# LOCAL SEED SYSTEMS FOR BEANS IN MALAWI

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# PREFACE

Recent poverty mapping highlights Malawi as a focus for rural poverty alleviation in Southern Africa. Beans are an important crop for nutrition and increasingly for income generation, and the Malawi Government maintains an active research and development program for improvement of the crop. This study was carried out by staff of Malawi's Department of Agricultural Research and Technical Services (DARTS), and the report was revised by Centro Internacional de Agricultura Tropical (CIAT).

This volume, the fortieth in a series that serves research on common bean (*Phaseolus vulgaris*) and its smallholder production systems in Africa, complements several previous publications. It complements No. 24 in this series by documenting seed aspects of bean production systems in Malawi. The considerable impact achieved by many African countries through disseminating new bean varieties – documented for example in No. 12 of this Series -- owes much to seed dissemination strategies based upon an understanding of the ways in which farmers access seed within their own social systems. Earlier studies of bean seed systems in other countries of the region are published as Nos. 13, 15, 19 and 21.

The Pan-Africa Bean Research Alliance (PABRA) serves to stimulate, focus and coordinate research efforts on common bean, the systems within which the crop is produced and the people who consume it. The Alliance is coordinated by CIAT in collaboration with two interdependent sub-regional networks of national programs: the Eastern and Central Africa Bean Research Network (ECABREN) and the Southern Africa Bean Research Network (SABRN) for southern Africa.

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# ACRONYMS

| | | |
|---|---|---|
| ADD | - | Agricultural Development Division |
| ADMARC | - | Agricultural Development and Marketing Corporation |
| BIP | - | Bean Improvement Program |
| CIAT | - | Centro Internacional de Agricultura Tropical / International Centre for Tropical Agriculture |
| EPA | - | Extension Planning Area |
| NSCM | - | National Seed Company of Malawi |
| NGO | - | Non-governmental Organisation |
| SSMS | - | Smallholder Seed Multiplication Scheme |

# Local seed systems for beans in Malawi

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## INTRODUCTION

Information on how small-scale farmers obtain, manage and share seed is crucial for designing appropriate mechanisms for the delivery of new crop varieties (Sperling, 1994; Sperling *et al*. 1996; David, 2003) or for intervening in post-emergency situations (Longley et al., 2002). Yet, world wide, local seed systems are poorly understood and few empirical studies on this topic exist (Cromwell, 1990, Almekinders *et al*., 1994; Rorhbach, 1997). Understanding seed demand among small-scale farmers is particularly crucial for crops whose seed cannot be produced economically by centralized seed companies. Such crops include self-pollinating crops (e.g. the common bean, groundnuts, rice), vegetatively propagated crops (e.g. potatoes, sweet potatoes, cassava) and crops with limited seed demand (e.g. indigenous vegetables, forages, open pollinated maize).

This paper reports on a study of farmers' bean seed channels in Malawi. The common bean (*Phaseolus vulgaris* L.) is an important food and cash crop for most Malawian farmers. However, they face major challenges in retaining and accessing bean seed due to the existence of a single rain fed growing season in most areas, a high dependence on beans for food and cash during a dry season that spans 7-8 months (April-October), recurrent droughts, low bean productivity (below 500 kg $ha^{-1}$ on average) and high levels of rural poverty. Malawi is one of the poorest countries in Sub-Saharan Africa, with a gross domestic income in 2000 of US$170 (World Bank, 2002). Until the mid 1990s, there were few new bean varieties and no effective system existed for bean seed production and dissemination. Various studies identified access to seed of both local and modern bean varieties as an important constraint for small-scale farmers in Malawi (Ferguson *et. al.* 1991; Cromwell *et. al.*, 1993; Scott and Maideni, 1998). The Bean Improvement Program (BIP), a collaborative project between the national bean program of Malawi and the International Center for Tropical Agriculture (CIAT), conducted the present study. We aimed to diagnose the strengths and weaknesses of local bean seed systems in order to develop appropriate interventions for seed delivery based on existing practices and an understanding of farmers' seed sourcing behavior[6]. Since at the time of the study (1996) the bean production system was relatively undisturbed by new introductions, this study assesses patterns of seed acquisition for traditional varieties, the necessary starting point for understanding demand for seed of new varieties.

This paper starts with a description of approaches used to produce and disseminate bean seed in Malawi up to the mid-1990s. Following a description of the study's methodology, the next

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section reports on farmers' seed sources and storage methods. The final section draws conclusions from the survey.

## Bean seed supply in Malawi up to 1995

Formal seed production in Malawi has been strongly influenced by a centralized approach well suited to hybrid maize but inappropriate for a self-pollinating crop like beans. Under this system, the then National Seed Company of Malawi (NSCM) served as the seed production wing of the national Agricultural Development and Marketing Corporation (ADMARC) until the late 1980s, with hybrid maize as its main product. In 1989, Cargill obtained the controlling share of NSCM, further entrenching the emphasis on hybrid maize. Recognizing the failure of the private sector to meet farmers' needs for seed of self-pollinating crops, from the late 1980s the government and NGOs initiated a number of seed supply programs and projects targeting crops such as beans, soybean and groundnuts. The Smallholder Seed Multiplication Scheme (SSMS) initiated by the Ministry of Agriculture in 1986 aimed to improve seed supply of non-hybrid grains and legumes. However, this effort to decentralize seed production to the Agricultural Development Division[7] (ADD) level was largely unsuccessful (Chirwa and Aggarwal, 2000). NGO programs such as those of Concern Universal, World Vision International and others mainly focused on disseminating seed of new varieties, through a seed loan scheme, seed exchange or free distribution. Other NGOs provided support to community-level seed production (e.g. Action Aid's Malawi Smallholder Seed Development Project). Formal seed exchange schemes are by definition unsustainable as farmers are not required to meet exchange transaction costs, and even projects that supported local level seed production did not build in elements to ensure sustainability after the end of the project. Notably, none of these interventions investigated farmers' traditional systems of obtaining and managing seed to see if there was anything to learn from local seed systems.

## METHODS

Formal surveys were conducted in 1996 in three extension planning areas (EPA) of Malawi identified by the BIP as key sites for monitoring the impact of bean research. In 1995, baseline information on bean production was collected in these three locations (Scott and Maideni, 1998). All study locations are at mid altitude and receive low to moderate rainfall (Table 1). The sample of households was selected through a simple random procedure to yield a final total sample of 355 bean growing households: 126 in Bembeke EPA, 118 in Kalira EPA and 111 in South Vipya EPA. Bembeke is in central Malawi, about 115 km southeast of Lilongwe, the country's capital. Because the area is near the Lilongwe-Blantyre highway, farmers here have easy access to markets in the two cities and are highly market oriented. Kalira, located in a hilly area, which marks the boundary between the Lakeshore area and the Kasungu/Lilongwe plains, lies along the main road from Ntchisi to Dowa, approximately 100 km northeast of Lilongwe. South Vipya is located in the Vipya Highlands in the northern part of the country, about 500 km from Lilongwe, and characterized by less acute scarcity of land than many areas of Malawi but great distance from urban markets[7].

[7] Malawi is divided into 8 agricultural development divisions (ADDs) for management of programs

**Table 1: Selected characteristics of the three study areas**

| | Bembeke | Kalira | South Vipya |
|---|---|---|---|
| Administrative Location | Dedza Hills RDP, Lilongwe ADD | Ntchisi RDP, Kasungu ADD | Rumphi RDP, Mzuzu ADD |
| Elevation (meters) | 1,600 | 1,560 | 1,530 |
| Rainfall (mm) | 1,076 | 954 | 848 |
| Crops grown | Maize, beans, potato, tomatoes, groundnuts | Maize, beans, tobacco, soybean, groundnuts | Maize, beans, potato, coffee |

Women farmers were well represented among those interviewed: 51% in Bembeke, 53% in Kalira and 42% in South Vipya. Most surveyed households were considered of average wealth by local standards: 60% in Bembeke, 57% in Kalira and 70% in South Vipya. Women headed a very high proportion of households (49% in Bembeke, 48% in Kalira and 42% in South Vipya), either in the absence of husbands or in their own right.

## BEANS IN THE FARMING SYSTEM

Beans, a traditional crop in all study sites, varied in importance by location and use. The crop was more highly ranked as a food crop in Bembeke and South Vipya than in Kalira (Scott and Maideni, 1998). However, a slightly higher proportion of farmers in South Vipya (34%) rated beans as an important source of income compared with the other two sites (21% in Bembeke and 25% in Kalira). Farmers in all three locations grew beans during both rainy and dry seasons, but the rainy season is considered more important for bean production. In the rainy season, farmers typically grow beans intercropped with maize and other crops. During the dry season, farmers grow a *dimba* bean crop where they have access to upland swamps or watercourses (*dambos*) to take advantage of residual moisture. Monocropping is more common in the dry season.

Surveyed farmers grew many bean varieties, with some variation across locations. The main varieties, all bush types, can be classified into six seed types described in Table 2. Preferred varieties in Bembeke were, during both seasons, Nasaka (38%), Phalombe (21%) and Nanyati (20%). In Kalira, farmers preferred Nanyati (29%) and Kawale (17%) in the rainy season and Nanyati (23%), Phalombe (22%) and Salima (21%) in the dry season. In South Vipya, Nanyati and Selenje were favored during both seasons. BIP's 1995 baseline survey documented the same varietal preferences (Scott and Maideni, 1998).

**Table 2: Description of commonly grown bean landrace varieties**

| Variety | Seed type |
|---|---|
| Nanyati | Medium or large variegated red or purple sugar type |
| Phalombe | Large, dark red kidney |
| Nasaka (Khaki) | Medium, tan |
| Salima | Medium, light red |
| Kawale | Medium or small, dark red kidney |
| Selenje | Medium, round, pink with brown speckles |

## SEED SOURCES

In 1995/96, farmers obtained bean seed from three sources: their own stock, saved from the previous season, local markets and other farmers. No information on the previous season was collected that would assist in assessing whether seed source patterns in 1995-96 were "normal" or unusual. The study did not distinguish between the types of market sources, and therefore what is referred to as markets in this paper includes local markets and shops where farmers obtain grain to be used as seed, as well as sources such as ADMARC that sold certified seed. The study also did not distinguish between different kinds of transactions between farmers such as purchase, gifts or exchange. Each seed source is discussed below.

### Own stock

Farmers' most important source of seed in the rainy season of 1995/96 was their own stock, with the vast majority of farmers in Bembeke and South Vipya obtaining seed from this source (Table 3). Notably, however, a smaller proportion of farmers in Kalira sowed their own seed and a significant proportion obtained seed from off-farm seed sources, mainly markets. A fourth of farmers in Kalira indicated that they did not usually save enough seed from the rainy season. In contrast, most farmers in Bembeke (60%) and South Vipya (79%) reported that they usually saved enough seed from the rainy season. Although the reasons for the lower dependence of Kalira farmers on farm saved seed are not clear, farmers' responses suggest that seed shortages in Kalira were mainly the result of low production (24%) and consumption (4%). By contrast, 16% of farmers in Bembeke and 10% of farmers in South Vipya cited low production as a reason for seed insecurity, while 3% of farmers in both locations mentioned consumption of seed stocks as a factor.

**Table 3: Farmers' seed sources, 1995/96 rainy season (per cent)**

| | Bembeke (n=115) | Kalira (n=102) | South Vipya (n=108) |
|---|---|---|---|
| Own seed | 83 | 58 | 81 |
| Other farmers | 10 | 17 | 18 |
| Markets | 9 | 39 | 17 |

*Note*: Column totals exceed 100% due to multiple sources

The vast majority of households normally sowed their own seed in the dry season: 92% in Bembeke, 80% in Kalira and 96% in South Vipya. The greater use of farm saved seed in the dry season compared to the rainy season is due in part to the shorter period between the rainy season crop harvest and dry season planting; in addition, the dry season crop is restricted to smaller plots with residual moisture (*dimbas*) and requires smaller quantities of seed. By contrast, planting of the more extensive rainy season crop starts in November/December, long after the previous rainy season harvest of March-April (for the many farmers that do not have access to *dimbas*). This means that much of the farmers' seed stocks would have been depleted.

The main reasons farmers gave for saving bean seed were lack of money to buy seed and a scarcity of seed at planting time. A minority of respondents indicated that saving seed enables them to maintain preferred varieties. In contrast with farmers in Eastern Africa (David and Sperling, 1999), surveyed farmers did not mention quality as an advantage of farm saved

seed. In the Malawian context, farmers' emphasis on availability and convenience as the main advantages of keeping their own seed highlights both their shortage of cash at planting time, due to the high levels of poverty, and a lack of confidence in both informal and formal seed sources.

Local bean seed systems studies have documented an association between wealth and bean seed self-sufficiency in Burundi, DR Congo, Rwanda and Uganda; David and Sperling (1999) attributed this association to higher production and the greater ability of better-off farmers to retain and store seed. Not surprisingly, in the 1995-96 rainy season, wealthier households in Malawi were more self-sufficient in seed than poorer households (Table 4). Poor households depended more than other wealth groups on purchased seed, as many were partially or chronically seed insecure because of the difficulties they faced in retaining seed rather than eating or selling a large portion of their harvest or due to poor storage. The association between wealth and seed security was also reflected in a lower proportion of female (64%)[1] than male headed households (74%) sowing their own seed in 1995-96.

**Table 4: Seed sources by household wealth status, 1995/96 rainy season (per cent)**

| | Wealthy | Average | Poor |
|---|---|---|---|
| Own seed | 77 | 70 | 58 |
| Market | 18 | 18 | 31 |
| Other farmers | 5 | 12 | 10 |

Throughout the world, bean farmers depend on off-farm seed sources for four main reasons: (1) to restock or top-up after crop loss or an emergency; (2) to restock or top-up after consuming or selling off existing stock; (3) to expand bean area or (4) to obtain new varieties. No information exists on whether Malawian bean farmers replace seed to reduce disease buildup and improve yields. An estimation of seed self-sufficiency status among Malawian farmers requires longitudinal information on seed acquisition. However, this study suggests that poverty related factors -- low production, a high dependence on beans for food and cash, illness and labor shortages, and unfavorable weather -- are the most important reasons for bean seed shortages.

## Markets

Markets were an important source of seed for farmers in Kalira but of less importance in South Vipya, and were used by only a minority of farmers in Bembeke (Table 3). The BIP baseline survey also indicated that ADMARC was an important source of bean seed for farmers in Kalira in contrast to the other two sites, where local markets were more important (Scott and Maideni, 1998). This finding concurs with observations from a 1991 study which documented the active presence of ADMARC in bean marketing in Kalira EPA and the relative absence of traders due to poor transport infrastructure (Ferguson *et al*, 1991). The present study did not provide detailed information on bean seed purchasing frequency or on quantities of bean seed purchased, but suggests general trends. Only a minority of farmers was chronically seed insecure and purchased seed every rainy season. Kalira had the highest number of regular seed buyers, followed by South Vipya and Bembeke; a similar trend was

[1] Typically, in Malawi as in most parts of Africa, households headed by women form a disproportionate number of the poorest households (IFPRI, 2000).

observed in the 1995-96 rainy season. A small number of farmers purchased seed during the dry season or every season. Most farmers who purchased bean seed claimed to do so irregularly. However, nearly all of them purchased all of their seed.

### Other farmers

Studies in Eastern Africa document a historical decline in the amount of seed bean farmers obtain from other farmers and suggest some degree of correlation between commercialization and gift giving (Sperling and Loevinsohn, 1993; David and Sperling, 1999; David, 2003). Relatively few farmers obtained seed from other farmers in these Malawian sites (Table 3). This data stands in contrast to findings from two other studies. The BIP baseline survey (1998) showed that other farmers were the second most important seed source, as reported by a third of farmers in Bembeke and Kalira and 17% of farmers in South Vipya. A likely explanation for this discrepancy relates to how the question was asked. Farmers interviewed for the baseline survey were asked to report their major source of seed without reference to a specific season. Farmers may have reported their ideal, rather than their actual behavior, a tendency also found among Ugandan bean farmers (per comm. S. David). A study conducted in the 1980s (Ferguson, 1987) found that most farmers obtained bean seed from relatives and friends. It is possible that seed exchange has declined in importance since the 1980s.

The poorest farmers were as likely as farmers of average wealth to obtain seed from other farmers (Table 4). In contrast, studies in Eastern Africa found that poor farmers tend to be excluded from local seed networks because they have little or no seed to offer in return (David and Sperling, 1999). In Malawi, however, seed exchange often takes place within the context of payment in kind for *ganyu* (casual) labor, a common income generating activity among poor farmers (Ellis et al., 2002).

## SEED STORAGE

Poor seed storage often contributes to seed insecurity, particularly in a situation where the dry season is long. Some surveyed farmers stored seed and grain separately but it was not clear how common this practice is. The most common container for storing beans was bags, while pots (mainly the traditional clay types) were second in importance and were widely used in South Vipya. The BIP baseline study showed that farmers used Actellic (20%), ash (24%) and tobacco waste (17%) to control storage pests (Scott and Maideni 1997). Farmers reported bean weevils as their principal storage problem. Others included rats, rotting and lack of storage facilities. The present study was not designed to assess the seriousness of storage problems and the extent of loss, but a relatively low number of respondents mentioned storage problems. Moreover, farmers did not mention storage loss as a major reason for seed shortage. The explanation is likely to be that farmers' storage methods are relatively effective in the low-humidity conditions prevailing in the long dry season, and/or that in some households the storage period is too short for pests to become a major problem.

## CONCLUSIONS

This study raises a number of important considerations for improving bean seed supply in Malawi that can be summarized as follows:

1. Against great odds, including low production, a long dry season and dependence on beans for both food and cash, the majority of surveyed farmers retain significant quantities of

bean seed for replanting. However, in many cases, and following a poor season, this seed is insufficient, particularly for sowing the main rainy season crop, and farmers seek seed from off-farm sources.

2. Local markets are the second most important source of bean seed, particularly in areas of low production such as Kalira. Many farmers, particularly the poorest, are already in the habit of purchasing bean "seed" from commercial sources to supplement farm saved seed, and a small minority are chronically seed deficient during both seasons.

3. Although, many Malawian bean farmers rely on off-farm seed sources, they have little confidence in either informal or formal seed systems for meeting their seed requirements. They complain that seed is often not available when they need it. For Malawian farmers, seed availability and price are key criteria for judging the success of a seed supply intervention.

4. Contrary to the assumption behind seed exchange programs, local seed networks are a relatively unimportant source of bean seed for the majority of bean farmers. This may be due to several factors including the precarious conditions under which farmers produce beans and the increased commercialization of the crop that may discourage gift giving. The study did not note exclusion of the poorest farmers from seed exchange transactions, probably because of the practice of working for seed.

By providing a cross-sectional view of bean seed channels, however, this study does not adequately portray the precarious conditions characteristic of rural Malawi, or the seasonal changes in farmers' seed acquisition behavior in response to periodic shocks such as droughts, floods and poor health. For example, there is need to assess the effects of free bean seed distribution through safety net programs on local seed systems along the lines of a recent study conducted in Kenya (Sperling, 2002). More detailed information is needed on a number of issues raised by this study including how farmer seed networks operate, farmers' seed purchasing behavior, quantification of seed purchases and exchange, seed management, perceptions of seed quality and actions taken to improve it.

## REFERENCES


Almekinders, C., N. P. Louwaars and G.H. de Bruijn. 1994. Local seed systems and their importance for an improved seed supply in developing countries. *Euphytica.* 78: 207-216.

Chirwa, R. and V. Aggarwal. 2000. Bean seed dissemination strategies in Malawi: A strategy. *Journal of Sustainable Agriculture* 15 (4): 5-24.

Cromwell, E. 1997. Local level seed activities: opportunities and challenges for regulatory frameworks. In: R. Tripp (ed.), *New Seed and old laws: regulatory reform and the diversification of national seed systems,* pp. 214-230. Intermediate Technology Publications, London.

David, S. 2003. Getting demand right: understanding farmers' bean seed needs in Uganda. Unpublished manuscript, CIAT, Kampala, Uganda.

David, S. and L. Sperling. 1999. Improving technology delivery mechanisms: lessons from bean seed systems research in eastern and central Africa. *Agriculture and Human Values* 16: 381-388.

Ellis, F., M. Kutengule and A. Nyasulu. 2002. Livelihoods and rural poverty reduction in Malawi. LADDER Working paper no. 17. Department for International Development, London.

Ferguson, A.E., P.S. Kambewa and R.M. Mkandawire. (1991). *Bean production and use practices: Results of the 1990-91 socio-economic research in the three regions of Malawi*. Bean/Cowpea CRSP. Michigan State University, East Lansing, USA.

Ferguson, A. 1987. *Socio-economic factors influencing genetic diversity in Malawian bean landraces, Central Region*. Malawi CRSP Project 1987 Detailed Annual Report. East Lansing: Bean/Cowpea CRSP Management Office, Michigan State University.

IFPRI, 2000. *The state of Malawi's poor: who are they?* PMS Policy Brief, No. 3. IFPRI, Washington, D.C.

Longley, K., C. Dominguez, M.A. Saide and W.J. Leonardo. 2002. Do farmers need relief seed? A methodology for assessing seed systems. *Journal of Disaster Studies, Policy and Management* 26 (4).

Rorhbach, D. 1997. Farmer-to-farmer seed movement in Zimbabwe: issues arising. In: D. Rohrbach, Z. Bishaw and A. van Gastel (eds.), *Alternative strategies for smallholder seed supply: proceedings of an international conference on options for strengthening national and regional seed supply in Africa and West Asia*. Proceedings of a workshop held in Harare, Zimbabwe, 10-14 March 1997. ICRISAT.

Scott, J. and M. Maideni. 1998. Socio-economic survey of three bean growing areas of Malawi. CIAT African Occasional Publications Series, No. 24. CIAT, Kampala, Uganda.

Sperling, L. 2002. Emergency seed aid in Kenya: some case study insights on lessons learned during the 1990s. *Journal of Disaster Studies, Policy and Management* 26 (4): 288-301.

Sperling, L., U. Scheidegger and R. Buruchara. 1996. Designing seed systems with small farmers: principles derived from bean research in the Great Lakes Region of Africa. Agricultural Research and Extension Network, Network Paper No. 60. ODI, London.

Sperling, L. 1994. Analysis of bean seed channels in the Great Lakes Region: South Kivu, Zaire, Southern Rwanda and select bean growing zones of Burundi. CIAT African Occasional Publications Series, No. 13, CIAT/RESAPAC: Butare, Rwanda.

Sperling, L. and M. Loevinsohn. 1993. The dynamics of adoption: Distribution and mortality of bean varieties among small farmers in Rwanda. *Agricultural Systems* 41: 441-453.

World Bank, 2002. *World Development Report 2002: Building Institutions for Markets*. Oxford University Press, New York.