own. The other livestock species and age classes are getting cheaper in the market. Also, emaciated animals cannot reach the market. Most of us are forced to sell at low prices and procure grain to survive at the expense of few productive animals."

Participants explained their concern that they may finish selling their more valuable stock for grain purchase shortly. They fear the end of pastoralism is within sight. They explained there are actions they can take to reduce the impact of drought and herd die-offs including: continue to find ways to increase the mobility of herds; build houses in local towns as an investment; sell livestock and keep money in the bank; and regain lost resource areas that were previously important fall-back zones during drought—such areas have been lost to overpopulation and resource degradation.

Practical Implications

Despite the various methods used in this research, the basic conclusions are clear. The Borana pastoral system, as traditionally practiced, is changing quickly. The results are consistent with the attributes of a production system that is strongly affected by livestock and human populations, as well as rainfall variability. This is unlike the framework proposed by Ellis and Swift (1988.)

This research has confirmed strong elements of predictability in the cattle "boom-and-bust" cycle, at least for the period between 1983 and 2005, which could be important in motivating pastoralists to consider diversifying assets and incomes, as well as helping relief and development agencies plan their activities. However, resource degradation, population growth, and rainfall variation may be working in tandem to further alter the production system. After 2005, herd crashes may become harder to predict. The 50 local focus group participants had a uniformly negative view of the future of pastoralism here - remarkable given that the Borana Plateau has long been regarded as an example of sustainable pastoralism. The options are few and focus on capacity building, livelihood diversification, markets, peace-building, and ecological restoration. Helping some pastoralists exit the pastoral sector could also be a prominent strategy.

Further Reading

Desta, S., and D.L. Coppock. 2002. "Cattle population dynamics in the southern Ethiopian rangelands, 1980-97." *Journal of Range Management* 55:439-451.

Ellis, J., and D. Swift. 1988. "Stability of African pastoral ecosystems: Alternate paradigms and implications for development." *Journal of Range Management* 41: 450-459.

Gebru, G. 2007. "Scope of impact from the 2005/06 drought in Borana." Unpublished report. GL-CRSP PARIMA, Addis Ababa. 13 p.

Mesele, S. 2006. "Land Use Dynamics and Impact on Selected Physiochemical Properties of Soils in Yabelo Woreda of the Borana Lowlands, Southern Ethiopia." Master's thesis, Alemaya University, Ethiopia.

About the Authors: Dr. D. Layne Coppock is an Associate Professor in the Department of Environment & Society at Utah State University, Logan, USA. Email Layne.Coppock@usu.edu. Dr. Getachew Gebru is a research associate with PARIMA through Utah State University and is based in Addis Ababa, Ethiopia. Email: G.Gebru@cgiar.org. Mr. Sintayehu Mesele is a staff researcher at the Pastoral and Agro-pastoral Research Center of the Oromia Agricultural Research Institute (OARI) in Yabelo, Ethiopia. Email: Sintayehu_mesele@yahoo.com. Dr. Solomon Desta is a research associate with PARIMA through Utah State University and was based in Nairobi, Kenya, at the time of this research; he is now based in Addis Ababa. Email: S.Desta@cgiar.org. Mr. Seyoum Tezera is a senior field assistant with PARIMA based in Addis Ababa. Email: S.Tezerra@cgiar.org.

The GL-CRSP Pastoral Risk Management Project (PARIMA) was established in 1997 and conducts research, training, and outreach in an effort to improve the welfare of pastoral and agro-pastoral people with a focus on northern Kenya and southern Ethiopia. The project is led by Dr. D. Layne Coppock, Utah State University. Email: Layne.Coppock@usu.edu.

The Global Livestock CRSP is comprised of multidisciplinary, collaborative projects focused on human nutrition, economic growth, environment and policy related to animal agriculture and linked by a global theme of risk in a changing environment. The program is active in East and West Africa, Central Asia and Latin America.

This publication was made possible through support provided by the Office of Agriculture, Bureau of Economic Growth, Agriculture and Trade, under Grant No. PCE-G-00-98-00036-00 to the University of California, Davis. The opinions expressed herein are those of the authors and do not necessarily reflect the views of USAID.

Edited by Franklin Holley & Susan L. Johnson