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Participatory Risk Mapping for Targeting Research and Assistance: With an Example from East African Pastoralists

KEVIN SMITH
International Rescue Committee, New York, NY, USA

CHRISTOPHER B. BARRETT
Cornell University, Ithaca, New York, USA

and

PAUL W. BOX *
Utah State University, Logan, Utah, USA

Summary. — This paper introduces a systematic but simple approach to classifying and ordering sources of risk faced by subject populations. By distinguishing between the incidence and severity of subjective risk perceptions, this method enhances understanding of the nature and variation of risks faced within a population. We demonstrate the usefulness of the method as applied to pastoralist communities in the arid and semi-arid lands of southern Ethiopia and northern Kenya. This method reveals the considerable heterogeneity of risk exposure and severity that exists within this seemingly homogeneous sector, particularly across strata defined by gender, wealth, and primary economic activity. © 2000 Elsevier Science Ltd. All rights reserved.

Key words — livestock, participatory methods, rapid appraisal, uncertainty, vulnerability

1. INTRODUCTION

It is often difficult for researchers or development practitioners to distinguish, much less to prioritize, among the many risks faced by peoples in arid and semi-arid lands (ASAL). ASAL populations have traditionally been less favored by both nature and states, leaving them relatively more exposed to varied risks—climate, disease, bandits, markets, wildlife, etc.—than are their counterparts in urban areas or "high potential" agricultural zones (Lipton, 1977; Barrett, 1996). Too often, research and development assistance proceeds on the basis either of outsiders' anecdotal assessment of the incidence and severity of risks, or of precon-

* The authors are with the International Rescue Committe, Associate Professor, Department of Agricultural, Resource, and Managerial Economics, Cornell University, and Assistant Professor, Department of Geography and Earth Resources, Utah State University, respectively. We thank the governments of Ethiopia and Kenya for research clearance, the International Livestock Research Institute for hospitality and support, Abdillahi Aboud, Luc Christiaensen, Layne Coppock, Peter Little, Jon Moris, Eric Roth, two anonymous referees, and participants at the June 1998 workshop on pastoralist risk management at Egerton University (Njoro, Kenya) for helpful comments, and, especially, our field research assistants, Hussein Gufu, Korea Leala, Daniel Lemoille, Silas Leruk, Dansa Orto, Mulugeta Shibru, and Godana Wario. This work was supported by grant number 103-19 from the Small Ruminant/Global Livestock Collaborative Research Support Program, in turn supported by grant PCE-G-98-00036-00 from the United States Agency for International Development. Final revision accepted: 2 February 2000.

ceptions based on subtropical and temperate agricultural zones. More detailed and accurate survey-based methods are costly and time consuming, especially since pastoral populations frequently traverse vast areas poorly served by transport and other infrastructure.

In an attempt to fill this void, we developed a systematic but simple approach to classifying and ordering sources of risk faced by pastoralist populations in the ASAL of southern Ethiopia and northern Kenya. Livestock producers in this region are regularly affected by a wide variety of shocks: droughts, floods, animal or human disease epidemics, armed conflict, border closures that restrict mobility, market access, grain and livestock prices, crop or livestock destruction by wildlife, etc. But with so many sources of apparent risk, and so much heterogeneity among individuals, ethnic groups, and ecologies within our study area, the first, basic step in our research program has been to identify and prioritize risks by distinct subpopulations. This paper describes the participatory risk mapping methodology we devised for this purpose.

We make no grand claims for this methodology, only that we have found it a convenient, inexpensive, and informative tool for capturing at a simple level within-group heterogeneity of risk exposure and severity. We do not advocate its use as a single source tool for either development practitioners or researchers. But the results generated by this method have proved easy to communicate to the subject communities, policymakers, and other researchers. They have likewise proved useful for drawing attention to underrecognized issues and for focusing attention on especially prominent concerns. We share our method in the hopes that others might likewise find it useful.

Participatory research and rapid appraisal methods have become understandably popular in recent years (Chambers, 1997; Holland & Blackburn, 1998). Affected communities often have a comparative advantage in understanding the etiology, consequences, and nuances of complex problems. Facilitating local identification and prioritization of key issues for research and intervention is thus a primary goal of many development and development research organizations.

The value of participatory research is perhaps highest in less favored areas, such as the East African ASAL, and among especially vulnerable populations, like low-income pastoralists. Besides, the occupants of these areas are acutely aware of the risks they face and their relative importance. Since vulnerable communities have generally received disproportionately little (positive) attention from private or public sector development or research organizations, outside appraisals of the challenges facing such communities tend to exhibit unacceptable levels of bias and noise. Appropriate targeting of research or development interventions in these areas therefore stands to gain disproportionately from participatory identification of concerns, their etiology, and prospective solutions, at least as compared to research or interventions in better studied, higher potential zones. Given a marginal study area and a vulnerable subject population, we therefore set out to develop a technique for gathering and communicating concerns from the bottom up. This is simply a twist on much existing good work in participatory appraisal methods, with a particular application to risk management.

2. THE PARTICIPATORY RISK MAPPING METHOD

There is a vast literature on risk and uncertainty, much of it quite ably reviewed by Hardaker, Huirne, and Anderson (1997). At the risk of oversimplification, one can identify two broad approaches to questions of risk. One focuses on subjects' perceptions and preferences, allowing for variation among otherwise identical subjects in their assessment of a particular risk (e.g., of violence or hunger), irrespective of whether any subject's assessment is statistically consistent with past history. The other, more objective approach is frequentist, emphasizing standardized, measurable occurrences (and sometimes severities) of various undesirable states of nature. Practitioners of the latter approach commonly define "risk" as imperfect knowledge with known probabilities of observing possible outcomes, as distinct from "uncertainty," for which the probabilities are unknown.

Let us be clear about our definition. By "risk," we mean uncertain consequences, and in particular exposure to potentially unfavorable circumstances, or the possibility of incurring nontrivial loss. This distinguishes risk from uncertainty, which reflects imperfect knowledge without any particular value assessment about consequences. Risk is therefore, by this definition, something undesirable. It may also vary

across individuals living in seemingly identical environments. So we take the subjectivist rather than the frequentist approach, for two reasons. First, objective measurement of the incidence or severity of undesirable events such as cattle raiding, price shocks, water shortage, etc., is difficult and unreliable in our study area, the East African ASAL, where systematic data collection has been disappointingly limited, both spatially and temporally. Statistical time series of direct relevance to the lives of most ASAL residents simply do not exist or are not of sufficient duration to enable meaningful statistical inference. Second, ours is perhaps the simplest, colloquial definition of risk, and therefore most appropriate for a participatory research method. It would be unwise to ask communities with high rates of illiteracy and innumeracy to identify issues according to statistical criteria unfamiliar to many university students. By contrast, asking people what worries them, and which worry is greatest, seems both practical and intuitive. As we show below, it works quite well in this setting.

Throughout this paper, we use the words "risk," "concern" and "worry" interchangeably because the pastoralists we studied do not make meaningful distinctions between these words. The three major languages within our study site—Boran, Rendille, and Samburu—all have words that can be interpreted as either "risk," "concern," or "worry": *ho'ol* in Rendille and *sinaa* in Samburu. In the Boran language, *deet* and *sodat* both mean "fear," the latter of which implies a riskier fear. Moreover, all concerns or worries can be related to risks. For example, the "worry" of insufficient school fees is one indicator of the "risk" of not having enough resources to meet school fees in addition to more immediate food and health care needs.

Although there are several ethnic groups and two different countries within our study area, their common pastoral history and heritage, as well as the periodic regional droughts they have faced over the years, leads to some commonality in perception of risk. Pastoralists' lives truly revolve around rainfall patterns and the welfare of their animals, things all pastoralists acknowledge but also know they cannot fully control.

While recognizing this base level of commonality, we want to be able to describe accurately the variation in risks experienced subjectively within a heterogeneous population. This variation can occur across space, time, demographic, or economic characteristics. We also want to be able to establish an accurate ranking of the severity of different sources of risk, conditional on the respondent group. Because it is incredibly difficult to construct an objective measure of risk severity—particularly one offering relevant comparisons among risks as disparate as ethnic violence and poor rainfall—we rely on respondents' necessarily subjective assessments. Given heterogeneous preferences—with respect to risk, among other things—this subjective method may be preferable anyhow if one wishes to establish the behavioral or welfare effects of risk exposure. It also allows the subjects to decide on their own what are the major risks rather than being told to choose from a list that is biased to begin with by the researcher.

The risk mapping technique can therefore be thought of as a two-stage system of ordinal rankings, wherein respondents first identify risks and then they rank the risks they identified. If repeated across a number of groups or individuals in a simple, random survey, the resulting sample frequency and severity data would provide statistically unbiased estimates of subjective risk incidence and severity in the population under study. More commonly—and in our case—respondents are selected opportunistically or purposively, so the resulting sample statistics are not statistically unbiased estimates of the corresponding population statistics. They nonetheless offer reasonable information about subjective risk incidence and severity. Bias of the sample locations is somewhat reduced by using local assistants to find locations that fit certain criteria, such as proximity to towns or predominant economy, so as to insure coverage over a wide area. Randomness of informants may not be preferable anyway, as participatory techniques work best with willing and talkative informants. This is especially important for female informants in the highly sex-segregated pastoral societies under study, in which many women may be afraid to talk openly in front of men in their community.

We use an open-ended questionnaire approach to the first step—risk identification—so as not to influence the cited risks, how many risks were mentioned, or in what order of importance. A brief introduction to community leaders and selected informants emphasized that informants could list as many or as few risks as they wished and that the researcher did not want informants to talk only about

particular kinds of concerns. Rather, they were encouraged to discuss among themselves and decide whatever they thought were the major risks encountered in their community. Local translators were always used and briefed as to the nature of the research and the importance of telling the researcher as accurately as possible what the informants said. Because different respondents will use different terms to represent the same concept, the researcher must categorize these subjectively. In practice we find this is usually not too difficult.

The second step then involves asking the respondent to rank order the risks they identified in the first step. We use a simple, ordinal scheme, assigning a value of one (1) to the risk identified as most severe, two (2) to the risk identified as second most severe, etc. This ordinal scheme was grasped easily by respondents. We were careful not to force informants into ranking risks they thought equivalent. Risks declared to be equally severe were assigned the same number, and any subsequently ranked risks pick up the numbering, accounting for ties. [1]

After ranking risks, informants were then asked to detail each in turn, making sure they discuss how they used to solve each of these, if and why they no longer could, and how they would like to solve them, if they had not already addressed this. No attempt was made to define the severity of risks for the informants or to make informants list a certain number of risks. These were instead left open-ended. Certain directional questions were asked where appropriate to elicit further detail or to pursue related topics. For example, if women mentioned one way they solved their worry of food shortage was by selling milk or firewood, they were asked other ways women in their communities made money and which were they best ways to provide for their families.

Representation of subjective risk incidence and severity for the sample or any subsample—e.g., women, a particular ethnic group, etc.—is reasonably straightforward. The proportion of respondents who identify a source of risk provides an index measure of incidence, ranging from zero (no one affected) to one (everyone affected). This proportional incidence measure, I, captures the breadth of the risk, i.e., how widespread the issue is within the population under study.

The severity measure is slightly trickier, because the data are ordinal and of different dimensionality. While one respondent may identify four risks and rank those four, another respondent may identify only three, and a third respondent may identify seven. The first of these will then have ordinal values ranging from one to four, the second from one to three, and the third from one to seven. Computing some sort of sample statistic requires converting these ordinal data into quasi-cardinal form, for which there is no uniquely appropriate method.

The approach we follow is the index method, wherein the severity of the risk is placed on a range from one (most serious) to two (least serious). [2] So the most serious risk declared by a respondent retains the value one, while all lower-ranked risks have to have their integer-valued, ordinal ranking converted to the index scale. Recognizing that the value of the steps between ordinal data is arbitrary, we assign the step value to be $1/(n-1)$ when there are n risks identified. [3] The severity index value, s_j, for a risk of rank r among a group of n risks identified by respondent j is thus $s_j = 1 + (r-1)/(n-1)$. This sets the most serious risk $(r = 1)$ to $s_j = 1.0$, the least serious risk $(r = n > 1)$ to $s_j = 2.0$, and the remaining risks assigned to equally spaced intermediate values. To compute the sample (or subsample) severity index, S, for a given risk, we then take the mean of the severity index for that risk from the subset of those respondents identifying that risk. By computing the index this way, we separate severity from incidence.

The two distinct index measures permit the analyst to combine them to generate a joint index measure based on context- appropriate weighting of severity and incidence. Such a measure should be increasing in the incidence and severity of the risk. One general class of such measures can be represented by the function $R_{\alpha\beta} = \alpha I/\beta S$, where α is the weight assigned to the incidence index and β is the weight assigned to the severity index. A simple special case is the measure $R_{11} = I/S$, which has the appealing feature of ranging from zero (zero incidence) to one (universally most serious risk). Below we use this particular measure to capture variation in risk assessment among East African pastoralists.

Any or all of these index measures lend themselves to graphic display. When the data are georeferenced using an inexpensive, handheld global positioning system (GPS) unit, the spatial patterns can be depicted easily enough in a geographic information system (GIS) display to capture the spatial/ecological heter-

ogeneity of risk incidence and severity. The next section demonstrates the application of this methodology to pastoralist populations in the rangelands of southern Ethiopia and northern Kenya.

3. DEMONSTRATION OF CONCEPT: AN APPLICATION TO EAST AFRICAN RANGELANDS

The major ethnic groups found in our study area are Boran, Gabra, Rendille, and Samburu living in Kenya's Marsabit, Moyale, and Samburu Districts, and Boran, Gabra, and Guji from southern rangelands of Ethiopia's Region Four. [4] Several common features of these pastoralists make the generation of risk maps of particular interest and usefulness. There are several experiences unique to pastoralists that should be considered (Waters-Bayer & Bayer, 1994). These pastoralists live in the lowland ASAL, where low human population density and considerable climatic variability drive spatial and temporal variation in the availability of crucial natural resources, notably forage and water. Spatial mobility of livestock, the main asset, is central to pastoral culture and economy. Land tenure tends toward common property regimes instead of individualized pastures or plots. Pastoralists also share resources either simultaneously or seasonally with other ethnic groups and therefore need to negotiate with these groups for access. ASAL pastoralists' food security has become precarious from increasing human population and simultaneous rangeland restriction. Climatic shocks, civil strife, and major economic shocks have only exacerbated the issue in recent years.

The economy of the ethnic groups in the study region is predominantly pastoralist, although there has been an increase in farming and the growth of pastoral towns, particularly within the last generation. Interhousehold cooperation for herd labor is common, with poorer households exchanging labor for access to animals, and the temporary fostering of children from low- to high-demand household labor. All of the pastoralists within the study region are influenced by conditions in terminal livestock markets in Nairobi and Addis Ababa. Yet there is still a preference to retain livestock for reasons of prestige or bridewealth payments, as well as for insurance purposes. Some observers have speculated that East African pastoralists practice herd maximization because the ASAL environment makes steady herd growth difficult (Roth, 1996).

One of the common organizational features of pastoralism is that the male household head owns or at least controls most of the family's herd, making wives and junior men dependent upon him (Coppock, 1994; Draper, 1989; Edgerton, 1971; Spencer, 1973). Women tend to be responsible for decisions concerned with milk production and the daily running of the household. There is also a preference for polygyny, a tendency for sons to live in their father's settlements, and for women to move to a husband's settlement upon marriage (although the reverse is sometimes true for a period of time immediately after the marriage). Large age disparities between husband and wife and widespread violence lead to a high number of households headed by widows.

Political organization helps define resource access (i.e., land and water) but also allows for a high degree of individual mobility via clan and ethnic ties. Ethnic group affiliation can, however, cause insecurity through raiding and fighting among rival ethnic groups. At the national level, these pastoralists represent a relatively powerless political minority viewed as backward by their governments. There has been relatively little state or colonial impact outside of administration in the pastoral areas. Much of the public services, famine relief, and livestock improvements have been provided by missionaries and nongovernment organizations (NGOs), especially in Kenya. In general, physical and institutional infrastructure is weaker in pastoral areas than in cropping zones or urban areas (Barrett, Little, Bailey, Chabari, & Smith, 1998).

The figures that follow are based on data collected during a six-month period from March through October 1998. [5] In all there were 120 groups interviewed within the study region, 49 from Ethiopia and 71 from Kenya. Of these 120 groups, 59 were comprised of women and 61 of men. The groups' spatial distribution is reflected in Figure 1. Attempts were made to interview one group of men and one group of women from each community, but this was not always possible. Some of the interviews were conducted opportunistically with, for instance, people who had come to town for the day. This opportunism added groups of women and men from communities we otherwise would not have had the time to visit.

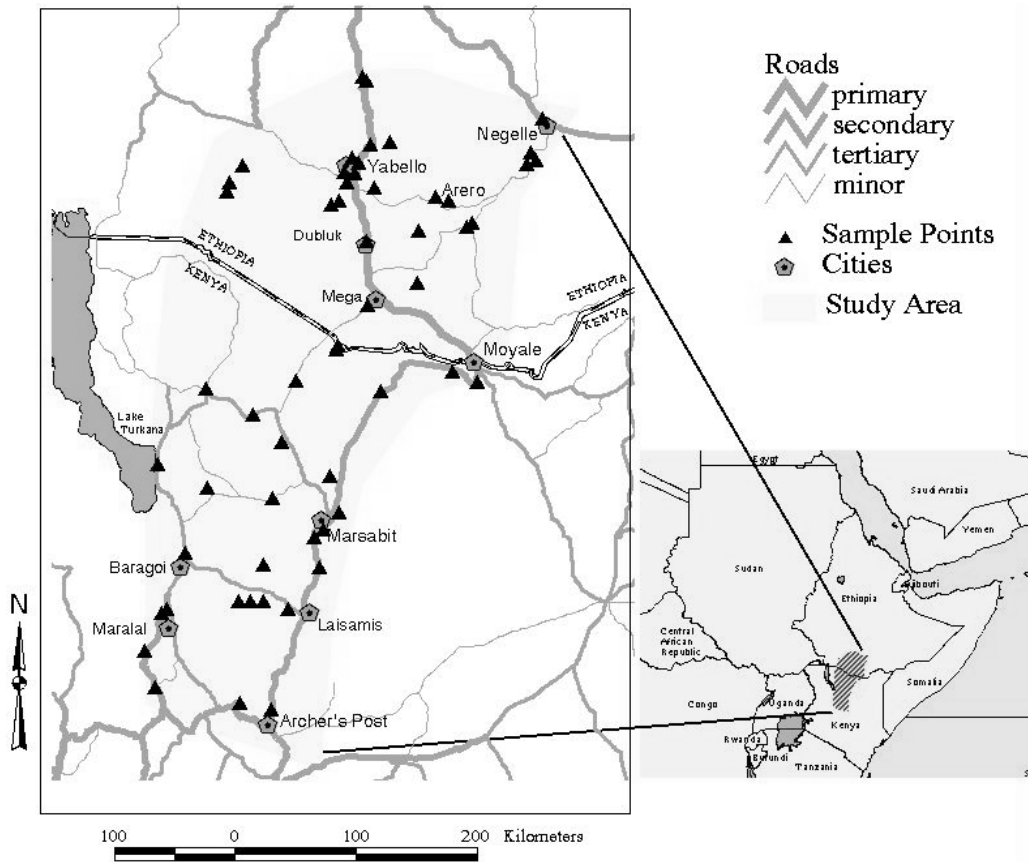

Figure 1. *Study area.*

For this particular study, we were able to categorize groups' responses into 15 major sources of risk. In no particular order, and with the labels used on the accompanying Figure 2 in brackets, these are: livestock prices [prices], pasture access and quality [pasture], food availability [food], water availability [water], crop failure [crop fail], crop destruction by wild animals [crop dest], livestock disease [disease], ethnic conflict, banditry, and raids [conflict], human illness, chiefly malaria [sick], access to a health clinic [clinic], access to shops [shop], access to a school [school], ability to pay school fees [fees], the need to relocate often [move], and transport and road conditions [transport]. The sample summary incidence, I, and severity, S, measures discussed earlier are presented in Figure 2. The risk index $R_{11} = I/S$, is presented in Table 1 for the full sample and for a variety of the strata of interest.

The most frequently mentioned worries are, not surprisingly for the ASAL, insecure access to food and water, both the result of periodic droughts and long dry seasons throughout East Africa and, for some, severe poverty. Livestock disease and access to health clinics are the other risks cited by at least one-third of the participating groups. Given that our subjects are pastoralists living in areas of low population density and limited-to-nonexistent public services infrastructure, these too are quite predictable responses.

What is perhaps more interesting is that outside of food and water shortage, none of the other 13 risks are declared by a majority of respondents. This risk mapping technique highlights that the nature of the risks faced by vulnerable populations, much less the subjective severity of those risks, varies considerably even among what appears to many outsiders a

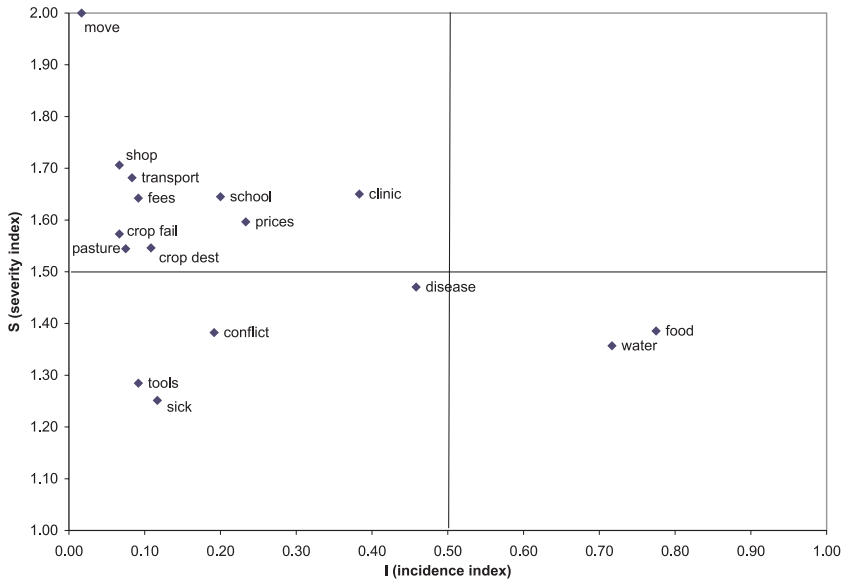

Figure 2. *Risk map overview.*

relatively homogeneous population with regard to economy and environment. Few risks are perceived by a majority of the population, in which case they would appear in the right half of Figure 2. Relatedly, those risks that are felt widely are also deemed relatively severe (i.e., the upper right quadrant is empty, as in Figure 2, for almost all strata in the sample). There are commonly a few risks that are intensely experienced by a small subpopulation (the lower left quadrant). A majority of the identifiable risk factors are neither widely nor severely felt, appearing in the upper left quadrant in Figure 2. This pattern, which seems a useful basic point to grasp, reappears throughout the figures we constructed along various lines of stratification, copies of which are available on request, can be viewed through the project web site [http://www.cnr.usu.edu/research/crsp/], and are discussed in greater detail in Smith, Barrett, and Box (1999).

The most severe concern expressed, conditional on being identified as a risk, relates to human illness. This is primarily malaria, a serious risk in parts of our study area during particular periods. Not all communities are equally exposed to human disease, as apparent spatially in contour mapping for disease, created by making a geographic information systems (GIS) layer of the risk index. [6] This and other GIS plots can be viewed through the project web site at http://www.nr.usu.edu/~sanduku/crsp/. Illness is rightly perceived to be of greatest danger during and shortly after the rainy seasons. In our case, an El Niño phenomenon brought unusually heavy and long rains to southern Ethiopia and northern Kenya from late 1997 to early 1998. The normal short dry season, which typically comes during January and February, did not occur. El Niño rains gave rise to epidemics of malaria and haemorrhagic fever in northern Kenya's Samburu and Marsabit Districts, for example (MSF, 1998, p. 4). Therefore, we happened to be risk mapping during an unusual year in which many informants claimed malaria outbreaks were notably severe. We also started our risk map as these rains were ending, when infectious diseases are especially serious worries on people's minds. This is evident by the striking difference in the severity measures for human sickness between only the April-June period, as the rains ended, and the July-September period, when the long dry season was underway. For the former period, $S = 1$, i.e., human illness was always ranked as the most serious by those who identified it as a risk they face. For the latter, by contrast, $S = 1.75$. Human illness was considered a relatively less severe risk as the dry season progressed. It is also appears that wealth class conditions vulnerability to risks such as human illness. No

Table 1. *Summary subjective risk index*[a]

Source of risk	Full sample	Ethiopia	Kenya	Female	Male	Poor	Middle	Wealthy	Agricultural	Agro-pastoral	Pastoral
Sample size	120	49	71	59	61	60	36	24	21	31	68
Food availability	0.56	0.69	0.47	0.64	0.48	0.62	0.48	0.51	0.37	0.60	0.60
Water availability	0.53	0.46	0.59	0.46	0.60	0.52	0.48	0.62	0.65	0.49	0.51
Animal disease	0.31	0.30	0.32	0.24	0.21	0.26	0.33	0.13	0.16	0.35	0.35
Access to health clinics	0.23	0.23	0.24	0.21	0.26	0.33	0.13	0.15	0.38	0.27	0.17
Livestock prices	0.15	0.15	0.14	0.08	0.21	0.08	0.25	0.16	0.07	0.13	0.18
Conflict/violence	0.14	0.06	0.19	0.15	0.13	0.20	0.15	0	0.09	0.11	0.17
Access to schools	0.12	0.17	0.09	0.12	0.12	0.16	0.11	0.05	0.21	0.14	0.09
Human disease	0.09	0.12	0.08	0.09	0.10	0.12	0.12	0	0.06	0	0.15
Wildlife crop destruction	0.07	0.01	0.11	0.08	0.06	0.04	0.17	0	0.21	0.08	0.02
Availability of farm inputs	0.07	0.16	0	0.06	0.07	0.09	0.04	0.07	0.15	0.11	0.02
School fees	0.06	0	0.09	0.07	0.04	0.08	0.06	0	0.06	0.05	0.06
Crop failure	0.05	0.11	0.08	0.03	0.07	0.04	0.09	0	0.10	0.04	0.04
Access to transport	0.05	0.01	0.08	0.03	0.07	0.02	0.12	0.02	0.08	0.03	0.05
Pasture availability	0.04	0.05	0.04	0.01	0.08	0.03	0.03	0.11	0.05	0.02	0.05
Consumer goods availability	0.04	0.02	0.05	0.05	0.03	0.04	0.01	0.09	0.02	0.02	0.05
Spatial mobility	0.01	0	0.01	0.02	0	0.01	0.01	0	0	0	0.01

[a] Index ranges from zero (no incidence) to one (universally most severe risk).

rich communities identified this as a risk, only poor and moderate wealth communities cited human disease as a significant risk factor. This likely reflects as well the spatial distribution of poverty in the East African ASAL, with poorer populations more clustered around settlements in which standing water often provides a breeding ground for mosquitoes and other vectors and greater human population density facilitates transmission of infectious disease (Smith *et al.*, 1999).

As with sickness, violent conflict was cited as an especially severe risk, but again by a minority of the population, and exclusively among the nonwealthy. All of the ethnic groups in our area have felt the effects of an increased number of automatic rifles that make livestock raids particularly deadly. But, as reflected in the spatial distribution of the risk measures, those that border hostile neighbors are particularly affected (Figure 3). Samburu living near Pokot Turkana (to the south and west of our study area) in Kenya and Boran living near Somali (to the east of our study area) or Hamar (to the north and west of our study area) in Ethiopia have fear of conflict on their minds more often and more prominently than do people from other communities in the region. [7] For example, the loss of livestock from intertribal raids rose to 70% in certain areas of Samburu and neighboring Turkana Districts by 1997 (MSF, 1998, p. 20). As with sickness, insecurity can lead to the worst of all possibilities, the loss of human life, thus figuring so prominently in the minds of those affected.

The frequency and severity of risks were broken down along several dimensions of potential stratification—by country, gender, wealth class, and primary economic activity—to see whether important differences appeared across distinct groups. As is apparent in Table 1, and substantially expanded upon in

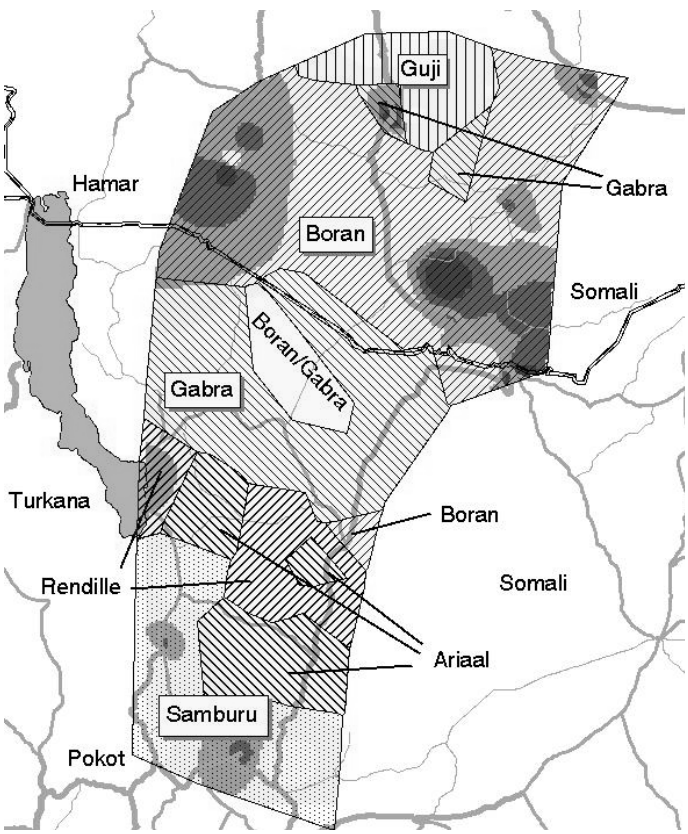

Figure 3. *Conflict risk and ethnic boundaries.*

Smith *et al.* (1999) several important differences indeed appear. We address each stratification dimension now in turn.

Although both northern Kenya and southern Ethiopia have been largely neglected by government and development agencies, discernible differences nonetheless appear. Food availability is of much greater concern in Ethiopia, where marketing systems are less well developed and relief distribution has been less widespread, especially as the Ethiopian Boran pastoralists have settled less than have the northern Kenyan pastoralists. The government of Kenya set the distribution of relief food to 3,000 90 kg bags of maize per district (MSF, 1998, p. 9), which amounts to 9,000 bags of maize per year for the three districts of Samburu, Marsabit, and Moyale within our study area, the total population of which numbers roughly 300,000. [8] This translates into 810,000 kg of maize per year. By contrast, only 61,667 kg of maize and wheat were distributed for southern Ethiopia's roughly 770,000 people within the study area in 1998. [9] Water availability, on the other hand, is a more prominent risk factor in northern Kenya, where mean rainfall levels are significantly lower than at counterpart sites in Ethiopia. In addition to many seasonal ponds, the Boran homelands of southern Ethiopia include several deep well complexes that provide water throughout the year. Permanent water sources in northern Kenya, such as seasonal ponds, exist but are few and far between. Mechanized boreholes have been built in northern Kenya mission towns, but are far from where many of the pastoralists live. Violence and wildlife crop destruction are nontrivial risks among our Kenyan respondents, but far less commonly cited or ranked as a prominent risk in the Ethiopian communities we visited. The Kenya government's protection of large game, which are virtually nonexistent in southern Ethiopia, is particularly problematic for anybody attempting to farm on the Kenya side of the study area. On the other hand, access to schools and the availability of farm inputs are prominent concerns in Ethiopia, where there has been less missionary school development and farming extension efforts than in northern Kenya.

As males and females in pastoral societies very often perform different tasks and have different responsibilities, we thought it fruitful to compare the sexes. Separate groups of married men and women were interviewed for this purpose since spatial variation will not account for all the risks or worries. Some of the largest differences, as far as frequency of mention is concerned, are related to the different responsibilities of men and women (Table 1). As men are responsible for the grazing, watering, and marketing of animals, it is no wonder that they more often mention livestock prices, and the availability of pasture and water as important sources of risk. Women mention risk associated with food availability much more than men do because women typically take responsibility for the procurement and preparation of food for the family.

Risks that affect everybody equally and have little to do with one's sex should not show much difference between male and female respondents. Human illness, access to health clinics, animal disease, and conflict are among the highest ranked risks when mentioned because they affect men and women equally. The lives of everybody are threatened regardless of what their duties are, even if women are the primary care givers and men protect the community from hostile neighbors. Of the 120 groups we interviewed, 60 could be categorized as coming from poor communities, 36 from communities of intermediate wealth, and 24 from rich communities. This crude, subjective stratification was based primarily on livestock holdings, the principal form in which wealth is held in these societies. Field assistants' knowledge was heavily relied upon for this stratification. Wealthier pastoralists tend to live further from towns, where pasture is better and more available, while the poor tend to concentrate around towns and take up farming, often after losing their herds to disease, drought, or raiding and having to migrate to town in search of jobs, relief, or to farm if possible. The better off pastoralists are, the more they can afford to live away from towns, as has been observed among Rendille (Nathan, Fratkin, & Roth, 1996, p. 513) and Samburu (Straight, 1997, p. 69). Towns also offer relief and various alternative income sources, such as selling charcoal, firewood, or one's own labor. One note of caution: as we divide our sample into smaller groups, into thirds now rather than halves, it becomes harder to generalize trends and the results become somewhat less robust to reclassification of particular observations. Nonetheless, Table 1 reveals some intriguing patterns worth reporting.

Among each of the three wealth categories, water and food (non)availability are the most

commonly cited risks, although respondents from the richest communities mention water shortage more than food shortage. They are more food secure and are more concerned with making sure their larger herds of animals have enough water. The reverse is true for respondents from the poor communities. They live in towns where permanent water is available, so food shortage is a more immediate concern than watering the few or no animals they have. The poor are also far more likely to worry about access to health clinics and schools (things available but difficult to afford), about conflict or illness than are the wealthy. By contrast, concern about livestock prices and pasture availability is, not surprisingly, an increasing function of community wealth, as reflected by livestock holdings.

Conflict is ranked as the most serious risk among the poor group, the second least ranked risk among the middle group, and not mentioned at all among the rich group. We relate this difference primarily to the differential effects of livestock raids. People do not lose their animals only to drought, but also to hostile neighbors who raid their animals. Those who lose most or all of their animals are forced to move to towns for security. Some of the poor people on the Kenya side in our sample are the victims of recent large-scale raids. For example, Samburu who have shifted closer to the administrative towns of Maralal and Baragoi did so because they lost many animals to Turkana raids that began in August 1996. Moderate wealth pastoralists also consider conflict to be an important enough risk to mention, but their lives have not been so drastically altered as have the lives of their poorer counterparts.

The risk of human sickness likewise never arose in the comments of our wealthiest respondents, but was ranked highly when mentioned by respondents from both poor and middle wealth communities. This observation may be attributed to wealthier pastoralist living further from towns where there is less standing water, the breeding place for mosquitoes, and where the quality of diet, and thus human health, is better. Limited available evidence from Marsabit District, Kenya, suggests that child malnutrition rates are highest in pastoral towns. A nutritional study among Rendille communities revealed that dry season malnutrition rates were significantly lower among nomadic (traditionally pastoral) children than those who were living in towns (Nathan *et al.*, 1996, p. 511).

Stratification based on communities' predominant economic activity likewise yields informative variation in respondents' declared risks. A majority (68/120) of our respondents live in communities one could label pastoralist, where there is little if any crop agriculture. About one-sixth of the groups come from communities that have become heavily dependent on crop production. Whereas a generation ago, practically everybody in our sample would have been exclusively pastoralists, agricultural production has increased as a way for many pastoralists to diversify. Although the general pattern, farming is not taken up only by poor ex-pastoralists or exclusively out of necessity. The Borana Plateau in southern Ethiopia receives enough rainfall for farming to be remunerative in many communities in at least some years. On the Kenya side, however, farming is practiced only at the few communities in higher elevations where rainfall is sufficient.

The characteristic trend of mentioning food and water the most is broken only by respondents from agricultural communities mentioning something other than water more often than food shortage. They noted the lack of a nearby health clinic more frequently than suffering from a food shortage. The reason for this may be twofold: greater reliability of food access from crop than animal production for farmers who live in areas of higher rainfall reliability, and closer proximity to towns where food can be purchased more easily. Pastoralists or agropastoralists will tend to live further from towns and occupy more arid areas, leading to greater food insecurity. As for farmers mentioning nearby health clinics more than food shortages, this may be because of greater contact with towns and nearby farming communities that have clinics. It is as if their expectation of public service availability has been raised.

Crop destruction, crop failure, and availability of farm inputs (e.g., tools, fertilizer, etc.) are not surprisingly mentioned most often by agriculturalists, followed by agropastoralists and rarely by pastoralists. These risks are likewise generally deemed more severe by agriculturalists (Smith *et al.*, 1999). Pastoralists and agropastoralists both more frequently mention and rank as more severe conflict and livestock prices than do agriculturalists. There are two basic reasons for this pattern: those who keep animals have more to steal and are more vulnerable to livestock terms of trade

shocks, and they live further from towns where security is less certain. In contrast, there is little to be raided from farmers, who also tend to live in or near towns with police or army posts that offer some protection from bandits and violent conflict.

One interesting, unanticipated difference is that agriculturalists rate access to schools as a far more frequent and serious concern than do either of the other two groups (Table 1). This pattern is attributable to exposure to and value of education. Farmers live in permanent communities in or near towns and can expect their children to attend school. But, if these communities are more than a few kilometers from the town's school parents complain about their children having to get up very early or return late from school. Schools within the farming communities allow children to work on the farms after school more easily. Pastoralists by contrast, cannot reasonably expect schools to be built in their comparatively small communities that shift periodically. In addition, herd labor is an all-day affair and is less compatible with school hours. Moreover, farmers lacking livestock tend to rely more on wage labor to supplement their incomes than do pastoralists, so education probably provides a greater return among this cohort, causing them to worry more about their children's access to schooling.

We presented and interpreted our findings with some of the informants in repeat visits. Particularly surprising findings to us, such as the importance of malaria over livestock-related risks for some groups of informants, were discussed. Informants seemed not at all surprised that there were so many different risks or that the spatial distribution of risks varied so widely. This is understandable given that ASAL pastoralists are used to living in an environment of such spatial and temporal uncertainty and unpredictability.

4. SOME SHORTCOMINGS OF RISK MAPPING AND OF THIS PARTICULAR APPLICATION

Like any method, participatory risk mapping has shortcomings. We obviously believe the technique's strengths—quick, low-cost collection, letting informants speak for themselves, ease of graphic representation of results—outweigh its weaknesses. But we advise cautious application and wish to point out some deficiencies, both of the method in general and of this particular application.

The main general worry is that the interconnectedness of respondents' challenges makes categorization of responses somewhat arbitrary. Even concerns as seemingly unrelated, at first glance, as an inability to meet school fees and food shortage both indicate the lack of resources to meet essential needs, i.e., they are particular manifestations of pervasive underlying vulnerability. Similarly, food shortage and water shortage are obviously related; insufficient water means that livestock or crops die and people ultimately go hungry. In the ASAL of northern Kenya and southern Ethiopia, people cannot be short of water and not of food unless they rely almost exclusively on relief food aid handouts. Indeed, food security is clearly related to most other responses—e.g., animal health, drought, insecurity—through the complex dynamics of decision- making under uncertainty (Barrett, forthcoming).

All things considered, we believe that letting informants decide the categories is best. For instance, when they mentioned insecurity or animal health as concerns, these risks were noted as such, even though they both influence food shortage. But, when drought or livestock losses due to drought, and food shortage were mentioned in the same sentence, the three were considered as one risk. When informants themselves discuss these risks separately we feel it is important to retain the distinctions they draw. And although some identified concerns, such as access to health clinics or shops or ability to meet school fees, might appear to academic researchers less as "risks" related to uncertainty than as structural "problems" associated with poverty, we feel it is important to maintain a fidelity to respondents' chosen descriptions. Their perceptions help us understand how they think about risk and threats to their livelihoods. Open-ended questions also let the subjects themselves identify their communities' most important worries, which can greatly assist in locating and differentiating risks spatially and inferring useful indicators. Policymakers and researchers are often unaware of microvariability that leads one community to suffer especially from, say, infectious human disease while a nearby community's greatest challenge is instead, perhaps, water availability. Risk maps can also bring to the surface important issues underemphasized or overlooked by outsiders.

A second general worry is the peril of exclusion. Not all community members are equally likely to speak out in group interviews. If likelihood of participation is positively related to education level and wealth, [10] then a small number of community interviews could well miss important, underprivileged subpopulations. Active collaboration with skilled, sensitive local assistants can reduce the chances of exclusionary sampling, but this remains a risk of any group interviewing methodology. Nonetheless, by paying attention to the apparent wealth differences between—rather than within—communities, one can capture variation across classes in subjective risk exposure, as we demonstrated in the previous section. This too can ameliorate the potential bias introduced by implicit exclusion of marginalized subpopulations.

The primary shortcoming of the particular application we presented above is that it is a static representation. We capture relatively little seasonality—although it is apparent in the health risks, as discussed above—and no interannual changes. These interviews were conducted in 1998, following unusually heavy rains that brought flooding and unusually severe human and animal disease outbreaks. A one-shot, cross-sectional representation of declared risks experienced or perceived in an unusual year may mislead policymakers and researchers.

The methodology is not, however, inherently limited to such cross-sectional applications. One could instead obtain risk mappings in which the first step was to declare risks, the second step was to declare the relative (or even absolute, as in "x" times in the past 10 years) frequency with a risk has been experienced, and then the third step was to rank the severity, conditional on experiencing that risk. The incidence measure, I, would then be the product of the frequency—rather than categorical—declarations. [11] Major risk factors—e.g., drought, serious disease outbreaks—are registered with respondents for long periods, so 5–10 year recall is probably defensible. For more idiosyncratic risks, however, incomplete or biased recall may be widespread. An alternative, more expensive method is to repeat the cross-sectional risk mapping periodically to capture the interseasonal and interannual variability of risks.

The value of participatory risk mapping lies in its ability to identify quickly who is experiencing what worries and where, with the ultimate goal of directing further research and assistance. For the authors, we thought it best to use this methodology prior to the design of long-term questionnaires and surveys in order to identify which issues we should be concentrating on, to confirm or reject our prior beliefs before we commenced with formal sampling, surveying, and hypothesis testing. For example, we had not anticipated the importance attached to risks of human illness or of not being able to meet school fees. Nor had we fully appreciated the wealth-differentiated exposure to risk of violence. Letting informants lead the discussions truly widened the scope of the questions we had initially set out to ask and answer.

We therefore believe any long-term research based on extensive surveys and questionnaires, especially in areas lacking strong previous research on risk and vulnerability, could benefit from complementary pilot research based on participatory methods. The method's value to researchers increases as one becomes more concerned about spatial and temporal variation in perceptions.

For policymakers, participatory risk mapping can be crucial to priority-setting that is sensitive to variation among distinct geographic, demographic, economic, or sociocultural subpopulations (Smith *et al.*, 1999). Especially if repeated at regular intervals, so that one can quickly look at changes in incidence and severity measures, it can even be a useful complementary tool in early warning systems that often rely excessively on physically observable phenomena such as staple food prices, rainfall, anthropometric measures of children, crop yields or livestock health. We particularly see this as complementary to other emerging methods that emphasize spatial visualization through mapping, for example various "vulnerability mapping" initiatives, such as that begun by the World Food Programme.

5. CONCLUDING REMARKS

The immediate usefulness of the participatory risk mapping method lies in its ease of graphic representation and thus of communication to and comprehension by subject communities and policymakers. When coupled with GIS, this technique can usefully represent risks spatially and when updated periodically, it can capture seasonal or other periodicity in subjects' experience of risk. By distinguishing

between the incidence and severity of subjective risk perceptions, this method enhances understanding of the nature and variation of risk. Three qualitatively different sorts of risk can be found: those that are widespread and generally perceived as serious (e.g., water and food scarcity in this particular setting), those that are quite serious, but not widely experienced (e.g., human disease and conflict in our study area), and those that are experienced sporadically, but are rarely considered leading sources of vulnerability (e.g., available shops and transportation). This taxonomy can be quite helpful in the targeting of both research and relief or development interventions, in that it facilitates identification of the self-proclaimed worries of specific subpopulations—defined by location, gender, class, or principal economic activity—or during particular periods.

Not only do risk map graphics, whether georeferenced or not, highlight areas of particular concern, but by comparing across distinct subgroup strata, they also demonstrate the considerable heterogeneity of concerns within even a relatively homogeneous population. One especially important point that emerges from the present application to east African pastoralists is that the dimensionality of risks faced by the poor tends to be greater than that faced by the wealthy. Put differently, the wealthy have fewer concerns than do the poor. Policymakers and researchers face a greater challenge in helping cushion the poor from adverse shocks.

NOTES

1. For example, imagine a respondent identifies four sources of risk—A, B, C, and D—and names risk B as most serious, with C and D tied for second most serious, and A the least serious. We would then assign A, B, C, and D ordinal rank values of 4, 1, 2, and 2, respectively.

2. In the rare instances where someone declares only one risk, it is assigned value one (1).

3. Spreadsheet formulae (for Excel or Quattro Pro) for these calculations are available from the authors by request. The computations are simple and quick.

4. For the sake of convenience, the Ariaal ethnic group, a combination of Rendille and Samburu pastoralists, were listed as Rendille or Samburu depending on where they were living. This ethnic group is not recognized by censuses, only by locals when asked for clarification as to their ethnicity.

5. Participatory risk mapping was only one among many activities undertaken during this period. If focused just on fielding this methodology, one could probably satisfactorily cover as many groups and as wide an area in six weeks. In our experience, this method is as quick in the field as other, more established participatory methods.

6. The contour surfaces in each map were interpolated using the inverse distance weighting method using the five nearest neighbors for each grid point in the map. Darker shades reflect higher levels of risk reported by communities in the area. The maps are directly comparable because levels of risk are represented in absolute levels, per the discussion of the previous section. They are not normalized by variables' standard deviations. In depicting categorical information (e.g., ethnicity), we have constructed 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. There is significant ethnic intermixing, especially between Ariaal and Rendille and between Boran and Gabra. Finally, where possible, data have been successfully validated by comparing our georeferenced data (e.g., on town locations) to established geographic data bases.

7. The region of high declared risk of conflict in the southwestern-most part of our study area may be slightly misplaced. Some of the interviewed groups were Samburu who had been attacked by Turkana further north, near Baragoi, and had subsequently displaced southward, toward Maralal.

8. The population figures are based on a 1989 government census (Kenya Population Census, 1994), and subsequent published population growth rates of 2.8% per annum during 1990–95 and 2.7%, 1996–98.

9. The Ethiopian population and food aid distribution data were provided by the regional headquarters of Borana zone.

10. Grootaert (1998) finds some evidence of such effects in rural villages in Indonesia.

11. For example, imagine there are two groups surveyed. Group 1 said risk A was an issue for them six of the past 10 years and risk B was an issue in 3 of 10 years. Group 2 said risk A was material to them five of the past 10 years and risk B was never an issue. The overall incidence measure, I, would be $((6/10) + (5/10))/2 = 0.55$ for risk A, and $((0.3) + 0)/2 = 0.15$ for risk B.

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