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Development Options for Local Seed Systems in Mozambique

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Abstract

Large quantities of free or subsidized seed have been distributed to small-scale farmers in Mozambique under post-war resettlement and drought/flood relief programs. A joint study by ICRISAT and World Vision assessed the impact of relief seed distribution, the adoption of new varieties distributed through relief programs, and the performance of local seed systems. While there was undoubtedly a need for well-targeted emergency assistance, seed losses associated with war, drought, and floods appear to have been overestimated. Village seed systems are remarkably efficient in meeting seed requirements and maintaining varietal diversity, even under drought or flood conditions. However, there remains scope for improving household seed selection and storage practices. In addition, sustainable seed supply systems (both community-level and commercial) are needed to improve the access of small-scale farmers to new varieties.

Despite the massive demand for seed for public distribution efforts, domestic production capabilities remain small, and most seed is still imported. The problems include shortages of breeder seed, poor market infrastructure, high marketing costs, uncertainty about levels of commercial seed demand, and farmer dependence on free seed. Specific recommendations are offered for strengthening both local and commercial seed supply systems in Mozambique.

Abrégé

Une grande quantité de graines gratuites ou subventionnés ont été distribuée aux petits fermiers au Mozambique pendant la reconstruction d'après-guerre et lors des programmes de secours durant sécheresse ou inondation. Une étude collective entre ICRISAT et World Vision a évalué l'impact du programme de la distribution des graines, l'adoption de nouvelles variétés distribuées durant le programme de secours, et la performance des graines locales. L'étude révèle que lorsqu'il y avait sans aucun doute un besoin pour une assistance d'urgence bien ciblée, la perte en graines associée avec la guerre, le sécheresse, l'inondation apparaît avoir été surestimée. L' installation des graines dans les villages est remarquablement efficace pour répondre aux besoins en graines et pour maintenir une diversité de variétés, même lors de sécheresse ou d'inondation. Toutefois, il reste la possibilité d'améliorer la sélection des graines par ménage et les pratiques de réserves. En plus, un système de distribution stable (au niveau communauté et commercial) a besoin de faciliter l'accès des nouvelles variétés aux petits paysans.

Malgré l'énorme demande d'un effort pour une distribution publique de graines, la capacité de la production domestique reste petite, et la plupart des graines restent importées. Les problèmes incluent un manque de semences de pré-base, une pauvre infrastructure du marché, un coût élevé du marketing, une incertitude à propos des niveaux commerciaux de la demande de graines et une dépendance des fermiers concernant les semences gratuites. Des recommandations spécifiques ont été offertes pour renforcer le système des semences au Mozambique.

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Acronyms

ARDP	Agricultural Recovery and Development Program
BMZ	Bundesministerium fur Wirtschaftliche Zusammenarbeit und Entwicklung
CSO	Central Statistics Office (Zimbabwe)
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
INIA	Instituto Nacional de Investigacao Agronomica
NGO	non-govemmental organization
SADC	Southern African Development Community
SEMOC	Sementes de Mocambique
SMIP	Sorghum and Millet Improvement Program
WVI	World Vision International
USAID	Unites States Agency for International Development

Summary

From 1988 to 1998, the NGO, World Vision International - Mozambique, distributed more than 10,000 t of seed to small-scale farmers in central Mozambique. Most of this seed was distributed under post-war resettlement programs targeting input delivery to farmers returning from neighboring countries. Additional seed was distributed to farmers affected by drought and floods. Almost all this seed was imported from neighboring countries.

Mozambique faces the challenge of converting its dependence on emergency seed supply programs to a sustainable delivery system for seed of improved varieties. Farmers need more consistent access to quality seed, and national crop improvement programs need an efficient delivery system for new varieties. These efforts are complicated by the limited development of market infrastructure in much of the country, and high marketing costs. Seed traders question the level of household demand, particularly for open- or self-pollinated varieties. Some farmers have developed a dependence on emergency deliveries.

Despite the massive demand for seed for public distribution efforts, Mozambique's domestic production capabilities remain small. The national research service, the Instituto Nacional de Investigacao Agronomica (INIA), has difficulty even maintaining breeder seed stocks of its released varieties. Commercial investment is limited to the production of small quantities of maize and rice seed for the most readily accessible markets. Most of the nation's commercial and public seed supplies are still imported. Much of the distribution effort remains ad hoc.

The foundation of Mozambique's seed system is the village market. The vast majority of farmers rely primarily on their own harvests for their annual seed stocks. Shortfalls of seed for particular crops or varieties are most commonly resolved through seed trade between neighboring households. Seed shortages at the village level are resolved through wider regional seed and grain trade. Farmers periodically travel long distances in search of new seed stocks.

This study examines the performance of the village seed market in areas where World Vision distributed the largest share of its relief seed. These include parts of Tete, Sofala, Zambezia, and Nampula provinces in central Mozambique, which are among the regions most dependent on relief seed.

The report summarizes data about the structure and conduct of village seed systems. The analysis examines the varied sources of seed used by small-scale farmers, factors underlying the quality of this seed, and the impacts of seed delivery through World Vision programs during the 1990-98 period. Preliminary conclusions are drawn regarding the capacity of the village seed system to cope with demand fluctuation associated with floods or droughts. The analysis also comments on the ability of the village seed system to maintain the purity of new varieties or to supply quality seed.

The analysis reveals that village seed systems are active and reasonably efficient in meeting annual seed requirements for most small-scale farmers in the survey regions. Farmers most commonly complain about the difficulty of maintaining high-quality seed stocks from harvest to the next planting season. The survey respondents also complained about their inability to obtain new varieties of alternative crops. The analysis reveals that while there is undoubtedly a need for well-targeted emergency assistance, seed losses associated with war, drought, and floods have probably been overestimated.

There is substantial scope for improving the capacity of village seed systems to meet both annual needs for quality seed and periodic emergency seed requirements. Development investments also need

to link local seed systems with the larger national seed market. Such linkages should prioritize the delivery of new, higher-yielding varieties. Improved public sector investments are essential for the dissemination of results from public crop breeding programs. Complementary private sector investments are needed to help farmers obtain access to higher quality seed.

The report concludes by outlining options for the development of village seed systems. These options highlight links between the investment decisions of small-scale farmers, public sources of breeder seed, and private agencies involved in the multiplication and distribution of commercial seed. Priorities for the sustainable development of the national seed system are highlighted.

Objectives of the Study

This study of Mozambique's local seed systems started as a review of what happened to the large quantities of seed distributed by World Vision under post-war resettlement programs. Are farmers still planting the varieties distributed under the relief programs? How have these varieties been maintained? What opportunities exist for strengthening the capacity of village seed systems to conserve and trade seed of both traditional and improved varieties?

Early reconnaissance surveys (Rohrbach et al. 1998) revealed the existence of an active rural seed system. The surveys also indicated that local seed systems are fairly resilient in the face of emergencies. However, fanners commonly sought assistance to improve their seed selection and storage practices. Additional questions were raised about the capacity of village seed systems to maintain new varieties.

The focus of the study correspondingly shifted from a limited review of the impacts of past seed distribution to a broader assessment of local seed systems. The analysis also sought to evaluate the capacity of local seed supply systems to maintain emergency seed stocks as well as an evolving range of new varieties.

In effect, this report provides a baseline characterization of village seed systems in Mozambique - the structure of the village seed market, the extent of household participation in local seed trade, assessment of the levels and determinants of seed supply, and a review of the structure of seed demand. The prospects for market development are then examined with a review of options for emergency seed supply and alternative delivery channels for new varieties. Finally, the report summarizes options for seed system development.

Sources of Data

Data were drawn primarily from a survey of 360 farm households in Tete, Sofala, Zambezia, and Nampula provinces. The survey was conducted between June and Aug 1998, after the 1997/98 harvest. In each province, the survey targeted two districts where World Vision had actively distributed emergency relief seed and one district where World Vision had not been active (Table 1). In each district, three villages were randomly selected; and in each village, 10 households were randomly chosen for interview. In sum, the sample comprised 360 randomly selected households: 270 households likely to have previously received seed from World Vision and 90 unlikely to have received this seed. Of the respondents to the main questionnaire, 48% were men, 13% were women, and 39% were jointly answered by husband and wife.

Table 1. Local seed systems survey sample: planned and actual, 1998.

Province	District	No. of households, planned		No. of households, actual	
		Received seed from NGO*	Did not receive seed from NGO	Received seed from NGO	Did not receive seed from NGO
Tete	Mutarara	30		29	1
	Changara	30		23	7
	Moatize		30	28	2
Sofala	Chemba	30		30	0
	Caia	30		29	1
	Maringu		30	21	10
Zambezia	Morrumbala	30		22	8
	Namacurra	30		26	4
	Mocuba		30	2	27
Nampula	Erati	30		14	16
	Murrupula	30		7	23
	Nacaroa		30	8	22
4 provinces	12 districts (36 villages)	240	120	239	121

* NGO = mainly World Vision, but some seed also distributed by other NGOs

One question in the survey checked what proportion of the sample had received seed from World Vision, or any other NGO. However, due to a mistake in the enumeration, we did not obtain information on the receipt of NGO seed prior to the 1994/95 cropping season. World Vision's emergency seed distribution programs started in 1988.

The data check revealed that in two of the four provinces the sample was skewed toward households receiving seed from World Vision. While the overall distribution of recipients and non-recipients was on target, the spatial distribution of the sample was not as planned. Further, the lack of information about seed receipts prior to 1994 limits the accuracy of even this stratification.

At best, the sample offers only an approximate indication of differences between the recipients and non-recipients of relief seed. Though the sample was not fully randomized, the consistency of responses implies the results can be generalized for these regions of the country. Most data are reported on a provincial basis, in recognition of the fact that public investment planning tends to be targeted within provincial boundaries. A few tables distinguish between recipients and non-recipients of relief seed. Several summarize regional data across the four provinces.

Data collection was initiated with a reconnaissance survey in Sofala and Zambezia in Nov 1997, where farmers and extension personnel were interviewed (Rohrbach et al. 1998). The results helped draft the main farm household questionnaire in May 1998. This was revised during pre-testing and enumerator training in June 1998. The questionnaires collected information about all major field crops except cassava and sweet potato.

The main source of bias in the survey results derives from substantial interventions by World Vision in the survey areas during recent years. Farmers were pleased to obtain free inputs, and despite warnings during the interviews, may have associated the survey with efforts to plan future assistance. Consequently, respondents may have underestimated their harvests or overestimated their seed needs. In practice, such biases are probably not severe. Nonetheless, concerns about possible bias are periodically highlighted in the summary of survey results.

Finally, some of the data on seed markets were not collected in Sofala because two pages were missing from the questionnaire. The results from the remaining three provinces are similar enough, however, that a supplementary survey was considered unnecessary.

Farming Systems

The four provinces surveyed encompass a wide range of agro-ecologies and soil conditions. However, the survey locations lie mainly in the drier and hotter regions within the Zambezi Valley, or in mid-altitude areas extending north out of the valley.

Most areas in the Zambezi Valley are at an altitude of less than 200 m; annual rainfall is 500-800 mm concentrated from Nov to March. Daytime temperatures range from 25 to 40°C, causing high rates of evapotranspiration. Soils tend to be sandy and drought is common. The main cereal crops are sorghum, pearl millet, and maize. Cowpea, groundnut, and cassava are also common.

Villages situated along the Zambezi River also practice floodplain cultivation, exploiting low or receding water levels along the banks of the river. Since the level of the river depends on rainfall across a catchment extending more than 2000 km west of Mozambique, flooding is common but unpredictable.

The upland survey areas, north of the Zambezi Valley, are generally characterized by an altitude of 200-1000 m, annual rainfall ranging from 800 to 1400 mm, and average temperatures of 20-30°C during the growing season. The soils range from sandy to clayish. Maize is the main cereal crop in this region, though sorghum and cassava are important in some areas. Cowpea and groundnut are also commonly grown.

Despite the variation in agro-ecology, farming systems in the survey areas of all four provinces are remarkably similar. Most farms are small (1.5-5 ha), with a range of crops - six different crops on average. In the drier regions of Tete and Sofala, farmers are more likely to grow sorghum or pearl millet in addition to maize (Table 2). In the wetter regions of Zambezia and Nampula, there is less pearl millet and more rice. Cassava is an important food crop in Sofala and Nampula but less common in Tete and Zambezia. Cowpea is the most commonly grown legume crop, followed by groundnut, pigeonpea, and bambaranut. Sesame is widely grown in Sofala. Sunflower is grown by 10-15% of the sampled farmers in Sofala, Zambezia, and Nampula. The production of a range of different vegetables is common; however, the survey did not collect data on vegetables.

Crop area

Estimates of planted area offer a preliminary basis for calculating seed demand for each crop. Since the area estimates provided by farmers were viewed as unreliable, the area planted to each crop was calculated from each farmer's estimate of the quantity of seed planted. This overestimates the planted area if farmers re-sow their fields (e.g. due to poor germination or flooding). Since flooding was common in the survey regions of Sofala, in particular, the area estimates for this province are biased upwards. However, the bias in the other three provinces is believed to be small.

Table 2. Major crops grown in the survey areas, 1997/98 season*

Province	% of farmers growing each crop					
	Cereals		Legumes		Other crops	
Tete	Maize	97	Groundnut	77		
	White sorghum	70	Cowpea	69		
	Pearl millet	48	Pigeonpea	29		
			Bambaranut	13		
Sofala	Maize	100	Cowpea	96	Sesame	62
	White sorghum	99	Groundnut	82	Sunflower	12
	Pearl millet	89	Pigeonpea	47		
	Rice	18	Sugar bean	33		
			Bambaranut	29		
Zambezia	Maize	80	Cowpea	63	Sunflower	13
	Rice	51	Pigeonpea	61		
	White sorghum	24	Groundnut	50		
			Bambaranut	13		
Nampula	Maize	80	Cowpea	91	Sunflower	24
	White sorghum	76	Groundnut	83	Sesame	17
	Rice	20	Pigeonpea	54		
			Bambaranut	50		

* Includes crops other than roots and tubers grown by 10% or more of households in each province

Based on seed data, small-scale farmers plant an average of 1 to 3 ha to major cereal and legume crops in the four provinces (Table 3). However, this figure includes neither cassava, which is particularly important in the survey regions of Nampula; nor sweet potato, which is commonly grown in small plots in all the survey areas. In Sofala, the area estimates appear high (relative to neighboring areas in the same province), because large quantities of maize, sorghum, and pearl millet seed were freely distributed in two of the three survey districts. The actual area planted to annual field crops in Sofala is probably closer to 3 ha per household.

The crop area estimates provided for Zambezia and Nampula appear unexpectedly low relative to neighboring countries in southern Africa with similar population densities (e.g. 1.8 ha per household for small-scale farmers in Zimbabwe, CSO 1997). However, the estimates are similar to those reported by Mozambique's Early Warning System for Food Security (Coordenacao do Sistema de Aviso Previo 1998). The estimates for Tete and Sofala are well above the national statistics reported for these provinces.

These data imply an annual demand for seed for at least six major field crops. An average farmer in Tete, for example, requires at least 9 kg of maize seed, 5 kg of white sorghum, 5 kg of pearl millet, 7 kg of groundnut, 5 kg of pigeonpea, and 4 kg of cowpea seed. There are an estimated 267,868 farmers in Tete - implying a demand of over 9000 t of seed per year in this province alone. Much of this will be met through seed retained from the previous harvest, but nonetheless, the market for seed of improved varieties should be substantial.

Quantities of grain harvested

As an initial measure of food (and seed) security, farmers were also asked to estimate the quantity of grain harvested in 1998 for each field crop. The aggregate grain harvests reported by the survey households were unexpectedly low (Table 4). These estimates roughly match those reported by the Early Warning System for Food Security. Yet they may also have been biased by the expectation that harvest estimates could affect future access to commodity or development assistance.

A portion of the grain deficit experienced by most farm households is probably resolved through harvests of cassava and sweet potato, particularly in Nampula and Zambezia, and to some extent in Sofala.

As a cross check on their production levels, farmers were asked to judge their own harvest levels and food security status (Table 5). Respondents in three of the four provinces judged the 1998 harvest to be worse than the previous two years. In Sofala, Zambezia, and Nampula roughly one-third of the

Table 3. Distribution of planted area (mean ha per household), 1997/98 season.

	Tete		Sofala		Zambezia		Nampula	
Maize	0.88	(.55)	0.97*	(.83)	0.52	(.81)	0.22	(.33)
White sorghum	0.68	(.81)	1.87*	(1.65)	0.16	(.40)	0.23	(.68)
Red sorghum	0.02	(.17)	0.01	(.05)	0.00	(-)	0.00	(.03)
Pearl millet	1.00	(2.15)	1.77*	(1.81)	0.01	(.11)	0.02	(.09)
Groundnut	0.07	(.12)	0.10	(.12)	0.03	(.07)	0.05	(.14)
Pigeonpea	0.08	(.29)	0.09	(.29)	0.23	(.65)	0.05	(.05)
Cowpea	0.06	(.17)	0.13	(.23)	0.06	(.14)	0.05	(.07)
Survey total	2.81	(2.94)	5.07*	(3.60)	1.12	(1.25)	0.72	(0.81)
National Crop Estimate**	1.14		1.05		0.92		1.18	

Numbers in parentheses are standard deviations

* Estimates are based on seed rates and thus inflated by replanting of flooded fields. Actual area planted is likely to be lower

** Coordenacao do Sistema de Aviso Previo 1998

Table 4. Mean quantity of grain harvested (kg per household) by sample farmers, 1997/98 season.

	Tete	Sofala	Zambezia	Nampula
Maize	354	265	248	163
Red sorghum	2	0	0	3
White sorghum	102	165	51	61
Pearl millet	27	78	0	1
All grains	485 (447)	509 (593)	299 (649)	228 (228)

Up to 10% of households claim they did not harvest in some areas due to floods, etc
Numbers in parentheses are standard deviations

Table 5. Food security status of survey households, 1996-98.

Harvest year	% of respondents evaluating their own food production levels as surplus, just adequate, or deficit			
	Tete	Sofala	Zambezia	Nampula
1998	surplus 3 deficit 64	surplus 6 deficit 40	surplus 21 deficit 28	surplus 23 deficit 35
1997	surplus 10 deficit 34	surplus 23 deficit 8	surplus 26 deficit 19	surplus 29 deficit 7
1996	surplus 19 deficit 21	surplus 60 deficit 19	surplus 26 deficit 46	surplus 28 deficit 25

survey households experienced a food production deficit. In Tete, two-thirds of the households reported a deficit. Almost no households claimed to have a food surplus in Tete and Sofala, whereas 20% of households in the Zambezia and Nampula samples indicated they had produced surplus food for sale.

The significance of the 1997/98 season flooding in the Zambezi River Valley is evident in the shift of many households in Sofala from a food surplus to a food deficit position between 1996 and 1998. When the rains were more favorable, in 1995/96, 60% of the surveyed households claimed to have a production surplus. This was more than twice the rate as in any other provincial sample.

In general, there appears to be a wide distribution of farmers at different levels of productivity in each of the provincial samples. This implies substantial scope for intra-provincial and intra-village trade as the first means to resolve household food deficits. As rural food markets develop and infrastructure improves, the proportion of households with surplus production can be expected to increase.

Evolving production patterns

The smallholder cropping system throughout the surveyed area is characterized by extensive cultivation with little or no purchased inputs. Fertilizer use is rare. Manure use is similarly rare as few households own cattle, goats, or donkeys. Most cultivation is done by hand.

This is a semi-subsistence cropping system. The majority of farmers remain at the margins of subsistence. However, a significant minority do appear capable of producing a crop surplus. The transformation toward more commercialized farming will depend on the availability of improved seed and fertility inputs.

Land is not a significant constraint in most of the survey areas. In all four provincial samples, the majority of farmers have been increasing the area they have been planting to major food staples during the past 4 years. Maize, white sorghum, pearl millet, groundnut, cowpea, and pigeonpea areas have all expanded in the areas where these crops are commonly produced.

The survey farmers indicated that the main reason for the recent expansion in planted area has been the need to produce enough food for their own consumption. The process of clearing land for production following post-war resettlement has been a gradual one. The speed and extent of crop area growth currently appears to depend more on the availability of family labor, and the associated costs of developing new fields, than on seed constraints. Future expansion is more likely to be linked with the

growth of the market. During the 1998 survey, approximately one-third of the households in each survey region indicated they were expanding their cropland in order to produce grain for sale. Farmers in all provinces are pursuing commercial sale of both cereal grains (particularly maize) and legumes. However, high transport costs and the limited development of agricultural markets still severely constrain commercial activity in most areas.

It was more difficult to obtain a clear explanation for the decline in area planted by some households. A small number of respondents cited seed constraints. However, this response appears associated with the expectation of receiving free seed from NGOs such as World Vision. The majority of farmers indicated that seed was readily obtainable either from their previous season's harvest or from neighbors.

Structure and Operation of Village Seed Markets

The structure of village seed markets is readily evident in the distribution of seed sources used during the 1997/98 planting season (Table 6). The single most important seed source for all major crops is the farmer's own seed stocks retained from the previous season's harvest. At least 70% of the farmers in each provincial sample obtained seed for major cereal grains from their own harvests. When household seed supplies are inadequate, farmers commonly seek assistance from neighbors. In general, 10-30% of households obtained seed of cereals from their neighbors.

NGOs represent an important source of seed in areas with emergency requirements. During the 1997/98 cropping season, World Vision was an important source of seed in regions affected by floods - particularly in Sofala. Other NGOs, including the Red Cross, also provided smaller quantities of maize and sunflower seed in Nampula and Sofala.

In addition, farmers commonly obtain seed from grain markets or local retail shops. While a few retail shops sell commercial seed distributed by the national seed company, Sementes de Mocambique (SEMOC), much of the retail seed trade in outlying areas appears to be grain which may have been cleaned for sale as seed. Such transactions appear relatively more common in Tete.

Finally, the surveys reveal that farmers will often travel long distances to obtain seed of specific traditional varieties or seed for crops where village seed supplies are limited. Anecdotal evidence gathered during the initial reconnaissance survey suggests long-distance seed trade was relatively more important during the immediate post-war resettlement period. Farmers returned to their original farming areas and sought seed of favored varieties from friends and relatives who had decided not to migrate during the war.

Village seed market

The strength of the village seed market is evident in the proportion of farmers *supplying* seed to their neighbors. During the 1997/98 planting season, almost 50% of the sample farmers sold, bartered, or gave seed to their neighbors (Table 7). The proportion of farmers participating in the market as seed suppliers was relatively higher in Zambezia and Nampula, and lower in the drier regions of Tete. Virtually all farmers know of another farmer from whom they could obtain seed. These are generally larger or better than average farmers with a production surplus, but not specifically producing seed for sale.

Unexpectedly, the majority of households also obtain a portion of their seed supplies from the village market. Virtually all farmers aim to retain seed from their own harvest, but will readily approach their neighbors for seed if harvests of any particular crop are limited. Some farmers will search among their neighbors for seed of particular varieties.

Table 6. Sources of seed for different crops, 1997/98 season (cited by % of households).

	Tete		Sofala		Zambezia		Nampula	
Maize	own stock	89	own stock	86	own stock	31	own stock	72
	other farmers	15	other farmers	9	other farmers	24	other farmers	22
	trader	21	trader	1	trader	24	trader	1
	NGO	12	NGO	68	NGO	24	NGO	12
	other	5	other	1	other	1	other	0
White sorghum	own stock	78	own stock	91	own stock	52	own stock	77
	other farmers	11	other farmers	21	other farmers	35	other farmers	22
	trader	8	trader	0	trader	4	trader	0
	NGO	2	NGO	46	NGO	4	NGO	0
	other	2	other	2	other	4	other	2
Pearl millet	own stock	67	own stock	71	*		*	
	other farmers	17	other farmers	10				
	trader	9	trader	0				
	NGO	7	NGO	47				
	other	0	other	3				
Groundnut	own stock	48	own stock	59	own stock	19	own stock	59
	other farmers	16	other farmers	7	other farmers	33	other farmers	31
	trader	23	trader	4	trader	29	trader	0
	NGO	10	NGO	33	NGO	21	NGO	10
	other	5	other	1	other	4	other	0
Pigeonpea	own stock	68	own stock	75	own stock	40	own stock	77
	other farmers	11	other farmers	13	other farmers	42	other farmers	23
	trader	4	trader	0	trader	12	trader	0
	NGO	18	NGO	15	NGO	4	NGO	0
	other	0	other	0	other	2	other	0

* less than 10% of farmers grow the crop

Other farmers: mainly neighbors, also distant farmers. *Trader:* mainly village store, also grain market (latter more important in Zambezia). *NGO:* mainly World Vision

Table 7. Percentage of farmers participating in the village seed market, 1997/98.

	Tete	Sofala	Zambezia	Nampula
Seed suppliers[1]	23.9	no data collected	58.9	66.7
Seed demanders[2]	55.5	35.5	73.3	54.4

1. Give out seed via sale, barter, or as a gift
2. Obtain seed through purchase, barter, or gift

In consequence, virtually all households participate in the village seed market, either as suppliers or recipients. Many both supply seed, of some varieties or crops, *and* receive seed of other varieties or crops.

Despite the breadth of participation in village seed trade, most transactions are small, and most households are involved in only one or two transactions a season. For example, the average quantity of maize seed delivered on the village seed market by an individual household 'supplier' during the 1997/98 planting season was 4.2 kg. Only 19% of the households supplying maize seed to the village market participated in more than one transaction. Though seed-deficit households commonly look to wealthier neighbors for assistance, no evidence was found of specialized seed producers or traders. And no evidence was found of farmers deliberately maintaining large seed stocks for sale to the community.

The informal character of most trade is evident in the fact that most seed transactions in the local market take the form of free gifts (Table 8). Small-scale farmers have an obligation to provide at least small quantities of grain or seed freely to neighboring house holds in need. The strength of this obligation has declined as grain markets have become monetized and families migrate over wider areas. However, the provision of small quantities of free seed remains a common practice throughout southern Africa. Such transactions carry a reciprocal obligation to return seed (or grain) to the supplying households when need arises.

Seed sales and pricing

Less than 5% of the survey farmers in Tete and Zambezia sold seed to others during the 1997/98 planting season. In Nampula, where more than 10% of the respondents sold seed, grain trade generally tends to be more monetized. Sales are more likely for larger quantities of seed. However, there is no obvious relationship between the crop and the likelihood of a cash transaction.

The undeveloped character of the village seed market is also evident in the mixture of pricing strategies when sales do take place. Seed sellers were asked to state whether their seed price was higher than, the same as, or lower than the prevailing grain price at the time of the seed sale. One would expect seed prices to be higher than grain prices, because seed quality standards must be higher than those for grain. Yet only 39% of seed sales were reported to be at higher than the prevailing price of grain. Almost 30% of transactions were priced equal to grain and 32% lower than grain price.

The survey data indicate that the seed price of rice, groundnut, and maize is more likely to be higher than the grain price. For other crops such as sorghum and pearl millet, seed price is more likely to be equal to or less than the grain price. This may reflect the relatively better developed commercial markets for some grains, but the strength of this relationship is limited.

The fact that seed prices tend to be equal to or lower than grain prices likely reflects the reciprocal nature of this transaction. This year's seed 'supplier' may need to obtain seed from neighbors next year. Also, many farmers feel an obligation to poorer members of the community, and will not charge full market price to poorer neighbors in need of planting seed.

Table 8. Percentage of farmers involved in seed supply transactions, 1997/98.

	Tete		Zambezia		Nampula	
Maize	Sell	4.4		3.3		2.2
	barter	5.6	barter	1.1	barter	2.2
	gift	10.0	gift	27.8	gift	30.0
	total	18.9	total	32.2	total	33.3
White sorghum	sell	1.1	sell	2.2	Sell	11.1
	barter	4.4	barter	1.1	barter	0
	gift	6.7	gift	4.4	gift	21.1
	total	12.2	total	6.7	total	31.1
Groundnut	sell	1.1	sell	2.2	Sell	11.1
	barter	2.2	barter	3.3	barter	1.1
	gift	4.4	gift	7.8	gift	23.3
	total	7.8	total	13.3	total	35.5
Pigeonpea	sell	1.1	sell	1.1	sell	0
	barter	0	barter	0	barter	0
	gift	3.3	gift	6.7	gift	1.1
	total	4.4	total	7.8	total	1.1
Suppliers of seed of any of the 4 crops		22.2		42.2		60.0

No data collected from Sofala

Seed Selection and Storage Practices

The performance of the village seed market can be partly evaluated in terms of the quality of local seed selection and storage practices. These practices influence both the likelihood that a farmer will have to obtain seed from a neighbor, as well as the quality of seed likely to be available. Selection and storage methods affect the purity of seed stocks, the intensity of variety erosion, the spread of plant diseases, and germination rates.

Seed selection

Seed selection is best done in the field before the harvest, when the farmer can select seed based on plant type as well as the quality of the grain. The likelihood of insect infestation is also reduced if grains are carefully chosen and immediately treated and stored.

Seed selection in the field is practiced by 10-20% of farmers in Tete, and 15-30% of farmers in Zambezia. However, the practice is rare in Sofala and Nampula. The reasons for this difference are unknown.

The majority of respondents in the four provinces select their seed after the crop is harvested, and before it is threshed. The common practice is to select and set aside grain heads or unshelled legume pods for seed storage after a crop is brought in from the fields. These are chosen for the size and shape of the grain (or seed pod), the lack of insects, and the absence of disease symptoms.

In contrast to the other provinces, the majority of households in Sofala select their seed only after threshing, but before the grain is stored. For maize seed, the heads are stored intact; for sorghum and millet the seed is removed from the head. The reason for these differences is not known.

A few households select seed from their grain stocks. But this is an unusual practice, most likely to be employed if seed stocks have been lost.

Farmers clearly recognize the difference between grain and seed, even in the context of free seed transactions between households. Of the farmers supplying seed to their neighbors, approximately 86% derived this seed from their household seed stocks, and only 14% from household grain supplies.

Even if farmers have to resort to grain stocks as a source of seed, they will still sort through these stocks to select planting seed. Similarly, when seed is bought in the village grain market, farmers will discard small or broken grains, saving the larger, whole grains for planting.

Seed storage

Respondents in all four provinces cited storage losses as the most important seed-related problem. During the reconnaissance survey, farmers commonly asked for advice on how to improve storage practices. Most respondents complained about losses due to insects and rats.

Unexpectedly, farmers rarely treated seed before storage. None of the farmers in the Zambezia sample treated the seed of any of their major field crops (Table 9). Ash treatments or insecticide treatments are used by 10-20% of farmers in Tete and Sofala. A few farmers in Tete used insecticide. Pre-storage seed treatment is more likely to be used for grains than for legumes.

No measurements were taken of the actual level of seed storage losses. Thus, it is difficult to estimate the true severity of this problem. Nonetheless, farmers were sufficiently concerned about storage constraints to request a technical assistance program on improved selection and storage practices. Futher data collection may help target this assistance.

Impact of NGO Interventions

Between the 1986787 and 1996/97 seasons, World Vision distributed more than 12,500 t of seed in the four provinces targeted in these surveys - over 7000 t of maize seed, 1700 t of sorghum, 1100 t of pearl millet, 1500 t of groundnut, 1200 t of cowpea, and 300 t of pigeonpea seed (see Annex for details). The seed distribution program peaked at the beginning of the 1994/95 cropping season when 3780 t of maize seed was distributed to an estimated 728,000 beneficiaries. This is enough seed to plant 190,000 ha of maize or roughly 0.25 ha per beneficiary. During the 1997/98 season just prior to the survey, over 58 t each of sorghum and pearl millet seed were again distributed free, largely to flood victims in Sofala province.

In an effort to encourage the development of rural seed trade and lessen the dependence on free seed handouts, World Vision also pursued a small seed sales program during the 1997/98 planting season. World Vision produced its own seed, and either sold this directly from its district offices or encouraged sales through small-scale seed retailers. The NGO views development of retail seed markets as a medium-term goal.

The impacts of World Vision's seed delivery programs are difficult to measure given that most seed was delivered at least 3 years before the survey took place. It is virtually impossible, for example, to assess the direct contributions of the relief seed to household food security. While there is evidence that the severity of seed shortfalls may have been overestimated, the relief programs undoubtedly contributed to the expansion of crop area and to the dissemination of new varieties.

Table 9. Percentage of farmers applying different seed treatments, 1998 (two most Important treatments only).

	Tete		Sofala		Nampula	
Maize	ash	8	ash	16	ash	0
	insecticide	6	insecticide	1	other	16
White sorghum	ash	5	ash	19	ash	2
	insecticide	7	insecticide	1	other	19
Pearl millet	ash	5	ash	19	*	
	insecticide	10	insecticide	0		
Groundnut	ash	5	ash	4	ash	0
	insecticide	7	insecticide	0	other	0
Pigeonpea	ash	4	ash	0	ash	0
	insecticide	0	insecticide	0	other	12
Cowpea	ash	6	ash	9	ash	0
	insecticide	7	insecticide	0	other	2

None of the survey farmers in Zambezia used any form of seed treatment
* Less than 10% of farmers grow the crop

Table 10. Percentage of households ever to have run out of seed, 1997/98.

	Tete	Sofala	Zambezia	Nampula
Maize	67.8	37.7	72.2	15.3
White sorghum	63.5	36.0	77.3	7.5
Pearl millet	65.1	33.7	*	*
Groundnut	74.3	29.7	82.2	48.0
Pigeonpea	42.9	19.0	76.4	6.1
Beans	*	26.7	60.0	*
Cowpea	64.5	31.3	75.4	24.4
Rice	*	*	63.0	44.4

* less than 10% of farmers grow the crop

Severity of seed security constraints

The primary justification for most seed delivery efforts by NGOs such as World Vision has been the need to provide seed for households with limited or no available stocks. However, evidence of the severity of seed security constraints across the surveyed households is variable.

One conservative measure of seed security constraints is the proportion of households *ever* running out of seed of the target crops. According to the 1998 surveys, in Tete and Zambezia, three-quarters of the respondents claimed they had entirely lost their planting seed of one or more crops at some point during their farming life (Table 10). One-quarter claimed never to have run out of seed.

Unexpectedly, in Sofala and Nampula, only one-third of households claim to have ever run out of seed. Two-thirds claimed to have never run out. While respondents in Nampula are situated in relatively favorable rainfall zones, those in the Sofala sample generally face high risks. The areas of Sofala covered by the survey were severely affected, during the previous 10 years, by the war, floods, and drought. The reason for the large, apparent difference in seed insecurity between neighboring provinces is unknown. However, a growing array of survey evidence from other parts of southern Africa (e.g. Rohrbach and Makwaje 1999, Rohrbach 1997) reveals that small-scale farmers tend to successfully maintain their seed stocks despite floods and drought.

A second, less rigorous measure of seed insecurity is how often farmers lose their seed stocks. The survey data also reveal substantial variability in the timing of seed losses within any given community. Evidence is lacking of a wholesale seed loss in any single community. Rather, in any particular year, some households run short of seed, while others are able to maintain their seed stocks.

For example, in Tete, approximately 8% of farm households last ran out of maize seed in 1997; 29% in 1996; 12% in 1995, and 12% in 1994 (Table 11). In Sofala, 5-10% of farmers frequently have difficulty maintaining maize seed stocks. Approximately 20% of households only occasionally run out of maize seed. The remaining 70% almost always have at least some seed for planting.

The situation for legume seed appears similar. For example, the likelihood of farmers losing their entire groundnut seed stock is only marginally higher than that for maize (Table 12). Over 70% of farmers in Sofala and 50% in Nampula claim to have never lost their entire groundnut seed stock. Only 10-20% of households appear to be at frequent risk of seed losses. This is surprising given that

Table 11. Last year in which households ran out of maize seed, 1990s (cited by % of households).

Cropping season	Tete	Sofala	Zambezia	Nampula
1997/98	8.0	1.1	0	4.2
1996/97	28.7	3.3	19.4	4.2
1995/96	11.5	6.7	19.4	4.2
1994/95	11.5	7.8	18.1	1.4
1993/94	2.3	2.2	11.1	0
Prior to 1993	4.6	15.6	4.2	1.4
Never ran out	33.3	63.3	27.8	84.7

Table 12. Last year in which households ran out of groundnut seed, 1990s (cited by % of households).

Cropping season	Tete	Sofala	Zambezia	Nampula
1997/98	17.1	0	2.2	2.7
1996/97	27.1	5.4	11.1	20.0
1995/96	10.0	4.1	22.2	6.7
1994/95	11.4	5.4	17.7	10.7
1993/94	4.3	0	20.0	2.7
Prior to 1993	4.3	13.5	6.7	5.3
Never ran out	25.7	71.6	20.0	52.0

groundnut area planted by smallholders in southern Africa tends to fluctuate depending on the previous season's rainfall - declining after a drought and then rebuilding slowly during favorable seasons. The survey data suggest, however, that area changes are related to the quantity of seed available to any given household, rather than to the overall availability of seed in the community.

Based on the limited evidence of this survey, the common view that most households had entirely lost their seed stocks by the time they were being resettled after the war appears untrue. Many farmers carried seed back to Mozambique from Zimbabwe, Zambia, and Malawi. Farmers also quickly sought planting seed from communities that had remained in Mozambique during the war. Given the importance of seed for resettlement, it should not be surprising that farmers sought planting material from multiple sources.

Nonetheless, the seed provided by World Vision and other NGOs almost undoubtedly speeded the recovery of agricultural production in Mozambique, allowing recipients to plant larger areas.

Though farmers are less likely to lose their seed stocks than is commonly assumed, many still face frequent seed shortages. Particularly for legume crops requiring higher seeding rates, stocks are likely to be inadequate to meet planting plans. Farmers still often lose preferred varieties.

These survey data suggest, however, that the efficiency of relief programs may be improved through better targeting of relief seed to build stocks of preferred varieties and introduce new varieties. Smaller quantities of better targeted seed are likely to be more valuable than larger quantities of seed of whatever varieties happen to be available on the market.

Sources of seed security

Seed relief programs also need to take account of the fact that farmers commonly rely on several alternative sources of seed when their household supplies run short. The survey respondents were asked to specify which sources they most commonly turned to when they last ran out of stocks. As expected, the most important single source is other farmers, i.e. neighbors or farmers in more distant communities (Table 13). This corresponds with the evidence that in any given year, only a minority of farmers run out of seed altogether. World Vision was the second most important source. This seed was generally distributed free of charge. Yet many of these same farmers also turn to the grain market as a potential source of seed. Ten to fifteen percent of households state they have been able to purchase seed from a store. Most of the retail outlets named appear to be local shops. While a few of these may be selling modern varieties, most are likely to be selling grain.

Table 13. Percentage of households citing alternative sources where they obtained seed after stocks last ran out, 1990s (all 4 provinces).

	Maize	White sorghum	Pearl millet	Groundnut	Pigeonpea	Cowpea
Neighbor	36.8	35.5	22.8	38.8	43.1	38.6
World Vision	36.2	16.4	40.4	21.8	15.4	27.6
Distant farmer	17.8	20.4	33.3	23.8	12.3	17.3
Grain market	16.5	7.9	14.0	21.8	33.8	18.9
Store	13.8	9.9	17.5	11.6	7.7	14.2
Other NGO	0.7	1.3	1.8	1.4	1.5	1.6
Other	5.9	5.3	8.8	4.8	1.5	3.9

Responses may add to more than 100% if farmers received seed from multiple sources

Table 14. Percentage of households citing alternative sources where seed was obtained after stocks last ran out — stratified by farmers receiving or not receiving NGO support, 1990s.

	Received seed from NGO	Did not receive seed from NGO
Neighbor	30	60
World Vision	38	0
Distant farmer	22	18
Grain market	19	14
Store	13	7
Other NGO	2	0
Other	5	5

More than one response is possible per household

Another measure of the relative significance of NGO interventions is a comparison of seed sources (when stocks run out) among households with and without access to NGO emergency seed. The main difference between these two groups is the degree of reliance on neighbors. Farmers receiving seed from NGOs (mostly from World Vision) also look to neighbors and the market as alternative sources (Table 14). Farmers without access to NGO seed rely almost entirely on neighbors. By implication, trade of seed between farmers is more developed in these communities.

Again, these data suggest the significance of variable losses within individual communities. In general, some farmers have seed while others run short. The survey evidence indicates village seed stocks are often available even under conditions of severe flooding or drought. NGO interventions tend to supplement these village seed stocks. In many cases, the additional relief seed may be critically important for helping farmers plant enough area to meet family food requirements. However, more information is needed about seed security options at the village level, before large quantities of seed are dumped on the local market.

Development interventions supporting the improved maintenance of household seed stocks, and encouraging greater seed trade between households, may provide a more sustainable source of seed security than periodic relief deliveries through NGOs. Such strategies build on the foundation of inter-village and intra-village seed trade already in existence. NGO seed may still occasionally be necessary in small areas with particularly severe emergencies, but this requirement is likely to be exceptional. The survey evidence clearly indicates that the wholesale loss of community seed stocks is uncommon.

Impact of NGO seed distribution on area planted

The survey data offer no direct evidence that the distribution of seed by NGOs has increased the crop area in the target provinces. In three of the four provinces (Sofala, Zambezia, Nampula), both recipients and non-recipients (at any time during the previous 4 years) of free seed planted about the same area to most major crops (Table 15). Unexpectedly, the past recipients of free seed in Tete appear to have planted smaller areas for most major crops compared to non-recipients.

There are many possible explanations for these anomalies. Most of the recipients of free seed were probably poorer households displaced by the war. Many were returning to Mozambique with almost no farming resources. The seed (and tools) distributed by World Vision probably improved the

Table 15. Comparison of average area (ha) planted by recipients (past 4 years) and non-recipients of NGO seed; 1997/98 season.

	Tete	Sofala[1]	Zambezia	Nampula
Maize				
recipients	0.61	0.89	0.58	0.31*
non-recipients	0.92	1.15	0.49	0.17
White sorghum				
recipients	0.36	1.73	0.14	0.16
non-recipients	0.73	2.20	0.17	0.27
Pearl millet				
recipients	0.27	1.75	0.00	0.02
non-recipients	1.11	1.80	0.02	0.02
Groundnut				
recipients	0.10	0.11	0.04	0.09
non-recipients	0.11	0.22	0.08	0.12
Pigeonpea				
recipients	0.20	0.12	0.05*	0.05
non-recipients	0.06	0.03	0.32	0.05
Cowpea				
recipients	0.02	0.14	0.05	0.04
non-recipients	0.07	0.11	0.06	0.05
Rice				
recipients	0.00	0.01	0.09	0.00
non-recipients	0.00	0.01	0.04	0.01
Total of major crops[2]				
recipients	1.49	4.74	0.93	0.61
non-recipients	2.96	5.39	1.13	0.63

* significantly different at 5% level

1. Estimates are based on seed rates and thus inflated by replanting of flooded fields. Actual area planted is likely to be lower
2. Except cassava and sweet potato

agricultural resource base of these households to a point similar to that of non-migrants. Once households returned to their land, labor - rather than land or seed - was likely to be the most constraining input, because the first priority for many of these households was to clear new land or re-clear old fields.

Introduction of new varieties

The main, longer term contribution of World Vision's emergency seed delivery programs appears to have been the introduction of acceptable, new varieties into the village cropping system. The distribution of adoption of modern varieties is closely related to the receipt of NGO seed. More specifically, over 80% of the adopters of modern varieties of maize, and virtually all adopters of modern varieties of white sorghum, pearl millet, groundnut, and cowpea, have received NGO seed (largely from World Vision) during the past 4 years (Table 16).[1]

1. Other adopters may have received seed from World Vision in earlier years, but not during the period 1994/95 to 97/98.

Table 16. Influence of NGO seed distribution on adoption of modern varieties, 1998.

	% of adopters who received NGO seed within the past 4 years	% of adopters who did not receive NGO seed
Maize	80.4	19.6
White sorghum	100	0
Pearl millet	100	0
Groundnut	94.7	5.3
Cowpea	100	0

Table 17. Percentage of households growing modern varieties, 1997/98.

	Tete	Sofala	Zambezia	Nampula
Maize	62.5	79.8	43.3	78.1
White sorghum	4.9	45.6	0	0
Pearl millet	0	83.3	0	0
Groundnut	52.2	55.1	0	1.4
Cowpea	5.4	92.5	10.0	0
Rice	Crop not grown	54.5	2.2	57.1

Roughly 20% of observations are missing because farmer did not know variety name. This may bias adoption rates downward

Only one alternative source of new maize varieties is known. The single national seed company, SEMOC, sold small quantities of the varieties Matuba and SEMOC 1 through its retail outlets in urban business centers such as Tete. However, few farmers had access to this seed. In most of the survey areas, World Vision was the only initial source of new varieties.

Many of the 20% of adopters who did not receive NGO seed (during the 1994/95 to 1997/98 period), likely received this seed in earlier years or from neighboring farmers. Also, the transfer of new varieties between neighbors represents an important spillover impact of World Vision's seed delivery programs. Such transfers were highly likely given the common occurrence of seed trade between farm households. It is therefore reasonable to conclude that virtually all the adoption of new varieties can be linked, either directly or indirectly, with NGO' distributions.

Adoption rates vary widely, however, for different crops. Modern varieties of maize have been well accepted in most of the survey communities. Over two-thirds of the respondents growing maize were planting modern varieties in 1997/98 (Table 17). This compares with a limited acceptance of modern varieties of white sorghum and pearl millet. Farmers were willing to plant the free sorghum and pearl millet seed distributed by World Vision. However, they appear to have been unwilling to subsequently maintain these varieties, often turning back to their traditional varieties the following season.

The extent of the rejection of the white sorghum and pearl millet seed was surprising given earlier reconnaissance survey results indicating a preference for the earlier maturity offered by these varieties. There may, however, have been problems with seed quality. The pearl millet, in particular,

was likely a mixture of improved and landrace seed grown by Zimbabwean farmers. The sorghum seed may also have been mixed.[2]

New varieties of groundnut have been generally accepted in Tete and Sofala and new rice varieties have been widely adopted (among the growers of these crops) in Sofala and Nampula.

As part of the impact assessment, farmers were asked why they chose to adopt the new varieties. The single most important reason cited was the availability of seed (Table 18). This is because farmers had little or no choice of varieties received. Many had no knowledge of the varieties they were receiving.

Table 18. Percentage of households citing alternative reasons for planting new varieties, 1997/98 season.

	Seed available	High yield	Early maturity	Good flavor
Maize	76.2	50.5	40.7	20.6
White sorghum	97.7	25.0	6.8	2.3
Pearl millet	100	2.5	10.0	0
Groundnut	89.3	34.7	25.3	16.0
Cowpea	89.5	10.5	14.0	10.5
Rice	53.3	6.7	20.0	53.3

Ultimately, the greater acceptability of the new maize, groundnut, and rice varieties is apparent in the identification of additional quality traits favoring their adoption. In the case of maize, adopters commonly noted improved grain yields as well as early maturity, and acceptable taste. In the case of groundnut, farmers also cited yield gains, and the advantages of earlier maturity. Farmers also expressed a preference for the taste of the newly distributed varieties of rice.

Yield gains

Though many farmers cited yield gains as a justification for continuing to plant new varieties, the true level of these gains is difficult to estimate. Variability in management practices and growing conditions inherent in cross-sectional production data masks the response to changes in seed alone. This is particularly true in a semi-subsistence production system with low levels of management.

The survey evidence highlights the yield gains being achieved with new rice varieties - a crop more likely to be grown under favorable management (Table 19). However, the survey data offer no evidence of major yield gains for crops other than rice - crops more likely to be grown under poorer and more variable management conditions. The corresponding evidence of yield gains in World Vision's on-farm trials (World Vision, undated) suggests the value of combining seed delivery with efforts to improve crop management practices.

2. Seed quality problems are common when seed is sought at short notice prior to the planting season. Much of the seed distributed in Mozambique was originally obtained from Zimbabwe, where seed of open-pollinated crops such as white sorghum and pearl millet is often produced under contract by small-scale farmers. However, close monitoring of the purity of seed purchased from small-scale farmers is difficult. Further, when the demand for emergency seed is higher than available stocks, companies sometimes purchase grain on the open market and try to clean this to seed specifications. The resulting "seed" is likely to germinate and provide a reasonable harvest. However, the productivity gains possible with pure seed may be lost.

Table 19. Comparison of average grain yields (kg ha^{-1}) from modern versus traditional varieties, 1997/98 season.

	Tete	Sofala	Zambezia	Nampula
Maize				
modern	570	488	950	1816
traditional	484	475	942	1697
White sorghum			-	
modern	500	256		-
traditional	340	168	200	259
Pearl millet				
modern	-	111*	-	-
traditional	152	37	-	76
Groundnut (unshelled)				
modern	397	488	-	405
traditional	441	539	1883	1991
Cowpea				-
modern	239	270	381	
traditional	306	256	543	913
Rice				
modern	-	1540	-	2307
traditional	-	1102	1845	1829

— = less than 5 observations

* statistically significant difference at 5% level

These yield estimates are highly dependent on the accuracy of estimated seed rates and harvests. They should be viewed as orders of magnitude only. In most cases there is a wide and relatively flat distribution between low and high yields. Therefore, the differences are not statistically significant.

Varietal diversity

One sign of the strength of local seed systems is the continuing production of a wide range of traditional varieties despite severe shocks associated with war, floods, and drought. Farmers attach priority to maintaining basic seed supplies even amidst political conflict and extreme weather conditions. These seed stocks are also being maintained in spite of the distribution of large quantities of free seed.

During the 1997/98 cropping season, two-thirds of the survey households continued to plant traditional varieties of maize (Table 20). Most farmers planted the new maize varieties distributed by World Vision side by side with traditional varieties. Farmers may still be testing the drought resistance, pest resistance, or other traits of the new varieties before shifting entirely out of their traditional germplasm. Alternatively, and more likely, the new and traditional varieties are viewed as complementary. Each carries traits which farmers would like to maintain. A fuller characterization of the relative value of these alternative traits may provide valuable insights for the national breeding program.

Virtually all households, regardless of whether or not they received free seed of modern varieties, continue to plant traditional varieties of white sorghum and pearl millet. Most also continue to plant traditional legume and rice varieties.

Table 20. Percentage of households planting traditional varieties, 1997/98.

	Tete	Sofala	Zambezia	Nampula
Maize	63.6	51.6	60.8	63.5
White sorghum	98.4	95.6	100	100
Pearl millet	100	73.4	100	100
Groundnut	50.0	75.0	100	98.7
Cowpea	95.0	75.8	91.5	100
Rice	-	81.3	97.8	56.3

Roughly 20% of observations are missing because farmer did not know variety name. This might bias adoption rates for traditional varieties downward

Table 21. Average number of varieties grown per district, 1998.

	Tete	Sofala	Zambezia	Nampula
Maize	11 varieties	4 varieties	6 varieties	8 varieties
White sorghum	11 varieties	6 varieties	2 varieties	7 varieties
Pearl millet	7 varieties	3 varieties	1 variety	1 variety
Groundnut	8 varieties	3 varieties	4 varieties	7 varieties
Pigeonpea	2 varieties	1 variety	6 varieties	4 varieties

Table 22. Number of varieties grown, cited by % of households, 1998.

	Tete	Sofala	Zambezia	Nampula
Maize	one 62%	one 65%	one 99%	one 76%
	two 36%	two 35%	two 1 %	two 22%
	three 1%			three 2%
	four 1%			
White sorghum	one 72%	one 52%	one 100%	one 73%
	two 25%	two 44%		two 25%
	three 3%	three 3%		three 2%
Pearl millet	one 97%	one 90%		one 100%
	two 3%	two 10%		

It is difficult to determine, from the survey evidence, whether farmers lost any traditional germplasm. The survey data indicate, however, that most communities were still growing an array of different varieties for most crops. The survey counted the number of different names that farmers within a single district identify for their varieties.[3] By this calculation, the number of maize varieties grown ranges from 3 in one district in Sofala, to 15 in a district in Tete (Table 21). At province level, the mean ranges from 4 varieties grown per district in Sofala, to 11 varieties per district in Tete.

Most farmers choose to plant only one variety of most crops. However, 20-45% of farmers plant

3. This assumes that variety names do not change across different parts of a district.

two varieties of a given crop (Table 22). A few farmers (<5%) maintain wider germplasm bases, planting 3 or more varieties of some crops. Multiple varieties were much less common in legume crops than in cereals. Local or traditional varieties are still commonly grown for all major crops.

Village seed systems have shown remarkable resilience in maintaining germplasm diversity, just as they have in maintaining seed stocks. While individual farmers undoubtedly lost seed of preferred varieties, communities as a whole do not appear to have lost much of their germplasm, and a wide range of traditional germplasm is still grown. Lost varieties are commonly obtained from neighbors. If seed is not available within the community, farmers will sometimes travel long distances in search of these varieties. The most conservative interpretation of available evidence is that germplasm losses were limited - certainly more limited than might have been expected.

Development Options for the Rural Seed Market

In regions of the world where agriculture is highly commercialized, seed supply is largely a private function. The seed system is highly competitive, and includes both large companies for major commercial crops and smaller companies targeting regional or crop-specific market niches. Two major factors, however, limit the development and coverage of a commercial seed industry in Mozambique.

First, commercial seed trade is severely constrained by high transport and distribution costs. Selling prices can double or triple between a central processing depot and a retail outlet in a distant rural area. High prices discourage seed purchases, and increase the risks of trade investment.

Second, the development of a commercial seed market is constrained by uncertainty regarding levels of demand. A commercial company must first determine whether farmers are interested in a new variety. Yet even if demand can be documented, private investments in developing seed trade channels are placed at risk by the possibility of free seed distribution by government or NGOs. Farmers accustomed to receiving free seed may be reluctant to purchase seed on the commercial market. Investments in developing retail trading channels will be constrained by even the possibility of free seed distribution in the future.

Estimation of seed demand is further complicated by uncertainty about farmers' willingness to pay for seed of open- or self-pollinated varieties, once they obtain an initial stock of a particular variety. Farmers generally appear satisfied with seed retained from the previous harvest. While breeders often suggest that farmers ought to enter the market every two to four years to 'purify' their seed stocks, there is little evidence to suggest that farmers are greatly concerned about seed purity. Farmers may not perceive substantial losses in seed purity over time, or they may view the diversity of their germplasm as a means to offset production risks. Some participatory plant breeders suggest farmers are better off with a more diverse array of genetic material.

Commercial seed demand may also depend on input and product market conditions. While many seed companies maintain high quality standards, many also market seed of more variable quality. Farmers may relate poor quality seed obtained through relief programs with the quality of commercial seed stocks. Demand is also affected by the degree of commercialization of crop production. Much of Mozambique's smallholder crop production is semi-subsistence in orientation.

The combination of high marketing costs and uncertainty so severely limit private sector investments in seed production in Mozambique that stronger public support is necessary for the development of national seed systems. The development challenge is to target public assistance in directions most likely to stimulate a set of complementary and sustainable private investments - particularly those extending to rural areas.

The surveys reported in this study provide no evidence that Mozambique's formal seed system, essentially made up of the single national seed company SEMOC, reaches rural households in the four major provinces of central Mozambique. In contrast, the survey evidence highlights the existence of an active, informal, village seed system. This dynamic village seed system offers a logical starting point for renewed efforts to strengthen national seed trade. Development efforts are needed both to strengthen this village seed system and to build sustainable links between the formal and informal seed markets. Public intervention should place a priority on introducing and disseminating new varieties and improving household seed security. Development programs should also target the establishment of a more competitive private seed sector encompassing broader investments in seed multiplication, distribution, and trade. Four specific objectives merit consideration:

- Improving household seed security
- Improving the efficiency of emergency seed supply programs
- Improving the flow of new varieties to rural communities
- Developing retail seed trade in the rural market.

Improving household seed security

Most small-scale farmers in the survey identified seed quality and storage as their main seed-related difficulties. Farmers want assistance in identifying technologies to help them better maintain their own seed stocks. If these stocks run short, they want an assurance that neighbors have been able to keep their own stocks in good condition. The main problems are losses to insects and rats.

Some farmers also expressed interest in selection techniques to improve the purity of their varieties. However, loss of seed purity does not appear to be a major concern. While farmers clearly distinguish alternative varieties, no evidence was found of deliberate seed plot isolations. Instead, varieties are often distinguished by their plant aspect in the field, or by the characteristics of the seed at the point of threshing. During the reconnaissance survey, farmers indicated a perception that they could obtain particular varieties from mixed plots simply through careful selection at harvest. However, the accuracy of this phenotypic selection was not verified during the survey.

There may be scope for interventions targeting the provision of information about seed purity and the need for isolations. Farmers may gain from advice regarding the advantages of seed selection in the field, as opposed to selection at the point of threshing, or even after threshing. Field selection may also reduce postharvest losses to insects.

Larger gains are likely to be derived by providing better options for seed storage. In order to design appropriate interventions, analysts should first evaluate the level of seed losses commonly encountered for different crops. Development strategies can then be tailored to particular crops.

Solutions are likely to involve simple seed treatments and better, locally available storage containers. Interventions targeting successful multi-year seed storage might target farmers interested in commercializing their seed trade. Most farmers, however, only aim to store seed for the period from harvest to the next planting.

Improvements in seed storage are likely to translate into improved, annual seed supply in the village. This may be the best option both for preserving traditional germplasm and assuring most households have ready access to small quantities of seed necessary to meet their annual needs. This is the most practical means to improve household seed security of many of the poorest members of any community. Yet in addition, better seed selection and storage practices also offer an important necessary condition for the further development of the village seed market.

Improving the efficiency of emergency seed supply programs

The survey evidence suggests village seed systems are capable of meeting all but the most severe supply shortfalls. Donors need to be cautioned about tendencies to over-estimate emergency seed needs. However, disaster relief will still occasionally be required. In order to be efficient, emergency relief must be targeted at households with the most severe production constraints. Ideally, the provision of emergency seed should help build, rather than compete with, the nascent commercial seed market.

In most cases, distribution of free seed must end. Free distribution encourages the view that seed has limited value, and directly undermines efforts to develop a commercial seed market. Most households can readily afford the limited cost of most varieties of seed. The constraint is not money, but the availability of seed on the rural market. Emergency supplies targeted toward the most destitute farmers can retain an element of commercial value if provided through vouchers encashable at retail distribution outlets. Such interventions encourage the development of rural seed trade while targeting farmers in greatest need.

The larger constraint is the difficulty of supplying quality seed at a reasonable cost. Two options for promoting sustainable, emergency seed supply may be considered. First, governments and donors can encourage greater seed trade from surplus to deficit regions. Emergencies are often fairly localized. Farmers in upland areas can be encouraged to sell seed, or to sell clean grain for use as seed, to farmers in areas affected by floods. Insofar as droughts are localized, farmers in neighboring regions with similar agro-ecologies could be encouraged to trade seed. But seed movements should not be encouraged between regions with substantially different agro-ecologies. Such opportunities can be facilitated by developing seed market information systems that track both seed availability and the range of varieties grown.

A second way to resolve larger regional shortfalls is the maintenance of national or regional seed security stocks. Public investments in grain security stocks are common throughout southern Africa. Yet there is little complementary investment in maintaining the seed necessary to rebuild production capabilities following seasons of severe drought. A few seed companies in southern Africa (in South Africa, Zimbabwe, and Zambia) maintain stocks in anticipation of emergency demand (Rusike and Rohrbach 1998). This practice has arisen in response to consistent demand for emergency seed since the 1991/92 drought. However, such reliance on regional stocks creates a dependence on whatever varieties foreign seed companies happen to maintain. In the past, part of this stock has consisted of grain purchased for sale as seed in anticipation of an emergency.

One option for resolving this dependence is for the Government of Mozambique to invest in maintaining an emergency seed stock. The costs of this intervention can be limited if this strategy is pursued in combination with the commercial seed sector. For example, a commercial company such as SEMOC could take responsibility for maintaining a minimum seed supply of varieties suitable for drought-prone regions. The costs of maintaining this stock can be divided between the company and the government. Insofar as the stock is sold, no liability would be incurred. However, the government might agree to pay part of the costs of maintaining a seed inventory that is ultimately unsold. The maximum liability could be the difference between the seed and the prevailing grain price - assuming the unsold seed could be readily sold on the grain market if the emergency stock was not needed.

Such strategies shift the focus of emergency seed supply schemes from the delivery of free seed toward the development of commercial seed markets. Donor assistance should be targeted toward the establishment of such capabilities, at both national and village levels.

Improving the flow of new varieties to rural communities

Investments in the development of new crop varieties provide no payoff unless seed of these varieties is distributed to and adopted by farmers. Yet seed multiplication and distribution remain problematic for open-pollinated varieties, crops of low commercial interest, and crops with low seed-to-grain multiplication ratios.

One development option may be to use village seed systems as channels for the introduction of new varieties. One or two better than average farmers could be selected by the community to act as entry points for new varieties provided by the research or extension services. These farmers would multiply small quantities of seed for sale to neighbors within the community. Selection of varieties for multiplication could be a community decision; and different varieties might be selected each season.

In effect, the village seed market would be developed as a conduit for an evolving set of new varieties. Recognizing that the demand for any particular variety is likely to fall within a few years of its introduction, emphasis would be placed on distributing a changing array of germplasm.

Note that this model does not depend upon the development of new market infrastructure or new trading relationships. Rather, it capitalizes on traditional, functioning seed trade relationships within village communities. As such, it avoids the pitfalls of many seed multiplication schemes led by NGOs in neighboring countries that successfully encourage many farmers to multiply large quantities of seed that they then have difficulty selling. If seed production is concentrated in a small area, seed marketing becomes a constraint. If seed production is highly decentralized, seed trade between neighboring households is more likely.

Developing retail seed trade in the rural market

The prospects for commercializing rural seed trade remain to be tested. This survey highlights the fact that most transactions on the village seed market are free of charge. Community obligations influence prices and the likelihood of transactions. However, there ought to be scope for commercializing a portion of this trade, insofar as farmers value seed quality and choice.

The only way to test commercial demand for quality seed is to place high-quality seed on the retail market. A rough, initial approximation of this demand was gathered during the survey by asking farmers about the frequency with which they might be willing to purchase seed in the rural market. Most farmers expressed interest in the commercial market. Yet in a remarkably consistent set of responses, only 10-15% of households expressed an interest in annual seed purchases (Table 23). Half to two-thirds of the surveyed households indicated they would only be willing to purchase fresh seed after a drought. This distribution of interest in the market appears similar across the four provinces.

These data should be interpreted with caution given the lack of experience with commercial seed sales. The reluctance to rely on commercial deliveries may partly reflect past experience with the sale of grain as seed on the village market. This may also indicate that farmers do not perceive the value of periodically renewing the purity of their seed stocks. These perceptions could change, however, if the market offered a clearly distinguishable, pure seed of particular varieties. The retail market would also be expected to grow if it served as a source for new, more productive varieties.

Two sorts of interventions targeting the testing and development of a commercial seed market at the village level can be tested. One option is to encourage SEMOC, or seed companies from neighboring Malawi or Zimbabwe, to test-market small packs of seed of new varieties of a range of different crops. Such a program would aim to introduce new varieties into the village seed system, and test the level of retail demand for the small pack seed.

Table 23. Percentage of households willing to purchase seed at varying intervals, 1998.

	Tete		Zambezia		Nampula	
Maize	every year	14	every year	2	every year	3
	every 2 years	23	every 2 years	50	every 2 years	45
	after drought	51	after drought	45	after drought	13
White sorghum	every year	12	every year	5	every year	6
	every 2 years	20	every 2 years	43	every 2 years	32
	after drought	61	after drought	52	after drought	21
Pearl millet	every year	10	every year	0	every year	13
	every 2 years	18	every 2 years	88	every 2 years	38
	after drought	67	after drought	13	after drought	25
Groundnut	every year	12	every year	0	every year	7
	every 2 years	28	every 2 years	47	every 2 years	68
	after drought	55	after drought	52	after drought	11
Pigeonpea	every year	9	every year	3	every year	7
	every 2 years	6	every 2 years	49	every 2 years	32
	after drought	81	after drought	46	after drought	21
Cowpea	every year	18	every year	0	every year	5
	every 2 years	15	every 2 years	51	every 2 years	49
	after drought	62	after drought	47	after drought	11

Sofala: no data available from surveys
Numbers do not add up to 100% because other answers are not included

Table 24. Preferred pack sizes (as % of households interested in buying seed), 1998.

	Tete		Zambezia		Nampula	
Maize	1-5 kg	10	1-5 kg	23	1-5 kg	90
	6-10 kg	22	6-10 kg	42	6-10 kg	10
	11-20 kg	38	11-20 kg	25		
	21+kg	30	21+kg	10		
White sorghum	1-5 kg	57	1-5 kg	95	1-5 kg	94
	6-10 kg	16	6-10 kg	5	6-10 kg	6
	11-20 kg	20				
	21+kg	7				
Pearl millet	1-5 kg	67	<10 buyers		1-5 kg	100
	6-10 kg	15				
	11-20 kg	17				
Rice	< 10 buyers		1-5 kg	22	1-5 kg	66
			6-10 kg	53	6-10 kg	20
			11-20 kg	16	11-20 kg	7
			21+kg	9	21 + kg	7

Sofala: No data available from surveys

Donor or related public sector support could help offset part of the costs of market development by providing information about potential seed demand, or monitoring the relative success of commercial interventions. In areas characterized by particularly high transport costs, or trading risks, public support may take the form of a nominal subsidy on initial trading costs. For example, retailers may be provided a subsidy on the capital necessary to establish an initial seed inventory. Or the donor could financially guarantee **a** minimum level of seed sale. In order for the test to have practical value, however, the seed company would have to share at least part of the risks of market development.[4]

The main assumption underlying the development of the rural retail seed market is that seed demand is higher than seed companies estimate. Once farmers have ready access to quality seed, particularly of new varieties, they are likely to purchase this seed, even at prices that include the full transport and trading costs. This assumption needs to be tested.

A second option is to build the capacity of farmers currently supplying seed on the village market to commercialize their operations. During recent years, NGOs have been promoting the establishment of village seed production schemes in several countries in southern Africa. Most of these schemes deliver foundation seed of one or two varieties to many farmers in a small number of communities, and encourage widespread involvement in commercial multiplication. They assume that farmers multiplying seed will be able to sell it to neighbors or neighboring communities. However, within a year or two most neighbors and neighboring communities already have the seed. Producers then wait for the NGO to purchase their stocks.

If such schemes are to become self-sustaining, seed producers and their NGO supporters must invest in developing seed markets. Investments are needed in the evaluation of market demand and the development of commercial contacts with retail traders. Quality control systems need to be put in place. These are significant additional tasks for programs aiming to develop local seed markets. Efforts to develop these markets ought to be monitored.

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4. This sort of scheme is currently being tested in varying forms in Zimbabwe, Malawi, and Kenya.

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Annex: Seed Distribution by World Vision International - Mozambique

Table A1. Quantity of seed (tons) distributed by WVI - Mozambique, 1986-97.

	Maize	Sorghum	Pearl millet	Groundnut	Pigeonpea	Cowpea
1986/87	30.8	5.6	2.1	10.5	2.2	6.7
1987/88	190.0	60.0	22.5	42.5	17.0	30.0
1988/89	190.0	60.0	22.5	42.5	17.0	30.0
1989/90	232.0	48.0	18.0	74.0	17.6	48.0
1990/91	252.0	48.0	18.0	84.0	18.6	54.0
1991/92	248.8	39.5	13.5	68.4	16.9	47.9
1992/93	813.3	268.9	65.3	160.3	36.6	130.4
1993/94	979.5	315.5	291.2	278.3	54.6	235.7
1994/95	3780.0	584.0	430.0	580.0	122.5	520.0
1995/96	1511.1	355.3	364.2	240.8	53.5	260.0
1996/97	160.5	6.0	1.0	28.5	5.3	31.1

Table A2. Number of beneficiaries of seed distributed by WVI - Mozambique, 1986-97.

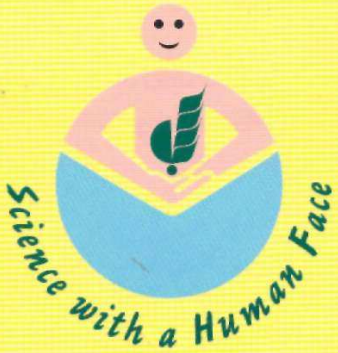
	Maize	Sorghum	Pearl millet	Groundnut	Pigeonpea	Cowpea
1986/87	5600	700	700	5600	5600	5600
1987/88	25,000	7500	7500	25,000	25,000	25,000
1988/89	25,000	7500	7500	25,000	25,000	25,000
1989/90	40,000	6000	6000	40,000	40,000	40,000
1990/91	45,000	6000	6000	45,000	45,000	45,000
1991/92	38,200	11,500	4500	38,200	38,200	38,200
1992/93	139,237	104,221	55,506	108,393	73,214	101,535
1993/94	111,600	106,500	99,500	130,500	109,200	130,500
1994/95	728,000	274,000	160,000	275,000	245,000	275,000
1995/96	160,957	116,400	140,400	115,900	106,900	142,516
1996/97	45,100	6,000	1000	28,500	10,500	31,050

About ICRISAT

The semi-arid tropics (SAT) encompasses parts of 48 developing countries including most of India, parts of southeast Asia, a swathe across sub-Saharan Africa, much of southern and eastern Africa, and parts of Latin America. Many of these countries are among the poorest in the world. Approximately one-sixth of the world's population lives in the SAT, which is typified by unpredictable weather, limited and erratic rainfall, and nutrient-poor soils.

ICRISAT's mandate crops are sorghum, pearl millet, finger millet, chickpea, pigeonpea, and groundnut; these six crops are vital to life for the ever-increasing populations of the semi-arid tropics. ICRISAT's mission is to conduct research which can lead to enhanced sustainable production of these crops and to improved management of the limited natural resources of the SAT. ICRISAT communicates information on technologies as they are developed through workshops, networks, training, library services, and publishing.

ICRISAT was established in 1972. It is one of 16 nonprofit, research and training centers funded through the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is an informal association of approximately 50 public and private sector donors; it is co-sponsored by the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank.



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