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Christopher B. Barrett
Cornell University

John G. McPeak
Syracuse University

Winnie Luseno
RTI International

Peter D. Little
University of Kentucky

Sharon M. Osterloh
Cornell University

See next page for additional authors

PASTORALIST LIVESTOCK MARKETING BEHAVIOR IN NORTHERN KENYA AND SOUTHERN ETHIOPIA: AN ANALYSIS OF CONSTRAINTS LIMITING OFF-TAKE RATES

Sharon M. Osterloh,[a] John G. McPeak,[b] Hussein Mahmoud,[c,d]
Winnie K. Luseno, [a,e] Peter D. Little [c] Getachew Gebru[f,g] and Christopher B. Barrett [a]

[a] Cornell University
[b] Syracuse University
[c] University of Kentucky
[d] Egerton University
[e] RTI International
[f] Utah State University
[g] International Livestock Research Institute

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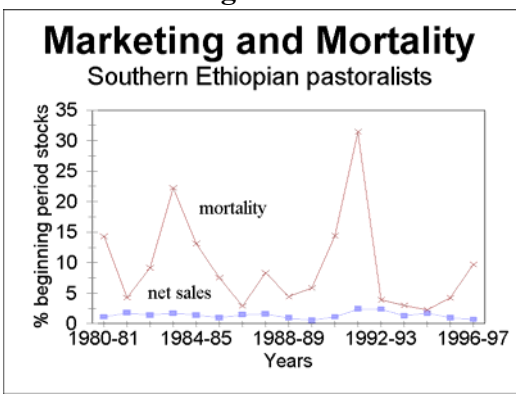
Authors listed in reverse alphabetical order, with no assignment of seniority of authorship. Correspondence should be directed to Barrett at 315 Warren Hall, Cornell University, Ithaca, NY 14853-7801 USA, tel: 607-255-4489, email: cbb2@cornell.edu. We thank Abdillahi Aboud, Francis Chabari, Layne Coppock, Solomon Desta, Michael Fleisher, Garth Holloway, Robert Kaitho, Kevin Smith, Jerry Stuth and Amare Teklu Yirbecho for helpful discussions and comments, our field enumerators and, especially, the survey households for their generous sharing of time and information, and the International Livestock Research Institute for hospitality. This research was funded by support to the Global Livestock Collaborative Research Support Program (GL CRSP) from the Office of Agriculture and Food Security, Global Bureau, USAID, under grant number DAN-1328-G-00-0046-00. The views expressed here are those of the authors and do not represent any official agency.

I. PROJECT OBJECTIVES

Introduction and Objective

Pastoralists in East Africa's arid and semi-arid lands (ASAL) regularly confront climatic shocks that plunge them into massive herd die-offs and loss of scarce wealth. One of the most puzzling features of pastoralist behavior in times of stress has been their relatively low and non-responsive rate of marketed off-take of animals when faced with likely losses to herd mortality. As Figure 1, from Desta (1999), finds in 17-year herd history data from Borana pastoralists in southern Ethiopia, mortality always exceeds net sales as a share of beginning period herd size, with the latter never exceeding three percent and moving hardly at all in response to shocks to rangeland carrying capacity that cause regular spikes in mortality rates. This case might be more pronounced than others, but the basic pattern is widely believed representative of herd dynamics and marketing patterns among east African ASAL pastoralists.

Figure 1



Converting any significant share of ASAL pastoralists' mortality losses into sales could avert widespread, acute human suffering and, by conserving local wealth, might accelerate both herd recapitalization once range conditions improve and economic growth more broadly. Investments that might increase pastoralist marketing responsiveness to temporal variation in range conditions might thereby quickly pay for themselves through reduced demand for relief aid. As part of a collaborative module between the Livestock Early Warning System (LEWS) and Pastoral Risk Management (PARIMA) projects of the USAID Global Livestock Collaborative Research Support Program (GL CRSP), we set out to improve our understanding of observed livestock off-take behavior by ASAL pastoralists so as to help identify feasible interventions that might induce conversion of mortality losses during times of stress into marketed off-take.

Toward that end, we aimed to understand two interrelated issues:

(1) what factors limit pastoralists' marketed off-take response to predictable fluctuations in underlying livestock productivity/survivability that are associated with shocks to climate, range conditions and disease? and

(2) what might be done to foster more responsive pastoral livestock marketing systems by relaxing those constraints?

This report presents our findings on issue (1) and discusses the implications for issue (2).

Research Design

In order to address the first issue above, we collected and analyzed primary data on pastoralist and trader behavior through survey-based methods at household and market level, participant-observer methods and social analysis of the livestock marketing chain, and integrated qualitative and quantitative analysis of livestock market performance, supplemented with analysis of secondary data on livestock marketing patterns and analysis of primary data our team had recently collected in the region under other auspices. We built on ongoing survey work by the PARIMA project among 330 pastoral households in northern Kenya and southern Ethiopia. We supplemented the household-level survey with a second data collection activity on livestock trade at the market level. A typology of livestock markets was created based on geo-referenced location, marketing chain position, institutional sales arrangements, throughput characteristics, etc. We then did daily or weekly transactions level surveys in Marigat, Marsabit, North Horr and Suguta Marmar periodic livestock markets in northern Kenya. This was complemented by an in-depth qualitative study of trader networks and animal processing facilities throughout the southern Ethiopia and northern Kenya region, down to terminal markets in Nairobi. This first phase was led by the PARIMA team.

This collaborative module's second phase addressed the second issue above by developing recommendations for ASAL stakeholders based on simulation modeling of alternative interventions meant to address the various limiting factors identified in the module's first phase. The second phase was led by the LEWS team. Our outreach partners in governmental and non-governmental organizations in Ethiopia, Kenya and the ASARECA region more broadly were especially involved in discussions of both issues (1) and (2) throughout the project.

The literature on ASAL pastoralism is replete with untested hypotheses as to why marketed off-take rates are so low and non-responsive to biophysical shocks to expected livestock survival rates. Some of these revolve around pastoralist behavior, some around trader behavior, and others around the functioning of the broader marketing system. Any successful effort at modifying pastoralist marketing behavior must be well-targeted at relieving which of the constraints proves binding. It thus becomes crucial to tackle systematically the various hypotheses extant in the literature. We were able to identify and test seven hypothesized constraints to ASAL pastoralist livestock marketing behavior:

a) There is nothing to spend cash on and no place to save financial assets securely at a positive real rate of interest. Such a finding would indicate a need for pastoral banking to create a supply stimulus for livestock markets.

b) Information (about future range condition, animal condition, or prices) is insufficient for pastoralists or traders to plan or justify incurring certain marketing costs in the face of uncertain receipts. If information is limiting, providing information (such as drought early warning, animal condition status, price broadcasts, etc.) may have significant, positive effects. Or perhaps the need is just for improved communication capability (e.g., public radio broadcasts, satellite phones, etc.).

c) Complex property rights in livestock restrict pastoralists' capacity to sell-off animals, either because they received the animals as gifts or loans—especially from relations

who may have some expectation of future reciprocity—or because of intra-household gender or generational disputes over who has the authority to make sales decisions.

d) Competition in livestock marketing channels is insufficient to provide reliable, remunerative prices for pastoralists. This may be because: (i) traders have insufficient information to find where there are healthy animals ready for purchase; (ii) traders' transport costs make traveling to pastoralists unprofitable; (iii) traders have insufficient access to transactional credit to operate at efficient scale; (iv) a lack of easily enforceable contract law, clan and ethnic ties drive inefficient exchange, thereby making it difficult for new entrants to compete with incumbents in the marketing channel; or due to (v) institutional arrangements of sales (e.g., dyadic versus auction markets). If market power is the issue, then changed institutional arrangements (e.g., introducing auctions more broadly) or start-up loans or transport subsidies for new entrants may be effective. If market power derives from ethnic/clan/social ties, it may be difficult to break without subsidization of competitors or the creation of herder marketing cooperatives.

e) Poor communications and transport infrastructure and high risk of livestock theft create transactions costs that are so high as to wipe out any gains from trekking animals to market to sell. If this is true, it would signal that improving roads or police protection are the keys to more responsive marketed off-take.

f) Pastoral herd structures are fragile, with most herders keeping a high share of reproductive stock that is difficult to restock commercially when range conditions improve. Moreover, restocking typically has to draw on imported animals from other areas whose breeds may not be well-adapted to local range or epidemiological conditions. Introducing such animals into herds may also dilute valued local genotypes. Such a finding would point toward the need for improved herd management advisories as well as coordinated commercial breeding and distribution systems that attend to locally adapted traits.

g) National policies with respect to both cross-border movement of people and animals and control of domestic animal diseases through movement restrictions and quarantines disrupt the natural flow of animals from rangeland areas with a surplus of cattle to highland areas exhibiting chronic excess demand for livestock. If such policies restrict pastoral marketing responsiveness, this would suggest a need for policy reforms aimed at finding alternative means to combat infectious animal disease and to stem cross-border violence and trafficking in contraband.

In summary, these are merely hypotheses, albeit ones informed by significant field observation and prior research. However, any effort to try to induce greater marketed off-take in response to variable range and animal conditions depends fundamentally on which, if any, of them are true and what is done to ameliorate the hypothesized constraints that are truly binding. It is also likely that constraints vary across time and space, hence the need for a spatial dimension to the research.

By establishing which hypotheses appear true – and which seem false, at least in the time and places we study – one can then begin to evaluate the likely effects of alternative policy or project interventions intended to stimulate increasingly responsive pastoral marketing. Figure 2 reflects the connection between the hypothesized constraints on pastoralist or trader behavior and prospective interventions to be evaluated through the simulation modeling component of the project.

Table 1

Constraints on		**Candidate Interventions to Increase Marketing Response**
Pastoralist Behavior	**Trader Behavior**	
a) no safe place to save cash	limited transactional credit available to traders	- Promote pastoral banking institutions
b) insufficient reliable climate or price forecasts	insufficient reliable climate or price forecasts	- Price and forage/livestock condition reporting systems - Improved communications technologies linked to early warning systems and markets
c) complex property rights in animals inhibit sales		- Change in laws
d) low and variable prices for animals sold	high transport costs, variability in terminal market prices, limited transactional credit, social networks paramount	- Transport subsidies, road improvements - Trader credit facilities and bonding/guarantees - Improved enforcement of contracts - Replace dyadic markets with auctions - Pastoral marketing cooperatives
e) high costs/risks of moving animals to market	high transport costs, risk of banditry during transit	- Road improvements - Improved police protection
f) fragile herd structures inhibit marketed offtake or restocking		- Extension services on herd composition and structure - Promote breed-specific stocking/restocking programs
g) border closures and domestic movement restrictions and quarantines	border closures and domestic movement restrictions and quarantines	- Develop alternative animal disease control methods - Relax cross-border trade restrictions

II. DATA

This report is based on repeat-visit survey data collected on a quarterly basis over a two-year period beginning in June 2000 and ending in June 2002. In June 2002, we supplemented the usual survey instrument – which included detailed information on marketed offtake behavior and a wide range of other data on household and herd status – with a detailed module to gather more precise information on recent livestock marketing transactions. A total of 330 households were randomly sampled from 11 different sites, six in northern Kenya (Dirib Gombo, Kargi, Logologo, Ngambo, North Horr and Suguta Marmar) and five in southern Ethiopia (Dida Hara, Dillo, Finchawa, Qorate and Wachille). The sites were chosen to capture variation in agricultural potential, market access, livestock mobility and ethnic diversity. As shown in Table 2, the study area spread over an area of approximately 124,000km^2 and spanned several ethnic groups, including the Ariaal, Boran, Chamus, Gabra, Gurji, Rendille, and Samburu.

Table 2

Code	Name	Country	Market Access	Ethnic Majority	Agricultural Potential	Annual Rainfall
DG	Dirib Gombo	Kenya	Medium	Boran	High	650
KA	Kargi	Kenya	Low	Rendille	Low	200
LL	Logologo	Kenya	Medium	Ariaal	Medium-Low	250
NG	Ng'ambo	Kenya	High	Il Chamus	High	650
NH	North Horr	Kenya	Low	Gabra	Low	150
SM	Sugata Marmar	Kenya	High	Samburu	Medium	500
DH	Dida Hara	Ethiopia	Medium	Boran	Medium	500
DI	Dillo	Ethiopia	Low	Boran	Low	400
FI	Finchawa	Ethiopia	High	Guji	High	650
QO	Qorate	Ethiopia	Low	Boran	Low	450
WA	Wachille	Ethiopia	Medium	Boran	Medium	550

Figure 2

Table 3 presents the number of households for which data were collected, by site and survey round.[1] The first group of six sites are located in Kenya. The latter group of five are Ethiopian.

[1] Numbers vary across rounds a bit due to temporary absence (e.g., due to long distance trekking), respondent mortality, replacement and other survey management details.

Table 3: Number of Household Survey Participants

	Jun-00	Sep-00	Dec-00	Mar-01	Jun-01	Sep-01	Dec-01	Mar-02	Jun-02
Dirib Gombo	31	31	28	31	31	31	31	31	31
Kargi	30	30	30	30	30	30	32	30	30
Logo Logo	30	30	28	30	30	30	30	30	30
Ngambo	30	30	29	30	30	31	31	31	31
North Horr	30	30	28	30	30	29	31	29	29
Suguta Marmar	30	30	27	30	30	30	30	30	30
Dida Hara	30	30	30	30	30	30	31	30	30
Dillo	30	30	30	30	30	30	30	30	30
Finchawa	31	31	30	31	31	31	29	31	30
Qorate	30	30	30	30	30	30	30	30	30
Wachille	30	30	30	30	30	30	28	30	30

Data collection was conducted by one pair of carefully trained enumerators (male and female) in each site, closely supervised by two field-based postdoctoral fellows. The enumerators all had high school education and spoke at least two languages, including one local language in the study area.

The repeated quarterly survey conducted by the PARIMA project in northern Kenya and southern Ethiopia provided the sampling framework for the Livestock Marketing module. This module was fielded in June through July 2002 along with the final quarterly repeat round of the PARIMA survey. The survey elicited information from pastoralists on their ranking of places where they prefer to sell or buy livestock and who they prefer to trade with when selling or buying livestock. The instrument also asked about sources of market information, how these sources are ranked in terms of importance and how frequently information is sought from them. Depending on whether they had bought or sold livestock respondents were asked to recall additional information on livestock marketed between January and December 2001. Information obtained from respondents during the repeat quarterly surveys conducted in March, June, September and December 2001 (for example, on livestock species, gender, age; price sold (bought); month of sale (purchase)) were used to assist respondent recall. Questions asked in this segment included where an animal was sold or purchased (e.g., market, on the way to the market, at the base camp or at the satellite camp), whether the animal was trekked or trucked to or from the market and by whom, whether a cost was incurred to trek or truck the animal to or from the market, and whether the purchase or sell price was higher, the same or lower than what was expected.

III DATA ANAYLSIS METHODS

Data analysis in this report follows two lines of inquiry. First, we use results from published project papers to address some issues. These papers involve a mix of qualitative and quantitative data collection and analysis methods. We supplement these findings with new, regression-based analysis in order to test simultaneously several hypotheses with respect to the determinants of livestock marketing patterns. As we are examining quarterly livestock sales and purchases data of 330 households across eleven sites between the period of June 2000 and June 2002, our data comprises a panel encompassing both intertemporal and cross-sectional variation.

The regression method we employ is known as a Heckman selection model, after the recent Nobel Laureate, Jim Heckman, who pioneered the method's use in studying market participation and market volume decisions jointly.[2] Heckman's method involves a two-stage estimator that controls statistically for those factors that affect households' discrete decision to participate in the market or not when estimating the relationship between net livestock sales volume and appropriate correlates of the continuous marketed off-take volume decision. The first equation representing household participation in the market takes the form:

$$(1) \qquad mp_{it} = \alpha + \beta x_{it} + \varepsilon_{it}$$

where mp_{it} is a dichotomous variable representing market participation, with
$mp_{it} = 1$, if the household participated in the livestock market during time period t, and
$mp_{it} = 0$, if the household did not participate during time period t.
x_{it} is a vector of household specific variables including initial household herd size – as measured in tropical livestock units (TLUs)[3] – ownership as reported in the baseline survey, percentage of initial herd that is female, percentage of initial herd encumbered with complex property rights, average log price of smallstock and largestock during the quarter in the local market, average marketing fees associated with taking smallstock and largestock to the local market, insecurity and quarantine dummy variables, a dummy variable equaling one if the respondent owned a bank account, as well as quarter-specific dummy variables. Finally, ε_{it} is a normally distributed error term with mean zero and constant variance σ^2, independently and identically distributed (iid) across observations.

We note in particular the construction of three binary variables: insecurity, quarantine, and bank. Both the insecurity and quarantine dummy variables were constructed from community surveys fielded monthly from June 2000 to June 2001. Key informants were used to ascertain average prices in the area for staple goods, rainfall information, the number of traders present in market, incidents of insecurity, and quarantines in effect. Responses were aggregated to the quarterly level, so that a one value for the insecurity variable for June 2000 means an at least one incident of insecurity occurred in the community between the months of April, May, and June of 2002. Both variables are locally defined and potentially variable across sites. The bank variable was

[2] Heckman's seminal work concerned labor market participation and hours worked decisions, but the methods transfer directly and appropriately to the questions we study.
[3] TLUs are a convenient way to compare livestock quantities across species. One TLU is equivalent to one head of cattle, 10 goats, 11 sheep, or 0.7 camel.

constructed from the PARIMA household head surveys. The variable takes the value '1' if at any point during the survey period the household held a bank account, and the value '0' otherwise.

Location dummies are included in the vector of independent variables and serve to identify the selection equation. While location impacts the decision to market animals or not by virtue of site specific characteristics such as population density and average distance to market, by assumption it does not affect the second-stage decision of how many animals to take to market conditional on participating in the market and other correlates of the continuous off-take equation, which we now describe.

Conditional upon having selected into the livestock market for any given quarter, we then regress the net TLUs marketed, i.e. sales minus purchases in TLU, upon the same vector of variables as above complemented by a vector of site specific dummy variables. In this equation, we have

$$(2) \qquad y_{it} = \alpha + \beta z_{it} + \delta_{it},$$

where y_{it} is a continuous variable equal to household i's net purchases, in TLUs, in time period t. This variables is therefore positive if the household is a net buyer of livestock, negative if the household is a net seller. The regressors, $z_{it,}$ are a vector of correlates of livestock off-take volumes, including the variables in x_{it} in the first-stage equation, minus the location dummies. δ_{it} is the error term, uncorrelated with $\varepsilon_{it,}$ and distributed iid $N(0, \sigma^2)$.

The regression was run three times to compensate for absences of reporting for certain variables. Of the 3038 total observations, the marketing fees data were missing for 1011 observations, representing all households at all sites between June 2000 and December 2000. Insecurity and quarantine information was not available from Dirib Gombo, Kargi, Logo Logo, North Horr, Dida Hara, Dillo, Finchawa, and Qorate from September 2001 through March 2002. In addition, this community level information was reported in the last quarter only by Ngambo, North Horr and Suguta Marmar. In total, 983 observations are missing insecurity and quarantine information. Complete information was available for 1039 observations, including data from all sites between the March 2001 to June 2001, and for some of the sites between September 2001 and the end of the survey period. To compensate for the lack of data, we ran the above equations in three groups: first with 1039 observations with all variables accounted for, the second without the insecurity and quarantine information with the observations missing these data combined with the observations for which all data were collected, and a third time for the sites lacking marketing fee information stacked on top of the data with all variables, this time ignoring marketing fees.

The standard mean squared error tradeoffs emerge among these different estimation methods. Though the point estimates of the equation with all variables are unbiased and consistent, the explanatory power is diminished due to smaller sample size. For this reason, we focus primarily upon the point estimates of these results and emphasize statistical significance less. In the other two formulations, larger sample size leads to more precise estimates. But the omitted relevant variables bias created by dropping information results in inconsistent and biased coefficient estimates. The incomplete nature of the data complicates interpretation of the results. We

derive our conclusions based upon the consistency of the sign of the coefficients and the overall significance of the variables in the three formulations. For example, if a coefficient is negative in all three equations and statistically significant in the two equations with larger sample size, but not significant in the first specification, we focus upon the magnitude of the unbiased result and find justification for statistical significance from the other two equations. The approach can be summarized as piecing together a coherent story as described by all three equations as opposed to having an a priori high degree of confidence in any one of them. Detailed results from the regression are reported in Appendix 1.

IV. BASIC DESCRIPTION OF MARKETING BEHAVIOR

During the survey period, we found that far from being autarkic, greater than nine out of ten pastoralist households in our survey sample used livestock markets at some point during the survey period. Market participation is defined as using the market either to purchase or to sell livestock. As seen in Table 4, market participation varies over time, with fewer households participating in livestock trading during the quarter of June 2002 as opposed to June 2000, with the exception of Qorate. The need to market animals was particularly high in June 2000, as we began the survey during one of the worst droughts in years. Note that each survey captures a three-month interval, therefore participating in the market in June 2000 is defined as either selling or buying livestock via the market at least once between April and June 2000. We can see this pinnacle of market participation most clearly in Figure 3a, which graphs market participation in Kenya over time, by site.

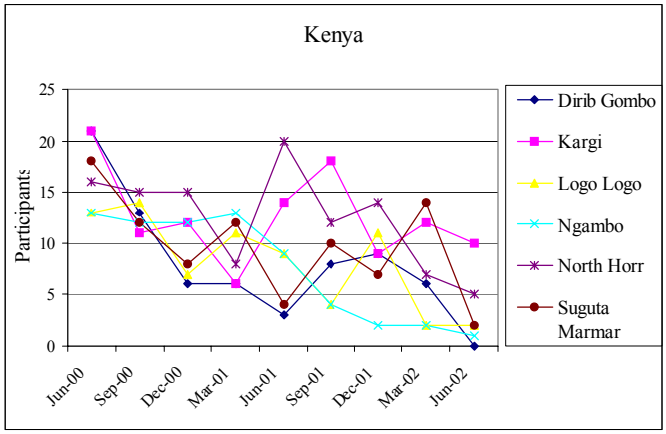
Table 4: Percentage of HHs Participating in the Livestock Market, by Quarter and Site

	Jun-00	Sep-00	Dec-00	Mar-01	Jun-01	Sep-01	Dec-01	Mar-02	Jun-02	HHs Marketing Livestock during Survey Period
Dirib Gombo	68%	42%	21%	19%	10%	26%	29%	19%	0%	97%
Kargi	70%	37%	40%	20%	47%	60%	28%	40%	33%	97%
Logo Logo	43%	47%	25%	37%	30%	13%	37%	7%	7%	87%
Ngambo	43%	40%	41%	43%	30%	13%	6%	6%	3%	87%
North Horr	53%	50%	54%	27%	67%	41%	45%	24%	17%	94%
Suguta Marmar	60%	40%	30%	40%	13%	33%	23%	47%	7%	90%
Kenya Weighted Avg	**56%**	**43%**	**35%**	**31%**	**33%**	**31%**	**28%**	**24%**	**11%**	**92%**
Dida Hara	57%	37%	23%	20%	23%	27%	39%	30%	37%	90%
Dillo	43%	33%	20%	23%	17%	17%	33%	33%	30%	87%
Finchawa	58%	48%	73%	45%	48%	32%	45%	10%	7%	100%
Qorate	13%	23%	0%	20%	20%	0%	23%	3%	33%	63%
Wachille	30%	37%	20%	43%	20%	20%	32%	33%	23%	93%
Ethiopia Weighted Avg	**40%**	**36%**	**27%**	**30%**	**26%**	**19%**	**34%**	**22%**	**26%**	**87%**

Kargi and North Horr tend to have the highest rates of market participation amongst the six Kenyan sites, which is to be expected as these sites are the most pastoralist of the sample. The pastoralist nature of these sites is reflected in the number of animals owned by the survey participants. As Table 5 shows, Kargi and North Horr respondents have the highest average herd size amongst the Kenyan sites.

Since it requires between 3 and 5 TLU per capita to sustain herders on milk and blood on the open range (Lybbert et al, forthcoming), fewer animals tends to indicate sedentarization. For example, respondents in Ngambo, a site with relatively high agricultural potential and a diversified economy, have the lowest average herd size of the Kenyan sites, and consequentially a lower rate of livestock market participation.

Figures 3a,b: Number of HH Livestock Market Participants



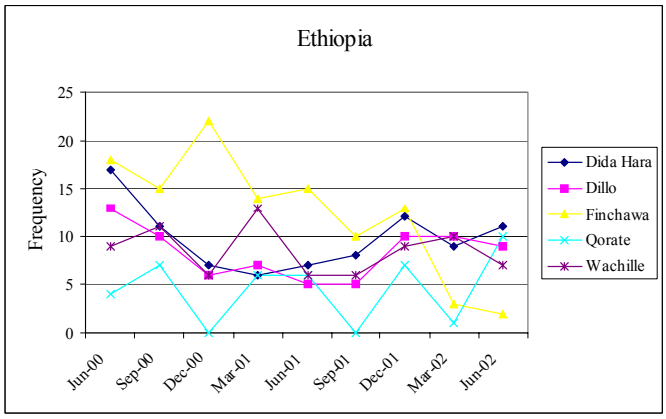


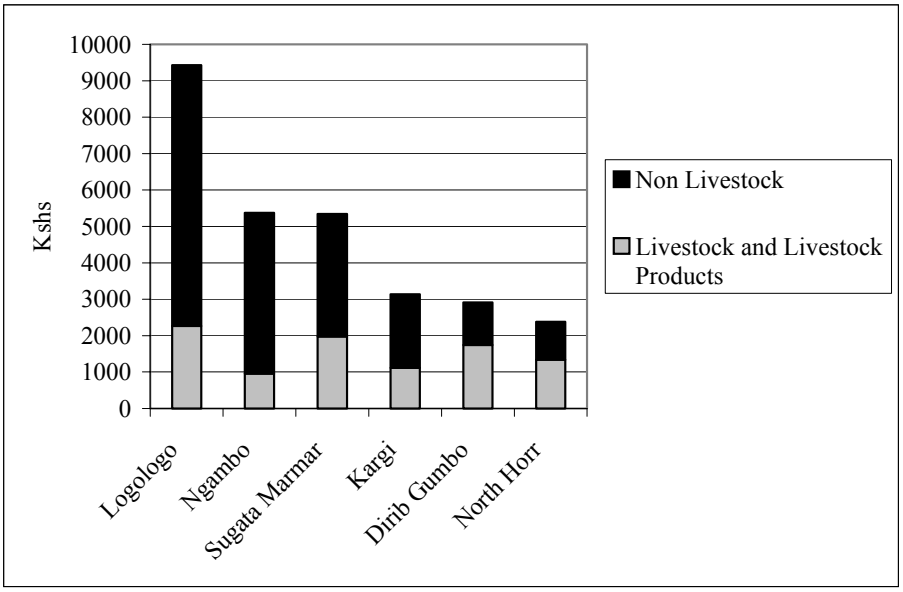
Table 5: Average Site TLU and Herd Composition

	AVERAGE SITE TLU/HH	LARGESTOCK %TLU	SMALLSTOCK %TLU
Dirib Gombo	13.3	92%	8%
Kargi	30.6	71%	29%
Logo Logo	21.3	85%	15%
Ngambo	6.6	47%	53%
North Horr	25.6	68%	32%
Suguta Marmar	13.3	78%	22%
Dida Hara	15.5	95%	5%
Dillo	45.1	84%	16%
Finchawa	14.7	96%	4%
Qorate	13.2	99%	1%
Wachille	15.3	98%	2%

Table 5 also illustrates the necessity of species diversity in areas of pure pastoralism, the more arid areas, void of agriculture and characterized by highly variable rainfall. The sites with high TLU ownership and low agricultural potential, Kargi, North Horr, and Dillo, all hold a significant percentage of their animals in smallstock, a term to describe small ruminants such as goats and sheep, as goats in particular are highly drought resistant. As might be inferred, largestock refers to larger animals such as cattle and camel. Sites with a high percentage of smallstock and a low average TLU, e.g., Ngambo, suggest a more settled lifestyle with smallstock providing supplemental milk, as opposed to subsistence.

In their analysis of livestock income and non-livestock income, McPeak and Little (forthcoming) show that non-livestock income sources provide the majority of income for three of our Kenya sites: Logologo, Ngambo, and Sugata Marmar (Figure 4). These three sites not only have higher income than the sites where income from livestock accounts for the majority of income, but these households have better access to markets and infrastructure, and enjoy higher and more diversified incomes. These households also tend to be characterized by a greater degree of sedentarization and decreased mobility, although there are important exceptions to this tendency.

Figure 4: Total Income Reported Over a Three-Month Period



Source: McPeak and Little, forthcoming
Note: $1 ≈ Kshs75

One point emerging early in our analysis comes from comparing the average livestock holdings of respondents differing by levels of market participation. Table 6 shows that the more active participants in livestock markets have higher average livestock holdings. Autarkic households own an average of 10.8 TLUs, as opposed to the households most active in markets, which average holdings of over 40 TLUs.

Table 6: Frequency of Market Participation and Average TLU

QUARTERS REPORTING LIVESTOCK MARKETING ACTIVITY	% OF RESPONDENTS, KENYA	% OF RESPONDENTS, ETHIOPIA	MEAN TLU OF MARKET PARTICIPANTS
0	9%	13%	10.78
1	19%	19%	15.59
2	23%	21%	14.47
3	16%	19%	19.58
4	12%	16%	19.70
5	6%	5%	35.72
6	9%	4%	30.28
7	4%	3%	45.86
8	1%	1%	48.30

Regression analysis confirms not only that greater livestock holdings results in greater livestock market participation, but that it also has an impact upon the numbers of livestock marketed. The sole variable consistently statistically significant and in all three equations, was total livestock holdings. In addition, the negative regression coefficient estimate implies that the greater the livestock holdings, the greater the capacity and willingness to sell animals. The key practical implication is that active livestock markets depend on pastoralists attaining and maintaining sufficiently large herd sizes that they become willing to liquidate animals through the market.

It is generally believed that pastoralists sell their animals at least partly in response to demand for cash to meet expenditure needs. Livestock thus serves as a "bank on hooves" as well as a productive asset. In this region of northern Kenya, a household of average size needs approximately 500 Kshs per month to provide a regular supply of consumption goods, such as maize, tea, and sugar, in addition to lumpy, seasonal needs such as school fees. Relatively wealthy pastoralists, with greater herd size, have considerably higher expenditure rates (Barrett and McPeak, 2003) and thus use livestock markets more frequently to cash out animals. When livestock prices are rising in the post-drought period, the wealthier households are able to sell surplus animals and take advantage of favorable prices, while poorer households tend to hold on to their few animals remaining after the drought, unless forced to sell by consumption needs.

Despite the prevalence of relatively wealthy participants in the livestock market, ironically, it is the poorer households who rely on market purchases for restocking, as they do not have sufficient scale of herd size for breeding operations (Little et al., 2003). In contrast, wealthier pastoral households rely almost exclusively on natural reproduction, perhaps purchasing livestock to diversify risk by investing in alternate types or species of livestock..

Table 7: Average Quarterly Net TLU of Livestock Market Participants

		Jun-00	Sep-00	Dec-00	Mar-02	Jun-02	Sep-02	Dec-02	Mar-03	Jun-03
KENYA	average net tlu	-0.7	-0.6	-0.5	-0.8	-0.4	-0.5	-0.6	-0.2	-0.3
	% of HHs participating in livestock market	56.35%	42.54%	35.29%	30.94%	32.60%	30.94%	28.11%	23.76%	11.05%
ETHIOPIA	average net tlu	-0.9	-1.1	-0.9	-0.9	-0.9	-1.8	-0.9	-0.1	-0.9
	% of HHs participating in livestock market	40.40%	35.76%	27.33%	30.46%	25.83%	19.21%	34.46%	21.85%	26.00%
TOTAL	average net tlu	-0.8	-0.8	-0.7	-0.9	-0.6	-1.0	-0.7	-0.1	-0.7
	% of HHs participating in livestock market	49.10%	39.46%	31.56%	30.72%	29.52%	25.60%	30.93%	22.89%	17.82%

The ASAL regions are net exporters of animals, as reflected in net sales of livestock. But volumes are relatively low per household, limiting their incorporation into broader national and international trade patterns. Market participants were generally net sellers of livestock , not net buyers. As Table 7 shows, in both Kenya and Ethiopia, the average marketed transaction was a

net sale. Over the course of the study period, of the 918 quarterly observations of market participation, 815 net sellers were recorded, as opposed to only 92 net buyers, while 11 households netted zero in their quarterly market transactions. If we consider net market transactions across the two year survey period, 271 of 337, or 80% of households participated as net sellers, as opposed to just 8% of households who purchased more TLUs than they sold, behaving as net buyers. 11% of households did not participate at in the livestock markets at all.

But one of the most striking features of Table 7 is the small average net sale quantity. In no period was the average household transaction more than 1 TLU over the course of a quarter. These data underscore the limited immediate gains to be reaped from generalized stimulus to regional and international livestock markets because ASAL pastoralist households are not heavy net sellers of animals.

Table 8: Births and Purchases in TLUs Across Species, by Quarter

	Camel Births, TLU	Camel Purchases, TLU	Purchases as a % of gross herd recruitment	Cattle Births, TLU	Cattle Purchases, TLU	Purchases as a % of gross herd recruitment	Smallstock Births, TLU	Smallstock Purchases, TLU	Purchases as a % of gross herd recruitment
Jun-00	117.3	0.0	0.00%	168.0	49.0	22.58%	67.8	5.0	6.87%
Sep-00	24.3	1.4	5.56%	99.0	11.0	10.00%	31.0	2.9	8.55%
Dec-00	80.1	7.2	8.20%	113.0	7.0	5.83%	51.7	2.3	4.26%
Mar-01	70.1	2.9	3.92%	105.0	12.0	10.26%	122.0	2.2	1.77%
Jun-01	62.9	1.4	2.22%	211.0	2.0	0.94%	153.4	1.6	1.03%
Sep-01	38.6	4.3	10.00%	212.0	4.0	1.85%	94.9	2.0	2.06%
Dec-01	123.0	2.9	2.27%	321.0	11.0	3.31%	119.7	4.1	3.31%
Mar-02	113.0	1.4	1.25%	343.0	24.0	6.54%	117.9	2.8	2.32%
Jun-02	127.3	0.0	0.00%	213.0	1.0	0.47%	91.7	0.9	0.97%
Coefficient of Correlation between Births and Purchases			**-0.3284**			**0.0579**			**-0.2395**

While pastoralists quite actively use the markets to offload animals, albeit in small quantities and primarily to meet immediate cash expenditure needs, restocking is typically relegated to births as rather than purchases. We compare purchases as a percentage of gross herd recruitment (purchases plus births) by species across periods in Table 8. Purchases comprise a relatively small share of herd growth. Note in particular the coefficient of correlation between births and purchases as calculated in the final row in Table 8. There exists a strong negative correlation between births and purchases for the dryland species, camels and smallstock, as opposed to a very slight positive relationship between cattle births and purchases. In the drier areas, pastoralists appear to use the markets to restock their animals in times when the birth rate is not high enough to restock herds back to a viable level. Part of this surely just reflects species differences. Cattle are more fragile and thus both reproduction and purchases increase as cattle mortality falls and the carrying capacity of natural resource base recovers. Camels and

smallstock are much more resilient than cattle. Thus pastoralists can use purchases and births as substitute methods of herd restocking.

One can likewise look at the relative importance of markets as regulators of pastoralist herd sizes by studying the ratio of purchases to births for restocking and by looking at the ratio of sales to deaths. A higher ratio indicates greater reliance on markets. We computed these ratios as well (not reported) and found that the ratio increases as market access improves, but in no case did that ratio approach one. Biology remains the dominant regulator of pastoralist herd size even in the most market-oriented sites in northern Kenya and southern Ethiopia.

V. HYPOTHESIS TESTING

In this section, we directly address the seven core hypotheses posed at the outset of this paper and captured in Table 1.

A. NO SAFE SAVINGS REPOSITORY

Given the dearth of formal financial savings alternatives in the study site, pastoralists rely upon their traditional store of wealth, livestock, to accumulate and safeguard their assets. Not only are these assets care-intensive and vulnerable to raids and disease outbreaks, they are also sensitive to the low and variable rainfall which characterizes the ASAL. Some observers therefore hypothesize that the introduction of banks might allow pastoralists to diversify their risk, holding assets in a different and perhaps safer form (vulnerable to non-trivial fees, institutional instability and theft, to be sure, but safe from raids, disease and drought) and that holding a bank account should decrease pastoralist reliance upon livestock as a means of asset accumulation, and decrease reliance upon the market as a means to liquidate assets for consumption smoothing (Desta, 1999).

Table 9: Bank Account Holders and Average TLUs across Sites

	RESPONDENTS	BANK ACCOUNT HOLDERS	AVERAGE SITE TLU	AVG BANK HOLDERS TLU
Dirib Gombo	31	2	13.3	22.2
Kargi	32	2	30.6	14.8
Logo Logo	30	5	21.3	22.6
Ngambo	31	2	6.6	9.2
North Horr	31	15	25.6	25.6
Suguta Marmar	30	1	13.3	36.0
Dida Hara	31	1	15.5	124.9
Dillo	30	0	45.1	n/o
Finchawa	31	1	14.7	4.0
Qorate	30	0	13.2	n/o
Wachille	30	0	15.3	n/o
Total	337	29	19.5	26.0

As shown in Table 9, few pastoralists (8.6%) in our sample held a bank account between March 2000 and June 2002. At one level, this makes it difficult to test the hypothesis that increased bank-mediated savings could affect livestock marketing patterns, as there is relatively little variation in our data. On the other hand, in a regression context, even this limited use of banks can prove significant holding everything else constant. Moreover, by trying to understand why so few pastoralists hold bank accounts we can perhaps uncover useful information relating to the role banks play with respect to pastoralist livestock marketing behavior.

Among the study sites, bank accounts were observed most frequently in North Horr. At this site, a Nairobi-based NGO, KREP Development Agency (KDA), opened a Financial Service Association (FSA), offering accessible accounts to locals purchasing shares in the cooperative constituting the FSA's loan fund. Though nearly half of the respondents in the North Horr site had bank accounts at some point between June 2000 and June 2002, membership in the FSA declined among the sample population between these periods (Table 10). Only one household in our sample maintained an FSA account over the entire two-year survey period.

Table 10: FSA Accounts in North Horr

	RESPONDENTS WITH BANK ACCOUNTS	NEW ACCOUNTS	CLOSED ACCOUNTS
Jun-00	8		
Sep-00	4	1	4
Dec-00	4	0	0
Mar-01	3	0	1
Jun-01	4	1	0
Dec-01	6	2	1
Mar-02	4	1	0
Jun-02	7	2	3

If banks indeed assist pastoralists in risk management, it is natural to ask why FSA membership among North Horr respondents declines over time. Osterloh (2001) found that the value of North Horr FSA shares declined in value by 50% from 1997 to 2000, due to an extraordinarily high rate of loan default. Far from providing a secure repository of cash, the FSA actually decreased shareholder wealth.

It is not only community-based non-commercial banks where participants suffer asset loss. McPeak (2003) finds that Chalbi herds measured in TLU terms returned an average annual rate of 6% from early 1993 and early 1997 (standard deviation 0.11, 28% of households experienced negative rates), while Dukana herds averaged 15% annualized livestock rates of return over the same period (standard deviation of 0.15, 12% of households experienced negative rates). Contrasting these livestock rates of return with the returns to formal bank-mediated savings in the study area illustrates why capital held as livestock is preferred to capital held in formal savings. Given current banking regulations at the nearest formal bank in the district capital, Marsabit, a cash deposit the equivalent of roughly 25 goats' value or more would return

approximately 2% per-year over a four-year period, between 18 and 25 goats would yield a return of negative 44 %, and an account of lower value than 18 goats would be completely dissipated by service charges in four year's time, earning a rate of return of negative 100%. The positive rate of return threshold herd of 25 goats is roughly 10% of average household herd size, and is equivalent to more than half of the average household's total livestock sales over the four year study period. Even including the losses of late 1996, and excluding the benefits of income generation and the costs associated with accessing savings in the district capital, livestock raising offers a higher average rate of return than savings. While it could be argued that formal banking may still be attractive in terms of reduced variance in return, discussions with herders suggest viewing bank savings as low risk may not be appropriate as herders express doubts about the safety of money placed in banks.

Though statistically insignificant in two of the three regressions, owning a bank account consistently has a positive estimated impact upon pastoralists' probability of participating in the livestock market, although since both bank accounts and market participation are positively correlated with wealth, it is difficult to determine the direction of causality in this association. In addition, having a bank account at any point in the study period decreases net sales. Since bank account holders can draw upon their financial assets in times of stress, they are better equipped to smooth over income shocks without resorting to liquidating assets. So the positive estimated correlation between net purchases and holding a bank account seems to underscore once again the role livestock sales play in meeting immediate cash needs, a role for which bank accounts can substitute easily. The implication, of course, is that rather than stimulating marketed livestock off-take in order to take advantage of intertemporal fluctuations in range carrying capacity and local livestock productivity, as has been hypothesized by advocates of pastoral banking, formal bank accounts appear to reduce marketed livestock off-take by supplanting the need to use livestock as a buffer stock. Furthermore, the evidence does not support the claim that lack of banking options significantly limits livestock marketing..

B. INSUFFICIENT RELIABLE CLIMATE AND PRICE FORECAST INFORMATION

CLIMATE FORECASTS[4]

Just as a skillful cultivator is highly regarded for her ability to predict and react to climate variation, conventional wisdom suggests that accurate forecast information should be useful to pastoralists who live in areas of characterized by especially pronounced climactic variability (with annual rainfall ranging between 200 and 700 mm/year). The study region has suffered three significant droughts in the last decade alone, resulting in massive herd deaths. Reliance upon the herd for sustenance, dearth of agricultural alternatives, and a notoriously poor infrastructure render pastoralists' livelihoods and behavior particularly vulnerable to climate fluctuations (Sandford 1983, Ellis and Swift 1988). Through the timely provision of information on upcoming rains, accurate climate forecasts have the potential to inform pastoralists' stock movement and marketing decisions based upon favorable locations for pasture and water household risks. Considerable resources have been directed toward building up climate forecasting and dissemination capacity in the region, with the Drought Monitoring Centre

[4] This section draws heavily upon Luseno et al. (2003) and Lybbert et al. (2003).

(DMC) in Nairobi the nexus of such efforts (Curry 2001). Highly advanced early warning systems are being developed predicated upon the assumption that climate forecasts will assist pastoralists in risk mitigation.

No studies have addressed the suitability of these systems to inform pastoralists and the effects of enriched climate information on pastoralists' decision making processes. To fill the gap between climate forecasting and pastoralists' utilization of such information, we fielded the first round of a household survey module on climate expectations and use of climate forecast information in March 2001, prior to the onset of the long rains. Between June and July 2001, the follow-up module was implemented (Luseno et al., 2003). This survey followed upon the heels of a severe drought, one of the worst in the Horn of Africa in many years. Having just endured an acute drought, pastoralists were sensitive to the upcoming season's rainfall, rendering our survey instrument particularly relevant.

Our survey found that modern seasonal forecasts, such as those issued by the DMC in Nairobi, though disseminated via newspapers, television, extension agents, and radio, are received by a mere 20% of households in our survey area. Radio is the predominant method of modern forecast broadcasting, as other media are infrequently accessible, with none reaching more than three percent of the pastoralist population. As only 23% of the Kenyan households and 5% of the Ethiopian households in our survey own a radio, material constraints place an upper bound upon the number of pastoralists who are able to receive radio-disseminated forecasts. In seven of the ten sites, a majority of those sampled either did not have access to a radio or were not aware that forecasts were available on the radio.

Lack of radios and DMC forecasts does not imply that pastoralists are ill-informed regarding climate. Pastoralists have a long and varied tradition of indigenous climate forecasting. In our sample, a broad spectrum of traditional forecasts methods ranging from animal and wildlife behavior observation to intestine interpretation were received by greater than 90% of respondents. Respondents typically had a high degree of confidence in these predictions, though some methods inspire more widespread confidence than others. Most respondents received traditional forecasts from multiple sources, reflecting that that the suite of traditional methods elicits confidence from the overwhelming majority of the regions pastoralists. The average overall confidence in traditional forecasts was 77%, far surpassing confidence in modern forecasts, which registered a mere 23%. Though there existed much site variation, in 10 of the 11 survey locations, confidence in traditional forecasts exceeded that for modern forecasts. In general, Kenyan respondents were more trusting of modern, computer-based forecasts than their Ethiopian counterparts.

Though indigenous climate forecasts dominate, a nontrivial cohort of pastoralists are interested in hearing external forecasts because they have both access to and confidence in them. Respondents in Kenya are more likely to have access to and confidence in external forecasts, as are those who reside near a town or major highway. Location of residence or work determines who receives information about meteorology-based climate forecasts, with more favored areas getting better information. In addition, educational attainment plays a significant role as well. Since greater educational attainment is associated with higher and more stable cash incomes, this implies the same type of wealth bias frequently found in technology adoption studies. Climate

forecasts based on meteorological science appear to be reaching a relative elite that has sedentarized and enjoys good market access and non-pastoral income within the drylands of northern Kenya and southern Ethiopia.

When asked what type of forecast information pastoralists deemed most useful, respondents overwhelmingly regarded knowing the start date for the rainy season as most valuable variable of interest. The amount of rainfall in their home area, the end date or duration of the rainy season, and the rainfall in areas they might migrate were also considered important forecasts. In regards to timing, respondents living in drier locales regarded four to five weeks of advance notice as ideal to take forecasts into account. In wetter climes where agriculture is practiced, the lead time for a forecast to be useful extends to eight or ten weeks. This is consistent with similar results among farmers in Burkina Faso, where Roncoli et al. (2002) likewise found that farmers sought forecasts one to two full months prior to the onset of the rainy season. Unfortunately, it is not clear whether climate modelers will have the capacity to offer long-lead timing forecasts in the coming few years (Goddard et al., 2001).

The biggest impediment to fulfilling the potential of forecasts is the transformation of acquired modern information into behavior modification. Information is valuable in so far as people are willing and able to act upon it. If people either cannot or will not change behavior in response to information they receive, then the information has no practical value. Despite the stated confidence in traditional forecasts, surprisingly few respondents altered their behavior after receiving forecasts. Only about one quarter of our respondents changed their behavior on the basis of the forecast start dates for the 2001 long rains, while fewer than ten percent of those who received external forecasts of rainfall volumes in their own locations adjusted behavior in response.

In a companion piece to the Luseno et al. study, Lybbert et al. (2003) investigate whether this lack of response is due to an inability of pastoral populations to comprehend probabilistic forecasts. This study addresses the hypothesis that the lack of a change in production practices observed resulted from an inability to understand and process the information contained in climate forecasts by the recipients. This hypothesis is rejected, as it appears that recipients update their prior beliefs based on new information as is predicted by the literature on the economics of information. The provisional hypothesis advanced to explain the relatively minor impact of forecasts on production practices is that the built in flexibility of pastoral production in response to rainfall makes it largely unnecessary to react to a forecast *ex ante.*

Of those who did alter their behavior based upon forecasts, most changes were with respect to cultivation practices, rather than herd management strategies. Since crop production systems require strategies based upon climate expectation, such as choice of crops and planting decisions, cultivators are inclined to employ climate forecasts. Pastoralists, on the other hand, move their herds based upon scouting reports of realized rainfall and range conditions in lands they have access to, rather than on the basis of forecasts. As opposed to sedentarized agriculture characterized by limited flexibility once crops are chosen and planted, highly adaptable livestock systems adjust to spatial-temporal variation in range conditions through migration.

Since crop cultivation is growing rapidly among the stockless pastoralists settled around towns where cropping is ecologically feasible (Little et al., 2001), climate forecasting may be of greatest potential benefit to these dispossessed subpopulations in transition. In the longer term, it may be that the emergence of reliable and accessible seasonal forecasts at appropriate spatial scale may help foster some shift from more flexible pastoralist production systems to potentially higher return sedentarized production systems in semi-arid areas where sufficient water can be tapped to support such strategies. However in arid areas and in the short term until technological limitations are overcome and long-lead spatially-specific forecasts can be made, there do not exist viable alternatives to the highly flexible system of semi-nomadic grazing. In this context, the value of computer-generated climate forecast information appears quite low.

Our evidence suggests that climate information is not a particularly limiting factor to pastoralists' livestock marketing behavior. Though few respondents received modern forecasts, confidence in traditional forecasts outweighed confidence in modern forecasts by a three to one factor, and despite the high degree of confidence in traditional forecasts, few respondents changed their behavior in response to the additional information garnered. This evidence calls into question arguments that improved production and dissemination of climate forecasts should be a high priority investment as donors and governments strive to reduce pastoralists' vulnerability to climate-related shocks. Rather, greater attention needs to be given to what infrastructural and institutional advances are necessary to facilitate the use of climate information within the livelihood strategies prevailing in these fragile systems. East African pastoralists appear to place negligible value at present on modern climate forecast information.

PRICE FORECASTS

There does not seem to be a dearth of information about livestock prices in the rangelands of northern Kenya and southern Ethiopia either. Respondents to the May-June 2002 household livestock marketing survey module were asked to cite up to four market price information sources they use and the frequency with which they update the information on livestock prices they receive from each source. On average, respondents received information from two sources, 1.9 sources in Kenya and 2.1 in Ethiopia.

Respondents gathered information about livestock prices primarily through those whose job it is to know about livestock prices and to work the margins, traders (Table 11). Other prominent sources of information are friends, relatives, and livestock brokers. In our sample, nobody seems exempt from livestock price inquisition, including travelers passing through as well as the local tax collector. Interestingly enough, only 24 respondents in our survey inquired after sellers of livestock about prices, perhaps reflecting the sensitive nature of livestock and money. Moreover, note that few respondents go to market to observe transactions and collect price information first-hand. Rather, people rely on information networks to generate and distribute reliable, timely information about market conditions. Given the range of price information sources used and the frequency with which they are consulted (Table 12), one needs to ask precisely what sort of price information seems to be missing from the local market in order to justify significant new expenditures in support of additional market price information generation and dissemination activities.

Table 11: Sources of Price Information

Traders	56.44%
Friends	45.45%
Relatives	38.64%
Brokers	34.47%
Others who go to market	13.64%
Sellers	12.88%
Producers	11.74%
Travelers	10.61%
Go to market	7.20%
Neighbors	5.30%
Other	9.47%

Table 12: Frequency with which Respondents Check Primary Price Information Source

	KENYA	ETHIOPIA
Daily	24.32%	6.03%
Every Few Days	20.27%	10.34%
Weekly	16.22%	37.07%
Every Few Weeks	19.59%	15.52%
Monthly	8.78%	10.34%
Every Few Months	4.05%	11.21%
Rarely	2.70%	9.48%
Never	4.05%	0.00%

Table 12 shows that nearly half (45%) of the Kenyan respondents checked on market prices either daily or every few days, as opposed to only 16% of respondents in Ethiopia. 80% in Kenya and 68% in Ethiopia checked their primary source of information at least every few weeks.

Pastoralists are not the only stakeholders who keep reasonably close tabs on market price developments. Modern technology enables traders to stay abreast of prices in major markets. As Mahmoud (2003) notes:

> The availability and use of mobile phones by northern traders in Nairobi makes it easy to communicate to their partners in Moyale about current market conditions in Nairobi. It is common to observe Moyale-based traders rushing back and forth between the market and phone facilities in Moyale to assess the current market conditions before making purchase decisions (p.186).

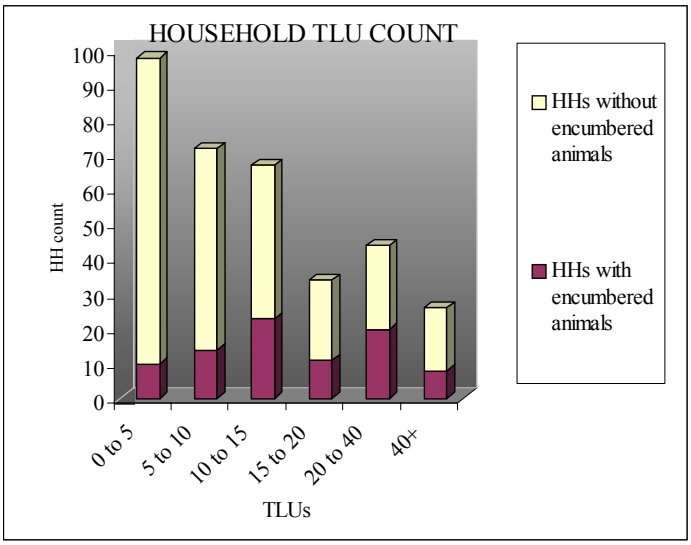
Many northern Kenyan traders based in Nariobi use mobile phones to call their Moyale-based partners to relay information about market prices and to 'order' shipments of cattle. Moyale only has land line telecommunications services at present, but plans are underway to extend the country's mobile phone service to the area (Mahmoud, 2003).

C. COMPLEX PROPERTY RIGHTS

In regards to market potential, borrowed animals or those herded for others are qualitatively different than those for which complete, alienable property rights are clearly established. In the study region, animals are often given or loaned to others in times of need. While the exact arrangements of gifts and loans vary subtly across ethnic groups and clans and over time, perhaps the most common arrangements give the borrower rights to the milk and any offspring born to the borrowed animal(s), while ownership claims over the loaned animal(s) remain with the lender. If in need of cash, a pastoralist must consider ownership of each animal while

making decisions as to which livestock assets to liquidate via the market. We hypothesize that traditional livestock loaning and gifting arrangements may constrain pastoralists' ability to market livestock burdened with complex property rights.

Figure 5: Households with Encumbered Animals, by Household TLU Holdings

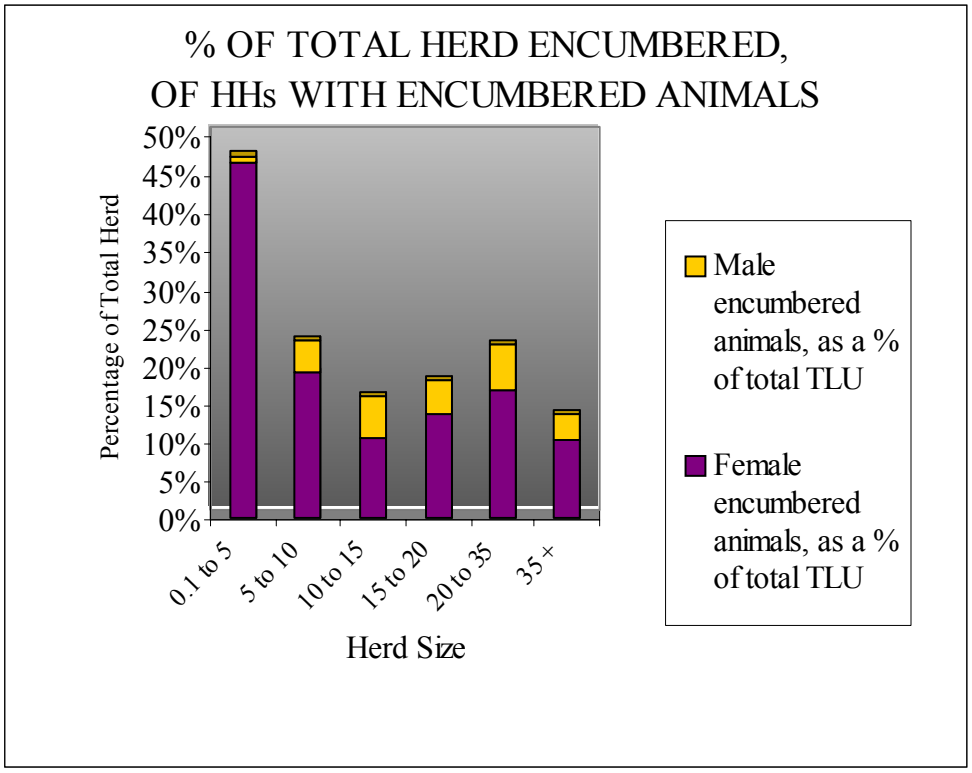


We define animals as encumbered with complex property rights if they are borrowed from or herded for someone else. Of the 338 participants in the household survey, 25% had animals burdened with complex property rights at the time of the baseline survey in March 2000.

Figure 5 presents these households stacked below households without encumbered animals, grouped by initial herd size. Of the 86 households, encumbered animals constitute 19% of the herd, on average. Animals borrowed are predominantly female. 40 of these 86 households received exclusively female animals, and the average household herd size of these respondents was 14.8 TLU. Of the 8 households that claimed only encumbered males, their average TLU was significantly higher, 40 TLU. This seems to reflect the difference between lending female animals to poor families, so as to augment milk production to help ensure survival, as opposed to lending male animals out to others to herd for reasons of convenience, as when a pastoralist with full-time salaried employment invests in a larger herd and loans many of his bulls out to his unemployed brother for trekking to distant pasture and water (McPeak and Little forthcoming). Figure 6 presents the percentage of household TLU comprised by encumbered animals across households arrayed by their initial TLU holdings.

Considering first the households with five or fewer TLUs., we find that 43.5% of their HH herd are encumbered females. These households teetering on the brink of catastrophe receive predominantly female animals to provide milk and, hopefully, offspring, thereby augmenting income and improving their chances of asset accumulation through herd rebuilding. Nearly half of the total TLU holdings of these households are encumbered, and almost all of these animals are females, underscoring the social safety net function of the complex traditions of livestock borrowing. The other recipients of animals encumbered with complex property rights own larger herds and receive fewer females relative to the first group. Owner convenience, as opposed to recipient insurance, explains the smaller proportion of encumbered animals to total household livestock holdings.

Figure 6: Percentage of Total Herd Encumbered



We used our regression model to test whether or not the percentage of a household's animals encumbered has any effect on its market participation or on its net livestock transfers conditional on participating in the market. We find that complex property rights have no statistically or economically significant effect on the market participation decision. The greater the share of encumbered animals in one's herd, however, the lower are a household's expected net livestock sales – a result that proves statistically significant at the 15% level in two of the three specifications. This not only corroborates the intuition that animals encumbered by complex property rights related to traditional gifting and loaning arrangements are less likely to be sold, these findings are also consistent with the observation that while most encumbered animals are female, greater than two-thirds of marketed animals are male (Barrett et al., 2003).

D. LOW AND VARIABLE PRICES FOR ANIMALS SOLD

In corroboration of previous studies such as McPeak (2004), we find an unclear relationship between the price of animals and both the decision to market animals as well as the quantity of animals marketed. We included the time and site-specific observations of the log of average smallstock and largestock prices in the Heckman regression model. In the market participation decision, the signs of the coefficients corresponding to the log of average prices prove inconclusive, equally split between positive and negative, and not statistically significantly

different from zero. Similarly, in the regression of net TLUs marketed, the signs of the coefficients are once again equally split between positive and negative, and significant in only one of the six instances in which log of price appears.

In short, there exists no clear relationship between the price of animals offered on the market and marketed offtake. This results from the forces driving the pastoralist decision to market animals. Livestock serve a dual role, providing a store of wealth as an asset, as well as providing a stream of income, via milk supply and calving. As noted by McPeak (2004), both asset shocks and income shocks impact herder sales behavior. During the rains when herds are increasing through natural reproduction, herders are more likely to sell animals, as they have greater confidence in the size of their future herd, thus rendering some older animals expendable on the market as new animals are born to replace them. In addition to the asset effect, during the rains there is more milk, enabling households to meet a greater share of their consumption needs via home produced milk, as opposed to selling milk for cash in times of rainfall deficit and milk shortage. Both sales and livestock prices tend to increase with the rains. Rainfall shocks impact both milk production and herd growth, resulting in simultaneous income and asset shocks.

In the opposite direction, low rainfall results in less milk production. This negative income shock pressures pastoralists to market their animals in order to compensate for fallen income. As animals fall victim to drought, the negative asset shock places downward pressure on marketed off-take rates as pastoralists struggle to preserve their herd in order to replace the animals lost to drought. Both sales and prices decline as drought hits. Concurrent income and asset shocks related to rainfall (or disease or other external drivers) influence sales, but in countervailing directions. The overall impression of net sales behavior unresponsive to price thus appears to mask household response to both income and asset shocks generated by single events such as drought.

E. HIGH COSTS AND RISKS OF MOVING ANIMALS TO MARKET

HIGH COSTS

Due to the poor state of transport and marketing infrastructure in the study region, many observers cite high costs of moving animals to market and of traders evacuating animals from up-country source markets to terminal markets (e.g., Addis Ababa, Nairobi) as a pervasive problem crippling the livestock marketing chain (Bailey et al. 2000, Mahmoud 2003).

In the Livestock Marketing Module survey fielded in May and June of 2002, we collected data on the animals bought or sold during the respondent's most recent trip to market and the cash expenses incurred in the process. We emphasize that we can only discuss cash expenditures, which clearly underestimate total economic costs that include the pastoralists' time, risk, etc.

Marketing costs can be divided between variable and fixed costs, where the former reflects costs that increase with each animal sold and the latter reflect costs that affect only the discrete decision to participate or not in the market. High fixed costs create increasing returns to scale in livestock marketing, discouraging small volume sales. High variable costs, by contrast, are scale invariant in their effects, serving just to reduce net proceeds from sales. Variable costs such as

animal transport, council fees, and animal health certification, are generally species and market specific. In principle, these fees constitute an unavoidable cost of selling livestock at the market, however some markets, such as Kargi, Suguta Marmar, Finchawa, and Wachille, are clearly more systematic than others in collecting these fees. Estimated fixed costs include transporting the seller or buyer, food, lodging, bribes, and broker fees, though inherent in the marketing process, vary from pastoralist to pastoralist, and with sales volume. As Table 13 illustrates, 67% of Kenyan market participants and 79% of Ethiopian pastoralists in our sample marketing their livestock incur some sort of cash costs in their livestock transactions, though the percentage of those incurring fees varies greatly by site. In sites close to large markets, Ng'ambo and Dillo, few respondents reported incurring marketing costs, as both sites are close to major markets so transportation, food, and lodging costs can be avoided, and the need for veterinary medicines can easily be met as the need arises. In more remote and pastoral sites, such as Kargi, trekking to town constitutes a non-negligible investment of time and needs such as medicines might be deferred until a trip to town to market livestock.

Table 13: Percentage of Participants Incurring Marketing Fees

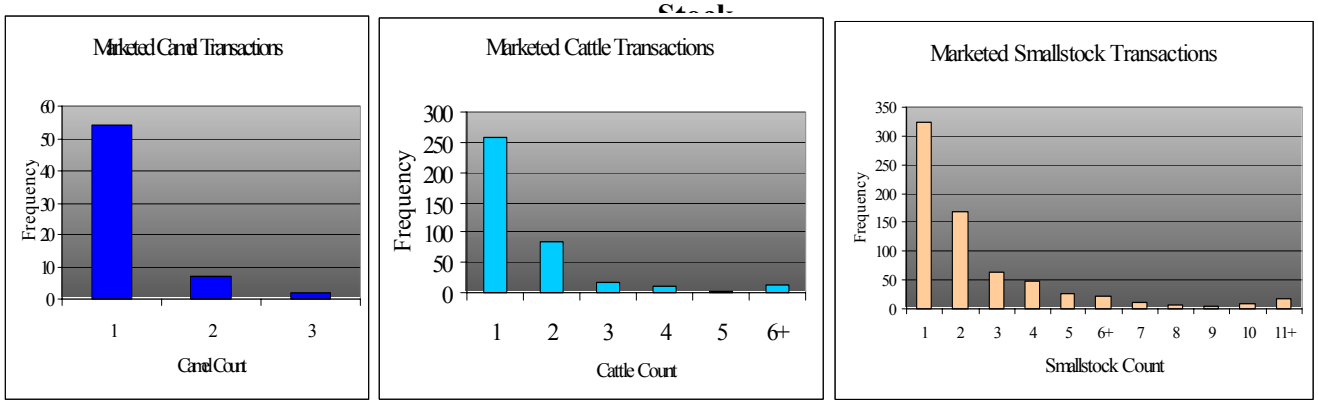
	Respondents Marketing Livestock	Total Respondents	% of Market Participants Incurring Marketing Fees
Dirib Gombo	18	22	77%
Kargi	20	20	100%
Logo Logo	21	18	83%
Ngambo	12	16	6%
North Horr	20	20	40%
Suguta Marmar	11	11	100%
Total Kenya	102	107	67%
Dida Hara	16	17	94%
Dillo	14	16	25%
Finchawa	18	9	100%
Wachille	20	20	100%
Total Ethiopia	68	62	79%

As evinced in Table 14, few of our sample pastoralist households paid to transport animals either to or from market either via truck or paying a trekker. In Ethiopia, only one pastoralist in Wachille paid to trek a herd of cattle to market. No other households incurred cash transport costs in marketing, although they certainly spend time taking animals to and from market. In Kenya, more pastoralists paid to trek or truck their animals to market during their last trip, though frequency varies with site. In Dirib Gombo and Ng'ambo, sites close to market, no pastoralists paid to transport their animals to market. In more remote locations such as Kargi and North Horr, 26% and 34% respectively of smallstock sold or bought incurred transportation expenses. Kargi was the only Kenyan site where pastoralists hired labor to trek their animals.

Trekking or trucking of animals are not the sole transportation costs borne by pastoralists marketing their livestock. They have to displace themselves as well. In both Kenya and Ethiopia, the average costs of human transportation exceed those of transporting the marketed animals. The sum of animal and human transport costs comprises the largest component of marketing costs in both Ethiopia and Kenya, 44% and 60%, respectively (Figure 8). Improving upon the notoriously poor infrastructure would presumably alleviate the high costs of transportation in the region by increasing security, traffic, market access, and speed of travel.

Perhaps more striking, and somewhat counter to what seems to be the conventional wisdom in donor and policy circles, pastoralist households' cash expenses in livestock marketing are quite low. As reflected in the two rightmost columns of Table 14, variable costs average less than six percent of total revenues in each site – and less than two percent in each of the Ethiopia sites. Fixed costs are uniformly larger than variable costs in Ethiopia, but still reasonably modest, at less than nine percent of total revenues. In Kenya, there is considerable spatial variation in fixed costs. With Kargi – a relatively remote site – and Logologo exhibiting the highest fixed costs of market participation. These figures are necessarily an overestimate since most pastoralists combine livestock sales or purchases at market with other transactions they need to execute in town (e.g., purchase of animal or human medicines, picking up food aid rations, or visiting government offices or shops). The relatively modest levels of fixed costs are likewise reflected in the relatively modest size of average transactions – less than two large stock or four small stock per transaction in each site – and the absence of any strong correlation between average fixed costs and mean livestock marketed per transaction. Just greater than half (50.5%) of marketed transactions are for one animal only. Figure 7 shows the distribution of transactions volumes, underscoring the small lots traded, no matter the species involved.

Figure 7: Frequency of Marketing Quantities of Camel, Cattle, and Small Stock



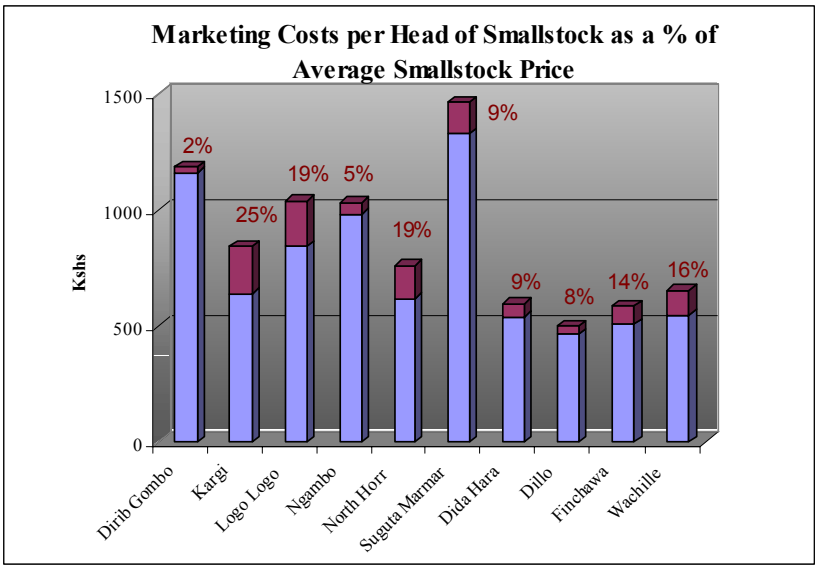
Figures 8a and 8b illustrate that, in percentage terms, marketing costs are relatively greater for small stock than large stock, largely reflecting the fact that, small stock marketed outnumber large stock marketed by a factor of three to one. Of the 3041 animals purchased or sold, as reported in the repeated household head surveys, 2280 were either goats or sheep. In more remote, drier sites, this factor increases. In North Horr, for example, 5 large stock were marketed, as opposed to 297 small stock. It is worth noting here that in North Horr, all livestock marketed during the course of the survey period were sold; there were no livestock purchases among our sample between March 2000 and June 2002.

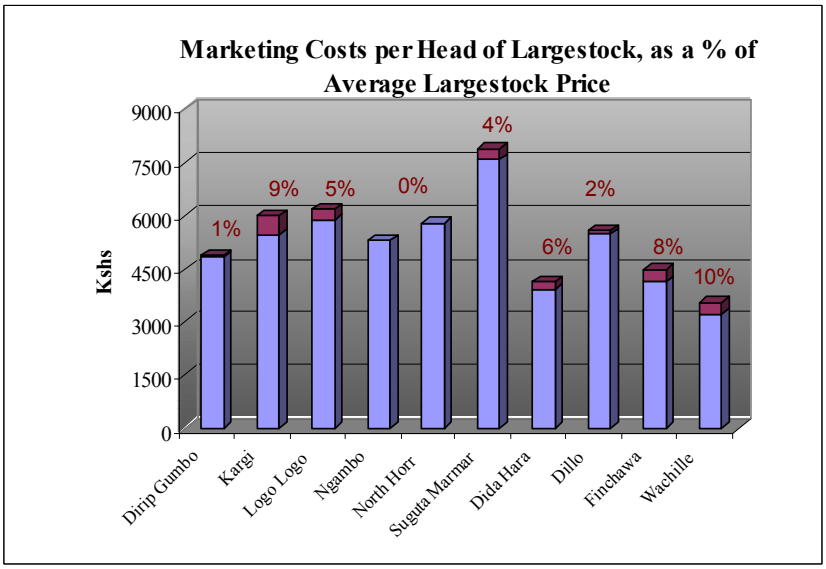
Table 14: Marketing Costs Incurred, by Cost Category and Site

	LIVESTOCK TYPE	LIVESTOCK MARKETED PER TRANSACTION	% PAID TO TRANSPORT ANIMALS	AVG COST TO TRANSPORT ANIMAL/HEAD (Kshs)	% INCURRING COUNCIL FEES	AVG COUNCIL FEE/HEAD (Kshs)	TOTAL AVG VARIABLE COSTS PER ANIMAL (Kshs)	TOTAL AVG FIXED COSTS PER MARKET VISIT (Kshs)	VARIABLE COSTS AS AN AVG % OF TOTAL REVENUE	FIXED COSTS AS AN AVG % OF TOTAL REVENUE
Dirib	Smallstock	1.79	0.0%	n/o	72.0%	26	26			
Gombo	Largestock	1.38	0.0%	n/o	72.7%	50	50	0	1.0%	0.0%
Kargi	Smallstock	3.41	75.0%	43.2	100.0%	44	87			
	Largestock	1.33	15.0%	300	25.0%	100	400	54	2.9%	11.1%
Logo										
Logo	Smallstock	1.25	14.3%	50	86.7%	39	89			
	Largestock	1.83	14.3%	150	90.9%	100	250	41	3.4%	17.6%
Ngambo	Smallstock	3.27	0.0%	n/o	5.6%	50	50			
	Largestock	1.80	0.0%	n/o	0.0%	n/o	0	50	0.2%	0.5%
North										
Horr	Smallstock	2.16	70.0%	61.7	43.9%	20	82			
	Largestock	1.00	0.0%	n/o	0.0%	n/o	0	440	5.4%	0.7%
Suguta	Smallstock	1.20	36.4%	42.5	100.0%	36	78			
Marmar	Largestock	1.00	9.1%	250	100.0%	50	300	24	5.9%	5.1%
Dida										
Hara	Smallstock	1.75	0.0%	n/o	85.7%	30	30			
	Largestock	1.67	0.0%	n/o	100.0%	120	120	16	1.6%	7.4%
Dillo	Smallstock	1.09	0.0%	n/o	0.0%	n/o	0			
	Largestock	1.40	0.0%	n/o	0.0%	n/o	0	96	0.0%	1.8%
Finchawa	Smallstock	2.13	0.0%	n/o	64.7%	40	40			
	Largestock	1.91	0.0%	n/o	100.0%	139	139	19	0.6%	8.9%
Wachille	Smallstock	1.50	0.0%	n/o	100.0%	40	40			
	Largestock	1.22	5.0%	100	100.0%	137	237	16	0.5%	7.5%

The cost of marketing animals relative to the price the animals received on the market varies from site to site. For small stock, marketing costs ranged from two percent in areas close to town like Dirib Gombo, to 25% in more remote areas like Kargi. Less variation was observed with regards to the costs of marketing large stock. No cash expenses were incurred in both North Horr and Ngambo, (recall that only five largestock were marketed in North Horr, and Ngambo has a major livestock market in the nearby town of Marigat), with a maximum of 10% of large stock price in Wachille.

FIGURE 8 a,b: Marketing Costs as a Percentage of Average Price





The informal impression that cash marketing costs do not pose a big impediment to livestock marketing appears borne out by the econometric analysis. Marketing costs have no statistically

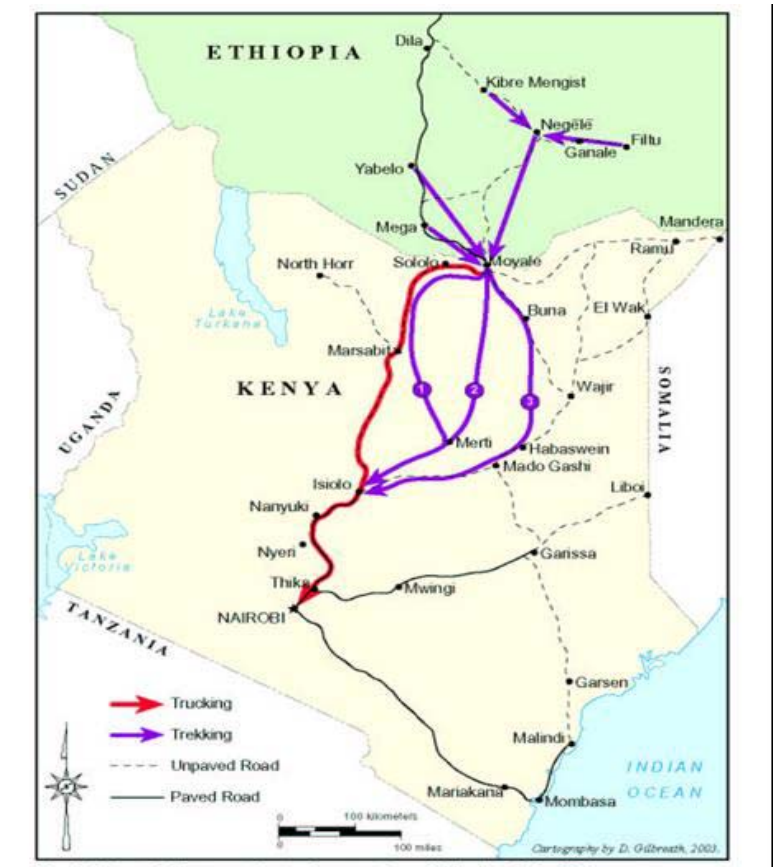
significant effect on either market participation or net marketed volumes. The point estimates are quite small for both small stock and large stock and the coefficient estimates are of opposing signs for the two.

While marketing costs do not appear to make a big difference for individual pastoralist households, they figure prominently in trader behavior and in the spatial correlation of livestock prices (Barrett et al. 2003). Mahmoud's study (2003) highlights the critical role that transport costs play in the regional livestock marketing chain. Most traders in the area indicate transport as the single most significant cost constraint. In one interview recorded by Mahmoud, a trader lamented that:

> "If really this data collection is going to be helpful to us (northern Kenya cattle traders), something must be done to stabilize trucking costs. We incur high transport costs, which consume a big portion of our profits. When cattle markets in Nairobi improve (leading to increased cattle in Moyale), truck owners increase transport costs as they wish."

The above trader has been in cattle business for only a year and has found the cost of trucking a constraint to his commercial progress. These sentiments are shared by the majority of traders (Mahmoud 2003: 272).

Figure 9: Livestock Trekking and Trucking Routes

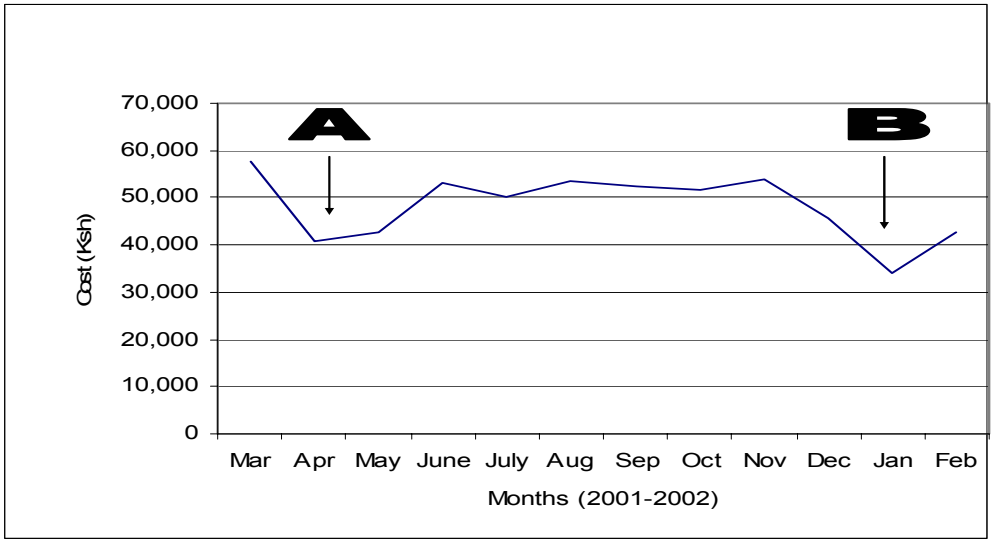


Map 3. Livestock Transport Routes from southern Ethiopia to Nairobi, Kenya.

Figure 9, from Mahmoud (2003), maps the livestock marketing routes used to move animals from southern Ethiopia to Nairobi. While lorries are regularly filled with animals, especially higher value Boran breed cattle, many animals are trekked long distance across the border and down to the region's principal terminal market at Nairobi. Some of these animals are no doubt further evacuated via Mombasa port to international markets. But the vast majority enter the domestic slaughtering and meat marketing channel.

From the perspective of the trader, livestock transportation costs in northern Kenya and southern Ethiopia are a function of several factors, including distance between markets, mode of transportation, and cattle supply. Trekking cattle to markets can be a cheaper way of transportation, but the decision to trek is influenced by yet a different set of factors: security, availability of water and pasture, and the kind of relationship between the trader and ethnic groups residing en route. The main commodity transported from Moyale to Nairobi is livestock, while a variety of merchandise – used-clothes, hardware materials, foodstuffs, timber, plastic ware, and household goods – are back-hauled from Nairobi to Moyale. The costs of hiring a truck from Nairobi to Moyale average about Ksh. 20,000, while the costs of transporting livestock from Moyale to Nairobi ranged between Ksh. 30,000 and 70,000 per trip from March 2001 to February 2002 (Figure 10, Mahmoud 2003, p. 181). Confronted with such circumstances, transporters make up for losses by charging cattle traders exorbitantly high trucking costs (Mahmoud 2003: 181).

Figure 10: Truck hiring cost in northern Kenya (for cattle, Moyale to Nairobi)[5]



HIGH RISKS

Livestock raiding has a rich and long history in the study area. Oral histories refer to years of particularly devastating (or alternately, rewarding) raids in reference to the raids themselves. Since time immemorial, livestock have been subject to raids from other tribes, and other clans

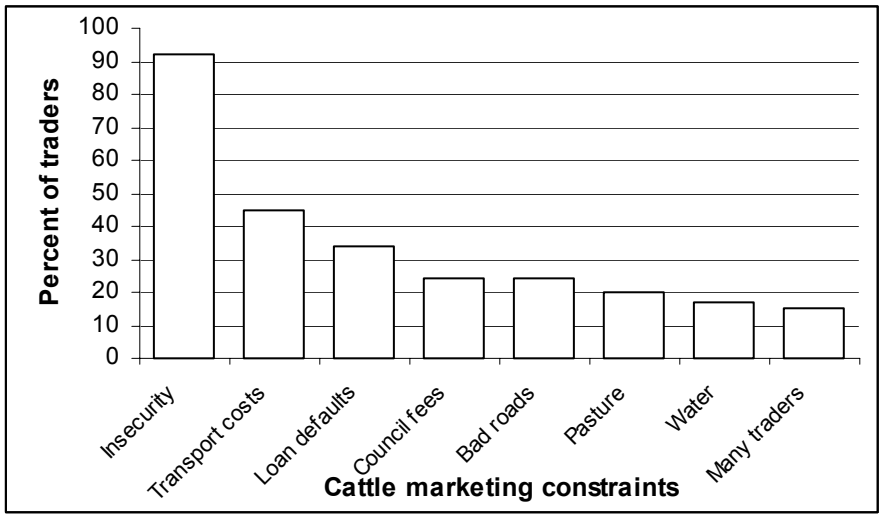
[5] Trough A represents low cattle trucking costs because of low levels of cattle supply from southern Ethiopia. Trough B represents low cattle trucking costs caused by low demand for beef in Nairobi.

within ethnic groups. The influx of automatic weapons has altered the scope of the danger associated with raids, which continue to play a focal role in rites of passage ceremonies (Fleisher, 2000).

Based on reports from the community surveys as to when residents had suffered raids, we were able to establish a dummy variable measure to capture the occurrence of a raid during a given survey period. When we include that variable in our regression model, we find that insecurity significantly increases the likelihood of market participation, and also has a positive and statistically significant effect on net livestock purchases. This is not a surprising conclusion. Instances of insecurity prompt pastoralists to relocate from relatively remote and dangerous areas to more populous areas closer to market, thereby increasing the likelihood of market participation. Insecurity is also more likely to force pastoralists into the market to purchase animals to replace those lost to raiding.

From the perspective of the trader, insecurity is the primary risk faced (Figure 11). To deal with the risk of transporting large amounts of cash across long distances from northern Kenya to Nairobi and vice versa, traders frequently use informal 'money services' to allow cash from Nairobi sales to be picked up back in Northern Kenya. They may also transfer their cash in Nairobi to a wholesaler who is buying goods for transport to Moyale and the trader can then pick up the cash from the wholesaler's business back in northern Kenya (Mahmoud, 2003).

FIGURE 11: Traders' declared cattle marketing constraints in northern Kenya (N=71)



Source: Mahmoud (2003:161)

Table 15: Cattle trading partnerships and ethnicity in northern Kenya (N=54)

Ethnic relations of trading partner	Percent
From the same ethnic group	96.3
From a different ethnic group	3.7
Total	100.00

Source: Mahmoud (2003: 218)

To deal with security and market risks, traders in northern Kenya frequently form partnerships and place a partner in the Nairobi market. These partnerships usually (> 95 percent of the total) are among members of the same ethnic groups (Table 15). Seventy-eight percent of traders in northern Kenya have at least one trading partner, although only 16 percent of Ethiopian traders do. Trading risks increase as one approaches the terminal market in Nairobi, which may explain the different pattern of partnerships in the two regions (Mahmoud 2003: 216). Partnerships also facilitate the collection of credit and payments from large Nairobi-based meat wholesalers, which can be a serious problem for northern Kenyan traders.

F. FRAGILE HERD STRUCTURE

Though greater than 70% of total herd is typically comprised of female animals, while less than one third of marketed animals are female (Barrett et al, 2003), we investigated the effect of percentage of herd which is female upon the marketing behavior of the survey sample. Kerven (1992, p. 109) asserts that historically livestock trade "provided [pastoralists] a vital means of restructuring or rebuilding herds or flocks, through conversion of one livestock species for another and by exchanging male for female animals." But as we have already demonstrated, pastoralists appear not to use markets much at all for purchases, almost exclusively for sales. If pastoralists do not use markets for restocking or restructuring herds – most likely due to limited cash liquidity – then herd structure may impede marketing as well, in so far as herders try to hold onto fertile females and quality bulls for breeding. We therefore hypothesize that since herd growth is critical to pastoralist welfare (Lybbert et al. forthcoming), and because herd growth comes overwhelmingly through biological reproduction (Table 8), pastoralists will be less likely to sell, for any given herd size, when a greater proportion of their livestock are female. In a regression context, this hypothesis would imply a positive coefficient relating net TLU purchases to the percentage of their herd that is female, as a greater proportion of female animals means fewer males available for market.

Our data fail to support that hypothesis. The coefficient estimates on the percentage of females in the herd are negative in two of three regressions, albeit only statistically significant at relatively high p-values. This further underscores the core point that northern Kenyan and southern Ethiopian pastoralists do not seem to be using markets to restructure or rebuild herds, contrary to existing claims in the literature.

G. BORDER CLOSURES AND QUARANTINES

Parallel research in this region using detailed transactions data finds that quarantines are a significant source of price risk and that they reduce expected livestock prices received by pastoralists (Barrett et al. 2003). Quarantine erects barriers to trade by impeding commerce and thinning markets in pastoral regions. These effects not only exacerbate risk but also cause substantial revenue losses for herders. Though the effects of quarantine upon livestock prices at terminal markets in Nairobi is negligible, Barrett et al. (2003) find significant negative effects on the prices received and the price variability faced by pastoralists. Pastoralist producers absorb the price shock created by quarantines, simultaneously insulating both Nairobi consumers and

protecting highland ranchers. As the highland subpopulations are much wealthier than northern pastoralists, quarantines appear a distributionally regressive means of animal disease control, wherin the poor pay the costs of benefits born largely by wealthier citizens.

Though more prevalent in Kenya, where four instances occurred between June 2000 and June 2001 as opposed to Ethiopia, quarantine remains a relatively infrequent event, making it a bit difficult to tease out marginal effects on pastoralist marketing behavior in our data. In our model, we find quarantine to be insignificant in both the market participation as well as the net purchases part of the regression model. This result makes sense if we understand quarantines to affect pastoralist marketing behavior primarily through the prices they receive for their animals, given that we control separately for prices in this regression. Quarantine thus enters twice into the regression, once directly through the aggregate variable quarantine, and once indirectly, through its effects upon smallstock and largestock average prices. The direct effects of quarantine, as reflected in the estimated sign of the livestock market participation variable, are negative but very close to and not statistically significantly different from zero, suggesting that quarantines have little or no effect on market participation beyond their price effects, which we have already established to be likewise close to zero due to pastoralists' offsetting asset management and consumption smoothing objectives.

We would expect traders to drop out of the market as quarantines are imposed, with a more pronounced effect the closer the market is to the place of the quarantine. The traders who transport animals to the terminal market are the ones directly affected by the quarantine, as the smaller scale traders who trade in bush markets or secondary markets do not directly negotiate the quarantine as the quarantines borderline is drawn at the edge of the arid lands, protecting highland stock. The data show that the secondary markets immediately closest to the terminal market in Nairobi are those most severely affected by the quarantines as evinced a drop in the number of traders. The Kenyan markets closest to Nairobi typically characterized by a substantial number of traders, Ngambo and Suguta Marmar, suffer a nearly 50% decrease in the number of traders in times of quarantine (Table 16). We similarly observe a muted effect in Finchawa, the most accessible of our Ethiopia sites.

Table 16: Average Number of Livestock Traders at Market

QUARANTINE	Dirib Gombo	Kargi	Logo Logo	Ngambo	North Horr	Suguta Marmar
No	4.56	1.19	0.04	19.50	13.00	31.48
Yes	6.00	2.00	0.00	11.00	n/a	17.20
No	Dida Hara	Dillo	Finchawa	Qorate	Wachille	
Yes	1.60	8.10	98.66	31.85	2.30	
	n/a	n/a	96.07	n/a	n/a	

V CONCLUSIONS

Pastoralists in northern Kenya and southern Ethiopia participate actively in livestock markets. But the volumes transacted are small, limiting the possibility of any significant near term impact due to stimulus to broader regional and international marketing opportunities. Market transactions are almost exclusively sales, primarily of small ruminants (goats and sheep), to meet

households' immediate cash expenditure needs. There is no strong price response, apparently because prices move largely with the net present value of animals, as determined by prevailing health and range conditions, and pastoralists balance long-term herd building objectives with short-term consumption smoothing objectives when deciding whether and what to sell.

Overall, the strongest correlated of livestock marketing is herd size, suggesting that preserving or restoring the viability of large herds is the single most important factor in stimulating livestock marketing expansion in the arid and semi-arid lands of northern Kenya and southern Ethiopia. Cash marketing costs incurred by pastoralist households are surprisingly modest, holding bank accounts has, if anything, a negative effect on net sales, and information on climate and prices does not appear a significantly limiting factor on pastoralist market participation or sales volumes. The complex property rights associated with traditional gifting and loan transactions indeed limit marketing, but they play an important safety net role for pastoralists exposed to considerable risk. In sum, we find scant empirical support for many of the claims commonly made in current discussions of how best to stimulate livestock marketing off-take among pastoralists in this region. The best strategy appears to be generalized support for viable pastoralism.

Interventions probably make a greater difference at the level of traders. Transport costs and physical insecurity pose problems more for traders than for individual pastoralists. Quarantines and other impediments to trade in livestock clearly reduce the number of traders present in markets, reducing aggregate demand and thereby lowering prices and increasing the price risk faced by herders seeking to sell animals. Clearly better control of security and improved transport and market infrastructure would benefit herders and traders and general market conditions in northern Kenya (as well as the elimination of outdated quarantine measures)

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