Not Necessarily In The Same Boat: Heterogeneous Risk Assessment Among East African Pastoralists
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Not Necessarily in the Same Boat: Heterogeneous Risk Assessment Among East African Pastoralists

KEVIN SMITH, CHRISTOPHER B. BARRETT
and PAUL W. BOX

This article studies variation in risk assessment by pastoralists in the arid and semi-arid lands of southern Ethiopia and northern Kenya. Despite superficial homogeneity among east African pastoralists, we show that there exists considerable within-group heterogeneity in their assessment of various risks. We conceptualise risk as comprising four distinct components: objective exposure, subjective perception, ex ante *mitigation capacity, and* ex post *coping capacity. This conceptualisation provides an effective framework for understanding the observed heterogeneity as the natural consequence of (sometimes modest) structural differences in economic activity patterns, agroclimatic conditions, proximity to towns, wealth, and gender roles. It therefore provides a useful tool for drawing out the policy implications of subjects' expressed concerns about prospective livelihood hazards.*

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I. INTRODUCTION

As in much of Africa, pastoralists predominate in the arid and semi-arid lands (ASAL) that occupy 52 per cent of Ethiopia and 72 per cent of Kenya [*Markakis, 1993: 1*].[1] There are several common features that clearly distinguish pastoralists from other rural populations [*Waters-Bayer and Bayer, 1994*]. They occupy lowland ASAL, where low human population density and considerable climatic variability affect spatial and temporal variation in the availability of crucial natural resources, notably pasture and water. This spatial and temporal resource variation necessitates mobility of livestock, the main asset at the center of pastoral cultures and economies. Pastoral land tenure tends toward common property regimes instead of clearly defined plots or pastures. Families, clans and ethnic groups commonly negotiate shared access to resources, and when negotiations fail, raiding and warfare commonly result. Although sizeable in number, pastoralists are economically, environmentally, and politically marginal populations [*Majok and Schwab, 1996: 100, Markakis, 1993: 9–10*]. Pastoralists tend to be poorer and more food insecure than their highland, humid, and subhumid counterparts, to be less literate, to enjoy less access to public infrastructure and services, and to depend disproportionately on food aid.

Life for these nomadic, semi-nomadic and transhumant groups can be precarious. Over fifty million Africans in arid regions of the Sahel, Sudan, and East Africa face regular drought, animal and human disease epidemics, and diminishing spatial refugia for seasonal migration due to crop and town expansion and government programmes to sedentarise pastoralists, usurp group territorial rights, or gazette protected areas [*Baxter, 1991, 1993; Bonte and Galaty, 1991; Fratkin, 1997; Gilles, 1990*]. These and other common characteristics seduce many into assuming, if only implicitly, that pastoralists' experience and assessment of risk is reasonably homogeneous.

However, many of the challenges confronting East African pastoralists today apply only to identifiable subpopulations. Sometimes even modest variation in agroclimatic conditions or in historical experiences, or differentiation by age set, gender, wealth, or primary source of employment, can lead to strikingly divergent patterns of risk assessment. Researchers, donors, policy-makers, and development practitioners who want to understand and assist specific populations must begin by acknowledging that not everybody is 'in the same boat' with regard to the hazards they face. In this article, we use data collected among pastoralists in southern Ethiopia and northern Kenya to show (i) the considerable variation in risk exposure across distinct subpopulations, and (ii) that this variation can be usefully disaggregated conceptually into distinct components that can more readily

inform policy and project interventions aimed at reducing pastoralist risk. The predictable heterogeneity of risk assessment suggests that project and policy interventions in the East African ASAL probably have under-recognised and perhaps unintended distributional consequences.

II. DEFINITIONS, DATA AND METHODS

We define 'risk' as exposure to uncertain and potentially unfavourable consequences, and use the term 'hazards' synonymously. Risk is more than mere uncertainty – much less probabilistic uncertainty – which stems from imperfect knowledge but has no particular value assessment about consequences [*Hardaker et al., 1997*]. This simple definition, by its focus on the jointness of uncertainty and adverse outcomes, fits well the colloquial use and understanding of the term 'risk' and is therefore well suited to direct elicitation from respondents.

Our study area encompasses the rangelands of southern Ethiopia and northern Kenya along a north-east-to-south-west transect roughly bounded by the towns of Hagere Mariam and Negelle in Ethiopia and Isiolo and Maralal in Kenya (Figure 1). The major ethnic groups surveyed are Boran, Gabra, and Guji in Ethiopia, and the Ariaal, Boran, Gabra, Rendille, and Samburu in Kenya. All of these ethnic groups are predominantly and historically pastoralists, although farming has become important in areas that receive more reliable rainfall. The major store of wealth and the principal source of income is livestock [*Desta, 1999; Little et al., 1999*], with most animals heading to the terminal markets of Addis Ababa or Nairobi for domestic consumption [*Coppock, 1994; Barrett et al., 1999*]. Rainfall is low and highly variable within and across years throughout the area.

Data were collected between March and October 1998 using structured and unstructured interview and participant observation methods. The findings we report are not based on a large-scale random survey, but rather on opportunistic interviewing of groups selected to ensure coverage of communities with different economies, climates, and access to towns. We studied 120 groups, 49 from Ethiopia and 71 from Kenya. Attempts were made to interview one group of men and one group of women from each community, but this was not always possible. Instead, some of the 61 groups of men and 59 groups of women were interviewed opportunistically in towns on market days. Repeat visits to as many communities as possible were made to elicit more detail on the hazards respondents faced and how they attempted to address them.

We developed a simple 'participatory risk mapping' method to describe accurately cross-sectional and intertemporal variation in subjects' risk

FIGURE 1

STUDY AREA
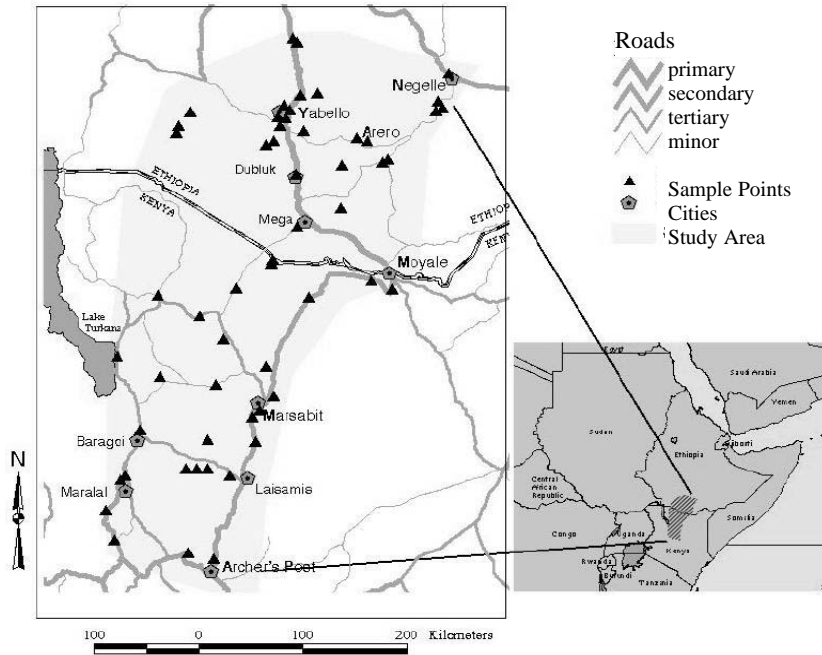
assessment. Respondents identify and order the hazards they perceive in an unrestricted fashion. Smith *et al.* [*2000*] describes this easy-to-field method in detail. Two key features of the data require some detailed discussion because they affect the empirical methods one can apply to these data. First, this participatory method has respondents identify the risks that concern them in an open-ended fashion, rather than respond to risks posited by the researchers. As a consequence, the number of hazards identified varies across respondents. Figure 2 shows that most of our respondents identified three or four hazards, with only three per cent declaring fewer than two or more than six. Second, once respondents identified the risks that concern them, they then ranked these by severity, so the data contain ordinal as well as categorical information on respondents' risk assessments.

The ordinality of the data permit ready comparison of risks for a given respondent, but since the number of identified risks varies across individuals, one needs to be careful about comparing the ordered data across respondents identifying different numbers of reportable hazards. Simply

FIGURE 2

FREQUENCY OF RISKS DECLARED
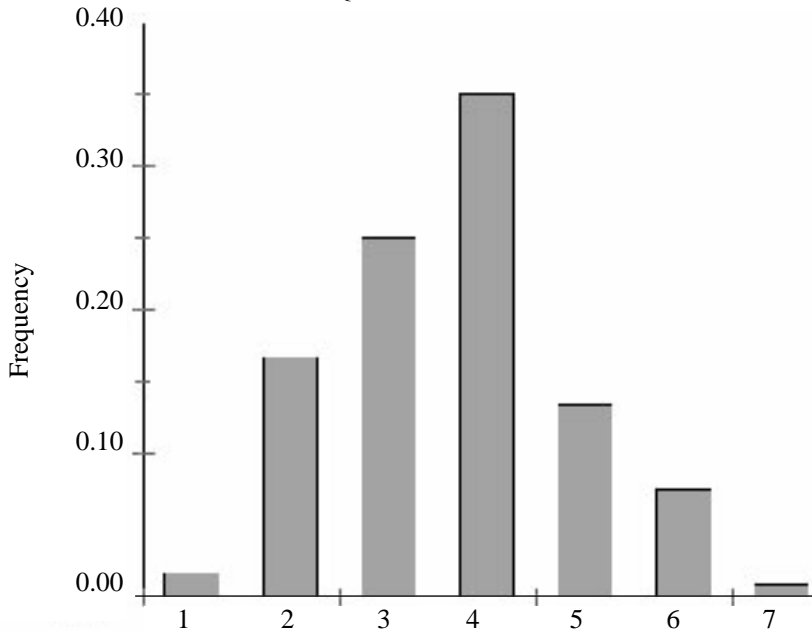
put, it matters whether a risk is assessed as second most important out of six or out of only two. We render the data comparable across respondents by constructing risk assessment indices, thereby rendering the ordinal data pseudo-cardinal. Later in this section we return to the implications of this for estimation.

The method of index construction is not self-evident with such data because of an unavoidable metric tradeoff. Any factor not identified as a hazard can surely take value zero, while the greatest hazard one faces can be arbitrarily assigned a value of one without loss of generality, yielding boundary values of zero (not identified as a source of risk) and one (identified as the primary source of risk) for each respondent. That part is straightforward. The question becomes how to handle 'interior values', those identified hazards not deemed of greatest concern.

A simple example might help clarify the issue. Imagine respondent one declares two factors, A and B, to be significant hazards, with A the more severe of the two. Respondent two declares five factors to be significant, A, B, C, D, and E, with A rated most serious, followed by B, C, D and E, in that order. So let A take value one for both respondents, as both deem it the greatest hazard they face. And factors C, D, and E clearly take value zero

for the first respondent since they were not identified as risks. The issue of index construction revolves then around how to handle factors like B. One reasonable approach is to employ uniform intervals between ranked factors for a given respondent using a risk-assessment index $R_{ij} = r_{ij}/n_i$, for respondents $i = 1,…,n$ and risks $j = 1,…,m$, where r_{ij} represents the ordinal ranking given risk j among the n_i risks identified by respondent i, with $r_{ij} = n_i$ for the most important risk, $r_{ij} = 1$ for the least important one, and $r_{ij} = 0$ for all factors not identified as risks by the respondent. R_{ij} therefore ranges from zero (not identified as a source of risk) to one (identified as the primary source of risk) for each respondent and prospective risk factor, with uniform intervals between interior risks. The weakness with this approach, however, is that the interval steps between identified hazards then vary across respondents because n_i is non-constant. In the present example, B is ranked second by both respondents, but would take value 0.5 for the first and 0.8 for the second. So interval lengths among ordered observations vary across respondents using the R_{ij} metric.

An alternative is to standardise the interval lengths across respondents using the alternative formula $A_{ij} = r^*_{ij}/n^*$, where n* is the maximum number of risks identified by any respondent ($n^* = \max_i n_i$) $r^*_{ij} = n^*$ for the factor j rated most serious by household i, $r^*_{ij} = n^*-1$ for the factor rated next most serious, etc. As shown in Figure 2, $n^* = 7$ in our data, so in the present example, B would take value $A_{iB} = 6/7 = 0.86$ for both respondents, resolving the problem with the R_{ij} metric. The weakness with A_{ij}, however, is that the intervals are now nonconstant across hazards within a household. For example, the step from A to B is of length 0.14 for the first respondent, but from B to C is of length 0.86 despite the fact that no hazard was identified as more serious than C but less serious than B. This imbalance in treatment among ordinal data is clearly undesirable.

The basic problem then is the unavoidable tradeoff between uniform intervals across or within respondents' listings when those listings are of different length. Each measure increases in the incidence of the risk, but the two measures represent the ordinal information in the data in slightly different ways.

Two reasonable, yet imperfect, candidate multivariate regression methods exist for data such as these. The first is doubly-censored estimation, in which the dependent variable, R_{ij}, maps to a latent variable, R^*_{ij}, and to the vector of independent variables, X, according to the following relation:

$$R_{ij} = 0 \text{ if } R^*_{ij} \leq 0 \qquad (1)$$
$$R_{ij} = R^*_{ij} = \alpha + X_i\beta + \varepsilon_i \text{ if } 0 < R^*_{ij} < 1$$
$$R_{ij} = 1 \text{ if } R^*_{ij} \geq 1$$

with $\varepsilon_i \sim N(0,\sigma^2)$. The distribution for R_{ij} is then a mixture of the continuous distribution of R^*_{ij} in the open interval $(0,1)$ and discrete mass at the boundary points, zero and one, absorbing the full density of R^*_{ij} outside the open interval $(0,1)$. The latent variable, R^*_{ij}, captures the unobservable full relationship of respondents to the factors under study. If we think of this in the framework of neoclassical economics, one might think of R^*_{ij} as the premium respondent i would be willing to pay to resolve the uncertainty surrounding factor j. Since risk premia can be negative or positive and the risk assessments in our data are defined purely in relative terms (relative to the greatest among them), the responses to our question about concerns, thereby implying a positive risk premium, are necessarily doubly-censored at zero and one, giving rise to our use of this method.

The β parameter estimates derivable using these data are none the less hard to interpret because of the underlying ordinality of the data and cross-sectional variation in the number of identified risks. The sign and perhaps the statistical significance of the parameter estimates probably tell us whether risk assessments are increasing with respect to change in a given independent variable, both with respect to the likelihood of a respondent identifying a particular risk and of that factor being deemed relatively more serious. The magnitudes of the coefficient estimates are, however, indisputably meaningless given the ordinality of the underlying data.

An alternative is an ordered multinomial choice model, which is simply a censoring model such as that in relation (1), but now the entire distribution of the dependent variable is discretised from the underlying continuous distribution of the latent variable, not just the distribution's tails. In the ordered probit model, the dependent variable, A_{ij}, maps to a latent variable, A^*_{ij}, that is itself a function of the vector of independent variables, X, as follows:

$$
\begin{aligned}
&A_{ij} = 0 \text{ if } A^*_{ij} \leq 0 \\
&A_{ij} = 1/n^* \text{ if } 0 < A^*_{ij} = \alpha + X_i\beta + \varepsilon_i \leq \mu_1 \\
&A_{ij} = 2/n^* \text{ if } \mu_1 < A^*_{ij} \leq \mu_2 \\
&\quad\vdots \\
&A_{ij} = 1 \text{ if } \mu_{n^*-1} < A^*_{ij}
\end{aligned}
\tag{2}
$$

with $\varepsilon_i \sim N(0,\sigma^2)$. The ordered multinomial choice model requires estimation not only of the β parameters but also of the n^*-1 μ interior boundary parameters. The relation between A^*_{ij} and A_{ij} is just like that between R^*_{ij} and R_{ij} already discussed.

The ordered multinomial choice model is likewise less than ideal. In addition to the need to estimate n^*-1 further parameters, this method confronts the index construction problem already discussed. One must have a finite set of uniformly ordered options across the entire data set,

necessitating use of the A_{ij} metric in the present setting. More fundamentally, the ordered multinomial choice model's β parameter estimates actually only provide direct evidence on the probability of identifying a risk (that is, of moving from $E[A^*]=0$ to $E[A^*]=1/n^*$) and on the probability of declaring it the most serious hazard faced (that is, of moving from $E[A^*]=(N^*-1)/n^*$ to $E[A^*]=1$) but, unlike the doubly-censored model presented earlier, do not imply any consistently-signed relationship between independent variables and risk assessments within these two boundaries [*Greene, 2000*].

In the end, the problem of index number construction using open-ended ordinal data inevitably carries over into the problem of multivariate regression analysis of such data. The doubly-censored model offers sign-consistent relationships but the coefficient magnitudes are uninformative, while the ordered probit model offers parameter estimates that are clear only on the risk assessment's boundaries. As a crude test of the robustness of our core findings, we therefore use both the A_{ij} measure in an ordered probit model and the R_{ij} measure in a doubly-censored model when statistical analysis seems appropriate. As it turns out, the qualitative results do not vary across these measures and methods, so the basic findings we report in section IV appear robust to the very real data challenges we face. With these characteristics of and caveats about the data and statistical methods firmly in mind, we now seek to understand better the cross-sectional heterogeneity in risk assessment articulated by East African pastoralists.

III. DISAGGREGATING RISK ASSESSMENT

The heterogeneity of pastoralists' risk assessments is immediately apparent in our data [*Smith et al., 2000*]. No one factor was cited as a risk by as much as 80 per cent of our respondents, and only food and water access were cited by even half the sample. In order to move beyond simple descriptive analysis to an understanding of the causal relations driving this heterogeneity, we find it useful to recognise that individuals' expressions of risk assessment reflect a composite of several factors relating to the biophysical characteristics of a hazard, respondents' socio-economic condition, and their cognitive understanding of and ability to deal with the prospective risk. We therefore conceptualise risk as comprising four distinct components: exposure, perception, mitigation, and coping.

Exposure is an objective, measurable component related to space or time, but not to a particular person. Certain people at a specific place or time face different likelihoods that a given hazard will occur than others do at another place or time, for example with respect to drought, disease, or conflict. So exposure is amenable to objective, biophysical measurement in

probabilistic terms. As a result, quantitative measures of risk typically rely exclusively on exposure data, for example proxying the risk associated with drought by measures of rainfall. As we demonstrate later, such objective exposure variables may have relatively weak (even negative) correlation with individuals' subjective assessment of the risk of interest.

Clinical psychologists and some economists have shown that individuals' risk perceptions and preferences cannot be reduced simply to preferences that are linear in probabilities; rather risk assessment and preferences appear to be a product of history and context [*Kahneman and Tversky, 1979; Machina, 1997*]. This points toward the second component of risk assessments, perception, a subjective component unique to individuals and not directly observable by a researcher. Perception reflects an individual's belief that he or she might experience a particular hazard and how severe its effects might be. Two individuals can have different subjective perceptions of their identical exposure to a given risk because of different histories, preferences, or information.

The last two components of risk assessment, mitigation and coping, relate to the capacity to reduce the adverse effects of hazards, either *ex ante* (mitigation) or *ex post* (coping). An extensive literature explores the topics of coping and mitigation.[2] Diversification of one's portfolio of assets and activities is a common example of mitigation behaviour, while borrowing and migration are examples of coping behaviours. Mitigation does not require prevention, which is a limiting case, but merely reduction of downside risk. The greater one's ability to reduce objective risk exposure and subjective risk perception through preemptive behaviour, the greater one's mitigation capacity. One who can respond quickly to and recover rapidly and completely from an adverse shock enjoys great coping capacity, while those who would likely suffer permanent damage from the experience of a shock have little capacity to cope with that particular hazard.[3]

Individuals' risk assessments are thus a composite expression of exposure, perception, mitigation, and coping. In particular, risk assessments increase with exposure and perception and decrease with respondents' capacity to mitigate or cope with risk. Cross-sectional or intertemporal heterogeneity in these four components thereby generates heterogeneity in the composite risk assessment one typically hears from subjects in the field. Different people living under objectively identical conditions commonly express different levels of concern about particular sources of risk. If human behaviour is associated more with composite risk assessment than with objective risk exposure, then it becomes important to try to elicit and unbundle risk assessments according to these four components. Unfortunately, one cannot directly measure either perception or mitigation

or coping capacity, as distinct from observed mitigation and coping behaviours. So quantitative measurement of the disaggregated components of individuals' risk assessment is infeasible. The best one can do is rely on correlates of these components in statistical analysis of various sorts, and that is the method we follow in the remainder of this article.

IV. PREDICTABLE VARIATION IN EAST AFRICAN PASTORALISTS' RISK ASSESSMENTS

In this section, we apply the conceptualisation of the previous section to the data described in section II, in some places making use of the two multivariate regression methods discussed earlier. Our objective is to show how one can use the framework of the preceding section to understand and explain the variation observed in subjects' risk assessments. Anyone who has worked in ASAL East Africa can easily make up a laundry list of hazards faced by pastoralists. But not all hazards appear everywhere, much less equally among all sub-populations, or at all times. In what follows, we focus on four specific hazards in order to demonstrate that exogenous structural factors correlated with the perception, coping or mitigation components – for example, gender, wealth, or location – have causal explanatory power with respect to heterogeneous risk assessments. We must point out that we use the term 'wealth' here in a purely relativistic manner. Poverty rates are extremely high in these less favoured regions. For example, the three northern Kenyan Districts of Isiolo, Marsabit, and Samburu in our study area average 81.7 per cent of the population below the poverty line [*DDC, 1999*]. So when we refer to a group as 'wealthy' or 'rich' it is purely in comparison to their even-less-fortunate neighbors and not in comparison to any reasonable absolute standard of living.

IVa. Drought and Drought-Related Risk

Drought risk is widespread in the ASAL, although droughts are irregular and vary considerably in severity and across space.[4] One especially threatening consequence of drought is reduced food availability as crops fail and animal productivity (in terms of milk, blood and meat yields) declines.[5] While drought is a climatic phenomenon readily described by meteorological data, the composite drought risk perceived and expressed by individuals or groups may bear little relation to the objective exposure reflected in rainfall data. This point becomes evident in a simple comparison of respondent drought risk assessment (Figure 3a) and of the spatial patterns of rainfall (Figure 3b). Both figures use GIS data layers to capture the spatial variation in the underlying variables of rainfall and expressed severity of drought risk.[6] Perhaps paradoxically, drought-related
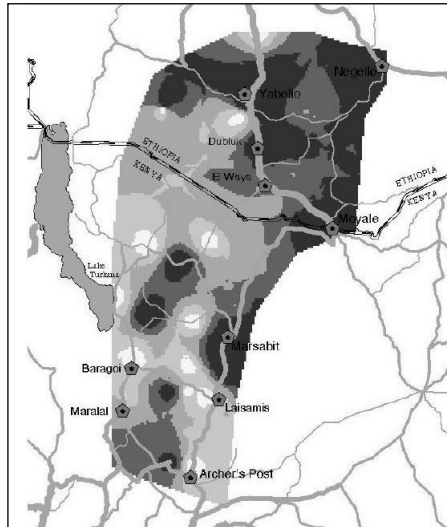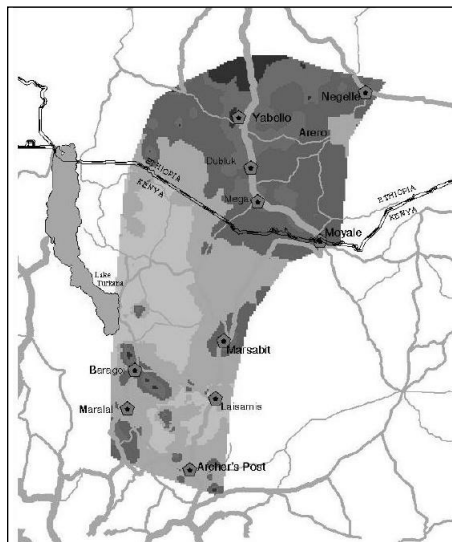
FIGURE 3A

DROUGHT RISK ASSESSMENTS

FIGURE 3B

RAINFALL CONTOURS

Darker shades reflect higher risk assessment (Figure 3A) or rainfall (Figure 3B) contours, respectively.

risk appears to be considered a more serious problem in areas that generally receive relatively greater rainfall.[7]

So why are rainfall data, alone, not a good predictor of people's risk assessments on the ground? The answer lies in the mitigation and coping capacity associated with wealth[8] and distinct production patterns associated with space and climate. Areas of high drought risk assessment are concentrated around higher elevation towns, where the poor disproportionately reside (Figure 4) and where rainfall is relatively greater and, partly as a consequence, crop agriculture is more common (Figure 5). Poor pastoralist households typically move to towns when they lose most or all of their herds and must turn to food aid, casual wage labor, small scale crop, firewood, or charcoal production for a livelihood. The poor are most sensitive to drought, both retrospectively, because they have often lost much of their wealth to drought-related shocks, and prospectively, because drought-induced increases in staple food prices have a greater adverse welfare effect.[9] Furthermore, range degradation is localised, almost always more seriously around towns. So in those areas, rainfall deficiencies interact with pasture rendered more fragile by disproportionately high stocking densities to more quickly and seriously affect forage availability adversely.

African pastoralists deal with low, highly seasonal and unpredictable rainfall through spatial fragmentation and dispersion of their herds, species diversification, transhumant and nomadic migration, and complex lending and exchange relationships among spatially dispersed kinship groups enhanced by rules of clan or sub-clan exogamy (if the clan is very large) that assure social relationships are not concentrated in small areas [*Majok and Schwab, 1996*]. Pastoralists, especially wealthier ones owning larger herds, tend to avoid living in or around towns when possible (Figure 4). Their

FIGURE 4

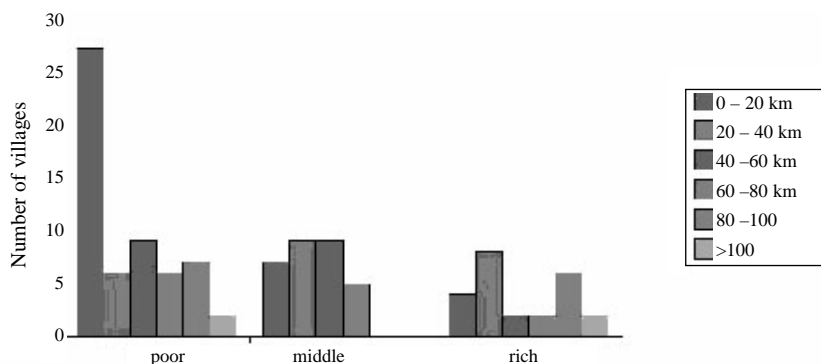FREQUENCY OF RESPONSE BY DISTANCE TO CITIES

FIGURE 5

DISTRIBUTION OF PRODUCTIVE ACTIVITIES BY SITE ELEVATION

■	140 – 600 m
▨	600 – 120 m
■	1200 –1600 m
□	1600 – 2200 m

agriculture   agropastoralism   pastoralism
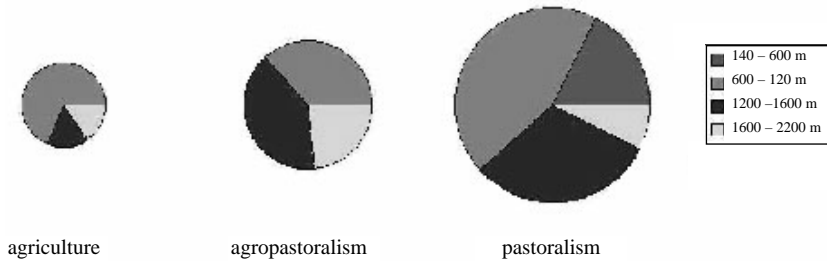
Note: Circle diameter is proportional to the number of respondents in each category.

superior drought mitigation and coping capacity manifests itself in lower assessment of the risk they face due to drought and drought-related shocks. Unlike pastoralists, crop producers cannot move when drought strikes without sacrificing their harvest, and therefore feel drought's effects more acutely.[10] *Ex ante* commodity choices that reduce vulnerability to prospective adverse biophysical shocks and the ability to make *ex post* adjustments without severe consequences reduce subjects' assessment of the severity of drought risk.

IVb. Livestock Management Risk

All pastoralists confront four basic, interrelated livestock management challenges: access to pasture, access to water, animal health, and livestock marketing. But within the population we study, there is considerable, structural variation in risk assessment with respect to these variables. The predictability results from gender-, and activity-based variation in the exposure and perception components of risk assessment and location-based variation in coping capacity.

Men invariably assess risks with respect to livestock management factors as more serious than do women for the simple reason that men's income earning potential, wealth, and social prestige are more intimately bound up with livestock. Men's objective exposure to biophysical and economic hazards of disease, insufficient water or forage, or price crashes is greater than women's, and men likewise take these risks more seriously because they devote more attention to them, thus their greater subjective perception of the risks amplifies the gender-based risk assessment differences attributable to exposure.

Male elders are the principal decision-makers among all the East African pastoral groups we study, especially with respect to livestock management.

They handle the animals, decide upon grazing routes and watering schedules, maintain wells and boreholes, direct seasonal herd migrations, slaughter and sell animals, especially large stock like cattle and camels [*Coppock, 1994; Edgerton, 1971; Fratkin, 1987; Fratkin and Smith, 1994; Holtzman, 1997; Kelly, 1990; Spencer, 1965, 1973; Straight, 1997*].[11] But women are not invisible or voiceless. They commonly oversee a wet (that is, lactating) herd and handle milk sales, especially when men are in satellite camps directing seasonal migrations. While the male household head has ultimate disposal rights over the family's herd, the decision to sell animals is not made by him alone. He is expected to discuss the matter with his wife, often seeking advice from her as to which animal(s) should be sold since she is more intimately familiar with the household's subsistence requirements. Still, even though a man should discuss a sale with his wife, he is the one who ultimately sells the animal and allocates the proceeds. The wife must wait to be given any money for her or her household's needs.

Not surprisingly, our participatory risk mapping data show that men are more concerned than women are about risks related to livestock management. In both the doubly-censored and ordered probit regressions of risk associated with animal disease, livestock prices, pasture availability, and water availability on respondent characteristics consistently show female respondents express statistically significantly lower levels of concern than do male respondents (Tables 1 and 2). Men worry more about water and pasture because they manage the larger, migratory herds that use dry season grazing and watering areas. In the ASAL, long distances between watering points challenge men, while the settlements at which women remain are usually not far from permanent water sources. As the ones culturally assigned responsibility for caring for and marketing the animals, men more frequently express concern about livestock disease and prices, although their level of concern is no greater than women's, conditional on expressing concern. Livestock markets in these areas are thin, infrastructurally deficient, and subject to regular disease quarantines. The result is remarkable variability in prices, for example an average seasonal variation of almost 60 per cent in the Marsabit cattle market [*Barrett et al., 1999*]. Because men sell livestock in these societies, their exposure to and perception of livestock price risk is greater than women's, as manifest in a significantly higher incidence of recognising price risk as a hazard.

Just as gender conditions individuals' exposure to and perception of risk, so too does one's choice of economic activity. Animal disease and livestock prices are concerns expressed far more commonly, ranked as more severe, or both, by pastoralists as compared to crop producers not entirely (or at all) dependent on livestock for their livelihoods (Tables 1 and 2). For similar

TABLE 1

DOUBLY-CENSORED REGRESSION RESULTS

Risk Factors →	Animal Disease	Livestock Prices	Pasture Availability	Water Availability	Crop Faiture	Wildlife Crop Damage	Human Disease	Violent Conflict
Correlates								
Constant	0.211	0.650*	0.668	1.080‡	0.431	0.012	0.208	0.346
	(0.394)	(0.375)	(0.960)	(0.333)	(0.296)	(0.034)	(0.301)	(0.281)
Agropastoralist	0.006	–0.349	–0.546	0.004	–0.344	0.418	–0.277	–0.650
	(0.289)	(0.280)	(0.877)	(0.294)	(0.530)	(0.434)	(1.331)	(0.657)
Crop Producer	–0.742*	–0.687*	0.199	0.454	0.538‡	0.972‡	–0.377†	–0.863
	(0.383)	(0.377)	(0.917)	(0.302)	(0.055)	(0.366)	(0.178)	(0.814)
Female	–0.516‡	–0.698‡	–0.555‡	–0.442†	–0.625	–0.185	–0.173	0.407‡
	(0.231)	(0.255)	(0.159)	(0.211)	(0.427)	(0.339)	(0.118)	(0.051)
Km from town	0.028‡	0.014†	–0.009	0.004	–0.020*	–0.041†	–0.074*	–0.060‡
	(0.008)	(0.007)	(0.021)	(0.006)	(0.012)	(0.017)	(0.045)	(0.021)
Poor	0.174	0.018	–0.125	–0.402	–0.244‡	–0.870	0.916‡	0.621†
	(0.375)	(0.339)	(0.972)	(0.314)	(0.057)	(0.658)	(0.109)	(0.301)
Middle wealth	0.439	0.713†	–0.622	–0.502	–0.658	–0.618	0.091	–0.297
	(0.312)	(0.351)	(0.578)	(0.329)	(0.431)	(0.414)	(0.122)	(0.584)
# left censored (R=0)	65	92	112	34	111	107	96	97
# right censored (R=1)	21	3	2	41	0	2	9	11
# uncensored	34	25	6	45	9	11	15	12
Mean log likelihood	–0.948	–0.563	–0.247	–1.034	–0.387	–0.367	–0.404	–0.610

The dependent variable, R, ranges from zero (not cited as a risk factor) to one (ranked as the most serious risk faced). See Section II or Smith *et al.* [*2000*] for greater detail on the data collection and index construction methods. Except for kilometers from town, the other regressors are all categorical variables equal to one when the respondent fits the variable title and zero otherwise.

Standard errors in parentheses.

*, †, and ‡ indicate significantly different from zero at the ten, five, and one per cent levels, respectively.

TABLE 2

ORDERED PROBIT REGRESSION RESULTS

Risk Factors →	Animal Disease	Livestock Prices	Pasture Avail- ability	Water Avail- ability	Crop Faiture	Wildlife Crop Damage	Human Disease	Violent Conflict
Correlates								
Constant	0.921	0.235†	0.209‡	0.850‡	0.123	–0.032	0.348	0.201
	(0.964)	(0.119)	(0.004)	(0.192)	(0.326)	(0.048)	(0.290)	(0.581)
Agropastoralist	–0.126	–0.156*	–0.244†	–0.344	0.146*	0.238*	0.107	–0.350*
	(0.409)	(0.098)	(0.129)	(0.265)	(0.087)	(0.131)	(0.184)	(0.179)
Crop Producer	–0.423†	–0.542‡	–0.247	0.564†	0.564‡	0.654‡	–0.231*	–0.610†
	(0.213)	(0.176)	(0.179)	(0.285)	(0.198)	(0.127)	(0.126)	(0.301)
Female	–0.705‡	–0.834‡	–0.701‡	–0.193†	0.435	0.005	0.173†	0.510‡
	(0.345)	(0.338)	(0.278)	(0.091)	(0.732)	(0.293)	(0.078)	(0.187)
Km from town	0.009†	0.108*	–0.112‡	0.014†	–0.109	0.010	–0.100*	–0.009*
	(0.004)	(0.061)	(0.044)	(0.007)	(0.123)	(0.009)	(0.054)	(0.005)
Poor	–0.084	0.194	0.232	–0.072	–0.324	–0.405	0.632‡	0.417‡
	(0.503)	(0.459)	(0.236)	(0.423)	(0.756)	(0.387)	(0.192)	(0.132)
Middle wealth	0.321	0.453	–0.098	0.202	0.089	–0.328	0.123*	0.127
	(0.297)	(0.554)	(0.183)	(0.425)	(0.217)	(0.842)	(0.072)	(0.432)
# left censored (A=0)	65	92	112	34	111	107	96	97
# right censored (A=1)	21	3	2	41	0	2	9	11
# uncensored	34	25	6	45	9	11	15	12
Mean log likelihood	–0.663	–0.387	–0.403	–0.907	–0.504	–1.298	–0.434	–0.476

The dependent variable, A, ranges from zero (not cited as a risk factor) to one (ranked as the most serious risk faced). See Section II or Smith *et al.* [*2000*] for greater detail on the data collection and index construction methods. Except for kilometers from town, the other regressors are all categorical variables equal to one when the respondent fits the variable title and zero otherwise.

Standard errors in parentheses.

*, †, and ‡ indicate significantly different from zero at the ten, five, and one per cent levels, respectively.

reasons, crop failure and crop destruction by wildlife are much less serious concerns to pastoralists than to sedentarised crop producers who depend heavily on crop production for income and subsistence. Relatedly, crop failure risk assessments are decreasing with distance from towns, where rainfall is higher and around which most cropping takes place.

One's capacity to respond to outbreaks of animal disease declines with distance from major towns with veterinary services, as manifest in the spatial patterns of animal disease risk assessment (Figure 6) and risk assessments that increase with distance from town (Tables 1 and 2). Government and NGO vaccination campaigns exist for major diseases such as rinderpest and contagious bovine pleuro pneumonia (CBPP), but it is otherwise up to the individual herder to purchase veterinary medicine as needed. Animal disease is of greatest concern in areas more distant from the main towns of Marsabit, Moyale, and Negelle, where veterinary services and medicines can be found.

FIGURE 6
ANIMAL DISEASE RISK ASSESSMENT
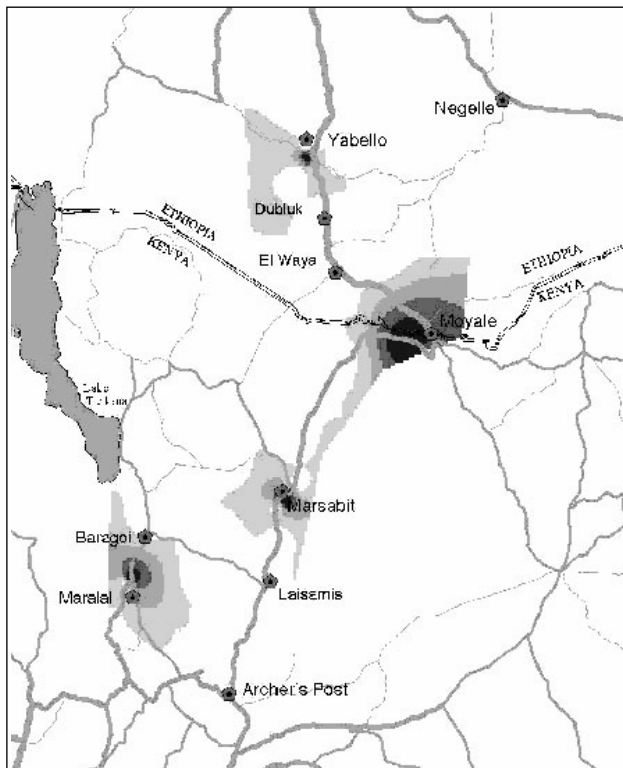
Livestock price risk assessments likewise increase with distance from market (Tables 1 and 2). Those who live near towns face less uncertainty with respect to prices because they can more easily inquire about local, regional, and terminal market (Addis Ababa and Nairobi) prices from those who have just returned selling animals. Livestock prices in northern Kenyan markets are extraordinarily volatile [*Barrett et al., 1999*], so better access to information and modern transport may confer considerable advantage to those living near markets. Moreover, since sunk transactions costs are an increasing function of distance from market and sunk costs amplify the marketing disincentives created by price uncertainty [*Chavas, 1994; Dixit and Pindyck, 1994*], pastoralists far from market are doubly penalised.
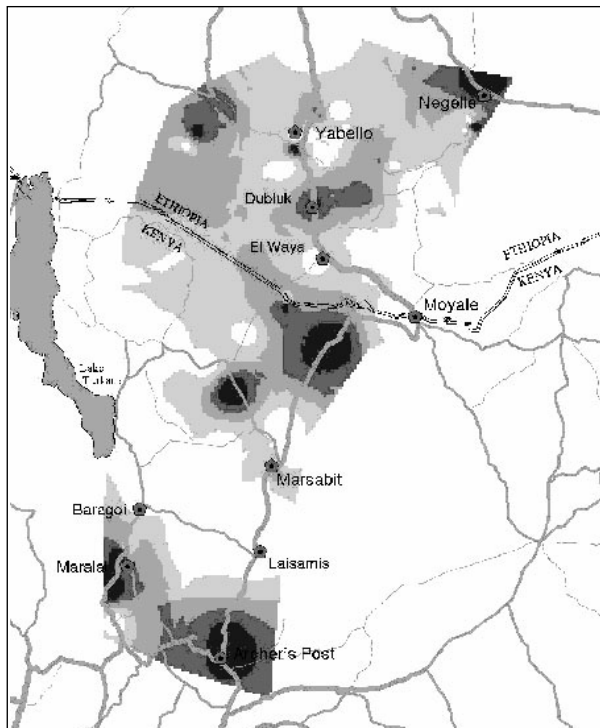
IVc. Human Disease Risk

Deadly human diseases are distressingly common in the East African ASAL, and an obvious source of concern for many pastoralists. Yet respondents' assessment of this risk varies predictably according to location, season, and wealth because of differences in objective exposure and in mitigation and coping capacity.

Season and location affect objective individuals' exposure to insect-borne and water-borne diseases like cholera, malaria, and typhoid. While disease outbreaks can occur without warning, malaria in particular is expected during and shortly after every rainy season, when the mosquito population flourishes. A health and nutrition study among Rendille pastoralists in our study area found significant differences in reported days of fever (an easy recall indicator of malaria) between the same months of a wet and a dry year in Marsabit District [*Nathan et al., 1996: 9–10*]. Our survey was conducted at the tail end of heavy rains brought about by the global El Niño event that inundated the area December 1997–February 1998, during what is typically the short dry season before the long rains of March–May. Heavy rain and flooding – uncommon events in the ASAL – gave rise to malaria and haemorrhagic fever epidemics in northern Kenya [*MSF, 1998: 4*]. Not surprisingly, our respondents were more likely to identify malaria as a risk, and when identified, to rank it as the greatest hazard they faced at the onset of our study. Through June 1998, the severity index for human disease equalled one, indicating that all respondents citing this factor identified it as their greatest source of concern. By contrast, as the survey progressed into the long dry season there was a marked decrease in its frequency of mention and in the severity assessment of the risk of malaria or other human illnesses. From July through October 1998, the severity index dropped to 0.25, underscoring the temporal variability in risk of exposure to infectious human disease.

Risk assessment with respect to human disease likewise varies by location because objective exposure is not uniform across space. Precipitation

throughout ASAL East Africa is low on average but varies greatly from place to place, from 300 to 900 millimeters of rain annually within our study area (Figure 3b). Extreme microvariability in rainfall patterns even within zones with common long-term precipitation patterns causes further spatial variation in risk exposure and assessment. Proximity to town matters as well, for two reasons besides the fact that towns in this region tend to be in areas of higher rainfall. First, towns have permanent water sources and large concentrations of people, a situation that allows standing water to accumulate, creating ideal breeding conditions for mosquitoes. Second, populations in and around towns are relatively sedentarised, and therefore have less capacity to mitigate emerging risks or cope with local disease outbreaks by migrating to less disease prone locations. The net effect is higher rates of disease and poorer anthropometric measures among town residents as compared to rural residents in this area [*Nathan et al., 1996*] and a concentration of high risk assessments of human disease around towns and higher rainfall locations in the study zone (Figure 7, Tables 1 and 2).

FIGURE 7
HUMAN DISEASE RISK ASSESSMENT

Wealth and education are also correlated with human disease risk assessment because these factors affect one's capacity to undertake preventative measures and to afford medicine or curative treatment. Pastoralists in this area rarely if ever take malaria prophylaxis drugs. While all appear aware of the virtues of mosquito netting, only some of the more educated indicate they use nets to protect themselves and their children against mosquito-borne diseases such as malaria. No wealthy communities in our survey cited human disease as a hazard, in comparison to poor and moderate wealth communities that cited it as a significant risk factor. In part this reflects the spatial distribution of wealth pointed out earlier (Figure 4), for wealthier pastoralists depend less on and therefore tend to live farther from towns, a point corroborated among the Rendille [*Nathan et al., 1996*] and Samburu [*Straight, 1997*] ethnic groups in our study area. But in part this also reflects the wealthy's superior capacity to purchase mosquito nets or curative drugs for malaria, such as Chloroquine or Fansidar. One countervailing factor is access to health care. Although settled pastoralists are more exposed to mosquito or water-borne diseases, they are also better able to cope with infectious disease if they fall ill because they have better access to health care facilities and professionals [*Fratkin, 1997: 247*].

IVd. Conflict and Vulnerability

Conflict appears to be increasing in East Africa today, both at the macro-political level in war between and within states, and at the more local level, in the form of contested resource access and banditry. Yet while conflict is of broad concern, its effects are not felt uniformly throughout pastoralist societies, due to structural factors that lead to differences in exposure, perception, mitigation and coping.

Pastoralists have long relied on livestock raiding as a way for individuals to amass quick wealth (including bridewealth for young warriors), to recover from herd crashes due to drought or disease, to revenge previous raids by enemies, or to demonstrate bravery. Contemporary circumstances, however, have made raiding more deadly, more commercial and seemingly more common. Automatic rifles are fast replacing the spear as the weapon of choice and are increasingly available, thanks to massive arms trafficking in the region associated with recent or ongoing conflict in Burundi, Eritrea, Ethiopia, Rwanda, Somalia, Sudan, and Uganda. The seemingly greater ease with which one can raid today is compounded by the perceived need to do so, making it more difficult to tell whether raids are motivated by tradition, commercial incentives, increased competition for pasture and water, or political factors [*Hendrickson et al., 1996; Keen, 1997; Krätli and Swift, 1998; Fleisher, 1999*].

Conflict is a serious problem for pastoralists because not only does it threaten human life and cause insecurity of asset ownership, it also inhibits movement, whether searching for pasture or water or trekking animals to the market, thus impinging on pastoralists' primary, traditional risk management tools. In extreme cases, families are forced to move from their home areas as a result of the loss of livestock and human life. While a potential threat to pastoralists everywhere, conflict risk – like rangeland degradation [*McPeak, 1999*] – is not uniformly distributed across space. Conflict risk can be highly localised, in at least four ways.

First, those living close to boundaries with hostile ethnic groups exhibit significantly higher risk assessments than do those on the interior of ethnic areas (Figure 8).[12] The western and eastern borders of Boran territory in Ethiopia are occupied by Hamar and Somali, respectively, two ethnic groups with whom Boran have long had regular conflicts. For example, Boran living near the Hamar (north-west) or the Somali (north-east) rank

FIGURE 8

CONFLICT RISK ASSESSMENT AND ETHNIC BOUNDARIES
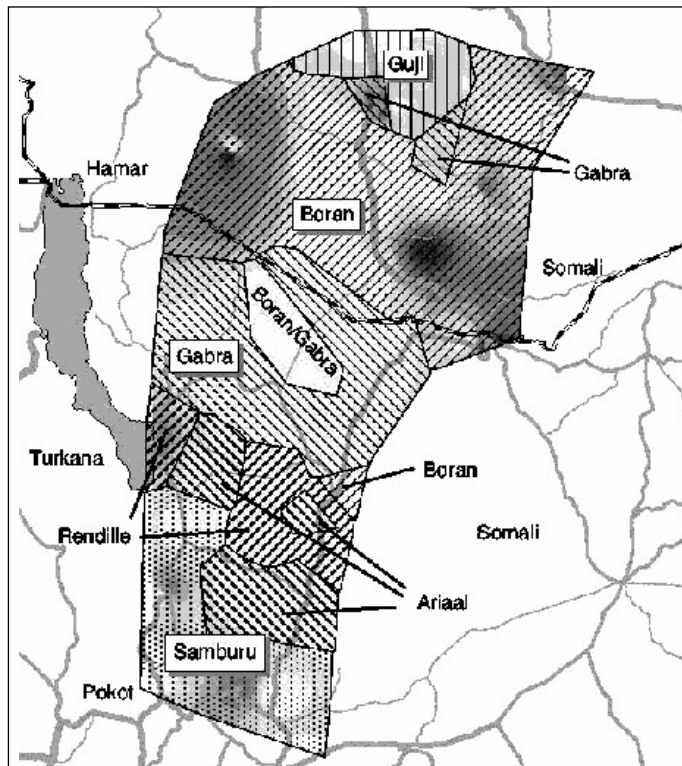
conflict higher than other Boran who live in the interior of their homelands where they remain more insulated from inter-ethnic conflict. Recent Boran-Somali clashes around the towns of Moyale and Negelle have been exacerbated by the creation of a new administrative region for Somali that includes two traditional Boran deep wells, a crucial dry season water source for animals. Similarly, Samburu who emphasise conflict risk live more in the southwestern region of that group's lands, around the towns of Maralal and Wamba, which have been subject to periodic large-scale raids by Turkana over the past several years. Some communities are reported to have lost 70 per cent of their livestock in intertribal raids in 1997 alone [*MSF, 1998: 20*]. Many of those impoverished by the raids moved to the outskirts of Maralal town for greater security. As a result of this conflict, one could find vast expanses of unused, high quality pasture on the El Barta plains between Baragoi and Maralal where large numbers of cattle normally graze. Only recently have Samburu herders begun to reoccupy this area.

This spatial heterogeneity based on ethnic space can be readily explained using the conceptualisation of section III. Since those living near ethnic frontiers are easier targets for prospective raiders or attackers from other ethnic groups, the objective exposure to conflict risk increases with proximity to ethnic boundaries. And because access to grazing and watering areas is not defined by ethnic area but by clan, subclan, or family [*Helland, 1980; Gulbrandsen, 1990; Mazonde, 1990; McCabe, 1990; Oba, 1990*], those households based near ethnic boundaries typically have less capacity to mitigate conflict risk by moving herds away from the frontier toward the safer interior regions.

Second, poor communities around towns are also more likely to articulate a high conflict risk assessment than are wealthier communities more distant from towns (Tables 1 and 2, Figure 8). Indeed, while the poorest respondents ranked violence as the most severe risk they face, none of the respondents classified as falling into the upper wealth group identified conflict or violence as a risk that concerned them. Conflict risk thus seems to be a burden borne disproportionately by the poorer segments of pastoral society. This is probably partly due to greater objective risk exposure, since the poor's herds are more spatially concentrated nearer towns – due to limited labor availability and inability to fully provide for the household's nutritional needs – and therefore easier to target and capture.

The heterogeneity of conflict risk assessment is also partly due to different subjective perceptions. Animal raiding is one reason why herders become destitute and fall out of pastoralism. They may then take up residence in or around towns and receive food aid while working as casual laborers, or selling firewood or charcoal [*Fratkin and Smith, 1995*]. Those who have suffered severely from conflict are more acutely attuned to its

dangers than those who have not faced violence first-hand. Finally, the poor have less capacity to cope with rangeland violence as their herds are too small to provide them a buffer against loss. They are typically net borrowers of animals, rather than net lenders, and so have less recourse to social insurance in the form of livestock loans [*McPeak, 1999*].

Third, agriculturalists are less exposed to conflict than are pastoralists or agropastoralists since traditionally most ASAL violence derives from cattle raiding or competition for grazing and watering areas. Predictably, agriculturalists' assessment of conflict risk is significantly lower than that of the other groups.

Fourth, men and women do not necessarily perceive conflict risk similarly. As depicted in Figures 9a and 9b, there is a striking spatial difference in risk assessment by respondents' gender. In the northeastern part of the study area, men are concerned about Boran-Somali violence, much of which seems associated with highly politicised disputes over deep

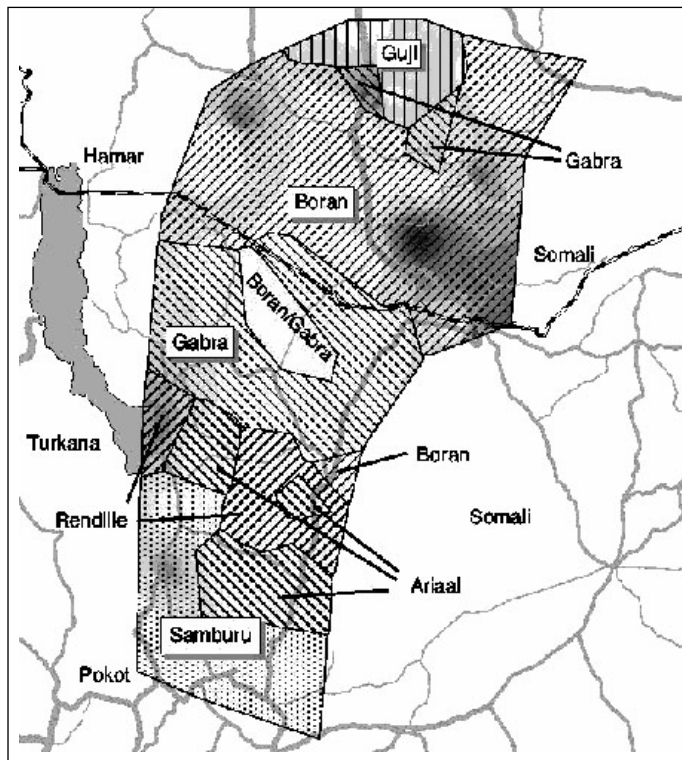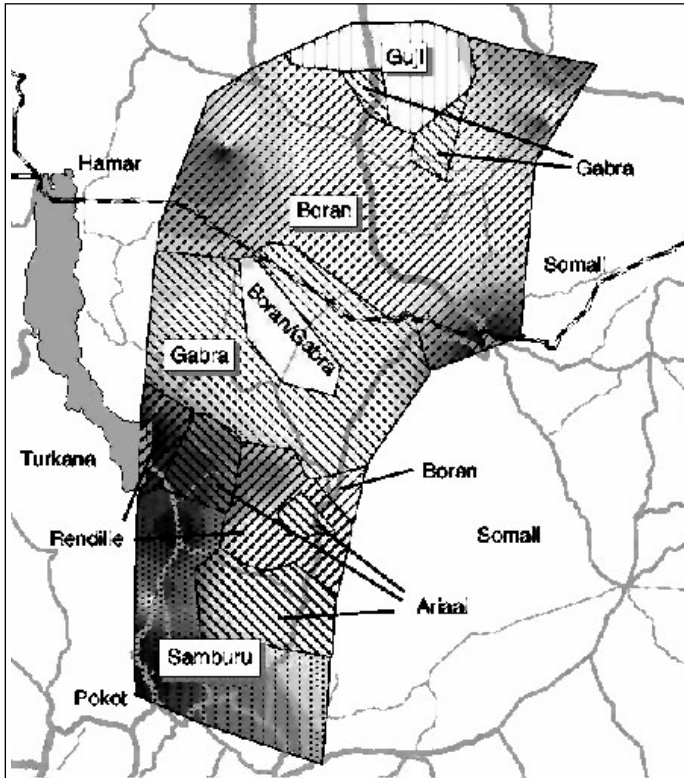FIGURE 9A

MEN'S CONFLICT RISK ASSESSMENT

FIGURE 9B

WOMEN'S CONFLICT RISK ASSESSMENT

well complexes (tula wells) traditionally claimed by Boran but now placed within Somali-controlled Region Five under the newly federalised governmental structure of post-Mengistu Ethiopia. Men are far more politically active than women, and water access is of greater concern to men than women, as discussed in section IVb. By contrast, women's concerns about conflict risk are generally greater than men's (Figure 8b and Tables 1 and 2). Moreover, women's concerns about conflict are concentrated more in the southwestern part of the study area, where violent raids by Turkana that forced evacuation of entire villages and left many men, women, and children dead [*Krätli and Swift, 1998*]. The household disruption caused by displacement and the emotional pain of the killings seem to have made more of an impression on women in the area than on men, and appear to be more salient to women than are the political and resource conflicts faced to the north-east, where men's conflict risk assessments are higher.

V. CONCLUSIONS AND IMPLICATIONS

Pastoralism remains widespread in ecologically and economically fragile areas, especially in the arid lands of countries such as Ethiopia and Kenya [*Majok and Schwab, 1996*]. Pastoralists' common heavy dependence on livestock in areas of low and highly variable rainfall at considerable distance from cities, and their relatively low rates of literacy, access to clean water, health care, and other basic services masks considerable within-group heterogeneity in vulnerability. Macro-scale variables such as average rainfall and distance from urban centers broadly applied to explain the risks facing East African pastoralists ignore patterns of spatial and temporal variation that are better explained by micro-level structural variables such as gender, wealth, proximity to the nearest towns, and production system type.

The implications of risk heterogeneity for intervention are far reaching. Many NGOs and government agencies today identify assuring 'livelihood security' as a core mission in their field projects and programmes. In so far as security reflects reduction in risk into the future [*Barrett, forthcoming*], however, it is essential to understand how patterns of risk assessment vary across distinct subpopulations and across time and what the implications might be for policies and projects meant to relieve some of the stress felt by these populations. Data from East African pastoralists reveal considerable heterogeneity in respondents' identification and ranking of various sources of risk, much of which can be readily explained by structural factors relating to location, gender, wealth, or season. The clear implication is that the benefits of interventions to reduce risk and increase livelihood security are highly likely to be unequally distributed, possibly in ways that unwittingly contradict the stated priorities of donors and implementing agencies. For example, one international NGO that trumpets its prioritisation of women and children has spent considerable resources in our study area combating bush encroachment and advising on the maintenance of permanent water sources, although these range and livestock management interventions are of interest overwhelmingly to men, not women. Gender blindness is not gender neutrality, so the neglect of structurally differentiated risk assessment may lead to inappropriate interventions in cases such as this one.

The record of pastoral development projects in the East African ASAL is undistinguished [*Moris, 1999*]. Indeed, ill-conceived interventions often exacerbate existing risks on the rangelands. For example, rangeland degradation in pastoral East Africa is never simply the result of generalised overpopulation, but rather to uneven human and livestock population concentrations around mechanised boreholes and small towns, often drawn in by the promise of regular food aid distribution [*Little, 1994; Spencer, 1998; McPeak, 1999*]. Since the 1980s, 45 per cent of Rendille [*Fratkin,*

1991: 130] and 30 per cent of Samburu [*Spencer, 1998: 225*] are believed to have settled in recently formed towns, at least partially relying on food aid. In one instance, local Ariaal and Rendille discouraged the development of a permanent water source in one town for fear they would not be able to resist the temptation to settle there [*Fratkin, 1991: 89*]. Their wishes were ignored by the resident missionary and the town is now home to many permanently settled and poor Ariaal and Rendille.

One apparent problem that emerges from the findings presented in this article is that traditional pastoral development efforts aimed at improved livestock management (especially water availability) and providing higher and more stable producer prices for livestock address primarily the concerns of more favoured sub-populations: relatively well-off male pastoralists. This is apparent in Tables 1 and 2, where the only statistically significant constant term coefficients – which reflects the mean risk assessments of wealthy male pastoralists – are for livestock prices and pasture or water availability. The poor's greatest expressed concerns, for human health services, conflict resolution, and access to schools, have been less frequently heeded in rangeland development. We are nonetheless encouraged that many field-based relief and development organisations in our study area now appear to recognise and be addressing this imbalance.

The broader point for development researchers and policymakers is that rather than proposing blanket approaches based on stylised characterisations of pastoralists' needs and concerns, it is necessary to tailor interventions to specific sub-populations, their locations and the source of the risk they perceive. The poor face more sources of risk than do the less poor, reflecting the positive correlation between asset poverty, vulnerability and food insecurity. Meanwhile, those who have diversified (wholly or partially) out of pastoralism and settled in or near towns face different problems than do migratory or transhumant herders. Similarly, men worry about different sources of risk than women do.

Donors, charities and governments wishing to help particular sub-populations thus need to adopt participatory approaches in order that efforts be focused on targeted beneficiaries' expressed concerns. Where risk is associated with insufficient coping capacity, facilitating physical food storage and the use of financial savings and credit may be the most appropriate instruments, while if the source of the problem is mainly subjective perceptions, then information dissemination and educational programmes may be the highest return intervention available. Pastoralists' vulnerability will only increase so long as their diverse experiences are glossed over by governments, researchers and development practitioners.

NOTES

1. Following Smith [*1992: 16–17*] we define pastoralism based on the economic and ideological role of domestic animals, which can include sedentary peoples who also practice farming as well as nomadic, semi-nomadic and transhumant populations. The emphasis must be on livestock dependence, mobility, extensive production systems, and, perhaps most importantly, whether people view themselves as pastoralists.

2. For example, see reviews by Alderman and Paxson [*1992*], Bernstein *et al.* [*1992*], Ellis [*1998*], and Barrett [*forthcoming*].

3. Our conceptualisation expands upon the distinction between mitigation and coping offered by the Board on Natural Disasters of the National Research Council [*1999*].

4. We use the term 'drought' loosely, to encompass not just insufficient precipitation, but also drought-related manifestations such as food or water shortages or poor quality of pasture, which are often the proximate threat perceived by respondents.

5. Drought is obviously not the only cause of food shortage. Indeed, our survey occurred after heavy rains associated with the El Niño, which caused large livestock losses and crop failures, in addition to damaging major and minor roads. The net result was severe food insecurity in some areas. Barrett [*forthcoming*] provides a broad survey of food insecurity.

6. The contour surfaces in each map were interpolated using the inverse distance weighting method using the five nearest neighbours for each grid point in the map. Darker shades reflect higher levels of rainfall (Figure 3b) or of risk reported by communities in the area (Figure 3a). The map in Figure 3a is directly comparable to later risk assessment maps.

7. Rainfall is also less variable, seasonally and inter-annually in the higher elevation areas, so this is not simply a matter of looking at the wrong moment of the rainfall distribution.

8. Without survey data on wealth, we stratified respondents based on herd size and other physical assets (for example, stores, home quality, etc.) then corroborated these classifications with key informants. Validation exercises find PRA wealth rankings to be reasonably accurate [*Chambers, 1994; Takasaki et al., 1999*].

9. Marketable surplus as a proportion of total income is a measure of the price elasticity of money-metric welfare, so net buyers who spend most of their income on food suffer relatively more from food price shocks [*Barrett and Dorosh, 1996; Deaton, 1989*].

10. Drought tolerant varieties of maize, sorghum or millet are neither widely available nor commonly used.

11. There is certainly variation among clans and ethnic groups in the roles and rights of men and women, but the stylised facts we present here hold almost universally throughout the region.

12. Ethnic groups areas are approximated using polygons around data points. The exact boundary locations of these polygons are therefore arbitrary, but this provides a reasonable approximation. One should keep in mind, however, that these ethnic boundaries are neither immutable nor as crisp as the graphic suggests. For example, there is significant ethnic intermixing in some areas, especially between Ariaal and Rendille and between Boran and Gabra.

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