Vulnerability in Farmer Seed Systems: Farmer Practices for Coping with Seed Insecurity for Sorghum in Eastern Ethiopia[1]

Shawn J. McGuire

School of Development Studies, University of East Anglia, Norwich, UK NR4 7TJ; s.mcguire@uea.ac.uk

Vulnerability in Farmer Seed Systems: Farmer Practices for Coping with Seed Insecurity for Sorghum in Eastern Ethiopia Many interventions try to address farmers' seed insecurity, though few assess the causes of farmers' vulnerability or understand their coping strategies. This paper analyzes farmers' practices for maintaining sorghum seed security in a specific season (1998–99) in Ethiopia, which provides a richer picture of coping strategies than accounts of "general" practices, as it shows how responses reflect events unfolding over time and household-specific situations. High seeding rates ensure against environmental uncertainty, but not everyone has sufficient seed for repeated sowing should stands fail to establish. Off-farm seed fills this gap, though payment is usually required for substantial quantities; only 20% of seed from other farmers came for free in 1998. Differences between seed suppliers and recipients suggest indicators for chronic seed insecurity. The discussion explores implications for supporting farmers' coping strategies. Helping the poorest farmers access off-farm seed, from other farmers or from merchants, can reduce their vulnerability.

Key Words: Vulnerability, farmer practices, coping strategies, seed insecurity, emergency seed relief, sorghum, Ethiopia.

There is an abiding interest in how farmers cope with and overcome agricultural crises such a drought or natural disasters (Dercon 2002; Devereux 2002; Sharp and Devereux 2004). Seeds are the fundamental input to farming, and vulnerability involving seeds can damage farmer welfare (Sperling, Remington, and Haugen 2006). Farmers are the major source of seed in most countries, with formal seed supply particularly weak in high-stress areas (Tripp 2001), so it follows that "farmer seed systems"—their seed saving, selection, and exchange practices, associated knowledge, and social relationships—are at the heart of strategies for coping with stress. Increasingly, both emergency aid and development interventions seek to support farmer seed systems by minimizing vulnerability or by strengthening post-stress recovery (Remington et al. 2002; Sperling, Osborn, and Cooper 2003). However, these efforts are constrained by limited, and mainly descriptive, information about practices in farmer seed systems, particularly in response to stress. This paper addresses this gap with a detailed study of sorghum (*Sorghum bicolor* [L.] Moench.) in eastern Ethiopia, the major crop in this chronically stressed region. I show how maintaining seed security is a central concern for households and drives a number of practices in the farmer seed system, and how vulnerability to seed insecurity varies between households and agroecologies. Improved understanding of farmers' vulnerability can assist interventions that support seed systems. Considering coping strategies may also provide fresh insights into farmers' genetic resource management.

After reviewing major knowledge gaps around seed security, I describe study sites and research methods. The results explore household-level practices in seed saving and exchange, showing different household strategies for maintaining

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seed security (Fig. 1). The discussion considers implications for interventions supporting farmer seed systems, highlighting the importance of seed exchange. I conclude by reflecting on the importance of studying actual practices to understand coping strategies.

Seed Systems and Seed Security—Gaps in Knowledge and Practice

Many efforts to address chronic poverty aim not only to protect vulnerable livelihoods but also to promote development (Devereux 2002). One reason that emergency seed aid has been such a popular intervention in drought- or conflict-affected regions over the past two decades is that it is seen as a bridge between relief and development, both meeting immediate needs and (potentially) delivering a means to improve livelihoods. However, recent studies show that seed aid often does not address the main sources of farmer vulnerability, and may even weaken resilience in farmer seed systems for coping with stress over the longer term (Jones et al. 2002; Sperling and Longley 2002). All too often in designing seed aid, vulnerability with seeds—seed insecurity—is simply extrapolated from food security. Yet vulnerability literature stresses that each hazard raises unique challenges (Adger 2006); seed insecurity is different than food insecurity and needs separate analysis. The poor impact of seed aid reflects a limited understanding of farmer seed systems, particularly of their vulnerability to stress. For instance, the most common aid approach is to distribute externally-sourced seed to farmers, on the assumption that farmers' vulnerability is mainly due to the absence of locally-produced seed following a crisis. However, where this has actually been studied, sufficient planting material was usually present nearby; vulnerability is likely to have other causes in most cases (Sperling, Remington, and Haugen 2006).

Remington et al. (2002) provide a useful framework for analyzing seed security, breaking down causes of vulnerability to availability, access, and utilization. Availability refers to the presence of planting material in a specific location and time, regardless of its quality or desirability. Access relates to a household's entitlements to seed via exchange networks or markets. Utilization reflects the usefulness of a given seed lot to farmers, based on its physical health and genetic traits. Seed security thus involves the ability to obtain sufficient seed from somewhere, and the usefulness of this seed. Aid efforts often assume that seed availability is the main problem following a crisis, discounting the possibility that local channels could supply good quality seed. However, these assumptions are rarely tested in advance, which contributes to ineffective seed relief.

Baseline assessments that identify vulnerable groups and coping strategies could greatly assist emergency relief (Maxwell and Watkins 2003). However, few studies of farmer seed systems focus on coping, and most of these are too descriptive or generalized. In a typical example, Longley et al. (2002) recommend asking where farmers normally obtain seed to gain baseline information on seed availability and access. Such generalized questions provide normative answers rather than actual responses to specific events. While Bramel et al. (2004) do analyze a specific season (2003) in Ethiopia, they only list percentages of households using different off-farm seed sources. However, a concrete picture of vulnerability, and how it varies by household, needs detail, such as the actual quantities of seed exchanged and terms of access. Therefore, this study uses details of actual farmer practice to develop an analysis of seed insecurity and coping strategies.

This emphasis on practice also provides a different lens for analyzing biodiversity management. Many studies highlight farmers' selection as a key influence on crop variety diversity, pointing to links between demand for different traits and levels of on-farm diversity (e.g., Bellon 1996; Teshome et al. 1999). However, there is growing appreciation that other practices, such as exchanging seed lots to maintain viability (Louette, Charrier, and Berthaud 1997), also shape diversity. Similarly, practices for coping with seed insecurity may also shape diversity indirectly, though few studies have considered this.

Location and Methods

Ethiopia has received seed aid nearly every year since 1974, with at least USD 15,000,000 spent in 2003 alone (Mburathi et al. 2003). Seed needs are simply extrapolated from assessments of food shortfalls, and distribution of externally-sourced seed remains the most common approach. Donors as well as national and international authorities recognize a need for seed-specific assessments to help guide interventions, though no assessments have yet been developed.

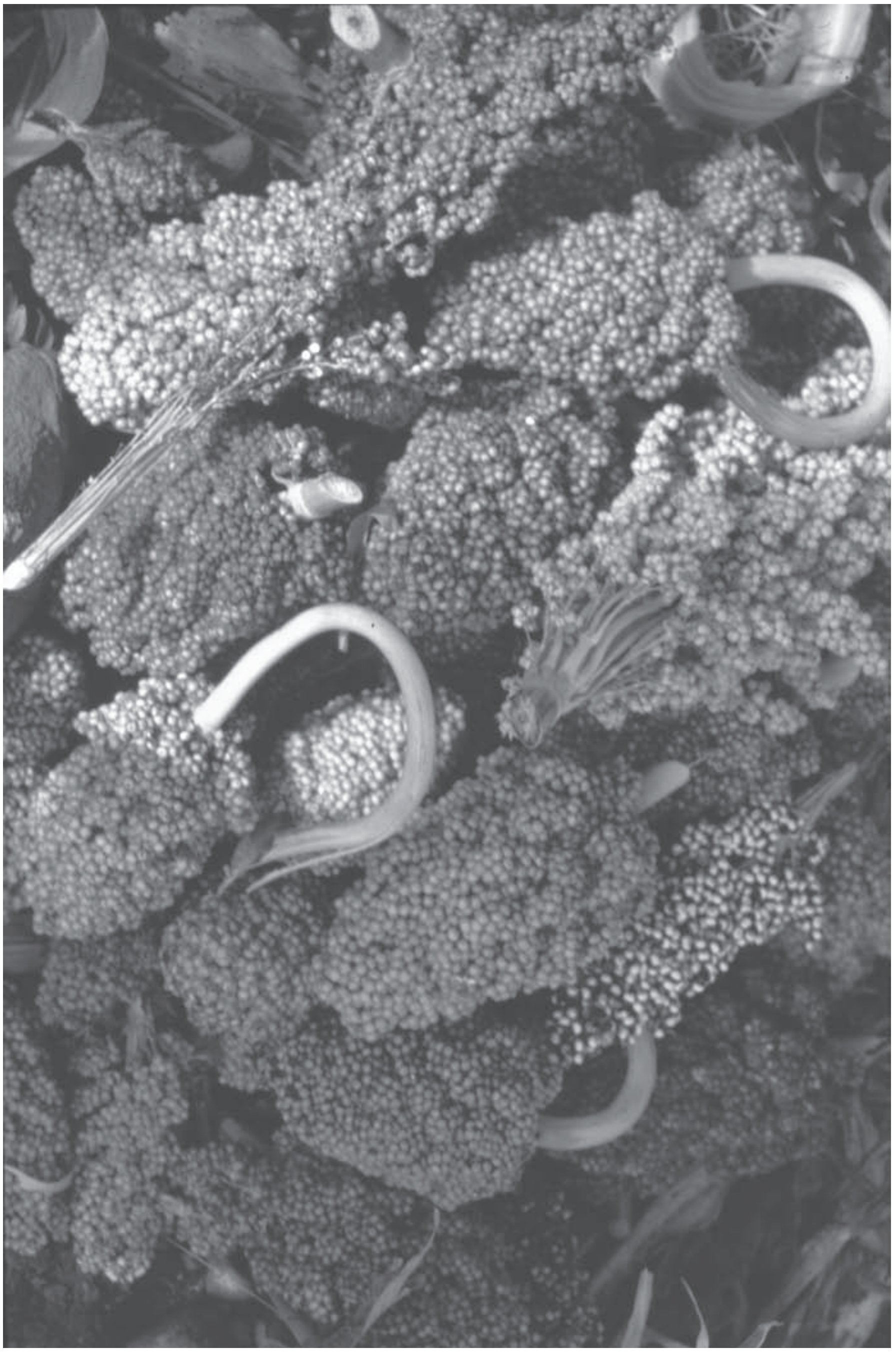

Fig. 1. Sorghum panicles left on the ground during harvest of Muhammed Yussuf Elemo's half hectare plot near Torbayo Village, Melkaa Horaa FA, in the Miesso District of Eastern Ethiopia. Local varieties seen here include Masugi Dima (red, compact panicle), Masugi Dalech (golden yellow, compact), Masugi Adi (cream, compact), Qirimindahi (red/brown, loose panicle), Wachela (cream, loose), and Challe (white). This varietal diversity came about because Muhammed lost his own seed stock in 1998 (he had two varieties), and he met this gap with small gifts of seed from several different farmers. Diversity in this case resulted from a strategy for coping with seed insecurity, rather than a plan to sow different varieties.

This study focused on the West Hareerghe Zone, Oromiya Region, in eastern Ethiopia. The main livelihood activity in the region is mixed crop–livestock farming, with sorghum the most important crop in the Zone, sown to 175,000 hectares (ha) (CSA 1995). Holdings are typically small, depend on ox tillage, and use very few external inputs. Food and seed insecurity are seen as growing problems in the region (Piguet 2003). Nearly all informants were ethnic Oromo.

Rainfall is bimodal, with short rains (*belg*) in March–April followed by more substantial rainfall between June and September (*kremt*). Fieldwork centered on two adjacent districts (*Woredas*), Chiro and Miesso, representing distinct agroecologies and sorghum variety populations. Chiro is in densely-populated highlands, Miesso on a more sparsely-settled lowland plain (respective population densities 2.2 and 0.5 people ha^{-1}; ICRA, 1996). Chiro has longer rainy seasons, but is constrained by soil degradation and small landholdings (mean farm size in Chiro survey was 0.6 ha). Miesso farmers have larger holdings (mean 1.3 ha in survey), but contend with shorter rainy seasons with more variable onset. Across both districts, less than a third of households have two oxen required for tillage, while 40% have no oxen at all. Farmers in both districts sow 1–3 varieties (mean 1.4), nearly always Farmer Varieties (FVs, usually landraces), as these have desirable characteristics (palatability, stress-tolerance, biomass). FVs are long-maturing, sown with the early rains and harvested 8–9 months later. However, poor *belg* rainfall—especially common in Miesso—or pest attack on seedlings can cause early sowings to fail. In such cases, farmers usually seek fast-maturing sorghum varieties to resow during the main *kremt* rains. This is the only time when demand for Modern Varieties (MVs) is appreciable for sorghum, as fast-maturing types are mainly MVs (or have MV origins). However, lowland farmers prefer to revert to FVs in subsequent seasons if they can (McGuire 2005).

Study occurred over 12 months in the 1998–99 season, a period which now is considered part of the build-up to a major food and seed crisis the following season (Hammond and Maxwell 2002). In each district I focused on one Farmers' Association (FA, roughly 1000 households). In Chiro, Funyaandiimo FA has above-average production, though is 25 kilometers from a market town. The FA in Miesso, Melkaa Horaa, has below-average production, but is 5 km from a market town and an agricultural research station. Much of my time was spent in these two FAs, with resident research assistants, observing farmers through the season. Nested sampling combined extensive surveys and interviews with more detailed case studies. Semistructured interviews on sorghum seed and variety management (57 in Chiro, 84 in Miesso) helped frame more detailed questions for focus groups and for contact farmers (10 in Chiro, 11 in Miesso) who were regularly visited. A formal survey in mid-season asked 41 Chiro and 53 Miesso farmers, from across each district, details about varieties, seed storage, exchange, access, and quantities. Contact farmers and focus groups were selected to reflect different farming conditions, household wealth, and seed security. Additional information came from key informants in government and non-governmental organizations (NGOs) in the region. Germination tests counted germination on moist petri-dishes after four days, using three replications of 100 seeds. SPSS was used to compare means (t-tests and ANOVAs), and STATA was used to develop probit regression models, with 5% the significance threshold for all tests.

Results

Seed Saving Practices

Farmers' most important source of planting material is their own saved seed. Typically, farmers designate some of their harvest as "seed," treat and store it separately from grain, and only sow from this the following season. The survey asked what quantities farmers intended to save (Table 1). Though Miesso farmers intended to save significantly more seed than farmers in Chiro, larger Miesso field sizes mean that quantities are roughly equivalent in terms of crop area, around 30 kg ha^{-1}. This is 3–6 times the sowing rate recommended by agricultural research organizations (IAR 1995).

Farmers explained that high sowing rates are needed to cope with uncertainty. First, not all seed may germinate—though farmer-managed sorghum seed usually germinates well. Second, ox ploughs sow 10–15 cm deep (Goe 1999) (by comparison, research stations sow to 5 cm), seedlings emerge through soils that are sometimes heavy or have surface crusting, and develop under uncertain rainfall. Third, pests may attack seedlings. Thus, high sowing rates improve the chance of

Table 1. From surveys, means (with standard errors) of the absolute amount of sorghum seed farmers planned to save at end of 1998/99 season, relative to the area they sow to sorghum, and as a percentage of what they consider a good or poor harvest on their farm.

Amount of seed planning to save	Chiro (n = 53)[1]	Miesso (n = 41)
Absolute amount (kg)	15.5 (2.7)*	27.7 (4.0)*
Relative to sorghum area (kg ha^{-1})	29.0 (3.9)	36.4 (6.1)
As proportion of a “good” harvest (%)	1.3 (0.2)*	2.5 (0.7)*
As proportion of a “poor” harvest (%)	7.1 (2.0)*	21.8 (4.5)*

[1]* District means significantly different, based on t-tests.

even crop establishment stand under farmers' conditions. Once seedlings are established, farmers selectively thin stands to minimize interplant competition, using thinned plants as fodder. Indeed, some cited livestock as an important consideration in sowing rates: “I sow at the higher rate [16 kg ha^{-1}] for animal feed, but without animals, I sow at the lower rate [8 kg ha^{-1}]” (farmer interview). A study in the region (Wilbaux 1986) found that farmers reduced sorghum densities from a mean of 168,000 plants ha^{-1} at emergence to 30,000 at maturity, and that they adjusted sowing rates and final plant densities in response to soil moisture levels. High sowing rates are therefore calibrated to reflect individual household and seasonal conditions. Due to variable rainfall, sowings still often fail, so many farmers save enough seed for repeated sowing. As one explained, “I save 100 kg, and plant 3–4 times, waiting two weeks after each sowing until it is established.” Thus coping strategies require high seed volumes.

Individual saving practices vary considerably; some saved over 100 kg, others only 2 kg. Asset profiles, consumption needs, and attitudes to risk affect these quantities. Saving a small amount may increase vulnerability if it prevents resowing. In contrast, farmers saving larger amounts often supplied neighbors in need. For example, contact farmers who supplied seed to others in 1998 saved significantly more seed (2X in Chiro, 3X in Miesso) than other contact farmers (data not shown). Table 1 also presents seed-saving intentions as a proportion of harvest expectations for “good” and “bad” years, giving a rough estimate of the “cost” of seed security. Seed comprises a significantly higher proportion of harvests in Miesso than in Chiro. These figures highlight why seed insecurity is distinct from food insecurity: while a 50% drop in harvests would likely cause a food crisis (and trigger emergency seed aid), farmers only need 1.3–2.5% of a good harvest to be able to sow the next year. However, this does not mean that seed availability is never a problem; seed saving demands a larger share of harvests after a poor season, particularly in Miesso where yields can be very low. Low yields, or pressures to consume or sell grain, may also cause farmers to set aside less seed, lowering availability for resowing or exchange. Focus groups stressed that most would save enough to sow once: shortages usually were due to a lack of seed for resowing.

Finally, when poor *belg* rains cause long-maturing sorghum to fail, most farmers suddenly confront an acute need for fast-maturing seed, as very few save fast-maturing sorghum from year to year. This highlights the importance of off-farm supply for the seed security of all farmers, not only the most vulnerable.

Off-Farm Supply Channels

Roughly one-third of the farmers surveyed or interviewed in both districts reported receiving off-farm seed in 1998. Norms of self-reliance make some reluctant to admit receiving off-farm seed; my observations, and cross-checking specific exchanges with both donors and recipients, suggest that the proportion receiving off-farm seed is higher than this. Table 2 lists exchanges where farmers did specify quantities and source. On average, Miesso farmers received significantly more seed (19.6 kg) than Chiro farmers (8.8 kg), reflecting greater needs in the lowlands. Neighbors were frequently used, but markets tended to supply larger quantities; however, the small number of cases where quantities were specified meant that this trend was not statistically significant within each district. Interestingly, no Miesso farmer reported receiving seed from family members in

TABLE 2. THE NUMBER OF EVENTS WHERE FARMERS REPORTED IN SURVEYS AND INTERVIEWS RECEIVING OFF-FARM SORGHUM SEED IN 1998, WITH MEAN AMOUNT RECEIVED (AND STANDARD ERRORS) ACCORDING TO SOURCE AND DISTRICT.

	Chiro		Miesso	
Seed Source	n	Amount (kg)	n	Amount (kg)
Family	3	15.7 (5.0)	0	0
Other farmers	14	4.7 (0.9)	6	14.5 (2.1)
Market	2	27.0 (13.0)	3	29.7 (19.5)
All sources[1]	**19**	**8.8 (2.2)**	**9**	**19.6 (6.3)**

[1]* District means significantly different, based on t-tests.

1998. Kin are not always nearby, and may not have spare seed. Assistance from neighbors is especially important in the lowlands, something which focus groups repeatedly stressed.

The formal sector and NGOs play very minor roles in supplying sorghum seed. The parastatal Ethiopian Seed Enterprise (ESE) only produces enough MV sorghum seed to sow 2% of national acreage, most of this going to commercial farms (McGuire 2005). Market and communication links with smallholders remain very weak, so formal supply to farmers is shaped by top-down decisions. For instance, after early sowings failed in 1998, Melkaa Horaa FA (Miesso) requested 2,600 kg of fast-maturing MV sorghum seed as emergency assistance. However, district officials could only supply 100 kg, and stipulated that recipients must be able to sow 0.5 ha on a specified date. The most vulnerable have little flexibility with oxen and labor, and were unlikely to be among the handful who did receive assistance. NGOs sometimes also supply seed, though there was little evidence of this in the study area. No farmer I encountered reported receiving seed from government or NGO sources in 1998.

In contrast, local merchants are an important source. Some are grain traders with shops in larger towns, some small merchants who travel to weekly markets in each FA. "Seed" here is usually grain cleaned of impurities, generally bulked from different sources or varieties. Merchants purchase from other farmers, or occasionally from other merchants. Most sellers in Miesso market obtained seed from a 50 km radius, though some claimed to source seed from much farther away. No merchant reported problems in obtaining sorghum seed, even after a difficult year. However, the amount of seed available for sale in Miesso market did dwindle toward the end of the late rains.

Farmer-Farmer Exchange

Farmer-farmer seed exchange is important in addressing seed insecurity; differences between seed suppliers and recipients may suggest indicators for vulnerability. Table 3 compares characteristics of suppliers with nonsuppliers, and recipients (from all sources) with nonrecipients in each district, in order to see if suppliers/recipients differ from their neighbors. Yield per hectare, calculated by dividing production by area, was included along with gross production estimates. Wealth stratification among Ethiopian farmers tends to be less than most countries, owing to land redistribution, but differences between households may still mean the difference between being vulnerable or not.

Seed recipients in Chiro differed little from nonrecipients, apart from a trend to fewer oxen ($p = 0.08$). However, differences were clearer elsewhere: Miesso recipients expected significantly lower yield and production than others; suppliers in both districts expected significantly higher production in good and bad years. Miesso suppliers also had more land and oxen. The significant (though modest) differences in production and assets for suppliers suggests that these farmers (who reach five others, on average) have greater production security. Seed recipients, on the other hand, are less obviously distinct. Probit models were used to explore these trends further, testing whether district (as a dummy variable), household assets (number of workers, oxen, area to sorghum), and yield expectations affect the probability that an individual will supply or receive seeds (Table 4). Other variables were highly correlated to one of these and were excluded. Having more area to sorghum, and higher expected yield in a bad year, significantly affect the probability of being a seed supplier. The probability of receiving seed was significantly increased by lower expected yields in a good year. Together, these tables indicate that seed suppliers are less vulnerable to harvest reduction, in part due to assets. Seed recipients expect lower yields, though asset ownership is not such a clear indicator here. Vulnerability to seed insecurity may reflect land or labor quality more than quantity. In any case, low yield expectations of seed recipients suggest that at least some of this group regularly need off-farm seed, and thus are chronically vulnerable.

TABLE 3. MEANS OF SOME CHARACTERISTICS OF FARMERS IN WEST HARERGHE WHO STATED IN SURVEYS THAT THEY HAD SUPPLIED OR HAD RECEIVED SEED OFF-FARM IN 1998.

Farmer characteristic	Chiro				Miesso			
	Received in 1998[2]		Gave/sold in 1998		Received in 1998		Gave/sold in 1998	
	Yes	No	Yes	No	Yes	No	Yes	No
Number responding	6	47	19	34	9	32	9	32
Amount given / received (kg)	13.0	—	32.4	—	18.5	—	35.3	—
Number given to	—	—	5.8	—	—	—	4.7	—
Age of farmer	35.83	37.62	41.68*	35.03*	36.44	35.34	39.33	34.53
Number of oxen	0.83	1.35	1.39	1.24	1.89	1.16	2.33*	1.03*
Sorghum area (*Timad*)[1]	4.67	4.24	4.76	4.03	7.44	7.09	10.00*	6.38*
Seed saved/area to sorghum (kg/ha)	24.00	30.93	30.88	32.91	36.78	31.26	27.37	31.71
Expected production, good year (t)	1.27	1.28	1.71*	1.03*	1.30	1.93	2.86*	1.49*
Expected production, bad year (t)	0.41	0.39	0.53*	0.32*	0.17*	0.30*	0.44*	0.22*
Expected yield, good year (t/ha)	2.13	2.64	3.02*	2.33*	1.42*	2.36*	2.28	2.12
Expected yield, bad year (t/ha)	0.71	0.84	0.95	0.75	0.22	0.38	0.41	0.33
"Age" of seed stocks on-farm (yrs)	7.67*	12.98*	14.5*	10.9*	4.11*	11.30*	15.00*	8.23*

[1] *Timad* is a local measure, roughly ⅛ of a hectare.
[2]* Means for "yes" and "no" responses significantly different, based on t-tests.

The "age" of seed stocks is the number of years since a specific seed lot was replaced due to complete loss, averaged across all varieties grown (Table 3). This provides insight into the frequency of involuntary loss of seed lots, since farmers who replaced seed lots recently will have "younger" seed stocks than those who claim to have never replaced the seed they initially received from their parents. This method highlighted replacement following total loss, as the survey did not address partial refreshing of seed lots. Seed recipients had significantly younger seed stocks than other farmers, at a magnitude greater than the farmers' age differences. This suggests that seed recipients have generally greater seed insecurity as they replace seed stocks more frequently. These findings offer further evidence that some of the 1998 seed recipients are chronically vulnerable to seed insecurity.

TERMS OF ACCESS

Descriptions of farmer seed systems often assume free and unrestricted exchange among farmers but rarely test this (David and Sperling 1999). Mutual-aid institutions are common among the Oromo (Ta'a 1996), and norms stress generosity with seed, but actual practice does not always follow these norms. Farmers will give away small amounts (2–3 kg), but will often demand goods or cash in exchange for more substantial amounts to others who are not kin. However, a few prominent individuals in each community regularly give large (> 15 kg) gifts. The average supplier in each district provided around 30 kg

TABLE 4. PROBIT ANALYSIS MODELS FOR FACTORS INFLUENCING THE PROBABILITY OF GIVING OR RECEIVING SEED IN WEST HARERGHE IN 1998.

Model	Variables	Coefficient	Std. Error	z	p > |z| [1]
Supplied seed in 1998?	Number of workers	0.157	0.105	1.49	0.136
	Number of oxen	0.070	0.147	0.48	0.633
	Sorghum area	0.122	0.050	2.46	0.014*
	Expected yield "good" year	0.016	0.012	1.32	0.187
	Expected yield "bad" year	0.083	0.034	2.46	0.014*
	Constant	−2.439	0.506	−4.82	<0.001*
Received seed in 1998?	Expected yield "good" year	−0.042	0.017	−2.50	0.012*
	Constant	−0.120	0.365	−0.33	0.742

[1]* Variable has significant influence on model (probability of giving or receiving seed).

TABLE 5. COMBINING DATA FROM SURVEYS AND INDIVIDUAL INTERVIEWS, THE NUMBER OF TRANSACTIONS WITH MEAN TOTAL AMOUNTS (AND STANDARD ERRORS) INDIVIDUALS SUPPLIED OR RECEIVED IN 1998.

Terms		Chiro		Miesso	
		n	Amount (kg)	n	Amount (kg)
Supplied	Gift	32	33.2 (7.2)	27	32.7 (6.6)
	Non-gift[1]	14	59.3 (15.1)	3	27.3 (11.3)
	Total	**46**	**41.2 (6.9)**	**30**	**32.2 (6.0)**
Received	Gift	5	6.4 (2.3)	2	17.0 (0.0)
	Non-gift[1]	14	9.6 (2.9)	7	20.3 (8.3)
	Total	**19**	**8.8 (9.7)**	**9**	**19.6 (19.0)**

[1] Non-gift: cash sale, exchange for grain, exchange for other seed, or seed credit.

(usually to several recipients), though Chiro suppliers on non-gift terms provided 59 kg (Table 5). This table also compares amount received by terms. The sample of recipients generally did not receive seed from the sample of suppliers, so values for recipients in this table do not match those for suppliers, but are an independent sample. Fewer recipients specified quantities and terms, so sample size is lower.

Access to seed is a major constraint to seed security for many households. In both Chiro and Miesso, only 20% of the seed received was free (Table 5), and social relationships influence who can access this limited supply of free seed. For instance, seed donors are more likely to give seed freely to neighbors who had earlier assisted them with collective labor works. However, the poorest households are often labor-constrained and do not take part in collective activities, risking exclusion from such mutual-aid channels. I explore the evidence for patron-client relationships in more detail elsewhere (McGuire n.d.). Purchasing enough seed to resow a plot poses a serious challenge to the poorest households, and several of my informants had to sell assets such as livestock to buy seed. Access may also be constrained by transaction costs. A third of Miesso survey respondents reported problems obtaining even small amounts from a neighbor, while a similar proportion in both locations preferred markets when their own seed ran out, complaining it was cumbersome or humiliating to seek seed from a neighbor. Thus households lacking financial or social assets are especially vulnerable around seed access.

Table 6 considers the geography of seed exchange, based on seed exchanges in the survey that specified source and destination location. Of the recipients recorded here, a third sought seed from another FA, while half of Miesso donors supplied farmers from outside their FA in 1998. Most interesting is that 9 of the 11 Miesso who admitted replacing their entire seed lot (82%) traveled to another location to get this seed. These are small samples, but do provide some insight into the geographical extent of seed exchange, showing that it is not exclusive to the immediate locality. In the lowlands, acute environmental stress may occasionally restrict local seed availability, requiring that farmers seek seed elsewhere.

As mentioned, high sowing rates mean farmers often need over 10 kg to (re)sow their plots. Such quantities are not always available from a single source. Moreover, the poorest often lack cash or other means of exchange and rely on free gifts of seed, which tend to be small quantities. Because

TABLE 6. THE TOTAL NUMBER OF SEED EXCHANGE EVENTS THAT SPECIFIED SOURCE/DESTINATION FAS IN SURVEY, AND NUMBER OF THESE THAT WERE NON-LOCAL.[1]

	Chiro		Miesso	
Seed exchange event	all cases	non-local	all cases	non-local
Received in 1998	7	2	8	3
Gave/sold in 1998	23	4	10	5
First obtained a given variety	76	6	49	9
Replaced seed stock after significant loss	9	1	11	9

[1] Non-local: to/from a different Farmers' Association than where the respondent lives.

of these availability and access constraints, some farmers sought small amounts from multiple sources (at least six in one case). Beggars cannot always specify the variety they get, and some contact farmers received several different varieties from multiple off-farm sources, without consciously choosing to introduce new varieties to their farms. Unplanned introductions of new varieties also occur when farmers discover different—and unexpected—sorghum varieties mixed in off-farm seed. Thus some movement of diversity between farms results from coping strategies, rather than conscious choices.

Utilization

Highland and lowland farmers have distinct sorghum types, in the survey naming 29 and 15 different FVs, respectively. As seen elsewhere in Ethiopia, these FVs have distinct characteristics and adaptation zones (Teshome et al. 1999). Farmers' variety preferences are thus local and individual to some extent, though seed exchange does not always supply preferred FVs. Emergency relief or extension programs tend to supply a single MV across a broad agroecology. Fast-maturing MVs are appropriate for late sowing, but their low biomass means they are not preferred when there is enough rainfall for FVs to mature. Institutional selection limits farmers' choice of sorghum with traits that meet their needs.

Farmers use various locations (e.g., above cooking fire, underground pit) and treatments (e.g., salt, chaff) for seed storage, and these practices generally maintain seed viability. However, losses to pests, moisture, or seed-borne diseases do occur. For instance, unusually late rains during the 1997 harvest in Chiro affected seed viability, with 40% of interviewed farmers reporting germination problems the following season. Saving more seed may not guarantee household seed security in such cases, and many highland farmers sought off-farm seed—though viable seed was scarce in some areas in 1998.

Seed from merchants may not be stored any differently than grain, and farmers often complain that merchants supply poor-quality seed. I assessed germination rates of seven lots of sorghum seed, purchased from six different vendors in Miesso market in June and July. Though four samples had good germination rates (>85%) and one was moderate (60%), two samples were very poor (<20%). Seed from the latter sources is clearly unacceptable and would increase vulnerability, especially if farmers sacrifice assets to obtain it.

Discussion

Seed insecurity can have various dimensions: a household may lack sufficient seed to (re)sow, may only have poorly-adapted or unhealthy seed, or need to sacrifice other productive assets to obtain off-farm seed. Seed insecurity thus constrains potential production, and farmers' strategies for maintaining seed security are important in chronically-stressed regions such as eastern Ethiopia. The gradual weakening of their coping capacities over several years contributed to a "slow-onset crisis" in the region (Hammond and Maxwell 2002), culminating in large-scale food and seed relief in 1999–2000 and 2002–2003. What does this study of farmers' practices say about vulnerability to seed insecurity and coping strategies?

One finding is that unpredictable environmental stresses require high volumes of sorghum seed, sometimes late in the sowing period. This is particularly true for the lowlands. Season- or even farm-specific factors such as rainfall distribution, soil conditions, and sowing times affect whether multiple sowings are required. Amounts saved vary, reflecting attitudes to risk and other claims on grain, as well as harvest size: some set aside ample seed for contingencies, others save enough seed for only one sowing. Even though seed usually comprises only a small proportion of harvests (Table 1), multiple sowings can still deplete a household's seed stocks if the rest of the harvest has been sold or stored underground (reducing viability). Some (e.g., Jones et al. 2002; Remington et al. 2002) argue that farmers rarely face problems with sorghum seed availability. However, by looking at farmers' responses to conditions as they occur, this study shows that availability sometimes is a constraint. Usually, though, household shortfalls can be met by off-farm supply (Table 2) or exchanges between localities (Table 6).

Limited access is a greater source of vulnerability than limited availability. Large gifts of seed are scarce, and those lacking kin or patronage ties to a major supplier must meet shortfalls through purchase or with several smaller gifts. This can be a serious burden on the poorest.

Finally, poor utility—low-germination seed or varieties with undesirable traits—sometimes also contributes to vulnerability. Farmers are generally adept at maintaining seed health, though uncommon events such as late rainfall in 1997 can undermine this and render even those saving large quantities seed insecure. However, low-germination seed from some merchants poses a more serious hazard, as purchases tend to occur after other sources are exhausted, late in the window for sowing, leaving little time for finding and sowing new seed. Utilization also poses problems when *belg* rains fail in the lowlands, as little of the available seed is suitable for late sowing. Poorly-adapted or undesirable seed is also an issue with off-farm seed when farmers cannot choose the varieties they receive (often the case with emergency seed distributions).

Seed system support should address actual, rather than assumed, causes of vulnerability. This study agrees with others for Sudan (Jones et al. 2002) or Kenya (Sperling 2002) in questioning the value of distributing externally-sourced seed. Availability is generally not the primary problem, though localized shortages can occur. Instead, improving farmers' access to seed, through interventions such as vouchers or cash, is likely to have a bigger impact on vulnerability in many chronically-stressed regions, provided seed is available from merchants or neighbors, and farmers can choose which varieties they obtain. Merchants also emerge as important to coping strategies, and improving the viability and diversity of seed they offer would be useful to farmers. However, imposing strict formal-sector standards on local merchants (see Federal Democratic Republic of Ethiopia 2000) would be counter-productive if it constricts this important seed channel. Informal markets certainly merit more study. Overall, this paper highlights the need to understand and support specific farmer coping strategies rather than simply produce standardized blanket interventions.

The low seed saving rates for some, and the lower production expectations of seed recipients (Tables 3 and 4), are evidence that some households are chronically seed insecure, particularly in the lowlands. Contemporary "safety net" programs address chronic vulnerability but generally emphasize food insecurity. Seed insecurity should also be part of the safety net discussion. However, in the long run, addressing chronic poverty underlying vulnerability will entail helping the poorest build assets or investment (Devereux 2002).

There is growing interest in seed system assessment to guide effective support, though rapid assessments risk standardizing needs and responses (e.g., obtaining "standard sowing rates" from secondary sources; Longley et al. 2002). This study, by emphasizing actual farmer practice, shows that vulnerability and coping strategies arise out of specific environmental and household situations (e.g., stresses that affect stand establishment, levels of access to off-farm seed). Vulnerability needs to be understood in social and ecological context (Adger 2006); for seed security, this entails considering what assets (social, financial, natural) a household has for responding to particular events as they unfold. Seed need assessments therefore should aim to gather individual responses to specific circumstances, rather than generalized accounts.

Finally, seed exchange is a key coping strategy, moving large volumes of seed between farms and localities. While diversity management may not be a conscious goal of seed exchange, this introduces new varieties (and different populations of the same varieties) onto farms. Louette et al. (1997) found that seed exchange influenced maize genetic diversity in Mexico. This may also occur with sorghum: genetic studies in Morocco (Djè et al. 1999) and Ethiopia (Ayana, Bryngelsson, and Bekele 2000) found low levels of difference in neutral markers between populations or regions, suggesting considerable gene-flow. Seed exchange to address seed insecurity likely plays an important role in this gene-flow, though more information on quantities, frequencies, and the long-term fate of exchanged seed would be needed to understand this more fully.

Conclusions

There is a growing interest in understanding vulnerability around seeds and farmer strategies for coping with seed insecurity. Programs addressing vulnerability need to deal with its actual causes, requiring careful assessment. This study shows the value of focusing on farmer practices for these, like vulnerability and farmers' responses, are context-specific. Though study of multiple seasons might uncover a wider set of coping strategies to different hazards, this analysis of a single season highlights how practices are in response to specific events as they unfold. In chronic stress areas such as eastern Ethiopia, high volumes of seed are insurance against environmental uncertainty, and off-farm seed is important for many farmers in meeting their needs. Thus support for farmers' coping strategies will often involve ensuring their access to off-farm seed. However, analysis needs to treat each case individually, considering specific hazards and practices for coping with them.

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