ALTERNATIVE APPROACHES TO BEAN SEED PRODUCTION AND DISTRIBUTION IN EASTERN AND SOUTHERN AFRICA

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PREFACE

Publications of the Network on Bean Research in Africa serve to stimulate, focus and coordinate research efforts on common bean (*Phaseolus vulgaris*). These publication series serve as a principal channel for communication of research results and deliberations of three sub-regional networks: for Eastern Africa and for the Great Lakes region of Central Africa (networks under the Association for Strengthening Agricultural Research in Eastern and Central Africa – ASARECA), and for the SADC Bean Network of the southern region.

This volume reports the proceedings of a working group meeting on seed systems research in Eastern and Southern Africa. The meeting was held in Kampala, Uganda, 10-13 October 1994, with the objectives of reviewing experiences in bean seed production and distribution and assessing the effectiveness and sustainability of alternative (both formal and non-formal) approaches to producing and disseminating bean seed.

The working group meeting was organized by CIAT. The meeting, and this publication, were made possible through support provided by the Canadian International Development Agency (CIDA), by the Swiss Agency for Development and Cooperation (SDC) and by the Office of Agriculture, Bureau for Research And Development. U.S. Agency for International Development (under Grant No. LAG-4111-G-00-2025-0). The opinions expressed herein are those of the authors and do not necessarily reflect the views of these contributing donor organizations.

Further information on regional research activities on beans in Africa is available from:

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Coordinator, SADC Bean Network, P.O. Box 2704, Arusha, Tanzania

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An additional character for sexing the adults of the dried bean beetle *Acanthoscelides obtectus* (Say)(Coleroptera: Bruchidae). J. Stored Prod. Res. 30 (1): 61-63.

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ACRONYMS

ISABU - Istitut des Sciences Agronomiques du Burundi

ISAR - Institut des Researches Agronomiques de Rwanda

NGO - Non-governmental organization

RESAPAC - Reseau pour l'Ameloriation du Haricot (Phaseolus) dans la region de l'Afrique Centrale

CONTENTS

INTRODUCTION

Good quality seed is central to raising the productivity of beans (*Phaseolus vulgaris* L) in Eastern and Southern Africa. It is now recognized that efforts to supply bean seed of improved varieties cannot be the responsibility of only the formal seed system. Non-governmental organizations (NGOs), other development agencies and small-scale farmers themselves have comparative advantages in providing the quantities, quality and types of bean varieties needed by resource-poor farmers. Developing and supporting sustainable and innovative alternative mechanisms for the production and dissemination of bean seed in Africa has important implications for the adoption of new varieties as well as for the conservation of genetic resources.

The Centro Internacional de Agricultura Tropical (CIAT) organized this working group to address issues relating to various aspects of bean seed systems. Members of the group include bean scientists from the national research organizations of Burundi, Ethiopia, Rwanda, Tanzania, Uganda and Zaire. Representatives of the formal seed industry and NGOs from Ethiopia, Malawi and Uganda, as well as regional staff of CIAT, also participated.

The working group sought to review experiences with planning and implementing new ways to distribute bean seed, assess the comparative advantage of different types of institutions involved in bean seed production in terms of effectiveness and sustainability and explore the implications of non-formal seed systems for varietal adoption and genetic resources conservation.

This document is a compilation of the papers presented during the working group meeting and the results of small group sessions.

INTEGRATION OF FORMAL AND NON-FORMAL BEAN SEED PRODUCTION IN UGANDA: SOME POLICY ISSUES

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INTRODUCTION

The seed industry in Uganda is about 25 years old. In 1968, the Overseas Development Administration (ODA) provided funds to start a program for producing improved seed of the major food crops—beans, maize, groundnuts, sorghum and soya bean—and selected pulses. This program, then known as the Uganda Seed Multiplication Scheme, was headquartered at Kawanda Research Station, and its seed production activities were carried out in Masindi District. Foundation seed was produced on Sendusu farm (near Namulonge Research Station), and certified seed on four state farms in Masindi District. These farms eventually became uneconomic to operate, and the scheme resorted to contracting growers to produce certified seed.

The ODA grant was withdrawn in 1973. By then, the program was handling over 1500 t of improved seed per year. In 1976, the Food and Agricuture Organization of the United Nations (FAO) and the United Nations Development Program (UNDP) provided the program with processing and laboratory equipment, tractors, Land Rovers and lorries. In 1982, the Uganda Seed Project, funded by the European Economic Community, replaced the Uganda Seed Multiplication Scheme. The Legume Seed Project at Mubuku in Kasese District was funded by the German Government through the German Agency for Technical Cooperation (GTZ). At present, the African Development Bank provides financial support for the seed industry, under the Seed Industry Rationalization Project (SIRP).

The history of seed production in Uganda points to the importance the Government of Uganda attaches to the provision of quality or improved seed to farmers. However, farmers believe that none of the seed schemes has addressed their requirements—to avail seed of good quality, in sufficient quantities, at the right time and at an economic price.

These objectives are not easy to achieve where infrastructure is poor. It is very difficult to distribute and market seed in rural areas. Pricing is also critical since farmers have limited resources and may not be prepared to spend money on bean seed which, in many cases, they feel they can produce themselves. Therefore, in most cases, farmers save their own seed for planting. Other farmers buy or barter seed.

Two independently operating seed distribution systems exist in Uganda—the formal and non-formal systems. Each system has its advantages and disadvantages. Integrating them to supply bean seed to farmers raises a number of policy issues.

FORMAL BEAN SEED SUPPLY SYSTEM

Certified bean seed is produced by the Uganda Seed Project in Kasese District. Foundation and registered seed are produced on the project farm, while certified bean seed is produced by contract growers. An internal control unit ensures that the seed produced is of high quality in terms of genetic, physical, physiological and sanitary factors. The project pays the seed growers Uganda Shillings (Ush.) 100 per kg above the open market price. This encourages the growers to pay extra attention to the bean seed crop. Other facilities operated by the project include a seed drying yard, storage facilities and a small processing unit.

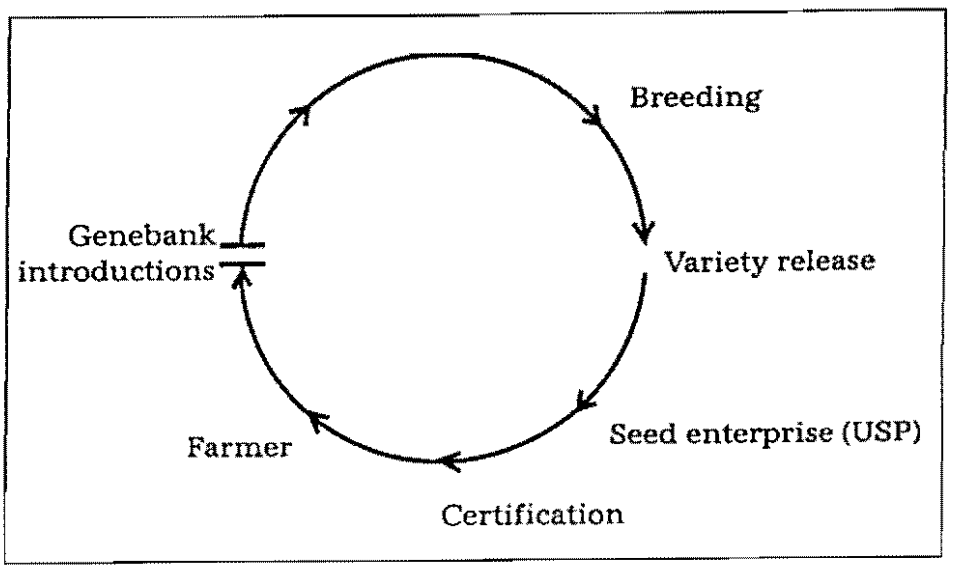

Figure 1. Structure of the formal bean supply system

The formal bean seed supply system has its limitations. The project produces bean seed of only one variety, K20, released in 1972, that has lower consumer preferences than local landraces. Most of the seed produced is bought by relief organizations for either drought relief or for people living in areas experiencing civil strife. The amount of certified seed left over is enough to supply only a small number of farmers.

The inability of the formal system to provide timely delivery of seed to farmers is another limiting factor. It is difficult to supply seed in good time to farmers who live far from Masindi and Kasese Districts where the processing plants are based. Coupled with this is the poor rural infrastructure. It is difficult to get seed to remote areas in time for planting without incurring enormous costs, which would make the seed price too high for farmers.

NON-FORMAL SEED SUPPLY SYSTEM

The majority of bean growers in Uganda use seed saved from previous harvests, buy seed from local markets or barter other commodities for seed. The seed planted is of either a single variety or a mixture of landraces. Farmers prefer to plant local landraces for their taste. Single-color beans have a higher price on the open market. The informal seed supply system ensures adequate and timely supply of beans for home consumption and for sale in the markets.

The major limitation of the non-formal seed system is that seed quality is not a concern. Seed is not checked for seed-borne diseases, of which farmers have limited knowledge. The poor storage conditions in the rural areas also cause poor germination, which results in low crop production. During drought or civil strife, non-formal systems become non-functional.

INTEGRATING FORMAL AND NON-FORMAL SEED SYSTEMS

The formal seed supply system reaches only a small number of bean farmers, while the non-formal system supplies the majority. The integration of both system is likely to play a major role in ensuring that quality seed is available to farmers at the right time, in sufficient quantities and at an economic price.

The following section discusses important issues pertaining to the process of integrating the formal and informal seed systems.

Coordination of the national seed industry

The Agriculture Seeds Bill, which will soon become a statute, proposes the establishment of the national seed industry authority with the following functions:

- To establish a system for implementing seed policies through a technical committee
- To formulate a national seed policy
- To constantly review the operation of the national seed supply and advise the government on the administration of the seed industry
- To coordinate and monitor the public and private seed sectors to achieve the objectives of national seed programs.

Essentially, the Seed Industry Authority will provide the policy direction and achieve co-ordination among the parties involved in seed production. This becomes especially important as the seed industry diversifies and more institutions become involved. All the interested parties, including farmers, are to be represented in the Authority. The Authority will be responsible for the administration of the statute. This means that it will have real authority to review and adjust policy. The two members appointed by the minister will represent other institutions producing seed.

Pricing and subsides

Seed pricing is one of the most sensitive and difficult areas in many seed programs. When seed is simply given away to farmers as a general subsidy to production, there is a large but quite unreal demand. In that situation, seed may be misused and even consumed. Another problem is that with the very large quantities of seed produced, seed quality is poor and, consequently, farmers do not appreciate the value of quality seed.

Seed prices should cover at least the direct cost of production. This will be about 50–100% above the price of the grain. Since transportation is a major cost component in seed production, it could be minimized if local processing units are installed in rural areas. If seed multiplication is incorporated in on-farm trials or in the training-and-visit programs coordinated by extension workers, demonstration plots managed by contract farmers could serve as seed-multiplication blocks, with the seed being exchanged among farmers after harvest.

Diversification

As the seed industry in Uganda becomes more rationalized, hybrids and other high-value seeds will become popular with farmers. The private sector may also find it more profitable to operate in the most favored parts of the country where there is good infrastructure and cash-based agriculture. It will be much more difficult to supply seed to subsistence farmers located in remote or less productive areas on an economic basis. Rather than privatization, I would propose diversification, that is increasing the number of producers—including cooperatives, farmers' associations and even NGOs in seed production.

If wider private sector participation is to be encouraged, it is essential that the interests of that group are represented at the high levels, that is, at the National Seed Industry Authority.

Quality issues

The Agricultural Seeds and Plant Statute provides for the establishment of an institution—the National Seed Certified Service—to be responsible for the establishment and improvement of certification standards, methods and procedure. The Service will also be responsible for advising the Authority on the need for modification of seed standards and technical aspects affecting seed quality. The Service will have to deal with questions such as, What class of seed do farmers produce during on-farm trials? Does this seed need to be certified?

There is need to have a close working relationship between the formal and informal seed supply systems. The informal system could be supplied with certified seed from a national seed program for use in commercial production of seed by farmers. This seed would be exchanged on a farmer-to-farmer basis. It is, therefore, very important that the formal seed section be involved in on-farm trials. The formal seed sector has staff trained in quality control who can advise farmers on how to produce quality seed.

Setting national priorities

As the seed industry becomes more rationalized in organization and operation, it may not be possible to supply seed throughout the country as different parts of the country will grow different varieties of bean. The national program will find it difficult to satisfy the requirements of subsistence farmers, particularly those in remote areas. In these situations, an alternative strategy, based on local production and distribution needs, may be required.

CONCLUSION

The integration of formal and non-formal bean seed production and supply touches on a number of policy issues. Technical problems can be overcome by providing improved facilities and staff training. However, other issues depend on policy decisions if both systems are to co-exist. The following policy guidelines are suggested:

1. There must be a high level national seed industry authority responsible for policy direction and coordination and monitoring of seed supply systems. All interested parties in seed production should be represented in this authority.

2. Realistic policies on seed pricing should be implemented so that farmers who have the resources can buy seed. It is difficult to establish financial viability in an economic system distorted by subsidies or price controls.

3. To achieve objective (2), there is need to involve other participants who can offer a competitive service in a particular crop or area. Privatization looks attractive but may not be an easy solution.

4. The National Seed Program or seed companies find it difficult to satisfy the requirements of subsistence farmers, especially those in remote areas. An alternative strategy, based on local seed production and distribution requirements, may be needed.

INTEGRATED SEED SUPPLY: INSTITUTIONAL LINKAGES IN RELATION TO SYSTEM EFFICIENCY, BIODIVERSITY AND GENDER

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INTRODUCTION

Institutional links in alternative seed supply systems are usually poorly developed. This is mainly due to the fact that interest in alternative seed supply generally does not originate from the formal (institutional) seed sector. Combined with this is a variety of reasons given to justify the attention given to local seed supply systems, each resulting in policies to develop alternative systems. The main reasons are:

- Inefficiency of the formal system, combined with a perceived lack of (internal) sustainability
- Effects of seed sources on stable and sustainable production
- Developments in discussions on conservation of biodiversity, with special emphasis on *in situ* approaches
- Equity and, in particular, gender analysis supported developments in the thinking on seed supply

These factors fit into three sustainability factors: economic, ecological and social sustainability .

This paper characterizes the two main systems of seed supply—formal and local—and points at possibilities for integrating the most efficient components of both into seed supply approaches. It addresses the need to distinguish among four main issues—efficiency and sustainability of production, biodiversity and gender—in discussions on institutional linkages in alternative seed supply systems, and points to some research needs.

CHARACTERIZATION OF SEED SUPPLY SYSTEMS

The formal seed supply system is defined as "the chain of activities from breeding to marketing and distribution, run by specialized 'seedsmen' and supported by well defined rules and procedures, that supplies seeds to farmers with some level of quality guarantee. These systems are rather uniform in time and space." The formal system has been described in detail by Thomson (1979) and Wellving (1984). The local seed supply system are "activities within the farming community that ensure the availability of seed for the next planting. These systems are heterogeneous in space and flexible in time" (Almekinders et al., 1994).

By identifying the weaknesses of both systems, we will show the need for integrated approaches. Integrated seed supply can be defined as "any action geared to introduce technologies or methods from formal seed supply into local systems or vice versa" (Louwaars, 1994).

A major factor distinguishing formal and local seed supply is that the former is vertically organized, whereas the latter can be considered horizontal. In formal seed supply systems, activities follow one another. This system has been rightfully compared with a chain, which is as strong as its weakest link. The main links are plant breeding, seed multiplication and seed distribution. The chain aspect means that all factors have to be developed in harmony. There is no point in producing seed when there are no distribution facilities or demand, and an efficient seed production and marketing system cannot survive without the supply of breeder's seed and new varieties on a regular basis.

There are two possible starting points in formal systems. In commercial seed systems, it is the market that drives the chain. The market defines the breeding objectives, the research budget and the seed production planning: the market pull drives the chain. In many developing countries, it is the existing breeding infrastructure that finds ways to get its results to farmers: the chain is driven by the research push and can, in practice, only survive with significant subsidies. The seed multiplication process itself is just a necessary intermediary in both approaches. These two approaches are the basis of the dichotomy between commercial and developmental aspects of seed policies (Louwaars, 1990).

Local seed supply systems basically consist of the same components as formal ones—selection, production and diffusion—but are horizontally organized. Seed production is the starting point in local seed systems. Because seed is the basis for crop production, its selection and diffusion are not necessary in every year of the seed production cycle. The horizontal pattern of local seed supply systems indicates that they are more sustainable.

SUSTAINABILITY

Sustainability is a key word in any development discussion and it is becoming a major issue in discussions on seed supply as well. Sustainability analysis of seed systems can be done to establish the economic sustainability of a seed supply system itself, and the contribution of the system to ecological, economic and social sustainability of agriculture.

Economic sustainability of seed-supply systems

Formal seed systems can be sustainable provided that a number of mainly economic or political parameters 'fit'. When farmers are inclined to buy seed at a cost-covering price on a regular basis and when the formal seed system is able to supply the required qualities, the regular demand will sustain a commercial formal seed supply.

The important quality aspects—value for cultivation and use and genetic homogeneity—are, in many cases, genetic in nature. This was by far the most important factor in a recent survey of bean farmers in the Great Lakes Region of Central Africa (Sperling, 1994). In other situations, other seed quality factors play a major role, for example, physiological quality for soybean, sanitary quality for cassava and analytical purity for grasses. When genetic factors are important, the formal seed supply of cross-fertilized crops is more easily sustained than the supply of autogamous crops for which new varieties have to be offered to maintain a regular market. The hybrid seed market is very specific in this respect. Other crop-specific factors pertaining to viability of formal seed supply are economic—multiplication factor (large seed, combined with high plant population) and the level of market orientation of production (the major factor).

Commercial formal seed supply systems can be sustainable, as is the case of the seed industry in Europe and the USA and of the successful maize and vegetable seed companies in developing countries. The subsidized formal seed supply systems found in many developing countries can also be considered sustainable systems as long as political factors allow them to operate at a loss. Political support could be justified when macro-economic analysis shows that funds 'earned' by import substitution through national increases in yield due to use of quality seed are used to subsidize the seed supply. In practice, these macro-economic analyses hardly ever hold against pressures to reduce public expenditure: subsidies decline, seed prices rise and the formal seed supply system concentrates on a limited number of crops (mainly cross-fertilized crops, market crops or biennials) and on the financially stronger and more accessible sections of the farming community. The policies thus give rise to inequality, which is not compatible with most developmental policies.

Local seed systems are generally considered sustainable because they have operated through the centuries, before formal seed supply systems emerged in the late 19th Century. Unfortunately, there is a great deal of romanticism in this view. Local seed supply systems are slow in responding to changes in ecological or social conditions. A local landrace cannot be adapted to chemical fertilizers in a few generations only and without the introduction of additional genes. Similarly, genetic variation within landraces may not be large enough to cope with declining soil fertility levels resulting from pressure on the land. Local landraces may also not stand large-scale social disturbance in which people are displaced for long periods. Little systematic research has been done on this aspect. The recent civil strife in Rwanda will provide a test case for sustainability of local systems and the application of CIAT's vast knowledge of bean systems to maintaining genetic diversity in that country.

Alternative seed systems may have to be designed as a response to reduced subsidies in the formal system as part of the worldwide policy of privatization of public institutions. Only economically interesting products and market segments, along with increased internal efficiency, will remain after such reorganization of the formal seed system, leaving many farmers, who cannot rely purely on local seed supply systems in their rapidly changing agro-ecological and socio-economic conditions, without support.

SUPPORT OF SEED SYSTEMS TO SUSTAINABLE AGRICULTURE

A major difference between formal and local seed supply systems is that the former aim at supplying genetically homogeneous varieties, whereas the latter deals with landraces and less homogeneous improved varieties.

Local seed systems have developed and sustained high levels of genetic variation within crop species. Such genetic variation can add to yield stability, especially in areas with heterogeneous growing conditions (Ceccarelli et al., 1991). Secondly, genetic variation in landraces is an important source of genes for modern plant breeding (Harlan, 1975). Moreover, the use of uniform varieties is not scale neutral, and there are important gender aspects related to seed supply systems. These aspects correspond to the major factors of sustainability—economic, ecological and social factors.

Yield stability

Formal seed supply systems may not contribute to the farming objectives of resource-poor farmers living in areas with heterogeneous distribution of stresses for whom yield stability may be more

important than potential yield. This does not mean, however, that all the sectors of the formal system would not be valuable for such farmers. Modern plant breeding can develop resistance to biotic or abiotic stresses, which can be useful for farmers, either for modern varieties or when incorporated into local mixtures. Such research can, for example, reduce the effects of the changing agro-ecological conditions mentioned above on yield and yield stability. Large-scale introduction of uniform varieties in areas where they increase variations in yield over time reduces the economic stability of a farming system.

Genetic resources

Local seed supply systems may significantly contribute to the conservation of crop genetic resources in farmers' fields. Genetic conservation in genebanks has saved a lot of genetic material (genes and gene-complexes) from extinction. It is now accepted that these methods of germplasm conservation cannot solve the global problem of depletion of crop genetic diversity. *In situ* germplasm conservation has received considerable attention in recent times (Brush, 1991; Cooper et al., 1992; Friis-Hansen, 1993). Sustaining local seed supply systems is one of the major approaches of *in situ* conservation of crop genetic resources.

Equity

Formal seed-supply systems are less valuable to remote and resource-poor farmers than to their better endowed colleagues. The needs of farmers who can control a number of stress factors (for example, through mechanical land preparation, irrigation or fertilizers) can be addressed relatively easily by plant-breeding programs. Breeding for heterogeneous conditions is much more difficult. Breeding programs are, therefore, often geared to those better-off farmers; this presents a certain level of inequality, although wealth can also have significant effects on the operation of local seed systems (Sperling, 1994).

An equity factor that has not yet been researched in detail is gender influence in the development of seed systems. Women have a very important role in local seed supply. Seed selection is often a woman's task (Berg, 1993; Tapia and de la Torre, 1993), as are seed cleaning, processing and storage. Women thus determine to a large extent the types within a landrace that are selected, which has considerable effects on crop production and, in particular, on yield differentiation. This is the case of potato seed selection in Peru, where different user groups can be identified (Zimmerer, 1991). The person who selects the seed tubers determines the part of the crop that will be used for cooking, frying or storage, for example.

With the emergence of the formal seed supply systems, seed production and distribution became men's responsibilities. Except for plant breeding, where women are often still relatively well represented, the supply side of the seed chain is dominated by men. Also, on the demand side, the influence of the often male head of the household is stronger than in the local seed systems because men are in charge of most cash transactions. Therefore, a shift from local to formal seed systems often means a significant shift in the control of agricultural production from women to men. Fernandez (1994) adds to this discussion the issue of farmers' dependence on "external solutions designed to solve their local problems".

It is clear that the sustainable agriculture related reasons given above in support of local seed supply

systems are very different from the efficiency considerations mentioned in the section above on economic sustainability of seed systems.

INTEGRATED APPROACHES

Having identified the major shortcomings of formal and local seed supply systems and analyzed them along with the more general sustainability theory, we now focus on a framework for integration of the two systems.

In the abstraction of vertical and horizontal seed supply systems, we can look for an optimum combination of factors, combining results of modern research and the adaptation to local ecological and socio-economic conditions. For some crops and regions, for example hybrid maize in the Kenyan highlands, there is no reason to abandon the vertical seed supply system since it benefits small-scale farmers. For other crops—for example, beans in eastern Africa—this option is not viable since field bean is a large volume, self-pollinated crop that is mostly consumed at home. Complete dependence on local seed supply systems for this crop, which is important for local food security and the quality of the diet, may mean a standstill or even a reduction in its productivity. This is one good reason to develop integrated approaches for seed supply or even a holistic, integrated seed system.

Integration may result in the improvement of either the formal or the local system by introducing the positive aspects of one into the other. In cases where physiological seed quality is a problem, improved seed harvesting and storage methodologies may be introduced, while leaving all other aspects of seed supply intact. Where physical seed quality is a major problem, the use of small-scale seed cleaners may be promoted. Where genetic quality of seed is a bottleneck, new varieties may be introduced into the local experimentation and diffusion system. Various models for accelerated variety diffusion exist, such as the random distribution of samples (Grisley and Shamambo, 1993), directed distribution of production kits (Douglas, 1980, p. 155), sale of samples (Mansheviale and Bock, 1989), and different levels of on-farm demonstrations and on-farm research (Janssen et al., 1991). Where suitable varieties cannot be bred by conventional methods, adapted breeding strategies may be developed to enhance selection efficiency by adapting the selection environment (Ceccarelli et al., 1992) or the selection procedure (Sperling et al., 1994). Where seed availability is the major problem—in cases where this is not related to any of the problems mentioned above—seed security centers may be established. Cromwell et al. (1993) describe some experiences with such centers. Another approach is to promote seed production by farmers' cooperatives in a semi-formal manner, as described by Garay et al. (1989). This is done by directed subsidies or tax relief for starting seed enterprises and temporary relaxation of certification standards.

INSTITUTIONAL FACTORS

Crop varieties and problems in seed supply among crops, within crops, between social classes and between regions, make it impossible to design a blueprint for a seed supply system. Efforts to design and execute such a blueprint model have resulted in the multitude of formal seed projects started in developing countries during the past 30 years (Douglas, 1980). The problems encountered by these projects can be considered as indicators of how unworkable a global blueprint would be.

There is an urgent need, though, to link the multitude of often isolated activities in integrated seed supply undertaken by the public and especially non-governmental organizations (NGOs). The isolated position of most of these activities and the variety of underlying objectives—efficiency, biodiversity and equity—make it difficult to coordinate activities or to learn from experiences of others. A comprehensive, integrated seed-supply system has not been developed in any country as a result.

There are two main reasons why the formal seed supply system, which has a wealth of knowledge of seed technology, does not cooperate in integrated approaches to seed supply initiated by often not technically well-qualified NGO staff:

- Seed technologists are generally not trained on how to work with social scientists: they are unfamiliar with the participatory approaches and methods related to community development;
- Activities that might reduce the dependence on seed from outside the community might be regarded as a threat to the commercialization of the formal seed sector.

Another reason for the lack of coordination of seed supply activities is that the reasons put forward for supporting the conservation or enhancement of local seed systems—their efficiency and economic, ecological and social sustainability—may give rise to activities in the field of seed supply that the formal seed sector would not want to be involved in.

When new and uniform seed varieties clearly have advantage over local landraces (for example with respect to disease resistance), their introduction will be supported—when the objective is based on economic factors—by groups that support *in situ* conservation of genetic resources, but their introduction may be inhibited. A similar dilemma could be expected if quick cooking bean varieties are introduced that reduce the workload of women and slow ecological degradation by reducing the consumption of firewood. There will always be situations where all sustainability factors cannot be served together. There should be a central unit with the task of dealing with such dilemmas and to coordinate activities. Only then can we talk about an integrated seed supply system.

According to Louwaars (forthcoming), a number of integrated seed supply activities can be incorporated in on-farm research programs where important research-extension linkages are maintained, especially when varietal aspects are considered the major constraint. The major disadvantage is that the formal seed sector is not involved in these programs, which are themselves very research-oriented units and may not have particular interest in economic aspects. Another option could be the national seed committees. In many countries these were established to prepare national seed policies, supervise national seed production, control trade and quality and to link research, seed production and extension services. They could, however, also promote, coordinate and monitor integrated seed supply, whether undertaken by the public sector, NGOs or private companies. An important aspect is that such

committees are also responsible for regularly reviewing and adapting the national seed legislation, which is a necessary prerequisite for any integrated seed supply activity in most countries, because national seed legislation often outlaws the sale of unlabelled (or uncertified) seed and the marketing of varieties that have not been officially released. A major problem is that, in most countries, these committees comprise mainly high ranked public servants from different ministries who may have little commitment to rural development. Whichever institution is chosen, a national knowledge center on seed technology and supply has to be built that can promote and coordinate such activities. These centers may only be effective when a flow of ideas and experimental results among the participating countries is maintained. International centers can play an important role in this supra-national cooperation through networking. They can also be instrumental in coordinating research into insufficiently developed sectors of national seed supply, such as participatory breeding, development of local farmer seed specialists and ensuring local seed security in stress-prone areas. The centers can also play an important role in developing a specific interest in seeds, working with social scientists.

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LOCAL BEAN SEED SYSTEMS IN UGANDA: PRELIMINARY RESULTS FROM SURVEYS IN TWO DISTRICTS

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INTRODUCTION

In most countries in the eastern and southern Africa region, the formal seed industry gives low priority to seed of self-pollinating crops such as the common bean (*Phaseolus vulgaris* L.) because its production is not considered profitable due to competition from farm-saved seed. Demand for 'clean' bean seed by resource-poor farmers is also depressed by the limited numbers of widely adapted, improved varieties promoted by the formal seed industry, the high price of certified seed and farmers' limited access to this seed due to untimely and ineffective delivery systems. A major bottleneck in bean research in sub-Saharan Africa, therefore, is the lack of appropriate channels for disseminating new bean cultivars.

Although local bean seed systems in Africa have proved dynamic and resilient, they often cannot adequately meet the needs of farmers under present precarious production and socio-economic conditions. Increased land pressure, changes in agricultural production conditions, crop failure due to drought and other natural calamities and civil disruption in the wake of war weaken the ability of local seed systems to provide the quantities, quality and types of bean varieties needed by resource-poor farmers (Almekinders et al., 1994; Louwaars, 1994). The genetic and physical quality of bean seed are important in the complex and diverse production environments of eastern and southern Africa, where typically small-scale farmers use few techniques and technologies to increase agricultural productivity. The use of good quality seed affects bean productivity in sub-Saharan Africa primarily through higher germination rates, decreased transmission, through seed, of certain diseases and pathogens (i.e., bean common mosaic virus, common bacterial blight, halo blight, ashy stem blight and *Fusarium* spp.) and improved plant health. The maintenance of genetic diversity in beans is another issue related to seed quality and supply since varietal loss may be linked to seed viability and availability.

An integrated approach to production and dissemination of bean seed that draws on the comparative advantage of local seed systems and the formal seed industry could offer a solution to the problem of how to supply resource-poor African farmers with good quality bean seed of improved and local varieties. The first step in the process of developing an integrated seed system is to assess the strengths and weaknesses of each existing system in a country-specific context. In most countries, however, there is limited systematic and quantitative data on farmers' seed systems. Consequently, seed regulatory frameworks and approaches to disseminating new varieties in most countries are based on a number of commonly heard premises, such as "farmers don't buy bean seed" or "the quality of farmers' seed is poor".

This paper reports on a diagnostic study of local or informal bean seed systems in selected areas of Uganda aimed at documenting how farmers acquire and manage bean seed and their knowledge of seed health issues.

THE SETTING

The common bean is the most widely grown and consumed grain legume in Uganda and is produced in all areas of the country. Beans are usually intercropped with bananas, cassava, maize or sweet potatoes and are eaten together with these and other staples. Bean yields are relatively low—at 741 kg/ha. The major constraints to production include poor soils, diseases (common bacterial blight, bean common mosaic virus, anthracnose and angular leaf spot) and field and storage pests. It appears that the predominant consumption of dry beans (as opposed to fresh beans) in many areas only dates back to the 1960s when the crop was promoted as a source of protein by development agencies. Women provide most of the labor for field and post-harvest tasks, but their control of the income from crop sales appears to differ by region. In most parts of Uganda, beans are grown in both seasons (March–June and July–December). Bush beans predominate: climbing varieties are only found at high altitudes in Kisoro, Kabale, Mbale and Kabarole Districts.

METHODOLOGY

Surveys were carried out between March and June 1994 in Mubende District in the central part of the country and Mbale District in the east. The two districts were selected to represent specific bean production environments and to reflect differences in the market orientation of the crop. Mubende District represents an area in the tall grass agro-ecological zone[1] where beans are an important food crop grown primarily for subsistence. Mbale District falls within both the tall grass and the highland zones and represents a high potential agricultural area where beans are an important cash crop. Table 1 describes the agro-ecological and socio-economic conditions of Mubende and Mbale Districts.

A two-stage approach to fieldwork was adopted whereby key informant interviews were conducted first followed by a formal survey. In Mubende, the sampling unit for the survey was sub-zones, identified by an NGO, while in Mbale sampling was carried out at the parish level in three targeted altitude zones—1200-1300, 1400-1700 and 1800+ masl. A non-random, systematic sampling procedure was used to select the 235 respondents interviewed (115 from Mubende and 120 from Mbale). The vast majority of the respondents (74%) were women living in male-headed households (77%), but 17% of the respondents were *de jure* female heads of household. About 15% of the households were of below average wealth.

BEAN PRODUCTION IN MUBENDE AND MBALE DISTRICTS

Beans are an important crop in the two districts. The major bean diseases in Mubende District and in the lowlands of Mbale District are common bacterial blight and angular leaf spot. At high altitudes in Mbale, the important diseases are anthracnose, halo blight, angular leaf spot and bean common mosaic virus (Wortmann and Allen, 1994). District-level statistics show considerable differences in the level of bean production. In 1990-91, Mubende District produced 39,368 t of beans on 21,871 ha, while production in Mbale District was 5,118 t grown on 3,656 ha (Republic of Uganda, 1992). Survey results, however, show a higher intensity of production in Mbale compared with Mubende, which may reflect the specificity of conditions in the areas sampled. On average, after a 'normal' harvest the previous season, farmers in Mbale plant 46 kg of bean seed (s.d. 14.57) compared with 16 kg (s.d. 36.12) for Mubende. The range in amount planted between farmers is considerable: the smallest quantity

[1] Three agro-ecological zones—the highlands, the short grass and the tall grass zones—are used to identify bean producing areas by differences in altitude, vegetation and rainfall.

of seed sown was 1 kg in Mubende and 4 kg in Mbale, while the largest quantity was 80 kg in Mubende and 200 kg in Mbale.

Table 1: Selected characteristics of Mubende and Mbale Districts

Characteristic	Mubende	Mbale
Annual rainfall (mm)	1218	1311–1993
Dominant soil type	Alfisols	humic Nitisols
Slopes	3-4%	10%
Major ethnic group	Baganda	Bagisu
Average household size	not available	5.2
Average farm size	0.5-1.5 ha	< 1 ha
Population density (km^2)	not available	494
Labor availability	limited	high
Major food crops	cassava, bananas, beans sweet potatoes	maize, beans, sweet potatoes, potatoes, bananas, cassava
Cash crops	food crops, coffee	coffee, food crops

Sources: Martin, 1990; Kayiso, 1993

The differences between the districts in the quantity of beans planted cannot be attributed to the differences in the size of land holdings since roughly half of the sample in both districts (47% in Mbale and 55% in Mubende) had a total land holding of 0.5–1.5 ha. A slightly higher number of farmers in Mbale had less than a half of a hectare (7% compared with 3% in Mubende). The greater intensity in production observed in Mbale may be attributed to the superior market opportunities and production conditions in the areas of the district bordering Mt Elgon where the survey was conducted. Following the decline of coffee production in the early 1980s, farmers in Mbale began to grow beans as a cash crop in response to market opportunities across the border in Kenya. Although no household-level data are available on bean yields in the two districts, it would be reasonable to expect higher yields in Mbale than in Mubende because the former has better soils and higher and more reliable rainfall.

Since the amount grown of a crop is related to its end use, the difference in the amount of beans sold by respondents in the two districts is not surprising. Data on bean sales over two seasons are shown in Table 2. The data suggest that while more farmers in Mbale than in Mubende sell beans in larger absolute quantities, the proportion sold relative to the amount usually planted is higher for Mubende farmers.

Table 2: Mean quantities (kg) of beans sold during 1993 in Mubende and Mbale

Season	Mubende	Mbale
1993A	26 (n = 31) Min: 9 Max: 100	87 (n = 52) Min: 2 Max: 600
1993B	29 (n = 18) Min: 1 Max: 100	118 (n = 45) Min: 10 Max: 1000

GENETIC DIVERSITY

The findings of a postal survey of district agricultural officers in 29 districts of Uganda revealed that 135 landraces and cultivars were commonly sown (Grisley and Sengooba, 1993). K20, a Calima seed type released in 1968, was clearly the most popular bean variety in Mubende and Mbale Districts: 73% of the farmers indicated planting the largest area to this variety. Mutike, Kanyebwa and Wotawa (Mbale only) were other commonly grown varieties. In Mubende, 14 bean varieties were recorded compared with 12 in Mbale. A few of the farmers interviewed had grown recently introduced improved cultivars.

The majority of the farmers interviewed planted sole varieties: only 3% planted mixtures. There appears to be little seasonal variation in varieties planted. The average number of bean varieties grown in the two districts differed slightly: 2.97 for Mubende and 2.47 for Mbale. As Table 3 shows, a more diverse genetic profile exists in Mubende than in Mbale: 22% of the respondents in Mubende grew four or more bean varieties compared with 13% for Mbale. The regional variation may be largely attributed to differences between the districts in the market orientation of the crop. In Malawi, Ferguson and Mkandawire (1993) also reported that a strong market orientation in bean production in southern areas of the country is one factor accounting for the limited number of bean varieties grown. Evidence that genetic erosion is influenced by marketing considerations is shown in the reasons given by farmers for intentional varietal loss. While only 8% of the farmers in Mubende mentioned marketing problems as the reason they stopped growing some bean varieties since 1986, 28% of Mbale farmers cited this as the reason. The most important reasons given by Mubende farmers for intentional varietal loss were low yields (33%) and poor cooking qualities (23%). Other reasons offered by Mbale farmers were poor resistance to rain (i.e., disease) (29%) and low yields (20%).

Table 3: Number of bean varieties usually planted in Mubende and Mbale

Number of varieties usually planted	Percentage of farmers	
	Mubende	Mbale
1	10	13
2	31	41
3	36	33
4	10	12
5+	12	1

SEED SOURCES

Information about seed sources was obtained by asking farmers where they got bean seed in most years, and specifically during the first season of 1993[2]. Farmers indicated the proportion of seed acquired from each source using a counter method, whereby they allocated a set number of pebbles to piles representing different seed sources. Over half of all respondents (64%) usually rely on only one source of bean seed; in 87% of cases the most important source was their own seed. As Table 4 shows, in 1993a most farmers (69%) relied totally on their own seed stocks, while 30% obtained a portion or all of the seed they planted from other sources, mainly markets, shops or as gifts from other farmers. Farmers pointed out the advantages of using farm-saved seed—no cost, not having to depend on others for seed, availability at the required time, control over the quantity desired, knowledge about quality and choice over varieties. The major disadvantages of depending on one's stock are being restricted to known and available varieties and the poor quality of this seed as a result of improper storage.

The second most important source of seed for farmers is the commercial sector—shops and markets. In 1993a, 22% of the farmers interviewed purchased some amount of seed from shops or markets, while 3% purchased seed from other farmers. If the pattern of purchasing observed in 1993a is typical, farmers tend to purchase either all (40% of the farmers who purchased seed during that season) or relatively insignificant proportions, i.e., less than 50% of their seed (36%). Shops are a more important source of seed in Mubende, while purchases from markets are more common in Mbale. In answer to a specific question about the frequency of seed purchases, 23% of the respondents indicated that they never buy seed (n = 233). Of the 178 farmers who buy seed, 60% do so rarely (i.e., on average one out of every three or more seasons), while nearly a third (29%) buy seed one out of every two seasons. Only 10% of the respondents who buy seed do so every season. These results suggest that the vast majority of farmers in the study area are usually seed secure, but most depend on other seed sources to top-up their own stock, to restock after a crisis or to obtain new varieties. In short, high risk production conditions and possibly the recent breakdown of seed networks, force farmers to depend on seed obtained outside the farm. A minority of farmers buy seed fairly frequently, and only a very small

[2] The previous season, 1992b, was considered 'average' in terms of climatic conditions. Comparison of answers given to general questions on seed sources with those given to questions about a specific season suggests that the former answer describes the ideal situation, while the latter better reflects reality.

number of farmers chronically do not have sufficient seed. Preliminary data analysis shows no relationship between farmers' socio-economic status and dependence on seed purchases, contrary to what was found in the Great Lakes Region of eastern Africa (Sperling, 1994).

Table 4: Major sources of bean seed in 1993a in Mubende and Mbale (% of farmers responding)

Seed source	Amount of seed obtained		
	None	Some	All
Own stock	10	20	69
Markets	85	10	5
Shops	93	4	3
Gifts	91	8	1
Purchased from other farmers	97	3	0.4
Borrowed or exchanged	99	1	0

Of the 160 respondents who could remember when they last bought bean seed, 51% of their purchases had been made in 1994[3], 19% in 1993 and 13% in 1992. Most purchases were made in the first season, which in both survey areas is considered the better season for planting beans due to its more predictable and less heavy rainfall. Farmers buy an average of 1.2 varieties, and the means of the quantities purchased were 7 kg for Mubende and 21 kg for Mbale.

Farmers mentioned several advantages of obtaining bean seed from commercial outlets—varietal choice, availability of new varieties, access to seed when needed and in the required quantity and credit facilities. On the other hand, obtaining bean seed from market outlets has a number of disadvantages—poor quality of the beans, distance to shops and markets and high seed cost. Farmers attribute the poor quality of commercially purchased seed to poor management by shopkeepers (i.e., failure to sort seed by variety and poor storage) and the age of the seed. The poor quality of this seed may also reflect farmers' tendency to sell off their worst grain.

SEED NETWORKS

In the past, the only other source of bean seed for farmers besides their own stock was neighbors and relatives[4]. Survey results show that the respondents receive very small proportions of the seed they plant from other farmers. In 1993a, only 8% of the farmers planted bean seed obtained as gifts, 3% purchased seed from other farmers and about 1% obtained seed through exchange (Table 4). Of the 17 farmers who received seed gifts, 18% obtained all the seed sown from this source, while 70% received

[3] Harvests in 1993b were exceptionally low due to the dry conditions that prevailed during that season in many parts of the country.

[4] Regional differences exist regarding where a new bride traditionally got bean seed. In Mubende and possibly the rest of Buganda, a woman got her first bean seed from her in-laws or her husband, while among the Bagisu, a new bride brought bean seed (and seed of other crops) with her to her new home.

less than 50% of their seed as gifts. As Table 5 shows, giving away bean seed is an irregular practice among most farmers: 41% reported doing so rarely, while 21% never give away bean seed. In 1993, however, 49% of the farmers interviewed gave out dried beans as a gift. The most frequently mentioned amount of beans provided as a gift was 2.5 kg in Mubende and 2 kg in Mbale. A strong social obligation exists regarding the exchange of fresh beans. The vast majority of farmers give and receive fresh beans every season compared with only 15% and 4%, respectively, of farmers who reported giving out and receiving gifts of dried beans on a seasonal basis.

Table 5: Percentage of farmers giving and receiving gifts of fresh and dried beans in Mubende and Mbale

Frequency	Giving gifts of fresh beans (n=232)	Receiving gifts of fresh beans (n=233)	Giving gifts of dried beans (n=233)	Receiving gifts of dried beans (n=234)
Every season	75	59	15	4
Season A only	6	13	3	3
Season B only	4	0.9	13	4
Season A or B	3	6	6	6
Rarely	11	17	41	56
Never	0.9	4	21	26

In 1993, the gifts of dried beans given by 116 respondents went to relatives (87%), friends (22%) and neighbors (19%) living in the same village (53% of cases). In 47% of cases, seed went to farmers living in other villages, and in 38% of cases, the seed was given to other parishes, indicating that the range of farmer-to-farmer diffusion is quite significant. Seed networks appear to be somewhat more active in Mbale than in Mubende, which challenges the premise that commercialization of a crop is responsible for the breakdown of exchange systems.

Since the major reason that farmers exchange seed is to ensure reciprocation (52%), it is clear that bean seed networks serve to ensure seed security. Therefore, in most cases, with the exception of gifts given on social occasions (e.g., funerals) or to the elderly or urban relatives, farmers give out dried beans for use as seed, and accordingly, most farmers are selective about who they give seed to. Reflecting the latter point, as well as the role of beans as a social currency, farmers stressed that they would not give bean seed to people whom they consider socially undesirable (21% in Mubende and 36% in Mbale), those who would not plant the seed (16% in Mubende and 25% in Mbale), those who do not grow beans (6% in Mubende and 14% in Mbale) or those who would not keep the seed (6% in Mubende and 10% in Mbale).

Despite the apparent decline in importance of seed networks in the two districts, farmers rank this source second in preference because of the good seed quality and the access it provides to preferred, diverse varieties. But dependence on other farmers for seed is not without disadvantages, which include the sense of dependence, lack of control over quantity and time of delivery, and in some cases, the poor quality of the seed given as gift.

SEED MANAGEMENT

For the most part, Ugandan farmers, like farmers in most parts of eastern Africa, do not distinguish between bean grain and seed at the level of field production. In contrast to Rwanda (Sperling et al., 1993), seed 'experts', i.e. farmers who are recognized as having superior seed or knowledge about beans were not found in the two study sites. Seed only becomes of concern to farmers at the time of storage and before planting. The majority of the farmers interviewed (66%) select seed for planting just after the harvest is threshed. Seed selection and sorting at this stage usually involve sorting by variety and removing damaged seed. Separately stored seed is sorted again before planting. The second most common practice is sorting just before planting (23%). A minority of farmers (4%) do not sort or select seed but plant whatever seed is available, increasing sowing rates to compensate for damaged or unviable seed. Sorting is an exclusively women's task, although children of both sexes may be assigned the work. The majority of farmers interviewed (70%) store seed separately from grain. In most cases, beans are not stored in a special structure but are kept inside the house (99%) in sacks, open baskets and plastic containers.

Nearly all farmers practice some post-harvest protection of grain (91%) and seed beans (98%). The major measures used are: sunning, applying ash or pepper, coating the seed with banana 'juice', soil from a termite hill and insecticide (Table 6). Different pest control practices are used for bean seed and grain where they are stored separately. Farmers favor the use of insecticide and protectorants on seed beans probably because of the toxicity of the chemicals and the desire for better protection of seed compared to grain.

Table 6: Percentage of farmers using storage pest control practices in Mubende and Mbale Districts

	Weekly sunning	Periodic sunning	Ash	Pepper	Banana 'juice'	Termite hill soil	Pesticide	Other
Food beans (n = 214)	21	72	8	3	4	3	21	5
Seed (n =161)	16	58	16	8	4	12	44	9

SEED QUALITY

The quality of bean seed is related to (1) the presence or absence of seed-borne pathogen infection (2) the presence or absence of post-harvest pests and (3) seed viability (i.e., germination rate). Farmer's management practices can influence quality at all three levels, although the first is the most problematic because the symptoms caused by some pathogens[5] are not visible. Farmers' seed selection criteria, views on seed quality and plant health and knowledge of diseases were elicited during the survey and key informant interviews, but more detailed work is needed on these topics.

[5] Depending on the severity of pod infection, symptoms of some bacterial and fungal pathogens will be visible on seed. Viral infections are asymptomatic.

Since farmers in Mubende and Mbale rarely practice in-field disease control methods such as rouging of diseased plants, they mainly influence seed quality during seed selection[6]. The major criteria used in selecting seed are varietal characteristics, physical appearance and seed size. When asked to state up to three indicators of 'bad' seed, besides varietal characteristics[7], the farmers, in total, mentioned 10 physical qualities, three (shriveled, weevil-damaged and rotten) of which were mentioned by nearly half of all respondents (Table 7). It is notable that four (shriveled, rotting/moulding, undersized and discoloration) of the criteria cited may be associated with diseases or physiological problems, which suggests a significant degree of success by farmers in eliminating diseased seed through selection. However, since none of these characteristics was mentioned by the vast majority of farmers, significant differences probably exist among farmers in the amount of care they take in seed selection and their knowledge about seed quality. Although farmers clearly are aware of the relationship between the physical properties of seed and germination, they generally appear less clear about the relationship between seed and plant health, and for the most part, are not aware of disease transmission through seed. Farmers attribute plant health and most bean diseases to the soil condition, the presence of insects and the weather (i.e., excessive rain or drought). The absence of names for most bean diseases in most Ugandan communities also suggests that there is limited indigenous knowledge about plant health[8].

In the absence of quantitative data, little can be said about the quality of farmers' bean seed in Uganda. The above information on farmers' selection methods, however, suggests that the quality of farmers' seed is reasonably good, and survey results indicate that farmers are satisfied with the quality of farm-saved seed. Of more dubious quality is seed obtained from off-farm sources, i.e., seed purchased in markets or shops or obtained from other farmers. Further research is needed on the quality of both farmers' own seed and seed obtained from other sources, farmers' decision making processes about bean sales and exchange (i.e. which beans are sold/exchanged and the timing of these transactions) and how management of beans by sellers affects quality.

[6] A survey of Rakai, Mpigi, Mukono and Hoima Districts of Uganda also revealed that few farmers (7%) regularly rogue diseased bean plants (Grisley, 1991).

[7] When farmers mentioned varietal characteristics in response to a question about seed quality, it is unclear whether this reflects connections they make between variety and disease incidence and consequently seed quality, or has more to do with a translation/terminology problem.

[8] In contrast, Rwandan farmers have local names for all common bean diseases and associate "bad" seed with disease incidence (personal communication from L. Sperling). The difference between Uganda and Rwanda in bean knowledge systems may be partly explained by the relatively greater importance of the crop in the domestic economies of Rwandan households.

Table 7: Criteria used by farmers in selecting bean seed in Mubende and Mbale Districts

Selection criteria	Percentage of farmers
Shriveled	49
Damaged by weevils	47
Rotten/soft	45
Germinating	28
Broken/cracked	24
Discolored	23
Moulded	20
Under-sized	13
Light weight	0.4
Old	4
Other	17

While studies conducted on the quality of farmers' bean seed in other countries provide locality specific information on this topic, they suggest areas for further research. Studies conducted in Rwanda, Kenya and parts of Latin America show that the physiological and health quality of farmers' seed compares favorably with 'clean' seed (Buruchara, 1990; Trutmann and Kayitare, 1991; Janssen et al., 1992; CIAT, 1992; Mwang'ombe, Otieno and Shankar, 1994). Most studies found no statistical difference between the yield of clean seed and farmers' seed, suggesting that farmers stand to gain little by buying commercially produced bean seed. In Rwanda, the good quality of farmers' seed may be attributed to adequate crop management (e.g., in-field management practices, planting of disease-susceptible varieties in certain seasons), seed selection and varietal selection[9].

CONCLUSION

The results of this study raise important questions about farmers' access to bean seed, their perception of the quality of available seed, the relationship between access to seed and genetic diversity at the farm level and the efficiency of farmers' seed networks as a mechanism for the distribution of improved varieties. Several findings suggest that access to bean seed is problematic for small-scale farmers in the two study localities (and perhaps elsewhere in Uganda) and that the quality of available seed is of some concern to farmers:

1. The majority of farmers, with varying degrees of frequency, depend on off-farm seed sources.

2. Although farmers prefer the quality of farm-saved seed (both their own seed and seed from other

[9] Research by Opio (1993) suggests that seed-plant transmission of disease in beans varies according to variety.

farmers) and appear satisfied with the quality of their own seed, seed exchange is in reality the third most important source of seed and provides only a small proportion of the seed that farmers plant.

3. Commercial outlets are the second most important seed source, although farmers consider seed purchased from shops and markets to be of inferior quality.

A second set of issues raised by the study concerns the relationship between access to bean seed and genetic diversity. Although considerable genetic diversity of beans exists in Uganda, the findings indicate that farmers in the study areas grow few varieties. Yet, the demand for new varieties is high among Ugandan bean farmers, as shown by their willingness to pay high prices for seed of unknown improved varieties (David et al., this volume). Seed availability, along with several other factors (e.g., market forces in Mbale), probably accounts for the limited number of bean varieties grown by farmers.

Finally, the survey results suggest that due to the declining importance of farmer-to-farmer seed exchange, using this channel for disseminating new bean varieties would likely result in slow diffusion. The limitations of seed exchange as a mechanism for the diffusion of new varieties is also confirmed by evidence from Rwanda showing that farmers only exchange seed of new varieties after several seasons of multiplication and testing (Sperling and Loevinsohn, 1993). These conclusions suggest that there is room for improving local bean seed supply systems and that demand exists for good quality, low cost bean seed of improved and local varieties produced through both formal and non-formal approaches.

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HARICOT BEAN SEED DISSEMINATION IN THE CENTRAL RIFT VALLEY OF ETHIOPIA: A CASE STUDY

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INTRODUCTION

The common bean, *Phaseolus vulgaris*, is an important food and cash crop in Ethiopia and is grown in almost all administrative regions. Nationally, the area under haricot bean currently is estimated at more than 300,000 ha. In the Central Rift Valley Region, the area under haricot bean production during 1991 and 1992 was estimated at 14,214 and 16,579 ha, respectively. In the Central Rift Valley Region, haricot bean is surpassed in importance only by maize.

Farmers produce beans in traditional production systems and usually obtain low grain yields (500-700 kg/ha). However, at research centers improved haricot bean varieties produce grain yields of over 2000 kg/ha. Two improved haricot bean varieties are currently produced in the region. Awash-1 (Ex-Rico 23), a white seeded bean, is mainly produced for export, and the beige colored Roba-1 (A-176) is generally used for food.

These varieties have been demonstrated to farmers around Nazaret, Wolenchiti, Bofa and Wonji for the last five to six years using the formal demonstration method. These demonstrations do not cover many farmers, and technology transfer has very slow. Thus, it became necessary to initiate a non-formal haricot bean seed dissemination program. This paper assesses that program and evaluates farmers' reactions to the new varieties and to the program itself.

MATERIALS AND METHODS

The study, which was conducted during the 1993 and 1994 seasons, covered four sites—Bora, Dugda, Adami Tulu and Shashemene Woredas—in the Central Rift Valley Region of Ethiopia. Work was initiated in Dugda and Bora, which receive bimodal rainfall and are prone to drought. In 1993, the total rainfall recorded at Melkassa Research Center, which is located in a similar ecological zone as the two sites, was 868 mm. According to a study reported by the Water Resource Development Authority of Ethiopia (1987), soils in Dugda and Bora have a pH ranging from 6.5 to 9.1, with low phosphorous, potassium, magnesium and sodium content and high calcium content.

Two seed dissemination methods were followed:

Method 1. Thirty contact farmers were selected in Dugda by development agents and research extension staff. The selection criteria included their economic status and how well they managed their fields. Five kilograms each of Awash-1 and Roba-1 were distributed to the farmers.

Method 2. Beans of the same varieties and amounts as given to the contact farmers were distributed to 30 randomly selected farmers.

Table 1 summarizes data on distribution activities for 1993 and 1994. Seed was distributed to a total of 120 farmers. Advice on improved management practices was given by development agents.

Table 1: Haricot bean seed dissemination activities in the Central Rift Valley, 1993-1994

Woredas	Method	No. of farmers	Amount of seed/ farmer (kg)		Total seed required (kg)	Seed rate (kg/ha)	Weeding (weeks after planting)	Planting date
			Awash-1	Roba-1				
Dugda	1	30	5	5	300	125	2–3	15-30 June
Bora	2	30	5	5	300	125	2–3	15-30 June
Adami Tulu	1	30	5	5	300	125	2–3	15-30 June
Shashemane	2	30	5	5	300	125	2–3	15-30 June

RESULTS AND DISCUSSION

The means of the yield of Awash-1 in 1993 for contact and non-contact farmers were 1230 and 1020 kg/ha, respectively (Table 2). Mean yields for Roba-1 were 1000 and 800 kg/ha, respectively. Most non-contact farmers obtained yields similar to the national average yield (Table 3). Only 10% of the non-contact farmers got more than 1000 kg/ha, and only one farmer obtained 2000 kg/ha (Table 4).

Table 2: Mean grain yield (kg/ha) of beans by method of bean seed dissemination, 1993

District	Method	No. of farmers	kg/ha	
			Awash-1	Roba-1
Dugda	Method 1	30	1230	1020
Bora	Method 2	30	1000	800

Even within groups, there was a noticeable yield difference. Contact farmers who prepared their land well, planted and weeded on time (n = 3), obtained over 1500 kg/ha compared with 380 kg/ha for the less diligent contact farmers (Table 3). Late planting, poor land preparation and weed infestation caused the low yields obtained by non-contact farmers. This can be attributed to the limited access of these farmers to various farming resources.

In two of the four districts, a preliminary investigation was conducted to find out whether farmers saved seed of the new varieties for the next season. Eighty six per cent of the contact farmers did this compared with 70% of the randomly selected farmers. This suggests that disseminating seed of new bean varieties through contact farmers is more effective than through randomly selected farmers. However, it is still too early to conclude that the farmers directly or indirectly benefited from the seed dissemination program. Reports from the district's Ministry of Agriculture staff and our observations indicate that farmers and development agents are becoming aware of the improved bean varieties and are asking for them.

PROBLEMS ENCOUNTERED

Some major problems were encountered during the seed distribution exercise that may have affected bean yields:

- There was no haricot bean seed multiplication scheme
- Some farmers did not plant their seed while others planted late because they received the seed late
- There was shortage of rain during flowering
- Most farmers did not weed their bean fields
- Some farmers refused to plant Roba-1 as they were not familiar with it.

SUGGESTED SOLUTIONS

To ensure that the non-formal haricot been distribution process succeeds, it is necessary to:

- Encourage seed multiplication at research centers and on farmers' fields
- Organize training programs for development agents to create awareness of newly released varieties
- Advise farmers to weed their plots or to use high seed rates at planting to suppress weeds.

FUTURE PLANS

A survey will be conducted to assess farmers' reaction to the new varieties and how methods of dissemination affect adoption of the new varieties and to measure the level of diffusion of the improved varieties.

Table 3: Grain yield (kg/ha) of haricot bean seed distributed through method 1 in Dugda during 1994

Farmer	Variety	Yield (kg/ha)	Remark
1	Awash-1	2000	Good land preparation (3 times), fallow land; manure applied
	Roba-1	2150	
2	Awash-1	1480	
	Roba-1	1700	
3	Awash-1	1300	
	Roba-1	1630	
4	Awash-1	2000	Good land preparation (3 times); weeding (one time)
	Roba-1	2010	
5	Awash-1	1400	
	Roba-1	1280	
6	Awash-1	1600	
	Roba-1	1750	
7	Awash-1	1630	Good land, weeding
	Roba-1	2000	
8	Awash-1	750	
	Roba-1	-	Not planted
9	Awash-1	-	Eaten by duck
	Roba-1	-	Eaten by duck
10	Awash-1	1750	
	Roba-1	1880	
11	Awash-1	1630	
	Roba-1	1880	
12	Awash-1	1480	
	Roba-1	1530	
13	Awash-1	1850	
	Roba-1	1130	
14	Awash-1	1680	
	Roba-1	1680	
15	Awash-1	1400	
	Roba-1	1150	
16	Awash-1	380	Planted late, water logging
	Roba-1	630	High weed infestation
17	Awash-1	1230	
	Roba-1	980	
18	Awash-1	1480	
	Roba-1	1030	
19	Awash-1	1230	
	Roba-1	830	
20	Awash-1	880	
	Roba-1	630	
21	Awash-1	1130	
	Roba-1	750	
22	Awash-1	940	
	Roba-1	630	
23	Awash-1	1000	
	Roba-1	880	
24	Awash-1	1000	
	Roba-1	750	
25	Awash-1	880	
	Roba-1	750	
26	Awash-1	880	
	Roba-1	750	
27	Awash-1	1130	
	Roba-1	880	
28	Awash-1	-	Not planted
	Roba-1	-	Not planted
29	Awash-1	1000	
	Roba-1	950	
30	Awash-1	750	
	Roba-1	1000	

Table 4: Grain yield (kg/ha) of haricot bean seed distributed using Method 2 in Bora during 1994

Farmer	Variety	Yield kg/ha	Remark
1	Awash-1	1380	
	Roba-1	1250	
2	Awash-1	2 630	
	Roba-1	500	
3	Awash-1	1180	
	Roba-1	930	
4	Awash-1	1300	
	Roba-1	880	
5	Awash-1	1000	
	Roba-1	880	
6	Awash-1	1130	
	Roba-1	830	
7	Awash-1	930	
	Roba-1	1050	
8	Awash-1	500	Planted late
	Roba-1	250	Inadequate rainfall
9	Awash-1	300	Planted late, water logging
	Roba-1	580	
10	Awash-1	500	Planted late, water logged
	Roba-1	400	
11	Awash-1	1380	
	Roba-1	1280	
12	Awash-1	1450	
	Roba-1	750	
13	Awash-1	1130	
	Roba-1	880	
14	Awash-1	750	
	Roba-1	630	
15	Awash-1	2050	Good land preparation, weeding(once)
	Roba-1	1750	
16	Awash-1	750	
	Roba-1	500	
17	Awash-1	550	
	Roba-1	500	
18	Awash-1	630	
	Roba-1	580	
19	Awash-1	700	
	Roba-1	550	
20	Awash-1	800	
	Roba-1	880	
21	Awash-1	1230	Planted late
	Roba-1	830	
22	Awash-1	1080	
	Roba-1	880	
23	Awash-1	880	
	Roba-1	750	
24	Awash-1	650	Planted late, shortage of rain at flowering, weed problem
	Roba	630	
25	Awash-1	950	
	Roba-1	800	
26	Awash-1	1250	
	Roba-1	930	
27	Awash-1	1180	
	Roba-1	1000	
28	Awash-1	1280	
	Roba-1	950	
29	Awash-1	1380	
	Roba-1	880	
30	Awash-1	880	Planted late
	Roba-1	380	Eaten by oxen

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DISTRIBUTION OF BEAN SEED THROUGH SHOPS AND RURAL MARKETS IN UGANDA

Summary report by Soniia David

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INTRODUCTION

Although small-scale farmers in eastern and southern Africa rely predominantly on their own stock for bean seed, significant amounts of seed are acquired through the market. Research conducted in Rwanda, Zaire and Burundi indicates that market channels are the second most important source of bean seed, with poorer farmers being particularly dependent on them (Sperling, 1994). In a 1994 survey of 108 Ugandan bean farmers, 59% reported having ever bought bean seed from markets or shops, and 20% of the respondents purchased more than a quarter of the bean seed they planted from commercial sources (David et al., 1995). Another survey in two districts of Uganda identified shops and markets as the second most important source of bean seed for farmers, with 22% of the farmers interviewed reporting to have purchased seed from commercial sources during the main growing season of 1993 (David, this volume). Commercial outlets, therefore, appear to have great potential as distribution points for seed of newly introduced bean varieties.

METHODS

Two separate seed distribution exercises were carried out in Uganda with the objective of assessing the effectiveness and ease of bean seed distribution through rural shops and markets. The aim of devising alternative seed distribution channels is to reduce costs in the effective dissemination of newly released varieties. The bean varieties distributed were CAL 96, a Calima type similar to the popular K20, and MCM 5001, a Carioca seed type unfamiliar to farmers in Uganda. In both exercises, seed was packaged in heat-sealed, clear plastic packets containing an information leaflet in Luganda, the most widely spoken language. The name of the variety, number of days to maturity, resistance to disease, yield and cooking time, relative to popular bean varieties, were described in the leaflet.

Distribution through shops

In February 1993, seed of MCM 5001 (then at the pre-release stage) was packaged in 500 g amounts and made available to one-three purposively selected shopkeepers in five trading centers, in four districts in the east and central regions of the country. Each shop received 15 packets of seed. Shopkeepers were advanced the seed and asked to sell it for Ush. 400/kg (US$0.44), about 150% of the farmgate price of local bean varieties at planting time following a 'normal' season. They kept 25% of the proceeds and returned 75% to the Uganda National Bean Program (UNBP). The shopkeepers were requested to record the names and addresses of the people who purchased the seed.

In the first season of 1994, three seasons after the initial seed distribution, a follow-up survey was conducted. Because of poor record keeping by shopkeepers and difficulties in locating people, the sample was limited to 47 farmers. Farmers were asked to evaluate the new variety and were questioned about its performance over the first and second seasons of 1993 and exchange and sale of seed. The objectives of this study were to assess the appropriateness of shops as an outlet for seed of new bean varieties and to document adoption and dissemination of the variety by buyers.

Distribution through markets

At the start of the second planting season of 1994, 50 each kg of MCM 5001 and CAL 96, packaged in 250 and 500 g packets, were given to two extension agents in Mpigi District, central Uganda. The seed was sold in five rural markets at Ush. 800/kg (US$0.87), about 300% of the lowest price of seed of local bean varieties at planting time following a 'normal' season. The objectives of the exercise were to assess the effectiveness of rural markets as an outlet for seed of newly released bean varieties, investigate what quantities of a new variety farmers are prepared to buy and at what price, and determine the effectiveness of extension agents as seed distributors and promoters. Each agent was required to record the number of sales, the quantity and variety bought and the sex of the purchaser on a prepared form. Assessment of this exercise is based on observation, discussions with the extension agents and sale records.

RESULTS FROM DISTRIBUTION THROUGH SHOPS

Farmers' characteristics

The farmers surveyed were concentrated in the East and Central Regions of the country—Masaka (n=18), Pallisa (n=11), Mukono (n=10) and Jinja (n=8) Districts. The majority of the 47 respondents (62%) lived less than 1.5 km from the trading center from where the seed had been bought. Half (51%) were male and 79% had bought the seed themselves. Most respondents (64%) were between 18 and 40 years of age. With 35% of the respondents having some secondary education, the sample is better educated than the wider rural population. Nearly half of the farmers (47%) cultivated 2 ha or more of land, which is in line with the average holding size of 2.2 ha for 26 districts of Uganda (Republic of Uganda, 1990-91). Most farmers (62%) hired labor either on a regular basis (48%) or infrequently (52%), while only 2% sometimes worked as casual farm labor. Nearly half (47%) of the respondents owned a business. Based on a subjective assessment, the interviewers classified 22% of the households as below average in wealth. The above indicators of socio-economic status suggest that the majority of farmers who bought seed of the new variety were average or above average in wealth, which confirms the view regarding the risk-taking behaviour of better-off farmers.

Seed purchases

While all purchases of MCM 5001 seed were made during the first season of 1993, only 31 farmers planted the seed that season. Most farmers (51%) bought 0.5 kg of seed (Table 1), but three of them bought 3, 4 or 9 kg. Of those who could remember the price they paid for the seed, 21% paid the recommended price of Ush. 200 for 500 g; the rest paid more (the highest amount paid was Ush. 500 for 500 g). In most years, over half of the farmers surveyed obtain some bean seed (local varieties) from shops and markets, with 15% relying on this source for half or more of their seed.

Table 1: Quantities of MCM 5001 seed purchased by farmers from shops in five districts of Uganda

Amount purchased (kg)	Percentage of farmers
0.5	51
0.1	26
1.5	9
2.0	9
2.0+	6

Farmers bought the new variety primarily out of curiosity and the desire to experiment (56%), but 36% of the respondents had been persuaded by shopkeepers to buy the seed. One farmer bought the seed because there was no other bean variety available. In the remaining cases, the seed had been bought by someone other than the respondent. In only 4% of the cases, the purchased seed was never planted.

Production

Although farmers were asked about the performance of MCM 5001, even when amounts harvested were reported, data based on farmers' recall are, for the most part, unrealistically high (seed return rates ranged from 15 to 80 times the amount planted) and therefore not reliable. It is notable, however, that 81% of the farmers praised the high yielding characteristics of the variety, an indicator that it probably out-yielded local varieties. Adverse weather conditions, notably drought during the second season of 1993, also affected the results of this study in two ways—(1) yields were lower than usual and 33% of farmers who planted during that season experienced crop failure of the new variety, and (2) due to food shortage, some farmers ate the seed of the new variety.

Seed exchange

Of the farmers who grew MCM 5001 to maturity during the two seasons, about a quarter gave away seed, and even fewer sold seed (Table 2). The major reason offered by farmers for giving away seed was the desire to share an appreciated variety (39%). Farmers who gave out seed because they wanted others to multiply it (22%) as a means of ensuring its availability to the donor and the wider community, probably felt a sense of personal commitment for the diffusion of new varieties. Other reasons for seed exchange—request for seed from other farmers (17%), to reciprocate (11%)—were not specifically related to farmers' (that is, donors') preferences.

Table 2: Reported quantities of MCM 5001 seed given away and sold over two seasons by farmers who purchased seed from shops

Year/season	No. of farmers who harvested	% of farmers who gave away seed	Mean quantities of seed given as gift (kg)	Mean quantities of seed sold (kg)
1993A	30	40	2.40	14 (n = 3)
1993B	18	39	2.90	50 (n = 2)

Insufficient seed and the desire to eat or replant seed of the new variety were the primary reasons cited by farmers for not selling or exchanging seed of MCM 5001 (Table 3). These results are however to be expected after only two seasons of cultivating the new variety. Sperling and Loevinsohn (1993) also observed that the factor accounting for the late starting time for diffusion among Rwandese bean trial farmers was the farmers' desire to build up seed stocks. A few farmers refrained from selling or giving away seed because they were under the impression that researchers would come to buy it. It is probable that this idea was suggested by shopkeepers in response to farmers' queries about markets for the new variety. Since most respondents actively participate in seed exchange of local bean varieties (only 11% claimed never to have shared seed with others and 28% reported to have never received seed from others), there is every reason to believe that, as multiplication of the variety increases, significant diffusion of seed from the farmers surveyed will take place.

Table 3: Farmers' reasons for not sharing or selling seed of MCM 5001 in 1993 (percent)

	Poor harvest/ small quantities	Ate all seed	Kept for seed	Kept for food	No market	Not requested for seed	Seed belonged to researchers	Other
Reason for not selling (n = 42)	29	19	26	17	12	N.A	7	7
Reason for not giving away seed (n = 33)	36	27	18	0	N.A	15	12	21

RESULTS FROM SURVEYS OF SEED DISTRIBUTION THROUGH MARKETS

Seed sales

Over a period of approximately 27 marketing hours, 29.75 kg of MCM 5001 and 30.5 kg of CAL 96 were sold in markets. Due to a misunderstanding, the extension agents sold 11 kg of MCM 5001 and 16.25 kg of CAL 96 to farmer groups; 2 kg of MCM 5001 and 3.25 kg of CAL 96 were also sold from an extension agent's home. The total amount of seed sold to 160 farmers was, therefore, 92.75 kg, representing 42.75 kg of MCM 5001 and 50 kg of CAL 96. The response to the sale of the seed in

markets was overwhelming: the extension agents reported being swamped with farmers anxious to try the new varieties. On one occasion, after exhausting the supplies taken to the market, farmers followed the extensionist home to buy seed.

Both extension agents enjoyed the distribution exercise and provided valuable feedback. They endorsed the use of small packets instead of bulk selling as they felt that the latter makes theft of small quantities of seed easier (cf. Sperling et al., this volume). They also felt that the packets lend credibility to the new varieties and are a guarantee of the quality of the seed, an important aspect in view of farmers' experience with expired inputs (including seed) sold in markets.

Farmers' responses to the new varieties

It can be assumed that the majority, if not all, of the farmers who purchased the seed were first exposed to the new varieties during market sales, since both varieties were officially released in April 1994, only 5 months before the exercise was conducted. The importance of the informational leaflets was clear, as most buyers first read the leaflet before making their purchase. Farmers frequently queried extension agents about the new varieties, notably regarding the resemblance of CAL 96 to K20 (Nambale), a variety that is commonly grown in Mpigi District, and the marketability of the small-seeded MCM 5001. Two-thirds of the purchases were made by men, which is explained by their greater involvement in trade relative to women.

An insignificant difference was observed in the demand for the varieties. Slightly more farmers bought CAL 96 than MCM 5001 (91 compared with 89) and in larger quantities (Table 4). Women buyers showed a preference for CAL 96 (58%), while half (54%) of the male buyers bought MCM 5001. Ninteen percent of the CAL 96 buyers bought 0.75 kg or more compared with 13% for MCM 5001. Twenty farmers bought both varieties. The perceived disadvantages of MCM 5001 were its small seed size, which for most farmers indicated th at it would be difficult to market, and the belief that it has a semi-climbing growth habit.

Table 4: Quantities of MCM 5001 and CAL 96 seed sold in markets (percentage of farmers responding)

Amount purchased (kg)	CAL 96 (n = 91)	MCM 5001 (n=89)
0.25	42	47
0.50	38	39
0.75	3	2
1.00	12	10
1.25	1	1
1.50	2	-
2.00	1	-

EVALUATION OF DISTRIBUTION METHODS

While it is difficult to quantitatively evaluate and measure the effectiveness of seed distribution through shops and markets given the different methodologies used in the two studies, a number of observations can be made on the two channels with regard to cost, promotion and farmers' ease of access to the seed.

Cost

Distribution costs through both channels include packaging of the seed (labor and materials), preparation of information leaflets, transportation of seed to the sellers and sellers' profit. The additional costs incurred during the market sales were transportation of seed to the market, market tax and lunch allowance for extension agents (Table 5). Even where seed is sold at a relatively high price, a considerable subsidy (over half of the cost of producing the packets) is required. The cost of distributing seed through shops is not significantly less.

In making cost estimates for the routine use of these distribution channels based on the above results, a number of points should be considered: (1) transport costs were relatively low since both exercises were conducted in areas within a 250 km radius of the research station; (2) the lunch allowance for extension staff could be omitted if seed distribution is added to their list of duties; (3) transportation costs from sellers' homes to markets are only incurred when the seller does not own a bicycle. A major expense of using the methods used in these studies is incurred in follow-up visits to collect the proceeds from seed sale. The willingness of shopkeepers to buy the seed outright was not investigated, but it is unlikely that Ugandan merchants would want to do this for the unknown varieties involved. It is notable, however, that shopkeepers in Rwanda bought seed of new bean varieties from researchers (Sperling et al., this volume). One way to reduce the trips made to collect money from the sellers is to have national programs deliver seed to district agricultural offices for distribution to extension agents. The extension agents would make reports to the officer in charge and it would be recovered the following season by the national program when more seed was delivered.

Table 5: Cost of delivering and selling 100 kg of bean seed through rural markets in Mpigi District, Uganda, in 1994

Aspect	Cost (US$)
Seed	100.00
Packaging (labor and materials)	28.00
Leaflet	3.50
Transport of seed from research station to seller	27.00
Transport of seed from seller's house to market and market tax	15.64
Lunch allowance for extension agents (6 days)	20.00
Seller's profit	20.00
Total cost	214.14
Sale price	87.00
Subsidy	127.14

Note: The cost of transportation to collect the proceeds from seed sales is not included.

Promotion

One possible drawback to the use of commercial channels for seed distribution is the bias among farmers in Uganda and elsewhere against store-sold bean seed. Farmers consider the quality of the bean seed sold in shops to be inferior to their own seed stocks and seed obtained from other farmers (David, this volume). Packaging and labelling are likely to suggest a reliable product, and, moreover, packaging would discourage shopkeepers from tampering with the seed (e.g., mixing new varieties with local varieties that resemble them).

While both shopkeepers and extension agents appear to be capable promoters of new bean varieties, their motives are likely to be different. Shopkeepers are likely to have little interest in selling new varieties outside of the profit motive, whereas extension agents may be professionally motivated to distribute new varieties, to encourage farmers to increase seed stocks of the new variety and should be able to provide better feedback to researchers on sales as well as varietal adoption.

Access

Since shops operate on a daily basis, in contrast to rural markets that are usually periodic (weekly or bi-weekly) and operate for a few hours only, they allow for more frequent access to seed, which may be crucial at planting time. However, farmers' preferences for seed delivery points appear to vary by region or district or even by income category. For example, shops are a more important source of bean seed for farmers in Mubende District, while purchases from markets are more common in Mbale District (David, this volume).

Depending on extension agents to sell bean seed could result in a number of problems that may hinder farmers' access to seed: (1) there might be time conflicts between this activity and other responsibilities, and (2) the agent's absence from work due to illness or other reasons could affect the timely delivery of seed. One way to avoid these problems is to have extension agents work in teams to distribute seed.

Ugandan farmers, unlike those in some countries (Cromwell and Wiggins, 1993), do not appear to have a strong preference for particular bean seed delivery points, probably because of their limited contact with the formal seed system with regard to beans. Farmers who bought MCM 5001 seed from shops recommended government agencies (e.g., the extension system) (62%), shops (28%), individual farmers (21%) and farmers' groups (9%) as channels for future dissemination of bean seed. Studies of local seed systems can provide valuable information regarding farmers' access to seed, which is needed for designing improved seed delivery systems.

CONCLUSION

The results from this study suggest that distribution of seed of new bean varieties through shops and markets in rural areas is feasible and both channels appear to be effective delivery points. Since neither channel has strong advantages or disadvantages over the other, simultaneous use of both is recommended for Uganda and other countries in eastern and southern Africa. The modalities of how the delivery points could be effectively linked to national program seed distribution efforts will require considerable planning. Questions that require careful thought include: How will shops and extension agents be selected? and How can the cost of trips to recover proceeds from sales be cut down or avoided? The use of shops and markets for bean seed distribution is proposed as part of a seed delivery system with multiple distribution points in order to cater to the needs of a diverse low-resource farming clientele.

This study has also scattered a tenacious premise: that farmers will not buy seed of unknown varieties, especially at higher than market prices. In the market study, it was clear that the small test quantities made available encouraged purchases, despite the relatively high price of the seed. However, investigation of farmers' response to bean seed prices is needed in other countries to confirm the observations made in Uganda and the Great Lakes Region. Although it is unlikely that farmers would be willing to pay prices that would cover the actual cost incurred by research institutions in producing and distributing bean seed, by selling seed even at subsidized prices, as opposed to distributing it free of charge, national bean programs that are involved in seed multiplication would come closer to making this activity more sustainable.

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BEAN SEED PRODUCTION AND DISSEMINATION IN SOUTH-KIVU, ZAIRE

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INTRODUCTION

In the South-Kivu Region of Zaire, the common bean is one of the basic food commodities, especially in the highland areas. It is grown mostly by smallholders who cannot afford seed of improved varieties. The high cost of improved bean varieties constitutes one of the main constraints to disseminating improved bean cultivars in the region. Only local varieties, which usually have low yields, are grown by farmers.

This paper describes the informal system of bean seed production and dissemination in the rural areas of South-Kivu. It identifies the weaknesses of the system and ways in which it can be improved.

BEAN SEED PRODUCTION IN THE NON-FORMAL SECTOR

In the traditional farming system, bean seed comes from the food crop. Therefore, requirements related to seed production in the field, such as varietal purity and disease and insect control by fungicide and pesticide or by cultivation practices, are not considered important. Sperling et al. (1993) reported that in defining 'good seed', farmers focus on varietal aspects and plant health qualities (Table 1).

Table 1: Criteria used by farmers in defining good bean seed

Characteristic	Frequency (%)
Adaptedness	42
Earliness	23
Good general appearance	15
Seed treated (with pesticide)	7
Good germination	2

Source: Sperling et al., 1993.

The physical quality of seed is strongly linked to the presence or absence of pathogens in the grain (Trutmann and Kayitare, 1991). Seed produced by farmers using traditional farming practices is of poor quality. To prepare their seed for sowing, farmers select good seed by removing broken, immature and small grains and those with bad shape, disease spots or insect damage around the hilum. Seed with spots far from the hilum area is considered good. Thus, a high proportion of seed processed in this way is blemished and constitutes a source of pathogens (especially seed-borne-disease pathogens), which affects its quality. Trutmann and Kayitare (1991) observed that dry bean seed produced using traditional practices contained a higher percentage of blemished seed compared with seed produced using improved practices. However, the crop yields of seed from the two sources did not differ significantly over three seasons (Table 2).

Table 2: Yield of dry bean seed from traditional and conventional practices

Seed source	% of blemished seed	Yield (kg/ha) over 3 seasons			Average
		1987B	1988A	1988B	
Traditional	1.2[a]	996[a]	1140[a]	705[a]	947
Conventional	0.3[b]	1055[a]	1238[a]	805[a]	1039
C.V. (%)	-	14.4	10.9	15.6	-

Note: values followed by the same letter within a column do not differ significantly at $P< 0.05$.
Source: Trutmann and Kayitare, 1991

Since crop yields obtained from traditionally produced seed are similar to those of seed produced using improved methods, although the former is of poorer quality, the focus of activities to improve bean production should be on reducing disease pressure in the non-formal seed production system. Farmers' training and education in disease control practices may play a considerable role in this. Pyndji and Trutmann (1992) indicated, for instance, that removing primary and older, diseased leaves during weeding delays the development of the plant, thereby decreasing disease pressure in the field.

SEED DISSEMINATION IN RURAL AREAS

There are many ways of disseminating bean seed in rural areas. The most commonly used seed sources by farmers are their own production and local markets (Table 3). Exchanges and loans between relatives, friends and neighbors are the least used. However, they are faster and efficient in ensuring the adaptedness and productivity of the cultivars used under the local conditions.

Table 3: Methods of disseminating bean seed in the non-formal system (percentage of farmers using method)

Method	Frequency (%)
Own production and markets	75
Research + NGOs	14
Others	11

Source: S.N.V., 1994

Seed disseminated through traditional channels is generally composed of mixtures of local varieties. New improved varieties are rarely found and used by farmers in rural areas. Their cost is so high that most farmers do not access them easily. Only a few farmers obtain improved varieties through research and development projects. Sperling et al. (1993) stated that less than 2% of the farmers in Rwanda's rural area get bean seed of new improved cultivars through state organizations or development projects.

South-Kivu does not have a seed company for producing bean seed for farmers. Seed of improved varieties is multiplied at Mulungu Research Station and sometimes at the Kabare project (a state development project). The price of seed produced by these institutions (three or four times the cost of bean food grain) is beyond the reach of smallholder farmers. Presently, most of the new and improved cultivars found in the rural areas have been distributed by research and development projects. However, these projects are too few to cover most of the of the region.

CONCLUSION

The informal system of producing and disseminating bean seed has been more popular than the formal one for the rural farmers of the highland areas of South-Kivu Region for many years. Its weaknesses are the lack of disease control practices in the field and its restriction to the movement of only local cultivars. The system, however, produces seed cheaply and disseminates cultivars within a short time.

In order to render the traditional system more operational and efficient, training and educating farmers in disease control practices, such as sorting seed and roguing bean plants with seed-borne disease symptoms, and using improved varieties in on-farm research activities are recommended.

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INFORMAL SEED INDUSTRY IN UGANDA: ITS POTENTIAL AND POLICY IMPLICATIONS

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INTRODUCTION

The seed industry became the focus of controversial debate for the first time in the 1980s. In the international arena, the debate centered on the preservation of plant genetic resources, their ownership and how resource-poor farmers could have access to them. At the national level, declining government budgets and pressure from donors and local agribusiness and other constraints encountered by the formal seed sector had a major role to play in the decision of policy-makers to privatize the seed sector. The informal seed sector, however, is now one of the major contributors to national economic growth. In most African countries, it accounts for the bulk of employment and income generation, thus providing critical relief to the formal economy.

In the past, the informal seed industry in Uganda operated in a monopsonistic buying structure that extracted large amounts of tax revenue without corresponding investment in research, extension and development. Currently, the industry operates in a perfect competitive market environment in which farmers sell their bean seed at prices exogenously determined by the government. However, some market imperfections still exist. Knowledge about the informal seed industry in Uganda still remains fragmented. A study, aimed at exploring some of the key issues pertaining to the informal bean seed industry in Uganda, was undertaken with the following objectives:

- To identify socio-economic characteristics of participants (who are mostly farmers) in the informal bean seed industry, their mode of operation and constraints encountered in bean seed production
- To identify the existing potential of the informal bean seed industry
- To formulate policy recommendations for addressing the constraints to bean seed production, for developing the industry and for defining further research agenda.

The major hypotheses were:

- New bean technologies have high input and distribution potential within the informal bean seed industry
- Informal and formal bean seed industries act as substitutes to one another

This paper presents the results of a study of the informal seed industry conducted in 1993 in Katikamu and Nakaseke counties in Luwero District.

METHODOLOGY

The farmers who participated in the 1989–1993 on-farm bean cultivar trials and those who did not participate but had farms within a walking distance of the participants and had grown beans the previous year were interviewed. This method was used to save time and to reduce the cost of transporting enumerators to farms that were a long way off.

Two questionnaires (one for the farmers who participated in the trials and another one for those who did not participate) were used. The field enumerators involved in the survey were conversant with the local language and customs. They were trained for one day on how to ask the questions included in the questionnaire, the meaning of each question and how to stimulate interest in farmers to answer the questions. Single-visit interviews were conducted during which data were collected on factors pertaining to the informal bean seed industry.

The issues investigated included socio-economic profiles of the participants of the informal bean seed industry, current status of the industry, seed production activities, post-harvest handling, marketing aspects and the potential for technology uptake in terms of adoption and dissemination of new bean cultivars. Information pertaining to farmers' operations within the industry was also sought.

SOCIO-ECONOMIC PROFILES OF THE SAMPLE

Socio-economic profiles of the farmers interviewed were considered in terms of age, gender, marital status, family size, level of education, approximate total family income, off-farm employment, hiring of labor, methods of paying for extra labor and land tenure. The socio-economic profiles were classified under three categories. 'Adopters' referred to those who took up the new cultivars, 'non-adopters' to those who did not adopt the new cultivars and 'potential adopters' to those who did not participate in the trials but were willing to participate and were already disseminating traditional cultivars.

Age

The results of the survey, presented in Table 1 show an increase in the proportion of adopters with age and a decline beyond 60 years of age. About 60% of the adopters were between 41 and 60 years old, while the majority of the potential adopters were between 21 and 40 years old.

Gender and marital status

Over half of the adopters (55%) and potential adopters (53%) were male: the non-adopters were equal in proportion by gender. These gender differences may be attributed to the initial selection of the participants. Most of the participants who adopted new bean cultivars (65%) were married; and the smallest proportion were divorcees or those separated. All the non-adopters were married. The majority of the potential adopters were married.

Family size

The largest proportion of adopters and potential adopters had families with 6–10 people. However, a remarkably small proportion of adopters had families with more than 10 people. The high proportion

of adopters with large families has labor implications. Most Ugandan farmers, and farmers in Africa generally, use family labor. Large families are able to provide the extra labor required for new cultivars.

Education

There was an increase in the proportion of adopters with level of education up to the ordinary level and a decline thereafter. With the potential adopters, this was observed for the primary level (Table 1). This suggests the need for investing in farmers' education in order to enhance adoption of new technologies. This would enable farmers to read and interpret information that comes as part of the technological package to be adopted. Investment in farmers' education also enables them to make proper plans and decisions associated with fitting the new technology in a given farm setup. The decline in the proportion of adopters beyond the ordinary level of education does not necessarily mean that investment in education beyond that level would result in diminishing returns in terms of technological adoption.

Family income

Family income was used as a proxy for assessing the economic status of the farmers in general, since farmers could not provide information on their exact annual income as they did not keep income records. An increase in the proportion of adopters with total family income was noted up to Ush.100,000 (US$1 = Ush.900) and it remained constant up to Ush.500,000. The highest proportion of the potential adopters had an income of between Ush.50,000 and Ush.100,000. A decline was noted beyond this. These farmers' financial security enables them to allocate some of their resources to new bean cultivars.

Bean income

The proportion of adopters increased in relation to increase in bean income up to Ush.50,000 and declined beyond this level. All non-adopters obtain between Ush.10,000 and Ush.50,000 from bean sales. The majority of the potential adopters get less than Ush.10,000 from beans.

Labor

On-farm employment was used as a proxy variable for farmers' wealth status. About 72% of the adopters and all the non-adopters had off-farm employment. About 58% of the adopters hired extra labor, in most cases (91%) on a part-time basis. It was noted that farmers engaged in off-farm employment to diversify their sources of income. Farmers could not afford to hire labor on a full-time basis as labor costs are very high. Hiring extra labor indicates that there is a labor shortage on the farm, which may influence farmers' adoption decisions for labor-intensive technologies.

Table 1: Socio-economic characteristics of farmers interviewed (% of farmers responding)

Socio-economic characteristics	Adopters	Non-adopters	Potential adopters
Farmer's age			
<20 years	5.3	-	-
21–40 years	26.3	50	51.5
41–60 years	57.9	50	42.4
>60 years	10.5	-	6.1
Gender			
Male	55.0	50	53.1
Female	45.0	50	46.9
Marital status			
Married	65.0	100	78.6
Single	20.0	-	21.4
Widowed	10.0	-	-
Divorced or separated	5.0	-	-
Family size			
1–5	25.0	50	33.3
6–10	60.0	50	45.5
11–15	15.0	-	15.2
>15	-	-	6.1
Highest level of education			
None	15.0	-	6.5
Primary	30.0	50	80.6
O-level	50	50	12.9
Higher School Certificate	5.0	-	-
Approximate total family income			
<10,000	5.0	-	3.1
10,000–50,000	10.0	-	18.8
50,000–100,000	30.0	50	34.4
100,000–500,000	30.0	-	34.4
>500,000	25.0	50	9.4
Bean income			
<10,000	40.0	-	47.1
10,000–50,000	50.0	100	35.3
50,000–100,000	5.0	-	5.9
>100,000	5.0	-	11.8
Off-farm employment			
Yes	72.2	100	21.2
No	27.8	-	78.8
Hire extra labor			
Yes	57.9	100	41.9
No	42.1	-	58.1
Method of payment for extra labor			
Full-time	9.1	-	-
Part-time	90.9	100	-
Land ownership			
Personal	70.0	100	54.5
Rented	5.0	-	6.1
Both personal and rented	15.0	-	30.3
Family	10.0	-	9.1

Note: Column percentages may not add up to 100 due to multiple answers.

Land ownership

Most adopters (70%) and potential adopters (55%) owned land. However, a considerable portion of both categories of farmers personally owned land and also rented some (Table 1).

STATUS OF THE INFORMAL BEAN SEED INDUSTRY

The informal bean seed industry comprises mostly small-scale bean farmers. The bean production and post-harvest handling aspects of the informal bean seed industry investigated in this study included seed source, method of seed production, seed quality control, seed storage and distribution of beans. Information on these aspects was collected from the farmers who participated in the on-farm bean cultivar trials of 1989–1993 and those who did not participate in the trials. All of them were considered as major participants in the informal seed industry.

Production

Beans are produced for home consumption, for selling and for planting. Over 90% of the farmers interviewed intercrop beans with maize, bananas or sweet potatoes. This production method points to the risk averse nature of participants of the informal bean seed industry. Bean seed is planted, weeded, harvest and processed manually. About 90% of the participants interviewed store beans after harvesting (Table 2).

Seed storage

A large proportion of both participants (55%) and non-participants (80%) use traditional facilities for storage. These facilities include jerry cans, paper bags, tins, cans, plastic bags, cribs, pots and granaries. Gunny bags are used by about 41% of the trial participants and 55% of the non-participating farmers.

Quality control

Sorting was the main method used for ensuring seed quality in the informal bean seed industry. Over 80% of all those interviewed sorted beans before planting, cooking or selling. Removing diseased seed was reported by 72% of the trial participants and 58% of the non-participants as the main reason for sorting. Other reasons for sorting include stone removal, to ensure marketing of single-color beans and for proper assessment of taste (Table 2).

Seed source

The nature of the bean seed industry is mostly dictated by the seed source. About 83% of the trial participants and 89% of the non-participants reported saving their own seed for planting. This is the predominant source of seed in Luwero. Another major seed source is the formal market, which is an alternative when harvests are poor or when famine forces the household to consume all the harvest. Household cash obligations, such as buying salt and paraffin and paying school fees, force farmers to

sell all their harvest and later on buy seed from the market for planting.

Table 2: Seed production practices of farmers in Luwero District (% of farmers interviewed)

Practice	Participants	Non-participants
Storing of beans after harvesting		
Yes	90.0	-
No	10.0	-
Storage method used		
Gunny bags	45.0	54.5
Ash	-	1.8
Other	55.0	80.0
Sorting beans		
Yes	84.2	87.9
No	15.8	12.1
Reasons for sorting beans		
Stone removal	27.3	10.9
Marketing single-colored beans	13.6	16.4
Removal of diseased seed	72.7	58.2
Ensure uniform germination	4.5	-
Prevent rotting	22.7	21.8
To separate different varieties	4.5	5.5
Proper assessment of taste	13.6	3.6
To avoid pest attack	4.5	5.5
To harvest single-colored beans	4.5	-
None	9.1	-
Seed Source		
Own	81.8	89.1
Friends	4.5	1.8
Relatives	4.5	1.8
Neighbors	-	5.5
Market	31.8	40.0
Seed scheme	-	7.3
Whether or not seed is shared		
Yes	72.7	-
No	27.3	-
Person shared seed with		
Relatives	22.7	-
Friends	54.5	-
Neighbors	22.7	-

Note: Column percentage may not add up to 100 due to multiple answers.

BEAN SEED DISTRIBUTION

The bean seed distribution system is informal in the way that seed is shared. About 72% of the study participants indicated that they normally share seed. It was found that 55% of the participants shared seed with friends, while equal proportions of about 23% shared seed with relatives or neighbors. After new bean cultivars were introduced, the trial participants who tested them on their farms reported having disseminated them to four other persons on average. The vast majority (91%) of the participants disseminated seed of the new bean cultivars, 41% to friends and 37% to relatives. Seed was given out free of charge. This is the predominant seed distribution practice in Luwero District (Table 3).

Table 3: Some aspects of new bean cultivar dissemination (% of farmers interviewed)

Dissemination aspects	Participants	Non-participants
Person seed was disseminated to		
Relatives	36.6	43.6
Neighbors	18.2	80.0
Friends	40.9	50.9
Others	13.6	3.6
Method of dissemination		
Selling		1.9
Free of charge	100.0	98.1
Reasons for not disseminating		
Not enough	22.2	100.0
Ate and sold the rest	-	-
Spoiled in storage	-	-
No yield	11.2	-
Other	66.7	-

Adoption

New bean cultivars were adopted and disseminated by over 90% of the trial participants. This high proportion indicates the high potential of the informal bean seed industry in terms of new technology adoption.

Farmers' opinions

Farmers' opinions were sought on seed storage and clean seed production aspects. Data collected indicated that 65% of the trial participants were satisfied with the effectiveness of the methods used to control storage pests. A low response rate was noted for the pest control method preferred by farmers. Nevertheless, the few farmers who responded suggested periodic drying, chemicals and pepper as effective methods of controlling storage pests of bean seed.

Planting different bean cultivars in separate fields was suggested by 59% of the trial participants and 20% of the non-participating farmers as a prerequisite for clean seed production. It was suggested that

this would result in uniform maturity and make it easy to grade and market beans. Carrying out agronomic practices, such as timely harvesting, would prevent bean seed from rotting in the field. Leaving some space between fields planted to different cultivars would prevent cross-pollination and ensure harvesting of single-color beans preferred by consumers.

CONSTRAINTS TO BEAN PRODUCTION

High seed prices in the market lead farmers to seek alternative sources of seed. Cash and dietal needs of large families may result in the consumption of the entire family harvest, including seed saved for planting.

The main constraint in informal bean seed distribution system is low crop yields. This was indicated by 22% of the trial participants (Table 4). On the other hand, the fact that many trial farmers were not aware that they had complete freedom to disseminate bean seed may have constrained distribution of seed of new bean varieties. The low farm gate prices for seed distributed through the informal system compared with market prices for seed of similar quality in the formal system was a major constraint to bean seed production.

Table 4: Constraints encountered by farmers in bean production (% of farmers responding)

Constraint	Participants	Non-participants
Large family size (consumed whole harvest)	9.1	16.4
Unpredictable weather (poor yield)	22.0	-
High cost of seed	16.4	49.1
None	9.1	23.6
Uncertainty of quality bean seed marketed	3.6	7.3
Selling all bean harvest	1.8	-
Storage pests	3.6	-
Inaccessible to treated seed	1.8	-
Field pests	3.6	7.3
Drought	1.8	5.5
Termites	-	1.8
Sorting varietal mixtures	-	1.8

CONCLUSION

There is great need to establish an informal seed industry in Uganda, as the services offered by the formal seed industry are in accessible, unreliable and costly. In addition, there is a high potential for technological uptake in the informal bean seed industry as this ensures its sustainability. However, this requires that both the informal and formal seed sectors complement each other.

RECOMMENDATIONS

The Government of Uganda needs to assist the informal seed industry to properly organize its production and distribution system with minimum cost. Seed legislation and regulation need to be enacted to ensure the creation of high quality seed production and distribution systems that can serve both small- and large-scale farmers. The importance of seed quality needs to be emphasized to farmers operating within the informal bean seed industry.

The distribution and marketing problems farmers face need to be addressed in order to fully harness the existing potential of the informal seed industry in Uganda. A system of effective credit and capital input delivery needs to be fostered to facilitate the operation of the informal seed industry and promote the creation of farmers' associations. This needs to be complemented with proper pricing policies to ensure that farmers make proper investment decisions and that they fulfill their credit repayment obligations.

Government efforts rightly focus on smallholder farmers who constitute 90% of the farm households engaged in informal seed production. Nevertheless, Uganda's policy objectives can only be realized by consolidating technical and managerial knowledge of seed production at the farm level since such information is necessary for making proper future plans, and facilitates understanding of why past government efforts have had little effect on the informal seed industry.

FUTURE RESEARCH AGENDA

Research on farmers' costs of seed production and evaluation of the effectiveness of the various methods used to get seed of new bean cultivars to farmers is on the agenda. Research plans on resource allocation for different agricultural activities, input finance and marketing aspects for beans are being drawn up. Multinomial logit analysis will be carried out using data presented in this paper to test a number of hypotheses already formulated.

SOS SAHEL'S EXPERIENCE IN IMPLEMENTING COMMUNITY-BASED, NON-FORMAL SEED BANKING

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BACKGROUND

Africa is confronted with the dilemma of producing enough food for its rapidly growing population, on the one hand, and protecting the resource base upon which this is dependent, on the other. Maintaining a sustainable balance between these two has been a major challenge for many African countries that are often led to think that following the western model of development is the only way to increase food production. This usually requires high inputs, which the African peasant farmers have difficulty obtaining. Traditionally, peasant farmers maintained an appreciable amount of field diversity of their crops to sustain productivity and diversify their diet and income. This diversity allowed farmers to maximize output under farming conditions often characterized by highly varied micro environments and to produce stable yields over changing seasons.

It is also necessary to add new entries to the pool of elite landrace selections (mostly composites) that are now rapidly gaining acceptance with farmers. The network of *in situ* conservation plots being established will provide useful germplasm on a continual basis to improve or enhance the elite landraces, especially with respect to resistance to disease and pests and to stresses like drought. Elite selections may also become obsolete unless new entries are periodically introduced. Moreover, many of the seed multiplication programs operate in virtual isolation, with little or no support from genebanks or scientific back-up.

Ethiopia is one of the countries of the world rich in genetic resources, which presents the country with both opportunities and challenges. Frequent droughts and erratic rainfall are the major factors that seriously threaten Ethiopia's biological resources, particularly the crop genetic resources that peasant farmers have adapted over centuries of selection. Moreover, because there was no efficient way of conserving germplasm, some local germplasm have already been lost. To tackle this problem, the Plant Genetic Resource Center/Ethiopia (PGRC/E) was established to collect germplasm and conserve it for redistribution to farmers following calamities. Collection activities were carried out with relative ease, as farmers themselves were actively involved: they were aware, more than anyone else, of the implications of the loss of crop diversity.

SOS Sahel is an international, UK-based non-governmental engaged in environmental and rural development activities in Wolayta, southern Ethiopia. It has been operating the Koysha Rural Development Project (KRDP) for the last three and half years. The objective of the Koysha Rural Development Project is sustainable improvement of the food security situation in the district. A survey report indicates that 53% of the households in the area are chronically food insecure, while 40% face transitory food shortages. The project is trying to address the long-term constraints to food production through community-based development of several agricultural programs, among which crop production improvement is one.

Farmers in the project area have limited access to the improved crop varieties developed by research centers because the area is remote and not well served with communications services. The project is

working towards improving this situation through diversifying the range of crops grown by farmers. Crop diversification, through introducing new or improved varieties, is considered as one option to address the problem of food shortage. It is a means of minimizing the risk of crop failure in the light of recurrent drought and erratic rainfall.

SOS Sahel's initiative is a timely venture seeking to avert food shortages. Its main objective is to help peasant farmers to retain their genetic diversity while improving productivity. The program's success largely resides in the fact that a significant number of farmers are now benefiting from the use of the improved landraces that they themselves have selected and multiplied, assisted by KRDP staff. Equally important is capacity building: ensuring that the community is equipped with skills required for managing and circulating the planting materials in the project areas.

NON-FORMAL SEED BANKING

Community-based seed banking involves more than the mere irregular storing of seed. Rather, it is a cultural farming system in which crop seed is maintained and secured for future use by the community. Community-based seed banking is a component of the traditional agricultural system and includes village-level facilities—a garden or field where traditional varieties are safeguarded for communal farming and where wild relatives of cultivated crops survive. It gives farmers the benefits of a sustained supply of reliable planting material and the freedom to choose what to plant. This is indeed a big step toward attaining food security beyond the subsistence level and toward producing food for the people who live in cities.

METHODOLOGY AND ACTIVITIES

The methodology used to institute the community-based food banking system is a stepwise activity itself. First, crop varieties adaptable to the project area will be screened in on-farm trials in a participatory basis to enable farmers to evaluate the performance of the varieties. After that, the varieties preferred by the farmers will be included in the seed bank for better diffusion. Farmers will then purchase seed of the required crop from the Ethiopia Seed Enterprise (SEE), the Institute of Agricultural Research Center (Awassa) and from other farmers (for better performing local varieties). To determine the amount of seed required, needs assessment surveys will be undertaken in each project area by the community-based SOS Sahel Committee and animators—grassroots extension staff of the project. These teams will also identify and select the farmers to receive the seed. The next step will require coming to an agreement with seed recipients to return seed of the same quantity after harvesting their crop.

To qualify to receive seed, farmers are expected to have enough land, good crop-husbandry practices, good record of repayment, willingness to allow other farmers to visit their fields and willingness to adopt management practices recommended for the crops supplied by the project.

The seed received from the farmers by the project is handed over to the SOS Sahel Committee, which is required to sign for it. The committee then distributes the seed to new recipients and gets them to sign for it. After seed distribution, the committee members, the owner of the farm and the animator visit and supervise the farm plot and report their observations to the project on a monthly basis, especially if the crop experiences calamities beyond the farmer's control. The farmer has to report the problem to the committee or the animator so that they can visit the field to ascertain the extent of problem. Farmers who do not obtain a reasonable yield from their plots are exempted from repaying the seed

by the committee and the relevant project staff. At harvest time, farmers are expected to meet their obligations by bringing to the project committee the same quantity of seed they had previously received.

The seed collected is stored in the houses of selected SOS Sahel committee members. The project is planning to construct stores at the project area level to improve the storage conditions and to tackle storage problems such as pests. This seed will then be redistributed to the next group of recipient farmers during the following planting season on similar credit conditions, thereby setting into motion another cycle. The planting material circulation process will be maintained by the community itself. KRDP grassroots field workers will keep records and facilitate the system, in collaboration with the committee members of their respective project areas.

Records of the seeds distributed, the documents of agreements and the list of the recipients in the respective project areas will be the responsibility of the SOS Sahel committee and the animators in each area. The crops included in this seed banking system are beans, maize and groundnut (Table 1.)

DIFFICULTIES ENCOUNTERED

Seed purity is not maintained for cross-pollinating crops such as maize. This is a serious problem especially in the highlands and intermediate areas where land shortage does not allow farmers to maintain the recommended spacing between locally grown and improved varieties.

The benefits of improved varieties have not spread as widely as anticipated because many farmers did not repay the loans (the repayment rate was 50%). This is attributed to the heavy infestation of the bean crop with insect pests (termites, stalk borers and army worms), erratic rainfall, poor performance of improved varieties and repayment default problems.

LESSONS LEARNT

- Community-based seed banking is very useful in that it makes seed available to farmers who have no access to seed of improved varieties and those in remote areas that are not well served with infrastructure.
- The banks can be relied upon after drought spells, when farmers lose their seed reserves.

Table 1: Seed distribution in SOS Sahel's project areas

Crop variety	1991	1992	1993	1994	Total
Haricot bean (10 kg/farmer)					
Roba (Qt)			10	15	25
Beneficiaries			100	150	250
Project areas covered			5	6	11
Repayment (%)			25		
Repayment (Qt)			3		3
Beneficiaries				25	
Awash (Qt)			10	15	25
Beneficiaries			100	150	250
Project areas covered			5	7	12
Repayment (%)			32		
Repayment (Qt)			3	3	3
Beneficiaries				32	32
Red Wolayta (Qt)		5	10	10	25
Beneficiaries		50	100	100	250
Project areas covered		5	6	8	19
Repayment (%)		84	30		
Repayment (Qt)		4	3		7
Beneficiaries			42	30	72
Maize (5 kg/farmer)					
BH-140 (Qt)	20	30	35	40	125
Beneficiaries	400	600	700	800	2500
Project areas covered	5	6	7	9	17
Repayment (%)	80	95	36		
Repayment (Qt)	16	29	13		57
Beneficiaries		320	570	252	1142
Katomani (Qt)	10	15	25	35	85
Beneficiaries	100	150	250	700	1200
Project areas covered	5	6	7	9	10
Repayment (%)	60	62	70		
Repayment (Qt)	6	4	18		27
Beneficiaries		120	76	350	546
Local (Qt)	10	16	21	24	71
Beneficiaries	100	320	420	480	1320
Project areas covered	8	14	10	15	21
Repayment (%)	90	87	58		
Repayment (Qt)	9	14	13		35
Beneficiaries		180	280	244	704
Groundnut (3 kg/farmer)					
ICG 273 (Qt)			1	1	2
Beneficiaries			33	33	66
Project areas covered			3	2	5
Repayment (%)			80		
Repayment (Qt)			1		1
Beneficiaries				27	27

FUTURE PLANS

Future activities of the project will aim—

- To support contract farmers to produce good quality seed of improved varieties on isolated plots of land for sale to other farmers. This will focus especially on farmers who live in the lowlands where the land holdings are relatively large
- To introduce cash payment for seed in order to avoid redistribution of low-quality seed
- To give more emphasis to other self-pollinated crops adaptable to the area
- To facilitate further training for farmers in managing community-based seed banking and to organize visits to regional projects and workshops to share experiences
- To implement projects for multiplication of popular local varieties (Red Wolayta for haricot bean, for example)
- To collaborate with the Institute of Agricultural Research and CIAT to improve bean production practices in mixed farming systems, which are the major land use in the project area due to land shortage.

BEAN SEED MULTIPLICATION IN BURUNDI IN 1994

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INTRODUCTION

Beans are one of the major staple crops and the most important source of protein for the Barundi, particularly for the farming community who form about 90% of the population. The Barundi consume more than 50 kg of beans per capita, which is one of the highest in the world.

Beans are grown all over Burundi during the two rainy seasons. In the Central Plateau Region, where most valleys are situated, farmers also grow beans during the dry season. For centuries, farmers have grown mixtures of local cultivars, which always give them some food security in spite of many abiotic and biotic constraints. As a consequence, the Barundi have grown so accustomed to beans that this crop plays the leading role in market price fluctuations. Any seasonal fluctuation in bean production influences the price of all other food crops within a few weeks. The market price of beans is generally accepted as a measure of the real cost of living for rural areas and cities.

In 1985, the Institut des Sciences Agronomiques du Burundi (ISABU) and CIAT started collaborating in bean production, and since then, some considerable activities have been undertaken to improve, select and distribute improved bean varieties. However, since beans are not considered as a cash crop and since a proper seed-multiplication program, with or without the help of contract farmers, requires quite some time and money, one may ask whether there is real justification for multiplication of improved bean varieties. ISABU's production of pre-foundation seed increased twentyfold between 1985 (503 kg) and 1992 (10,188 kg). However, in 1993 it fell to 9,537 kg. Other improved varieties have been released by ISABU as its production capacity has grown. The requests for pre-foundation seed have increased enormously over the years, making it impossible for ISABU to satisfy the demand. The high price of this seed (sometimes three times more than of the local mixtures sold on the market), has not reduced its demand.

As a consequence of the civil unrest and the large numbers of people displaced after 21 October 1993, international organizations and donors started supplying humanitarian aid to Burundi. All these organizations quickly realized that beans had to be part of any aid program because refugees would exchange almost all types food they received, such as sunflower oil, for beans. Large quantities of beans have been distributed as food aid or as seed. Fortunately, the Bean Research Program of ISABU was consulted by most organizations in deciding the composition of the food aid package.

SEED MULTIPLICATION

ISABU's Bean Research Program, based at the Moso Research Station, has been used by breeders for seed multiplication activities because of its favorable climatic conditions and the availability of irrigation facilities. Pre-foundation seed is multiplied by ISABU at that station. The Murongwe Research Station was also used for this purpose before it was destroyed in October 1993. Up to now pre-foundation seed has been distributed to many projects although, theoretically, it is meant to be distributed to only the Appui au Secteur Semencier project.

The Appui au Secteur Semencier project is in charge of the production of foundation seed. Part of this is produced under the project's complete supervision and the rest with contract farmers. These farmers receive credit to buy pre-foundation seed, fertilizer and pesticide. After harvest the project buys the seed from the farmers if the seed quality meets the established criteria. The project produces 25 to 40 t of pre-foundation seed a year. The demand for this seed is higher than the production in spite of its high price, which covers all production costs except those of the salaries of the two Belgian agronomists working with the project.

Regional development societies, farmers' cooperatives and other organizations buy foundation seed from the Appui au Secteur Semencier project to produce certified and commercial seed, which is generally produced with the help of contract farmers. The quality of the certified seed is controlled by inspectors from the Department for the Promotion of Crops and Seed. Then, following seed generation, commercial seed is sometimes sold in proper bags. Certified and commercial seed is sold to farmers either directly or through established channels.

Since the country's bean production is estimated at 350,000 t a year, even a 5% yearly replacement of farmers' seed with the seed of released varieties by formal and informal methods could never have been achieved in the past. Moreover, farmers grow the released varieties either for sale in the market or for incorporating in their own mixtures, in which the varieties may or may not become the dominant seed component.

PROBLEMS UNDER NORMAL CONDITIONS

Government support for bean production has been lukewarm, and at some official levels, multiplication of bean seed is considered less important than of some other food crops, such as potatoes, or cash crops. Up to now, ISABU does not consider multiplication of pre-foundation as part of its Bean Research Program. Therefore, multiplication and release of recommended varieties have not been as rapid as could have been. Belgium, as a donor, has been supporting only the research activities of the Bean Research Program. Moreover, RESAPAC (Reseau pour l'Amelioration du Haricot Phaseolus dans la Region de l'Afrique Centrale) does not treat bean production as a top priority and has not supported any project that was aimed only at the production of bean seed. Lack of financial support from Belgium and RESAPAC is the reason behind the poor state of the storage facilities and technical equipment for seed production of the Bean Research Program.

At the government level, the legislation and incentives for the production of different categories of seed by projects or groups of farmers could be improved considerably. Distribution of seed of improved varieties to the farmers through formal and informal channels is quite slow. Other major bottlenecks to country-wide dissemination of bean seed in Burundi are the low multiplication rate of the bean crop, the low cash income of farmers who are only able to buy small quantities (250 g) of released varieties and the lack of roads in the hilly countryside.

PROBLEMS RESULTING FROM THE CIVIL UNREST

Local bean germplasm erosion

Erosion of germplasm of local bean varieties may be the most dramatic long-term consequence of the civil unrest that started on 21 October 1993 and spread over almost all the country except the southwest.

The diversity of the local bean cultivars has been studied by the Institut de Recherche Agronomique et Zootechnique (IRAZ) and ISABU, both of which collected more than 100 local cultivars. Some of these cultivars are well adapted to particular local conditions, such as poor, acid soils with low phosphorus content, heavy rainfall, drought, diseases and pests, having been grown in the area for generations. A survey carried out by ISABU, covering the whole Burundi, shows that beans are mainly grown as varietal mixtures (62%) and or pure varieties (38%). Also, most farmers (91%) multiply their own bean seed.

When the civil disturbance started, most farmers fled their farms before the first rainy season, which started very late. Many could not return to their farms in time to sow beans during the second rainy season. Therefore, thousands of farmers lost their bean seed stock. Many donors and humanitarian organizations quickly realized how dramatic this could be in the short term without somehow fully considering the long-term consequence. From January 1994, some of these organizations started importing large quantities of pure varieties from Uganda (Coco Rose), Tanzania (Jaune Long and Jaune Rond de Tanzanie) and Zaire. The ISABU Bean Program was often consulted regarding the varieties.

Most donor representatives were more concerned about purity and germination rate of the varieties they disseminated rather than about making seed of local mixtures available to farmers, and were even very reluctant to buy local mixtures. However, since these organizations did not differentiate between beans for food and for seed, most of them could be convinced to distribute these pure, imported varieties as food for refugees. At the same time, the ISABU Bean Program helped these organizations to buy large quantities of local mixtures from the markets in the Bweru Region near the border with Rwanda, where the farmers had managed, even during period of the serious civil unrest, to produce surplus quantities of beans. The price of this seed quickly rose in Bweru, but most donors were willing to buy it for the price they paid for imported seed. Seed of local mixtures was later sold in small quantities in many other regions at the same price as it was bought in Bweru; transport costs were not recovered. However, this was a big issue among the donors and, in a few areas, some donors distributed seed free of charge. In addition, in some areas, pure, imported varieties were distributed as food for community work (repair of village roads, houses, etc.).

Many local varieties may have been lost during the civil arrest. Moreover, the germplasm collections stored in the germplasm banks of IRAZ and ISAR (Institut des Recherches Agronomiques de Rwanda) were destroyed during the unrest.

Other problems

Within ISABU, as well within most seed multiplication projects, the civil unrest influenced almost all seed multiplication activities in a negative way. First of all, many technicians and field workers refused to travel to the project areas, even over very short distances, if they did not feel safe. Also, most technical operations were carried out badly. In some areas, bean seed was stolen from fields and storehouses and used as food or seed. This affected farmers who were involved in seed multiplication

in their fields in most regions.

SOLUTIONS TO SEED MULTIPLICATION PROBLEMS

RESAPAC has offered considerable help to the Bean Program, which may contribute to solving some of the seed multiplication problems:

- In view of the loss of many local varietal mixtures of Burundi and Rwanda, the coordinator of RESAPAC received seed of many local cultivars and improved varieties and started multiplying the seed in Arusha, Tanzania, during the dry season of 1994.
- Some of the local cultivars from Burundi have been stored in the germplasm bank of CIAT, Colombia. Multiplication of seed of these cultivars may help to restore some of the local varietal mixtures.
- Because of the urgent need for a practical guide for seed multiplication for projects in Burundi, the booklet *Multiplication de semences de haricot au Burundi* by W. Godderis and V. Schmit was published in collaboration with ISABU, RESAPAC and CIAT.
- ISABU and the Belgian Government have become fully aware of the importance of the Bean Research Program and multiplication of bean seed under the present conditions. With the authorization of the directors of ISABU and the help of RESAPAC and the Belgian government, pre-foundation seed multiplication operations and storage could be rapidly improved in the near future to produce a much greater impact than is presently the case. The Appui au Secteur Semencier project remains a top priority for Belgium, too.

RECOMMENDATIONS

- To help all farmers attain self-sufficiency in bean production and produce surplus for the cities, the Ministry of Agriculture needs to consider the bean crop as important as cash crops, such as coffee, tea and cotton—from the farmers' perspective, this certainly is the case—and put in place proper incentives for seed multiplication as soon as possible.
- ISABU needs to appoint a Burundian researcher as member of the Bean Research Program who should be in charge of seed multiplication for all bean varieties it releases.
- Under the present conditions, RESAPAC and the Belgian government should support collection and purchasing of small quantities of local varietal mixtures in local markets and multiplication of seed of improved varieties and local cultivars, to save them from loss.
- The large number of donors of humanitarian aid, which involves a lot of money, need to be informed correctly about the need for maintaining local mixtures and distributing their seed from regions producing surplus quantities to farmers elsewhere.

DESIGNING SEED SYSTEMS FOR SMALLHOLDER FARMERS: PRINCIPLES DERIVED FROM BEAN RESEARCH IN THE GREAT LAKES REGION OF AFRICA

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INTRODUCTION

New bean varieties can help boost smallholder farmers' agriculture. With their low initial input and low maintenance requirements, they are easily integrable in existing, even complex, cultural systems. Yet, new cultivars realize their worth only when they can be accessed and sustained by smallholders. While African national programs devote the lion's share of their budgets to varietal improvement, the research component often stops once the genetic material is identified. Multiplication and diffusion of seed are regarded as functional tasks, with the result that formal systems are relatively standardized and centralized. Seed multiplication and distribution are seen to present challenges in the sense that any mass reproduction presents challenges: techniques are known but they are sometimes hard to execute effectively.

Work underway in the Great Lakes Region points to a divergent view concerning seed sectors. Far from functioning well under standardized models, seed systems need to be tailored to the clientele as well as towards the agro-ecological environments they serve—much in the same way as varietal material needs to be tailored. Findings from the Great Lakes will probably be most relevant to other regions that typify intensive small farmer agriculture on the margins. The agro-ecological systems are highly heterogeneous, with stressed niches, e.g. those with poor soil fertility, still being farmed. Beans are primarily produced for home consumption, but while they are often well manured, they rarely benefit from purchased inputs.

This paper synthesizes five years' research on bean seed distribution and multiplication in the central African region and suggests basic principles for enhancing the development of sustainable seed systems. While our prime focus has been new cultivars, many of the lessons learnt also apply to seed interventions involving farmers' varieties .

PROBLEMS FROM ABOVE AND FROM BELOW

Concerns with bean seed multiplication and diffusion of new varieties emerged from studies in both supply and demand arenas.

The formal sector

The Great Lakes Region (Rwanda, Burundi and Zaire) bean seed conference of 1989 highlighted considerable discontent of all partners involved in the formal seed chain (Sperling, 1992). Even the term

'seed' itself emerged as highly controversial, with participants referring to it emphasizing different criteria and standards, including:

- Genetics (performance of variety and criteria of distinctiveness-homogeneity-stability (DHS)
- Phytosanitary quality (seed-borne, fungal, bacterial and viral diseases)
- Physical quality (purity, humidity, incidence of mechanical damage, rate of germination)
- Quantity and availability (where, when, at what price).

Many participants did not distinguish among these criteria, with a lot of them using the term 'improved seed' to refer to the one or two aspects that they found most relevant. Thus, seed producers reproached breeders for not having better varieties. Breeders reproached the seed service for not producing and distributing their varieties sufficiently. Seed-control representatives criticized the high infection rates of seed with bacteria and viruses, while producers pointed to the high costs of pesticides needed to control fungal diseases. Controversy also arose as to the relevance of the DHS criteria in a region where most beans are cultivated in mixtures. Typically, no results were presented as to how 'improved seed' or 'clean seed' might be superior to farmers' seed, save for the genetic component.

The economic analyses, when they were presented, suggested a damning assessment of the seed system most participants were trying to perpetuate. No demand estimates were presented for any of the three countries, and production costs for improved seed varied from two to six times the market prices for bean grain. Hidden subsidies were tolerated in most seed multiplication operations, with large quantities of seed being sold to development projects or intermediary organizations, which, in turn, subsidized sale to farmers at reasonable prices. Many of the institutions simply refused to calculate the production costs for seed as these would have been unreasonably high. Hence, the fact that most of the seed produced could be sold was by no means proof of the true demand for seed produced by the formal sector.

Evident from the conference was how little the formal seed sector knew of its own internal performance or of its effect on its client population of farmers. Subsequent research helped to better delimit some of the concerns. One study in Rwanda (Grisley and Sperling, ms.) traced the diffusion of seed from the government seed service to development projects that act as intermediate multipliers and diffusers. The process of distributing seed received from the service to farmers showed a shrinking pattern or what might be termed as negative multiplication (Table 1). The selection of varieties on offer also showed bias: the varieties multiplied in high volumes were mostly of large grains, suitable for fertile soils. The cultivar RWR 221 was not offered by the seed service although farmers placed it among the more desired cultivars: the service declined to diffuse it because of its susceptibility to rust in their low-lying, centralized multiplication plots, a problem that is of minimal importance in farmers' fields. The seed service in Rwanda reached one in 600 bean farmers (Scheidegger, 1992).

Farmer-to-farmer seed diffusion

Farm-level analysis highlighted other issues concerning seed distribution. Researchers had tacitly assumed that a spate of on-farm trials might help to move genetic material of bean, a self-pollinating crop, fast and widely. As common wisdom on farmer-to-farmer diffusion dictates, "varieties move

themselves". Yet studies of the trajectory from on-farm trials of three of the l'Institut des Recherche Agronomique du Rwanda's (ISAR) more popular bush cultivars showed different trends. Given the small size of farmers' plots, the initial distribution of seed from one farmer to the next was generally delayed for two to three seasons, with many farmers not distributing the seed over significantly longer periods. The circle of diffusion was socially narrow—best friends, close family and important neighbors—received seed, but certainly not all who asked for it. Further, the speed of diffusion differed significantly among varieties: the highly productive ones, that is, those with high multiplication rates and intended for fertile soils and more stable environments moved quickly. Those targeted for stress environments had lower multiplication rates and were more suitable for erratic production climates (for example, drought-prone, less fertile soils), moved much more slowly. Surprisingly, varieties highly appreciated by farmers sometimes disappeared from their plots altogether. Send of the new variety could be lost due to agro-environmental vagaries suffered by both local exotic varieties. Socio-economic factors might also have forced some farmers to stop sowing: illness could cause a farmer to abandon the new crop. A common problem was that poor farmers consumed the seed. Local varieties could be re-acquired from neighbors or local markets at planting time. However, access to new cultivars proved more restricted (Sperling and Loevinsohn, 1993). In sum, neither the formal system nor the farmer-to-farmer diffusion process (from on-farm trials) was performing as envisioned in terms of moving new cultivars.

Table 1: Seed multiplication rates from Rwandan Seed Service to development projects (1985–1991)

Variety	Seed distributed by seed service (kg)	Grain size	Seed distributed to farmers Seed received from Service
Bush			
Rubona 5	51,887	Large	0.58
Ikinimba	3,481	Small	2.27
Bataaf	4,878	Medium	0.55
Kilyumukwe	18,159	Large	0.53
Ikinyange	9,316	Medium	0.74
Urugezi	150	Medium	1.00
Kirundo	560	Medium	0.42
Climbers			
Gisenyi 2-bis	17,345	Large	1.03
Urunyumba	15,570	Large	0.43
Umubano	14,225	Medium	1.54
Puebla	5,507	Large	1.48
Vuninkingi	1,999	Medium	0.45
Muhondo 6	4,143	Medium	0.43
Cajamarca	1,342	Large	0.11

Source: Calculated from Grisley and Sperling, ms.

DIAGNOSIS OF THE INFORMAL SEED SECTOR: DISTRIBUTION ISSUES

The initial studies did not address the issue of how most farmers got most of their seed. Focusing on the formal seed system, researchers left some basic questions unanswered: Did farmers in the Great Lakes Region obtain seed outside their farms? If so, how great were their needs? What channels did they use and why? Were certain seed characteristics more valued than others? And the ultimate question, Could seed provision strategies for new varieties benefit from building on informal mechanisms?

Seed system diagnostics of the informal sector were subsequently carried out in all three Great Lakes countries—in the South Kivu Region, in southern Rwanda and in three major bean growing regions of Burundi (Sperling, 1994). Farmers were chosen randomly, with all wealth classes being represented. Interviews were held, by preference, with adult women, those most experienced and knowledgeable of bean seed. Perhaps only the Burundian findings can be extrapolated to represent the countrywide variation. The southern Rwanda and South Kivu studies, random within bounds, represent interests primarily of smallholder, non-commercially oriented farmers—indeed the majority of the population. Several of the findings, sketched below, directly affected the design of subsequent interventions.

Quantity and original sources of seed planted

Overall, the quantity of the bean seed planted by farmers in the three countries was relatively low. Annually, farmers in the middle income range plant 24, 34 and 81 kg in Rwanda, Burundi and Zaire, respectively, with seed use per major season varying between 10 and 45 kg (Sperling, 1994). More than 70% of the farmers surveyed obtained their original seed from relatives, usually the man's parents, who are usually their closest neighbors and whose seed is preferred as it is considered to be well adapted locally. With time, however, many farmers had also made partial modifications in the composition of their seed stocks (40% for the Zairean sample, 60% for the Rwandan and 22% for the Burundian), with a good number of them changing their seed stock completely (14%, 18% and 61%, respectively). Seed acquisition, including varietal composition, is very dynamic.

Sources of bean seed

Many channels exist for acquiring bean seed (Table 2 lists 11), with different farmers preferring specific outlets. In all the Great Lakes countries, about 60% of the farmers obtain at least some of their seed from their own production (Table 2). Markets are another very significant source. Farmers in South Kivu use the term 'market sources' to generally refer to the many decentralized markets at which they may sell their own bean seed. Hence the categories 'market—general category' and 'market—farmer merchant' are not well differentiated for Zaire. In Rwanda and Burundi, in contrast, farmers clearly distinguish among the large town markets ('market—general category'), the town wholesalers who own their own shops (large merchants), the decentralized country or boutique vendors ('local merchants'), and the farmers who sell their own harvest in town or rural market places ('market—farmer merchant'). Seed quality differs among these merchants as do opportunities for obtaining credit against future harvest. Farmer–merchants are relatively rare in Rwanda: farmers who sell (or exchange) seed they produce themselves usually do so in the countryside as one neighbor with another (the category 'neighbor'). This category is rare in the South Kivu Region. In terms of the overall market, the Burundi

results give an idea of the importance of the market as a seed distribution channel among this population of primarily subsistence farmers: on average each Burundian farmer purchases 5.4 kg from the market during the September to January season and 15 kg for the February to June season.

Table 2: Percentage of farmers relying on particular bean seed sources during the principal growing season (1991–1992*)

Source	Zaire (n = 194)	Rwanda (n = 144)	Burundi (n = 248)
Own stock	59	63	66
Relatives	-	-	1
Market	58	9	24
Farmer seller	1	11	12
Small local merchant	-	3	11
Large merchants	-	9	3
Neighbors	1	10	4
Development project	-	-	3
Church	-	3	<1
Cooperative	-	1	<1
Government outlet	-	1	-

* Percentages may exceed 100% as farmers used more than one seed source.

The use of the two major seed sources—own stock and markets (the latter being a composite category of all market types)—varies considerably by wealth. In the three regions, only about half of the poorer farmers can draw on their own stock for any quantity of seed. In contrast, all the wealthy farmers use their own harvested seed for at least one season of the year (Table 3). The richer farmers use markets for select genetic materials rather than to top up or fill in for inadequate seed stocks. Reliance of the poor on markets is quantitatively and qualitatively different among the three countries. In Rwanda, 33% of the poor farmers purchase all their seed at least for one season; in Burundi 70% do this and in Zaire 52%. This does not include farmers who depend on the church or the state for free seed (Sperling, 1994). Poor farmers may even consume their entire crop green, either the pods or the fresh seeds. Most farmers are desperate for seed, hence they are not concerned about seed quantity.

Farmers' assessment of seed quality and seed distribution channels

Because of their harsh economic constraints, farmers try to maximize their access to what they consider good seed. In describing desired characteristics for seed, Rwandan farmers (n = 89) focused on varietal aspects in 76% of their responses (emphasizing adaptedness to local conditions and earliness as the desired traits). Physical or phytopathological traits were the other criteria cited (good physical appearance, good germination and seed treated with pesticide). Burundian farmers' responses were similar (Table 4). Varietal aspects were particularly important (65% of the responses), with a preference for small-grained seed, which they reported did well on the poorer soils and was economic to sow. A

key finding was that the major concerns of the formal seed service, such as good conditioning and healthy seed, were given little prominence as farmers felt that they could readily control these aspects themselves. Aspects concerning the health of the seed produced by farmers are discussed in detail below.

Table 3: Percentage of farmers using the two major seed sources, by social class and season (1990–1992)

Farmers' status	Zaire		Rwanda		Burundi	
Season	A	B	A	B	A	B
Own stock						
Poor	51	49	44	62	55	34
Medium	65	64	63	85	81	73
Rich	80	100	91	100	100	85
Market						
Poor	66	60	46	26	51	80
Medium	40	53	36	5	22	52
Rich	13	17	6	0	4	32

Given the emphasis on varieties, farmers generally prefer to use mixtures long tested on their own farms because, through a process of selection, such seed has become well adapted to the farmer's specific agronomic conditions. In Rwanda and Burundi, in terms of both genetic and physical quality, second-best seed comes from neighbors whose planting conditions are normally similar to the farmer's and who have an obligation to deliver well-sorted beans (e.g., seed not broken, immature, discolored or damaged in storage) (Sperling in CIAT, 1988). In Zaire, farmers who buy seed in markets ensure that they obtain seed from sellers they know well or buy varieties with which they are very familiar. In the Rwanda and Burundi markets, farmers look for varieties they believe will do well and seed that is free of physical defects. Seed of this quality is both relatively expensive and not readily available. It sells quickly, and may cost 10 to 15% more than beans used for consumption. The implication is that wealthier farmers have greater access than their poor counterparts to better quality seed. For example, in Rwanda, 50% of the seed the richer farmers used in season A outside their own stocks was obtained from neighbors (better quality, local seed) or development projects and government offices (better quality, exotic seed). These locales represented 18% of the sources used by the poorer farmers for acquisition of seed off-farm. Ultimately, farmers may be obliged to buy from commercial channels just because these avail seed on request.

DISCUSSION: BEAN SEED AND THE INFORMAL SECTOR

Studies of farmers' seed systems show that relatively large numbers of farmers regularly procure a high proportion of seed from outside their own farms[1]. While neighbors' seed (locally adapted seed) is preferred (whether purchased at the farm or at the market), many farmers are obliged to purchase what they consider second quality seed through commercial channels that offer regular supplies of a range of varieties. Poorer farmers, in particular, are constant market clients because they are unable to save harvested seed or at times are forced to eat entire harvests green. Up to now, development projects and national seed programs have provided very small proportions of the bean seed in use, although some genetically improved varieties reach farmers through the informal channels (Scheidegger in CIAT, 1993). For farmers, the present seed procurement channels often represent a trade-off between quality seed (genetically and physically) and cost and availability.

Table 4: Criteria used by Burundian farmers to define good seed (n = 295)*

Criteria**	# Responses	% Responses	% Farmers
Varietal factors	422	65	90.2
Small grained			
Good yield			
Known variety			
Seed sorting	144	22	41.7
To eliminate rotten, immature, broken grains			
To remove bruchid-damaged grain			
Economic factors	35	5	9.8
Grains 'economic to sow' (small)			
Conditioning	25	4	7.8
To ensure good germination			
To ensure appropriate moisture content			
Seed health	18	3	5.8
Other	2	<1	0.7

* Farmers were permitted to cite up to three criteria.

** Each criterion represents a cluster of responses. Thus, varietal factors include factors such as desire for small-seeded varieties, early maturing varieties, varieties that resist drought, and so on. Only the major criteria have been listed.

[1]This data contrasts with recent reviews that suggest that, in developing countries, 80% of the total requirements are met by farmer-saved seed (Cooper, 1993, citing Cromwell et al., 1992). The Great Lakes work also contradicts some of the normal stereotypes about market orientation. The poorer the Rwandan, Burundian or Zairean farmer is, the larger is the proportion of the seed he or she buys.

SYNTHESIS: PRINCIPLES GUIDING DISTRIBUTION OF NEW SEED VARIETIES

The studies mentioned above helped to identify key principles for guiding the distribution of new bean seed varieties to meet smallholder farmers' needs. These principles are sketched below.

Farmers clearly use informal channels regularly. Building on these channels rather than creating new ones (a fault for which development projects are usually criticized) can help keep costs down as well as assure timely delivery of seed. Different clients use different channels; some prefer the open markets for the varieties they offer while others rely on neighborhood country stores for their convenience and credit possibilities. Building on a diversity of channels facilitates distribution of new varieties to different clientele and speeds up diffusion. Having many points of distribution, on a recurrent basis, can help farmers, particularly those who regularly consume their full harvest, to restock novel varieties. Finally, while many farmers buy seed, overall they plant relatively small quantities, and new varieties should be available in test-size packages. Small quantities allow farmers to test the new product with limited risk and expense, and they also facilitate seed services, with their limited volume capacity, to improve access to their products. These principles are summarized in pragmatic form in Table 5.

Table 5: Principles guiding distribution of seed of new varieties

Principle	Objective
Build on existing channels	Sustain low cost Ensure timely delivery
Use different channels	Reach different clients
Promote many distribution points	Allow farmers to restock
Diffuse small quantities to many farmers	Ensure efficiency

ACTION RESEARCH: SEED DIFFUSION EXPERIMENTS

The potential effectiveness of the principles outlined above was tested in a series of action-oriented experiments. These trials pushed national agricultural research systems (NARS), CIAT and development projects partners onto the borders of proper research, but proved vital for sharpening recommendations. They also served to break down long-held stereotypes such as "farmers do not buy new varieties in a cost-effective manner".

Design of seed the delivery package

A prelude to the diffusion experiments was the design of a simple product delivery package—of interest to seed purveyors, that is merchants and seed users (farmers). Small quantities (50, 100 and 250 g) of highly productive varieties (both bush and climbing beans) were packed in heat-sealed, plastic bags along with an identifying leaflet. From the merchants' point of view, the self-contained, premeasured

bags made distribution a clean and generally quick process. Farmers saw the test sizes as a low risk investment, and the finished packets suggested that the product was reliable (that is, it had standard quantities and research-proven varieties). The leaflet describing basic varietal characteristics (printed in Kinyarwanda, the local language) made the new technology easy to understand by all farmers: direct collaboration with an extension agent or a development agency became unnecessary (Sperling in CIAT, 1990).

CIAT's distribution experiments through local seed outlets

CIAT itself experimented with two local channels—local country stores and centralized open markets—as test distribution outlets. Four types of package were made available (Scheidegger in CIAT, 1991):

1) 250 g of a single bush variety
2) 250 g of a single climber
3) Set of 4 bush varieties (50 g each)
4) Set of 3 climbers and a sample of *Sesbania macrantha* (50 g each)

The total production costs—bags, labor for packing and labels—represented US$0.02 per unit of single the variety and $0.05 for each set. Seed costs (at the market price) were US$0.10 and US$0.08, respectively. The packages were sold to vendors at US$0.12 per unit.

In September 1991 (just before sowing time), 10 country store owners (all those contacted) readily took about 100 of these packages to sell on commission. These shops typically serve 1000 to 3000 farms and commercialize 1–3 t of seed of local mixtures per season. The merchants sold the packages to farmers at US$0.16–US$0.24 (US$0.20 was the average) per unit. Farmers thus paid on average $US 0.80/kg (single variety) and $US 1.00/kg (sets) for bean seed of new varieties. The going rate for seed of local cultivars was about $0.40 per kg. Demand appeared greatest for packages of single varieties, with bush beans being more popular than climbers. The merchants sold the most preferred packets within 2–3 days and showed great interest in continuing with the experiment.

Sales at the village market were logistically more difficult as the handy plastic packages were easily stolen (local mixtures are normally sold in bulk). As more farmers can be reached through open markets, the traditional sprawling merchandise display may need to be modified if the vendors are continue with seed sales. The single market merchant contacted disposed of 140 packages in two hours.

These distribution experiments confirmed that farmers are readily paying prices two to three times more for new varieties than for local seed at the open market. Merchants, in turn, obtain a profit from handling the seed sales. And ultimately, the country store seems to be an effective channel for reaching large numbers of farmers.

Seed distribution by development projects

The trends from the experiments reported above were confirmed in a series of development projects where the model was repeated and expanded. The experience of the Karama Agricultural Project of

is a case in point.

The Karama project carried out three sets of diffusion experiments. In September 1990, the first test packets of a single climbing variety, Umubano, were diffused in the zone. The climbing variety was largely unknown to farmers. The packets were sold via the government agricultural stores, and, with 225 kg of stock, the project was able to reach 900 farmers. The next year, Karama became the leading producer of climbing beans in the county.

By September 1991, farmer multipliers had produced 1716 kg of Umubano seed, all of which was sold and diffused. In this and the following season (September 1991 and February 1992), the project also introduced another variety, Vuninkingi, sold in small packets, because Umubano developed susceptibility to root rot disease. Through the new seed diffusion mechanism, varietal replacement moved swiftly onto farmers' fields.

In September, the project, already with formidable seed production and diffusion accomplishments, initiated activities to improve its performance—to diffuse a greater range of varieties, in less time, to more farmers. It was then that the managers decided to sell seed in the open markets—those normally frequented by farmers to buy household goods, fresh fruits, vegetables and livestock. The conscious decision to sell only small size packets—125 gm—was tenaciously held. Small quantities allowed farmers to buy samples with their pocket money, and stretched a limited seed stock a long way.

The project sold four climbing bean varieties—Puebla, Ngwinurare, Flora and Vuninkingi—with and without fertilizer accompaniment. All the 1590 packets of seed were sold within one week in six markets, and many potential customers were left clamoring for more. As about 60% of the buyers came from within the project zone, the project calculates that it reached 9.3% of the total zonal population of 6288 families with this small exercise alone. Table 6 presents details of the costs involved in the exercise. To keep the seed price down, the price of the packets of the new varieties was subsidized for 4% of the cost. The project manager believes that there still would be greater demand than supply even if the prices were raised to completely cover all costs (Projet Agricole de Karama, 1992).

Table 6: Production costs (FRw) of seed (Agricultural Project of Karama, September 1992)

Item	Seeds only (125 g)	Seeds (125 g) + DAP (200 g)
Seed (60 FRw/kg)**	7.5	7.5
Fertilizer DAP (45 FRw/kg)	-	9.0
Plastic packaging	1.0	2.0
Information sheet for seed	0.4	0.6
Labor for packaging	1.5	3.0
Total cost	**10.4**	**22.1**
Sale price	**10.0**	**20.0**
Information sheet for fertilizer	-	8.0
Subsidy	**0.4**	**10.1**

Note: 1 $US = 130 FRw

Source: Projet Agricole de Karama, 1992

Discussion: seed diffusion experiments

The success of the Karama seed diffusion project proves that development projects or non-governmental organizations could conduct such activities with ease. Even though the effort in the experiments was limited, the results were impressive, with seed being distributed to small farmers quickly. Similar experiments have been conducted in Zaire, Uganda, Tanzania and Ethiopia using market channels (T. Musungayi, C. Wortmann and O.T. Edje, personal communication). Diffusion of new varieties has also been tested through outlets not meant for seed distribution—nutritional centers, charitable organizations and agricultural training schools. With nutritional centers, a new range of clientele, generally unreached by extension efforts, showed unusual enthusiasm for the new varieties (Sperling et al., 1992).

The advantage of the small seed packet technique is its immediate simplicity and impressive potential for impact. In Rwanda, calculations show that with a mere 5 t of seed, 100,000 farmers can be reached, or just under 10% of the population. Getting the same seed out, but more quickly and widely, translates into discounted social benefits jumping from $5 to $8 million for each variety (Scheidegger, 1992). Such a diffusion paradigm looks for impact, rather than profits *per se*, and in the process shifts considerable gains over to small farmers.

CONCLUSION

Bean seed research in the Great Lakes Region has been influential not only at the farm level but also in the policy arena. Burundi and Rwanda are in the initial stages of exploring more decentralized seed systems (Walls et al., 1992; CONCEPTRA, 1993). Recommendations obviously differ by crop, but beans, self-pollinating and largely produced for home consumption, represent the prime candidate for alternative production and distribution systems.

In reviewing our five years of research, we were guided by one major tenet in our strategy: define your seed problem well and build on the promising opportunities. 'Lack of good seed', a phrase very commonly heard, is too vague a problem to be of operational use. Table 7 sketches a reflective framework for identifying such opportunities and indicates the choices made in the Great Lakes Bean Research Network. Choices elsewhere will vary according to factors such as agro-ecological climate, type of crop and, above all, user needs.

Table 7: Possible points of intervention to strengthen seed systems for small farmers, including specific strategies adopted within the Great Lakes Bean Research

Opportunities to improve overall availability of seed:	Applicability to Great Lakes
When beans move into a new area	no
In regions where good seed cannot be produced	no
In areas or for strata of farmers who are notoriously short of seed	yes- but difficult
In areas with storage problems (only one crop per year)	no
To satisfy high demand of seed because of unfavorable climatic conditions	yes- but difficult

Opportunities for improving seed quality might existing through research on:	Applicability to Great Lakes
Physical purity	no
Physical/physiological parameters	no
Genetic purity (within equal grain phenotypes)	not appropriate
Decreasing disease infection	perhaps in special cases

Opportunities for improving genetic acceptability/stability of seed through:	Applicability to Great Lakes
Better agro-ecological targeting	yes
Better differentiation of user needs	yes
Promoting range of cultivars on-farm	yes
Systematic screening and promotion of farmer varieties ('landraces') along with new cultivars	yes

Table 7. (cont'd)

Opportunities for improving direct access to seed through:	Applicability to Great Lakes
Use of different channels	yes
Making product more affordable e.g. offering in different sizes building on farmer production and distribution channels	 yes yes

Genetic acceptability/stability of seed through:	
Better agro-ecological targeting	yes
Better differentiation of user needs	yes
Promoting range of cultivars on-farm	yes
Systematic screening and promotion of farmer varieties (landraces) along with new cultivars	yes

Direct access to seed through:	
Use of different channels	yes
Making product more affordable	
e.g. by offering it in different sizes, or	yes
building on farmer production and distribution channels	yes

[Ed.: This is an abridged version of the paper presented]

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PRODUCTION AND DISSEMINATION OF IMPROVED HARICOT BEAN VARIETIES IN THE SOUTHERN REGION OF ETHIOPIA

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INTRODUCTION

In Ethiopia, particularly in the Southern Region, where subsistence farming is practiced, the basic food production problem is low yield per unit of land for the major cereals, pulses and other crops. Beans are widely grown in the region, with annual production exceeding 2150 t in 1989 (CSA, 1990). The total area under the crop in Sidama and Wolayita zones varies between 5150 and 5691 ha (CSA, 1990). Most farmers do not have access to improved technologies. As a result, average yields of the crop are only 600-700 kg/ha per year (Dugu and Workayehu, 1990). Farmers also grow cultivars or landraces using traditional practices.

BEAN GRAIN PRODUCTION

Beans are widely produced in the low and mid-altitude zones of Sidama and North Omo zones. This crop is typically produced on small, subsistence farms. The major production problem on the small farms is the lack of purchased inputs, such as improved seed, fertilizer and pesticides. Hoe cultivation is the predominant land tillage method in Sidama, while the ox-drawn plow is widely used in North Omo Zone. Beans are usually produced in association with maize, coffee and enset, as well as with root crops like taro and yams. Farmers in the area mainly practice multiple cropping to maximize production per unit area. The most common systems are double cropping, intercropping, relay cropping and crop rotation (Dugu and Workayehu, 1990). Farmers predominantly grow the local bean variety, Red Wolayta, which is early maturing and has a good taste and high market demand (Dugu and Workayehu, 1990). Figure 1 shows the location of Sidama and North Omo Zones.

Constraints to bean production

The major constraints to haricot bean production are bio-physical, agronomic, biological and socio-economic.

Climatic factors

Rainfall. In general, farmers have to grow beans and other crops under conditions of unpredictable rainfall patterns, within short rainy periods. Variations in yield are observed from year to year, and farmers cannot predict crop yields in any given year. The amount of rainfall per year is also decreasing.

Soil condition. Low soil fertility is a major problem in haricot bean production, particularly in the study area. It is likely that the decline in soil fertility has contributed to the low yields on farmers' fields. The causes of this problem are continuous cropping resulting from high population pressure on the land and the lack of appropriate soil erosion control and soil fertility maintenance methods.

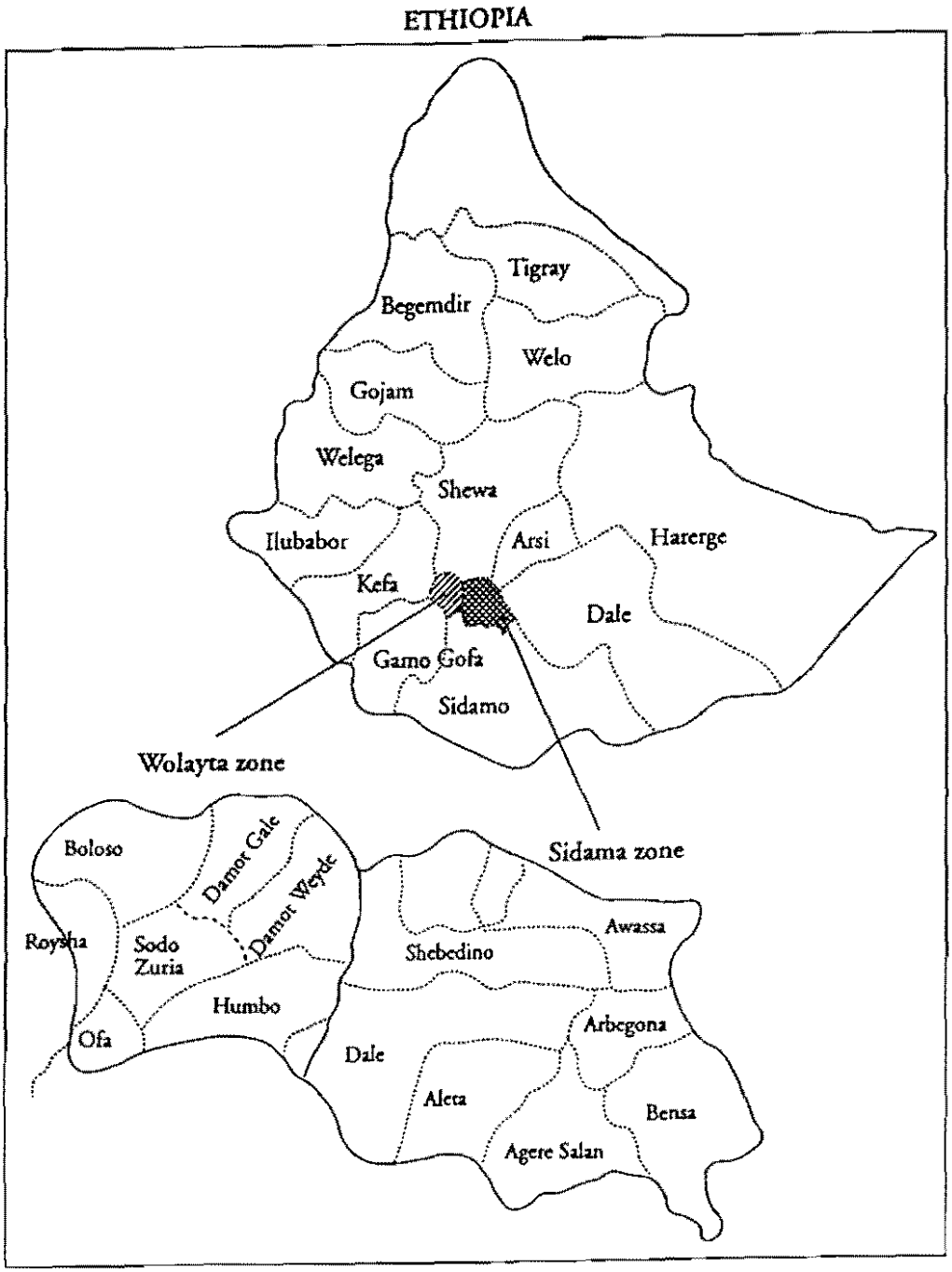

Figure 1: Map of Ethiopia showing the location of Sidama and North Omo Zones

Agronomic factors

Time of planting. Due to the unpredictability of rainfall, the planting periods for various crops in different agro-ecological zones vary considerably. The big difference between bean yields at research centers and on individual farmers' plots may be attributed to this.

Quality of planting material. Local cultivars have low yields due to their low pest resistance and the presence of other non-desirable characteristics.

Plant population. An optimum plant population is needed for maximum yield per unit area for various crops. Most farmers are not concerned about such considerations.

Biological factors

Pests. Insect pests and diseases are serious problems in bean production. Anthracnose is an important disease that attacks Awash 1 in the field. Termites are major pests in places like Gofa Zuria. Late blight is also indicated in some project areas.

Weeds. Weed control is a major factor in bean production, particularly in the Wolayta area. The labor and ox power available to most of the farmers are not sufficient for effective weeding of bean plots.

Improved varieties. The local cultivars grown by small-scale farmers are low yielders and susceptible to diseases and pests. The use of improved bean varieties is limited to just a few farming systems. Farmers' reasons for not using improved varieties of beans are unavailability of seeds, lack of information about the improved cultivars and the high cost of seed.

Socio-economic factors

Draft power shortage. Oxen are the most important source of draft power for crop production in the program area. The number of livestock in the area has significantly been reduced by drought, leaving most of the farming households without oxen. Shortage of cash and animal feed and animal diseases also contribute to the problem (Dugu and Workayehu, 1990).

Agricultural inputs. Inadequate supply of seed of improved cultivars or seeds generally, fertilizer and pesticide has hampered the success of bean production in the project area. Most farmers complain about late delivery and inadequate supply of fertilizer, which leads to late planting of maize and haricot bean (Dugu and Workayehu, 1990)

Credit services. Farmers in the region as a whole have a low level of cash income and do not have access to credit services. They cannot afford draft power, improved seed, fertilizer or pesticide.

Preferences. Consumers' preferences for bean varieties depend on taste, palatability, cooking time, storage period and marketability. In Wolayta, where research demonstrations and dissemination activities are carried out, farmers prefer Awash 1 for making sauce (shiro) and Roba for making nufro (boiled bean with other food or alone) (Kassaye, 1993).

Research and extension links

The poor links between the research and extension services have resulted in limited transfer of technology and information diffusion to extension workers and farmers.

Prior to this study, improved varieties of haricot bean - Awash 1 (Exrico-23) and Roba (A-176)- were demonstrated in various locations in Sidama and North Omo Zones (Table 1). Trials were conducted under improved and traditional management practices. The means of bean yields across the sites for improved and traditional management practices were 1415 and 925 kg/ha, respectively. The mean yield increase as a result of improved management practices was 53% (Table 2), indicating that management is an important factor for high bean yields.

Table 1: Number of farmers and amount of haricot bean seed disseminated in Sidama and North Omo Zone in 1992

Village	No. of farmers	Total amount of seed distributed (kg)	
		Awash 1	Roba
Sidama Zone			
Ramada	10	20	20
Taramesa	20	20	20
Biratedicho	10	10	10
Woinenate	20	40	40
Lela Honcho	20	20	20
Chuko	10	20	20
Bensa Wari	10	10	10
Hatche	20	40	40
Sub-total	120	180	180
North Omo Zone			
Shakiso Shone	10	10	10
Doge	10	20	20
Achura	10	20	20
Gurmu Koisha	20	20	20
Wazete	10	10	10
Baso	20	40	40
Zefene	20	20	20
Gotcho	20	40	40
Sub-total	120	180	180
Total	**240**	**360**	**360**

Table 2: Yields of improved and local haricot bean varieties under improved and traditional management (kg/ha)

Varieties	Management		% increase due to improved management
	Improved	Traditional	
15R-42	1714	1140	50.4
Awash-1*	1580	873	81.0
Roba*	1390	943	47.4
Red Wolayta	975	743	31.2
Mean	1415	925	53.0

* Mean yield of 1992 and 1993 demonstration results.

Extensionists were involved in demonstrations of improved varieties of bean and other crops on farmers' fields in different locations of the Southern Region. Farmers' interest in improved packages (variety and practice) has been very high. The objectives of these demonstrations were:

- To increase the supply of seed of accepted varieties in all demonstration sites, since these are not available to farmers
- To accelerate the adoption rate of improved varieties and further popularize research activities in the region.

METHODS

Between 2 and 4 kg of seed of Awash 1 and Roba were distributed to farms in 8 districts in Sidama and North Omo Zones. Table 1 provides details on the number of farmers involved and amount of seed distributed. The sample farmers were selected using the following procedure:

- From 8 villages, 4 were randomly selected and given 4 kg of seed each; the remaining 4 got 2 kg of seed each
- From the 4 villages given 4 kg, 2 were randomly selected, some with 10 farmers and others 20 farmers
- In the villages with 10 participating farmers, 5 were given Awash 1 and the others Roba. In the villages with 20 participating farmers, 10 were given Awash 1 and the rest Roba.

FUTURE PLANS

The results of the demonstration and dissemination activites of the new varieties will be assessed by a study designed to:

- Determine farmers' acceptance of Awash 1 and Roba
- Determine the differences in adoption rates of the two varieties and between villages
- Identify factors affecting adoption of the new technologies.

To achieve the above objectives, a survey will be conducted in each study area to determine the diffusion or adoption process, and an acceptability index will be derived from data on the rate of acceptance of new technologies introduced into the area.

CONCLUSION

Several considerations should be taken into account in the effort to improve bean seed distribution in the Southern Region of Ethiopia:

- The government should give priority to the supply of inputs (seed, fertilizer and pesticide), and the distribution program should concentrate on the supply side of the market.
- The Institue of Agricultural Research (IAR) supplies seed to farmers free of charge. This approach is not necessary to create a commercial demand for the seed.
- Because the new cultivars have desirable characteristics, they should be distributed through government agencies, NGOs and established market channels.
- Because farmers continue to use poor management practices and to plant low yielding landraces that are susceptible to pests, the impact of the recommendations from research institutions is yet to be felt.
- The extension services, particularly in Sidama Zone, are focused more on cash crops than on food crops. Therefore researchers dealing with food crops should target farmers directly to ensure that the new technologies are adopted.

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INFORMAL ON-FARM SEED MULTIPLICATION, DISTRIBUTION AND FUTURE IMPROVEMENT OF BEAN SEED DISTRIBUTION IN TANZANIA

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INTRODUCTION

Beans are a favored staple food in Tanzanian, providing up to 60% of the protein intake of rural communities. The process of bean varietal development, testing, release, multiplication, certification and distribution to clients can take up to 15 years or more (Mushi and Edje, 1990). Seed distribution through Tanzania's official seed company does not meet the farmers' requirements. Even after release, certified bean seed may not be available to farmers until after 4-8 years, which is quite a long waiting period for a needy farmer. If the official seed agency were to be responsible for the entire process, it would take 19-23 years from varietal development to the delivery of seed to farmers.

The quantities of certified seed produced by Tanzania's official seed company are insufficient, the prices are high and the packages of 100 kg too large for smallholder farmers. The limited purchasing power of smallholder farmers is a major handicap in the dissemination of improved bean seed for planting.

The failure of the national seed company to produce and distribute adequate quantities of improved bean seed at affordable prices and in small packages led to the initiation of the informal seed distribution scheme. The objectives of the scheme were to hasten the distribution of Lyamungu 85 seed to farmers and to improve bean production in high potential bean growing areas. The seed production and distribution activities were conducted in Arusha, Kilimanjaro, Tanga and Kagera Regions (Figure 1). Lyamungu 85 was widely accepted in these regions for its productivity, marketability and consumption characteristics.

MATERIALS AND METHODS

It was noted that a major constraint in the seed industry is the failure of seed companies to produce adequate quantities of seed for distribution. Consequently, bean scientists opted for on-farm trials, demonstrations and seed distribution schemes to accelerate the distribution of Lyamungu 85 to farmers.

Bean scientists and extension workers distributed seed of Lyamungu 85 to registered farmers, women and church groups and village leaders. In a village saturation approach, 2-10 kg of Lyamungu 85 seed were issued to registered farmers as seed loans. Collaborating farmers were requested to return seed of equal quantity and quality to the scientists after harvest for redistribution to new farmers (Edje and Mmbaga, 1990).

The second seed distribution approach involved on-farm trials and demonstrations. Trials were conducted on farmers' fields in Arusha, Kilimanjaro, Tanga and Kagera Regions. Elite bean cultivars and Lyamungu 85 were planted together in farmers' fields for two to three years. Farmers were allowed to retain and plant or to supply their neighbors with whatever quantities of seed they liked from on-farm trials. Farmers assessed these cultivars for productivity, marketability and consumption characteristics using a rating scale of 1-6, counter-checked with the coin method (Edje and Mmbaga, 1990; 1993). It was essential to repeat the on-farm trials not only to obtain reliable data but also to saturate seed supply in the area, since the initial bean harvest may not have been adequate for seed and for grain for home consumption.

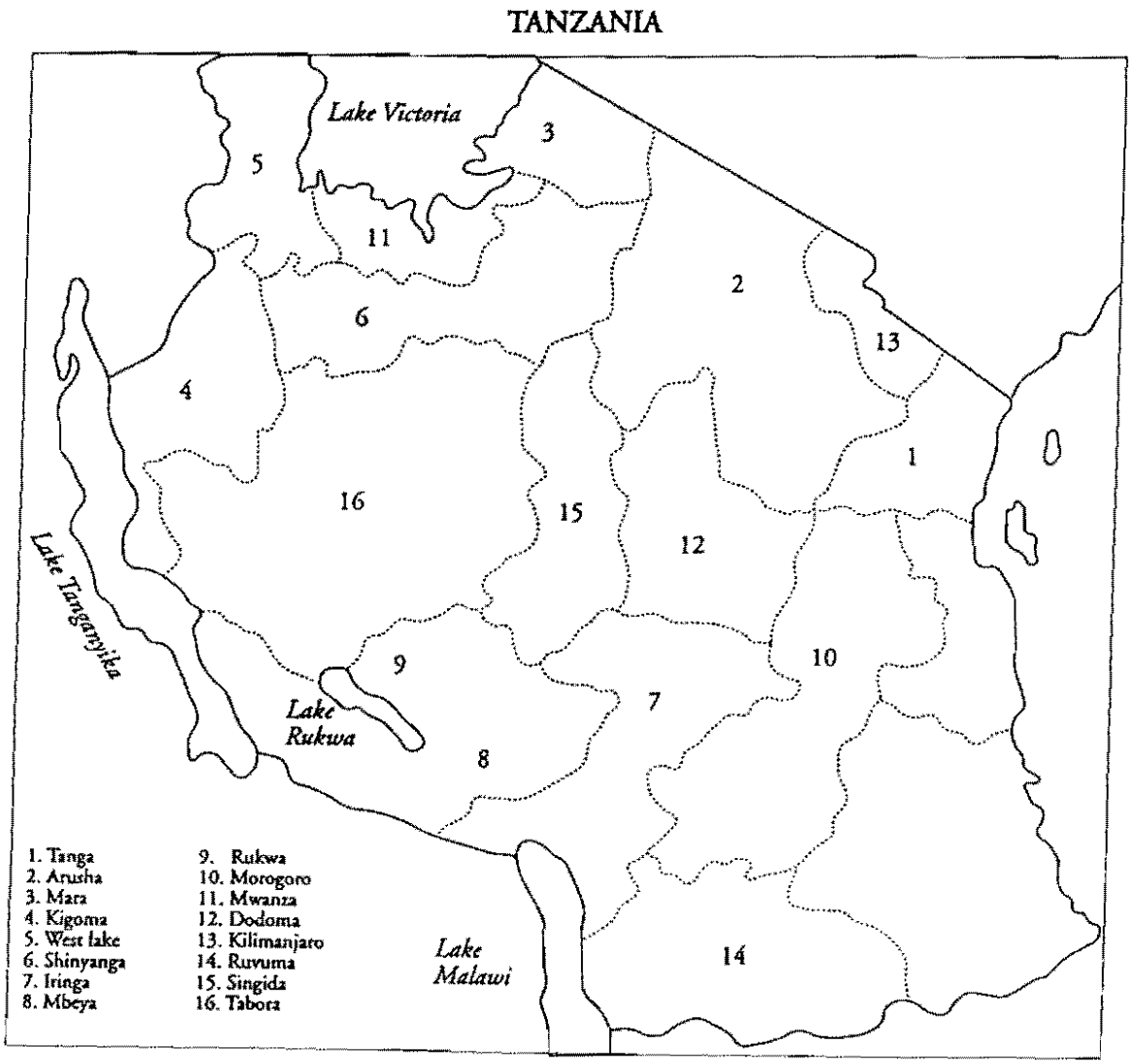

Figure 1: Bean producing areas of Tanzania

RESULTS AND DISCUSSION

The inability of the Tanzania Seed Company (TANSEED) to supply adequate quantities of Lyamungu 85 seed was one of the main constraints to efficient seed distribution in Tanzania. This suggests that the company did not have the capacity or willingness to produce and distribute Lyamungu 85 seed efficiently. In addition, the price of bean seed was so high that a common farmer could not afford it. This also applied to other grain legumes like cowpeas and green gram.

Lyamungu 85 was officially released in Tanzania in 1985, but certified production of its seed did not begin until 1989. The seed was not widely available in cooperative unions in 1991. Nevertheless, Lyamungu 85 was available in the Moshi and Arusha markets in 1989 (Edje and Mmbaga 1990) probably through collaborating farmers and those who had received gifts from registered farmers. Since the collaborating farmers were allowed to retain seed of the promising cultivars, it was likely that they sold the seed of Lyamungu 85 in markets or exchanged it for essential goods.

On-farm seed production and distribution approaches were developed to reduce the time between cultivar release and its availability to farmers. Consequently, in 1989 distribution of Lyamungu 85 was initiated with encouraging results as shown in Tables 1 and 2. After two years of seed multiplication, two farmers in Lushoto District of Tanga Region planted 1.5 ha each of Lyamungu 85 from the initial 2 kg of loaned seed (Edje and Mmbaga, 1990). In the same district, a farmer harvested 100 kg of Lyamungu 85 from the initial 5 kg of loaned seed after applying farm-yard manure (Edje and Mmbaga, 1991). On average, registered farmers produced more than 10 kg of seed for every kilogram of loaned seed.

The amount of seed distributed and the number of registered farmers who received Lyamungu 85 increased from 1989, reaching a peak between 1990-91 (Tables 1 and 2). The quantity of seed supplied and the number of farmers involved declined during the 1993 season, not because all farmers were saturated with seed but because the funds allocated for on-farm activities were inadequate. In 1991, 375 farmers received 1570 kg of seeds while in 1993 only 60 farmers had access to Lyamungu 85 seed, receiving only 230 kg, a 15% reduction in seed distribution.

Table 1: Number of farmers involved in the bean seed distribution scheme in the four bean growing regions of Tanzania

Year	Arusha	Kilimanjaro	Kagera	Tanga	Seasonal total
1989	30	30	27	40	127
1990	75	30	43	163	311
1991	44	214	12	105	375
1992	30	30	75	40	175
1993	0	10	13	37	60
Total	179	314	170	385	1048

Table 2: Distribution of Lyamungu 85 seed in the four bean-growing regions of Tanzania (kg)

Year	Arusha	Kilimanjaro	Kagera	Tanga	Seasonal total
1989	100	100	30	100	330
1990	557	200	70	800	1627
1991	540	500	20	510	1570
1992	200	200	170	500	1070
1993	0	10	20	200	230
Total	1397	1010	310	2110	4827

Over five years, the seed distribution scheme involved a total of 1048 farmers who received 4827 kg of Lyamungu 85 seed in total(Tables 1 and 2). The Tanga Region had the highest total number of farmers (385) who benefited from the seed distribution scheme, having received the highest amount of seed (2110 kg) through on-farm and seed distribution approaches. It is possible that more than 1048 farmers are now in possession of Lyamungu 85 through gifts, bartering and local market purchases. Collecting seed of Lyamungu 85 from registered farmers by bean scientists and redistributing it to new farmers proved inadequate and expensive due to financial and transport constraints. Consequently, there was little follow-up and poor control of seed distribution, hence the need to implement improved seed distribution approaches in the future.

APPROACHES TO SEED DISTRIBUTION IN THE FUTURE

To supply small-scale farmers with adequate quantities of improved bean seed may require more than one distribution system, hence the renewed emphasis on on-farm trials and demonstrations. On-farm trials should be conducted, particularly in new, potential bean-growing areas to create awareness and acceptability of new varieties and to hasten seed dissemination. To eliminate seed collection and distribution constraints, several approaches may provide possible solutions. One of the viable alternatives to official seed production and distribution is to issue seed to registered farmers in a village, requiring them to issue seed of an equal quantity and similar quality to new farmers after harvest. The new farmers in turn repeat the 'receive and give' approach under the supervision of extension workers until all farmers in the village have access to improved bean seed. The recipient farmer may give the seed donor an equivalent amount of low quality seed in return for high quality seeds as a gesture of goodwill. This approach will be cheaper than involving scientists in collecting and redistributing seed. Village extension officers would be responsible for monitoring the 'receive and give' approach. Since the improved bean seed would be already accepted for its productivity, marketability and consumption characteristics, farmers without seed of improved cultivar would make sure that they received their seed allotment when their turn came.

Another alternative would involve selling packages of uncertified seed of improved bean cultivars to farmers for multiplication and consequent selling to other farmers and cooperative unions. Bean breeders, seed certification agencies, extension officers and NGOs should jointly monitor the quality and purity of the seed. Burundi and Uganda adopted this approach with some success. Cooperative unions in Burundi bought the seed from farmers and resold it directly to new farmers (Dessert, 1989).

Primary schools could be used to produce seed of improved cultivars. We have at least one primary school in every ward in the bean growing districts of Tanzania. The school administration could be

given the mandate to produce seed and sell it to farmers. Seed availability would be announced during parents' meetings, with each parent being urged to send money through their children for purchasing at least a kilogram of improved seed. If the bean cultivar was popular, it would be packaged in small quantities (0.5 kg) and sold directly to farmers. It is likely that several farmers would afford to buy the seed and produce commercial quantities for local or international markets, thereby accelerating availability of seed to bean growers in the country.

SUMMARY AND CONCLUSION

Distribution of bean seed through Tanzania's official seed company is unsatisfactory, in terms of efficiency and speed. The company does not have the capacity to produce and distribute Lyamungu 85 seed efficiently and its seed is too expensive for the common farmer. TANSEED's failure to meet farmers' needs necessitated the initiation of the informal seed distribution scheme. The scheme's objectives were to accelerate the distribution of Lyamungu 85 seed to farmers and to improve bean production in potential bean growing areas of Tanzania.

It is likely that more than 1048 farmers are now in possession of Lyamungu 85 through gifts, bartering and local market purchases. Collection of Lyamungu 85 seed by bean scientists from registered farmers and redistribution to new farmers proved to be inadequate and expensive. This was probably due to financial and transport constraints. There is need to look into ways of improving seed distribution. Using farmers' seed distribution methods and selling uncertified seed in small packages were considered as possible approaches for future seed distribution.

The informal on-farm seed multiplication and distribution activities for Lyamungu 85 benefited many needy farmers. It is felt that the time spent on distribution of seed of Lyamungu 85 has been long enought to justify an impact assessment study. An impact study was initiated in 1994 and its implementation is in progress.

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SEED MULTIPLICATION AND DISSEMINATION BY THE CHRISTIAN SERVICE COMMITTEE OF THE CHURCHES IN MALAWI

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INTRODUCTION

The Christian Service Committee of the Churches in Malawi

The Christian Service Committee of the Churches in Malawi (CSC) is the development arm of Malawi's Christian churches. It was formed as an ecumenical organization in 1968, with Catholics (the Episcopal Conference of Malawi) and Protestants (the Christian Council of Malawi) as constituent bodies. The organization works in various sectors, including water, low-cost housing, women's rights and agriculture. The agriculture department has 18 extension workers. Of these, 11 (called development workers) work through churches, while the rest (credit assistants) work with women credit groups.

CSC's extension methodology

CSC's development workers pass agricultural extension messages through churches. For instance, they might attend a Sunday prayer service with a church congregation after which they give a talk on a specific subject. When demonstrations are required, the development worker arranges with the congregation for a suitable venue and day during the week for this. The development worker does not necessarily always need to be present at the church in order to make arrangements for the demonstration but may use the church leaders to do this. The development worker also uses the church for seed distribution.

The use of church leaders and volunteer extension workers is the basis of the direction CSC is taking in developing its agricultural extension program. There are 125 volunteer extension agents who help train farmers. Development workers use both group contact and home or farm visits for follow up.

CSC emphasizes the use of low-cost, low external input technologies, including soil conservation, agroforestry, soil fertility enhancement and the use of improved varieties of food crops, especially those that are drought tolerant.

SEED MULTIPLICATION AND DISSEMINATION

Although the research section of the Malawi Ministry of Agriculture releases improved varieties of crops appropriate to the needs of the smallholder farmers, very little is being done to get these varieties into farmers' hands. Funding is the major constraint. Seed dissemination projects that have been supported by donor funds have not been sustainable once the donor funding has been terminated. Of late, there has been increasing interest from the Ministry of Agriculture to work with NGOs, such as CSC, to deal with problems such as these.

History of seed dissemination activities in Malawi

Cromwell and Zambezi (1992) carried out a comprehensive study of the seed sector in Malawi. They reported that organized seed production has been carried out in Malawi for many years. The first locally bred maize was distributed in 1959, followed by other programs for groundnuts, rice, cotton and tobacco. In these programs, breeders multiplied limited quantities of seed. In 1968, formal multiplication programs were put in place for maize and groundnut seed through the Department of Agricultural Research, private growers and ADMARC (Agricultural Development and Marketing Corporation), a parastatal agricultural company. These bodies had recognized the need for a national seed program. By 1978, ADMARC and private growers were producing certified seed of maize, groundnuts, beans, sunflower, grasses, pasture legumes and tobacco. Later, a company to produce certified seed commercially was set up. In the mid-1980s it was felt necessary to create smallholder seed multiplication schemes for self-pollinated crops that were not sufficiently financially attractive to the commercial seed company. This need was strengthened by the removal of the subsidy on the retail seed prices, which made the seed too expensive for smallholder farmers.

NGO involvement in seed technology transfer

Until recently, the involvement of non-governmental organizations in the seed sector was mainly in providing relief in the aftermath of drought when smallholder farmers had not saved sufficient seed. NGOs distributed such seed free of charge.

Seed multiplication and dissemination activities of CSC

During the 1992/93 planting season, CSC worked with research teams to do on-farm testing of several improved varieties of sweet potato. One variety, Kenya, proved to be so popular with farmers that CSC decided to promote it during the 1993/94 planting season among the farmers with whom it was working. The planting material was received from Bunda College and the research centers at Bvumbwe, Chitedze and Lunyangwa. The material was distributed directly to farmers or used to start nurseries either at the churches or on private land. In total, 3,600 families received planting material during the 1993/94 planting season. The understanding with the recipient farmers was that they would be obliged to pass on planting material to at least three other farmers when their crop matured. Unfortunately, as a result of the 1994 drought much of the planting material on individual farms dried up, and, therefore, the multiplier effect was not as great as had been anticipated. This strategy will be followed in the 1994/95 planting season.

CSC also carried out on-farm testing of improved varieties of sorghum, pigeon peas and phaseolus beans during the 1993/94 planting season. If the varieties proved popular with farmers, the plan was to multiply their seed using a credit scheme whereby recipient farmers would, after harvest, return 50% more seed than they had received from CSC. CSC has been multiplying soya for the past four years using a similar strategy. However, several important questions came up after one season of small-scale trials with these new varieties. Perhaps the most important one is, 'how long does seed remain seed?' Another factor was that collecting the seed from the farmers was very labor intensive. It made the volunteer extension agents appear as bill collectors. It also unnecessarily limited the possible area of coverage.

CSC felt that it was time to implement a different seed multiplication strategy, one that considered aspects such as seed quality. There was also the question of sustainability: 'what would happen to

such a scheme when CSC pulled out of the area?'

As it turned out, the reactions of farmers to the varieties disseminated with seed loan scheme was so positive that CSC decided to embark on a pilot project of commercial on-farm seed multiplication during the 1994/95 planting season.

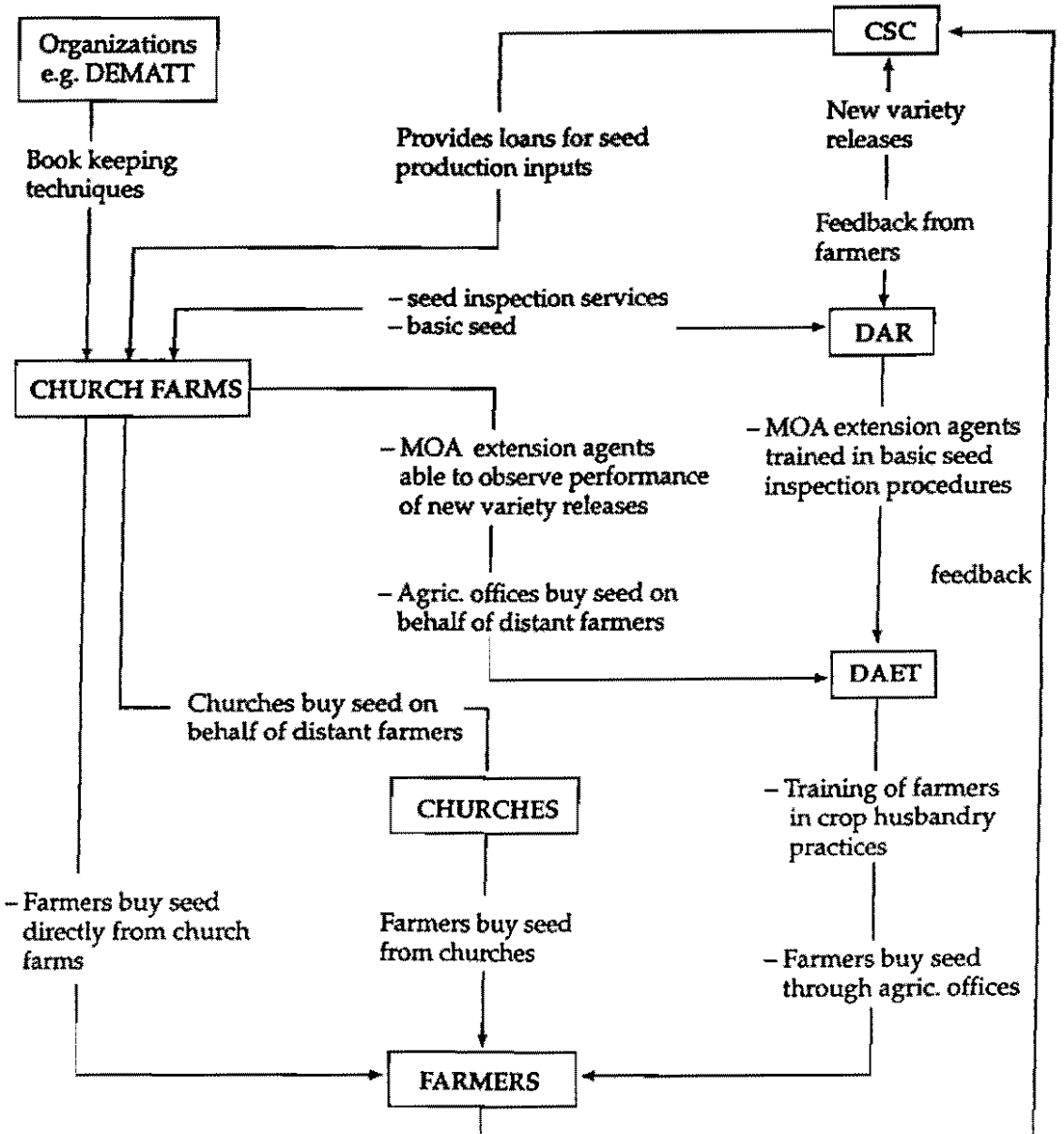
PRESENT AND FUTURE STRATEGIES

The first phase of the project involves working with five church farms that will receive a loan to produce improved seed of beans, pigeon peas, sorghum and millet, using breeders' seed purchased from research projects. The seed produced will be sold to farmers in the surrounding area the following year. The seed will initially be sold through churches, but may later be sold through government agents. The aim is that seed production by the churches should be a commercially viable operation. Two conditions that the project should meet to be regarded as successful are that the churches should be able to make a profit from the sale of seed and that there should be sufficient on-going demand for the seed produced. The scheme seems feasible on paper: implementation will determine if it is actually workable. Figure 1 presents an outline of the seed multiplication and dissemination scheme.

CSC will provide the initial coordination services of the project. The Research Department of the Ministry of Agriculture will work with the churches to ensure that the 'approved' seed produced is of commercial quality, and will be responsible for the training of government extension agents in various aspects of seed production such as quality control, selection and storage. The Extension and Training Department of the Ministry of Agriculture will be responsible for working with the churches and farmers in the training in appropriate cultural practices, along with implementing the training received from research systems. We envisage that the links made between the church farms and the Ministry of Agriculture will be strong enough to allow CSC to step aside after several years. This assumes that the church farms will make a profit and have an interest in continuing with the project.

In addition to producing seed, the church farms will act as demonstration sites for the introduction of improved varieties of crops released by research systems. Depending on farmers' reaction, these seeds will be included in the production schedule for subsequent years.

CSC is also working with the bean production teams of both Bunda College of the University of Malawi and Chitedze Research Station of the Ministry of Agriculture to conduct on-farm testing of several bean varieties. This collaboration started during the 1993/94 planting season and will continue in 1994. If farmers like the varieties, they will be included in the multiplication program.



KEY

CSC – Christian Service Committee of the churches in Malawi
DAR – Department of Agricultural Research (of MOA)
DAET – Department of Agricultural Extension and Training (of MOA)
MOA – Ministry of Agriculture

Figure 1: Outline of the seed multiplication and dissemination framework

BEAN SEED QUALITY: KNOWLEDGE AND IMPLICATIONS IN INFORMAL SEED PRODUCTION SYSTEMS

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INTRODUCTION

The area and extent of bean production in Africa require that large amounts of seed for planting be made available annually. Ideally, seed should be of good genetic and physiological quality. It should also be free of seed-borne pathogens.

Seed quality is a concept that, in specific terms, is relative and may mean different things to different seed producers and users. However, in general it denotes the capacity of the planting materials (seed) to produce full stands of vigorous plants, leading to productive mature plants. The standard criteria commonly used by the formal system are physical and genetic purity, physiological parameters, such as viability and germination, and seed health (Delouche, 1971). Studies carried out in Rwanda showed that farmers are aware of and are interested in good quality seed, but their criteria for good quality focus on varietal and physically observable characteristics, for example, if seed is rotten, broken, damaged or has bruchids, etc. (Sperling et. al, in press). Seed saved by the farmer is regarded as of the best quality, and seed from a close relative or a neighbor is considered better than that from markets and shops.

This paper reviews experiences and results of studies to evaluate the quality of seed produced under informal and formal systems and the implication on research and in developing policies on seed production.

SEED QUALITY PROBLEMS

Seed-borne pathogens, post-harvest pests and poor storage conditions may result in poor seed germination or plants that are not vigorous, thereby affecting the quality of the crop. More than 50% of the major bean pathogens are seed borne. *Colletotrichum lindemuthianum* (anthracnose) and *Phaeoisariopsis griseola* (angular leaf spot) are the most widespread bean diseases in Africa. Other diseases are *Pseudomonas syringae* pv *phaseolicola* (halo blight), *Xanthomonas campestris* pv *phaseoli* (common bacterial blight), *Phoma exigua* var *diversispora* (Phoma blight), bean common mosaic virus, *Macrophomina phaseolina* (ashy stem blight), *Sclerotium rolfsii* (southern blight), *Rhizoctonia solani* (rhizoctonia root rot), *Fusarium solani* (fusarium rot) and *Fusarium oxysporum* F sp *phaseoli* (fusarium wilt). Ellis et al. (1976) found a negative correlation between recovery of internally seed-borne fungi and seedling emergence.

Seed-borne pathogens can also be transmitted and transported from one location to another in seed. Infected seed also serves as a source of initial inoculum for disease development and spread. The formal seed production system emphasizes varietal purity, disease-free seed, good crop management, such as the use of fertilizers, crop protection and, ultimately, good post-harvest handling and storage.

SOURCES OF BEAN SEED

Certified bean seed is assumed to be of good quality and better than farmers' seed, but is rarely used by small-scale farmers in most bean growing countries in Africa. Specific reasons vary from place to place, but the primary one is that bean is a self-pollinating crop and can be multiplied without the risk of genetic degeneration. Beans are also produced largely for home consumption and farmers are interested in keeping production costs low. In many countries, certified bean seed is unavailable because demand is low or distribution channels are poor. When certified seed is available, it is considered expensive. In the Great Lakes Region of central Africa, beans are grown as diverse mixtures, varying from household to household. Mixtures are constituted for different purposes. For example, there are mixtures for disease resistance, poor or good soils, staggered harvesting, etc. (Voss and Graf, 1991; Sperling and Loevinsohn, 1991). It is practically impossible to produce seed of the diverse mixtures using the formal seed system. It is obvious, therefore, that the formal seed system, which is meant to produce good quality certified seed, is not the major source of the seed used for bean production.

The main sources of seed used by farmers are their own seed saved from previous seasons and markets or shops (Sperling et al., in press; CIAT, 1992). In the Great Lakes Region, about 60% of the farmers obtain at least some of their seed from their own production, with various forms of local markets being very significant sources as well. Neighbors, relatives and friends are other sources. It can thus be concluded that small-scale farmers are the main producers and users of bean seed.

Except for limited cases where there is some level of specialization in seed production (for example by seed experts in Rwanda), most seed in the informal system is obtained from the regular bean crop harvest. Crop management practices vary depending on the bean variety and the prevailing production constraints. In Rwanda, where beans are grown as mixtures, seed is also available largely as mixtures. The short rain season is preferred for bean production as there are fewer disease problems during that time. Whether farmers use their own or purchased seed, they select it before planting to eliminate physically damaged, blemished or diseased seed that would not produce a good crop (Buruchara 1990; Janssen et al., 1992; Voss, 1988). The strictness of selection varies depending on the amount of seed available, with farmers being less strict if seed supplies are low.

QUALITY OF FARMERS' SEED

Given that much of the bean seed used in bean production is produced by farmers, a number of questions have been raised both in Latin America and Africa as regards the quality of farmers' seed. What is the quality of seed the farmers produce and use? How does it compare with seed produced under the formal system? Is the quality of farmers' seed a limiting factor in bean production? Is there need to make the informal seed production system more efficient and effective as regards seed quality? Studies conducted in Latin America and Africa, the results of which are presented below, have attempted to address some of these questions.

Farmers' seed and yield

Poor quality seed may result in low yield of the resulting bean crop. This may be due to the low viability and poor germination of the seed or the presence of physical impurities and pathogens in the seed. Surveys conducted in Cost Rica (Sanchez and Pinchinat, 1974) to evaluate the planting quality

of (progressive) farmers' seed showed that, while purity was considered satisfactory, humidity was high and germination (72%) low, and 16.9 % of the lots (77 in total) carried bean common mosaic virus. They argued that poor seed quality is a basic limiting factor in bean production in Costa Rica. Trutmann and Kayitare (1991) showed that clean seed had higher yields of dry beans than seed selected by farmers. However, Janssen et al. (1992) found no difference in yields between farmers' seed and that produced by a cooperative society. Several similar studies to compare yields of farmers' seed and 'clean' seed have been conducted in Colombia and Guatemala. A summary of results from these studies is shown in Table 1. Clean or good quality seed resulted in higher grain yields than farmers' seed in only three cases: there was no significant difference in yields in 10 cases.

Table 1: Summary of studies comparing farmer-saved and 'clean'[1] seed

Year	Site	Variety	Crop yields		95% Statistical difference	No. of observations
			Farmer's seed	'Clean' seed		
1974	CIAT	Guali & ICA-TUI	85% increase		Yes	n.a.
1975	Guatemala	Not reported	515	1545	Yes	same farmers
1976	Valle de Cauca	ICA-Pijao	906	1060	No	30.
1976	CIAT	ICA-TUI	1691	2720	Yes	n.a.
1976	Palmira Popayan Monteria	ICA-TUI	Minimal effect		No	n.a.
1978	Huila	Calima	1509	1630	No	15
1978	Huila	Calima	1000	1138	No	13
1978	Restrepo	Calima	1341	1254	No	12
1978	Carmen de Viboral	Cargamanto	2019	1826	No	15
1979	Carmen de Viboral	Cargamanto	2136	2168	No	15
1979	Huila	Calima	1402	1333	No	30
1983	Carmen de Viboral, Marinilla	Cargamanto	no difference		No	n.a.
1983	El Tambo	Limoneno	557	514	No	4 places 2 reps

Source: Janssen et al., 1992

[1] 'Clean' seed refers to seed that is physically clean and apparently free of disease. In all cases, farmers' and clean seed were of the same variety.

Farmers' seed and seed health

Relatively few studies have been conducted to compare health aspects of farmers' seed with clean seed or seed produced by formal systems. Initial studies conducted in Kenya (Buruchara, 1990) and Rwanda (CIAT, 1992) showed that the level of infection of farmers' seed was low (Tables 2, 3). Assessment of several samples of farmers' seed in Rwanda showed that the overall germination rate was high and acceptable, but seedling vigor varied among farmers. Studies to evaluate the effect of premature harvesting (due to pressure on demand for food or to avoid theft), on seed quality showed no differences in germination rate, seedling vigor or yield between seed harvested prematurely and seed harvested at full maturity (Table 4).

Table 2: Levels of bean pathogen infection in farmers' seed for four districts of Kenya

Bean Pathogen	Level in farmers seed[1]
Colletotrichum lindemuthianum	1 out of 26 samples at 0.25%
Rhizoctonia solani	1 out of 26 samples at 0.25%
Phoma spp	12 out of 26 at maximum 3.2%

Note:
[1] = 400 seed per sample examined
Source: Buruchara, 1990

Table 3: Level of pathogen infection in seed from Rwanda

Pathogen	Level of infection per seed sample
Colletotrichum lindemuthianum	-
Fusarium oxysporum f. sp *phaseoli*	range 0-6%
Phoma exigua var diversispora	-

Source: CIAT, 1992

Diseases are a major concern in seed production and quality. Studies on climbing bean variety Umubano in Rwanda, comparing seed from the formal systems with farmers' seed, showed no difference in emergence, vigor and yield. Significant differences were observed for the presence of phoma blight but

the incidence of common bacterial blight was very low and erratic. Related studies were conducted in Rwanda to compare the quality of seed produced by seed experts and their neighbors with seed sold in nearby country stores. The pathogens detected were *Colletotrichum lindemuthianum*, *Fusarium oxysporum* F sp *phaseoli* and *Phoma* spp, but these occurred in very low levels to make a meaningful comparison. Both the farmer and the seed expert select out blemished seed, a practice thought to partly explain why the pathogen infection levels are low.

Table 4: Effect on bean yields of harvesting before complete maturity seed in Rwanda (1992B)

Variety	Ground cover DAP (37%)		Yield (kg/ha)	
	Seed harvested early	Seed harvested late	Seed harvested early	Seed harvested late
Rwandarugali	45.4	51.4	2252	2105
Urugezi	43.7	47.9	1987	2107
RWR 217	38.9	34.2	1896	1772
PVA 8	42.7	43.1	2431	2089
Mean	42.7	44.1	2141	2018

Source: CIAT, 1992

These studies show that seed health may probably be less of a problem in the informal sector than previously thought. There is need for more research on the benefits of using certified seed (yield, cost, etc) in countries where tests have not been conducted. Decentralized informal seed production of good quality seed at affordable prices might be a better option for distributing seed than markets, which farmers consider as sources of poor quality. Production can be done by seed experts, farmers' groups or cooperatives that will also ensure distribution of regionally specific or locally adapted cultivars. These groups could be assisted to improve their production techniques using low-cost methods to keep the prices low. Given that a good number of farmers do buy seed, this offers a potential market. The formal seed system can play a role in multiplying seed of new varieties that can be fed into the informal systems.

IMPLICATIONS

The seed produced by the informal sector is usually regarded as not being of good quality largely due to the way it is produced. But results of much of the evaluation work so far show that seed used by small-scale farmers is qualitatively not as poor as sometimes thought, and is comparable to that produced by the formal seed system. This is because farmers are conscious of quality aspects of seed and as a result obtain their seed from sources that guarantee quality or carry out practices, such as seed selection, to improve the quality of seed before planting it.

Unless the seed produced by formal systems is sold at affordable prices to poor farmers and the seed distribution channels are improved, farmers will continue using their own seed or seed purchased from shops or markets. However, formal seed systems can play a role in provision of seed of new and genetically improved varieties that farmers are ready to pay a higher price for. Seed purchased from local markets and shops constitutes a considerable portion of the seed planted although it is considered to be of poor quality. Selecting seed to remove physically damaged seed results in loss of seed, that, in some cases, could be used for food. Alternatively, higher seed rates are used to compensate for possible losses when poor quality seed is used, which means extra or increased production costs. The level and extent of seed loss arising from selecting out seed may vary due to a number factors, but has not yet been well quantified.

Given the variation in bean production systems, germplasm diversity and seed systems and needs, there is need to assess the comparative advantage of existing seed systems in different countries. There is need to understand the factors that influence farmers' seed 'production' practices and quality maintenance aspects. This should be done in order to improve seed multiplication capacities of farmers and small-scale commercial producers and to influence the development of policies for seed multiplication and distribution.

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ARTISINAL BEAN SEED PRODUCTION IN LATIN AMERICA

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BACKGROUND

Certified seed

Most Latin American countries have legislation on seed production and certification for their most important crops. State enterprises are involved in certified seed production, while private companies produce hybrid seed and seed of commercial crops. Inspite of the availability of certified seed, and especially for crops such as beans, for which grain is produced on small farms and by low income farmers, the use of such seed has been insignificant. Traditionally, farmers produce their own bean seed, or obtain seed from neighbors or local markets (Table 1). This is true even for countries where bean production is important, such as Mexico, Guatemala, Colombia, Ecuador and Peru.

Table 1: Source of bean seed in some regions of Latin America

Region	Year	Own seed (%)	Purchased seed (%)*
Santa Cruz, Bolivia	1992	20	80**
Sierra Norte, Peru	1986	78	22
Sierra Sur, Peru	1986	64	34
Costa Norte, Peru	1986	25	75**
Costa Sur, Peru	1986	90	10
Cusco, Peru	1992	44	56
Cajamarca, Peru	1991	61	39
Loja, Ecuador	1989	74	26
Imbabura, Ecuador	1992	45	55**
Cauca, Colombia	1988-89	65	35
Average	1986-92	57	43

* Includes seed exchanged with neighbors
** Bush beans commercially grown as a monocrop
Source: Diagnosis survey

The reasons for the limited use of certified bean seed include: (a) only small volumes of certified seed are produced in these countries, (b) the high cost of certified seed, (c) lack of information on the benefits of using high quality seed, (d) seed distribution centers are located far from crop production areas, (e) the absence of private seed producing enterprises, and (f) strict and bureaucratic legislation on seed certification.

Seed requirements

To a great extent, a good harvest depends on the quality of the seed planted, especially in areas where seed-borne diseases are common or where climatic conditions affect seed viability.

Several countries in Central America and the Andean Zone have identified the lack of seed as a real constraint to the rapid diffusion and use of new varieties by farmers. This situation becomes even more critical in countries such as Ecuador and Peru, where beans are harvested green for consumption.

National programs in Central America, where CIAT's Regional Bean Project, PROFRIJOL, operates, recognized the need to help state entities produce basic seed when the first improved varieties were released in the early 1980s. This endeavor received support from PROFRIJOL and CIAT. Considering the importance of this technological input in the diffusion of new varieties and its contribution to increased bean production in countries in the area, PROFRIJOL supported the search for other seed production options. Since its establishment in 1988, CIAT's Regional Bean Project for the Andean Zone (PROFRIZA) found that the scarce use of high quality seed constrained bean production in all the countries in its target area. Several activities were undertaken to solve this problem through CIAT's artisinal seed production sub-project.

ARTISINAL SEED PRODUCTION

In response to seed requirements primarily to support the use of improved varieties recently released by the national programs, PROFRIJOL started producing seed in collaboration with farmers in 1985. They organized the first course on artisinal seed production in Guatamela in 1986. More of these courses were held during the following years, and complimentary activities were increased.

From the onset, PROFRIZA supported artisanal seed production in the Andean Zone in aspects such as training, methodology development and production. CIAT's Participatory Research in Agriculture Project (IPRA) also supported the development of non-conventional seed production methods in response to the demand for seed of new varieties and local landraces, selected with the participation of farmers in Pescador (Cauca), Colombia. The pariticipatory working model followed by the project stimulated a group of seven farmers to establish an organization in 1990 to produce seed of local landraces and the new varieties. Additionally, CIAT's Seed Unit, initially created to train and support certified seed production, started activites in 1988 to support seed production systems for small-scale farmers, denominating this type of production as 'non-conventional'. The support of the Seed Unit was fundamental in developing small equipment for seed conditioning and in training oriented toward the establishment of small seed enterprises.

Evolution of artisanal seed production

National programs in the countries in Latin America where CIAT's regional programs have influence and in Colombia, where CIAT's IPRA Project operates, initiated activities during the 1980s to find ways

to produce high quality seed, different from the conventional certified seed production systems. This endeavor was motivated by the lack of use of certified seed (in the case of beans), the need to have seed available for promoting and diffusing new improved varieties and the erosion of local landraces from the local seed systems due to disease and storage problems.

It must be highlighted that the small seed enterprise projects in the countries supported by the CIAT projects mentioned above have gone through different establishment phases and evolution. Nonetheless, all have gone through some similar experiences. These include problem identification, sensitization, training and seed production at experiment stations and by individual farmers and organized groups.

Problem identification

In addition to the overall problem of limited availability of certified seed and lack of its use, in all cases, it was evident that the lack of seed was a real bottleneck for the promotion and diffusion of new varieties, including landraces introduced from farmers' experiments. Studies of indigenous seed systems showed that multiplication of the new landraces obtained from other areas was carried out by a few farmers who specialized in selecting and saving seed. Most low-income farmers were consuming improved seed stocks instead of planting them, and replacing these with grain of dubious quality, which they had bought or borrowed from 'seed specialists'. This problem was highlighted in the workshops on project planning.

Sensitization and training activities

Producing high quality seed using non-conventional seed certification systems was initiated with seed technicians. These professionals rejected the initial proposal to produce seed that was not certified, as was the case in Ecuador. Nonetheless, PROTECA's technology transfer program of the Ministry of Agriculture of Ecuador implemented a national artisanal seed production project in 1992 and 1993. Conferences and courses involving national technicians on artisanal seed production sought to increase awareness of the need for high quality seed.

Farmers in the areas supported CIAT's projects were trained in management of seedbeds, post-harvest conditioning and the benefits of using high quality seed. Training was more intense for organized groups dedicated to producing, conditioning and marketing high quality seed.

Seed production at experiment stations

When seed production centers are located in seed producing areas, and when a good relationship is established between researchers and producers, excellent sites develop for seed production, distribution and marketing. This is a good option, especially when a project is newly established or when there is a need for seed to support the release of a new variety. It has some constraints though: production and conditioning capacity is generally limited both in terms of infrastructure and personnel. In advanced projects, the centers' function should be to multiply basic seed for distribution to local seed producers.

The project initiated in Santa Cruz de la Sierra University, Bolivia, illustrates how successful these centres could be. Between 1985 and 1990, the university's El Vallesito Experiment Station was involved in seed production to support commercial bean production. During that period, the area planted to beans grew from 500 ha to more than 10,000 ha. In the last year of the project, the Vallesito Experiment Station produced close to 200 t of seed. Given the interest in bean planting and the incapacity to continue producing more seed, technicians at El Vallesito, with support from local organizations and

PROFRIZA, promoted the formation of a Bean Producers and Exporters Association (ASOPROF). The responsibility of this organization was to produce seed using its own technicians under the supervison of specialists from the university. Currently, ASOPROF produces close to 200 t of seed per year. This is sufficient to plant 4000 ha. The University is responsible for producing basic seed for ASOPROF and other small, seed producing enterprises.

Seed production with individual farmers

PROFRIJOL and PROFRIZA initiated artisanal seed production with individual farmers. The goal was to have these farmers produce and condition their own seed and sell or exchange the seed left over after planting with their neighbors. This modality proved that farmers could produce seed of the same quality as certified seed and at a lower cost. However, this system also had its constraints:

a) The majority of small farmers had a low production capacity
b) In order to produce and condition a considerable volume of seed, several producers had to be involved
c) Working with several individual farmers complicates training, advising and follow-up activities
d) Smallholder farmers cannot wait until the beginning of the following planting season to sell their seed and receive their profit.
e) The positive results from these activities were that farmers became better trained to produce their own high quality seed and the number of individual producers working on their own was reduced.

Table 2: Sources of bean seed used by farmers in several regions of Santa Cruz, Bolivia (percent).

Source	Center	East	North	South	Total
Purchased (certified)	49	100	53	58	43
Purchased from neighbors	16	0	5	0	11
Purchased at stores	0	0	29	0	27
From previous harvest	35	0	14	42	20

Seed production by organized groups

Experience has shown that seed production by farmers groups is one of the best methods for producing, conditioning and distributing high quality seed. During its second phase, from 1991 to 1993, PROFRIZA gave more attention to this option. The IPRA Project in Cauca, Colombia, initiated artisanal seed production activities using this modality in 1990 (Table 3).

Table 3. Small artisanal bean seed producing groups in the Andean Zone

Group	Site
APROSFYM	Mairana, Sta. Cruz, Bolivia
ASHORTOP	Pescador, Cauca, Colombia
CALIT	Media Luna, Cusco, Peru
CALIT	Ollantaytambo, Cusco Peru
CALIT	Lives, Cajamarca, Peru
DANDAN	Yunguilla, Azuay, Ecuador
INCA	Pimampiro, Imbabura, Ecuador

Note: ASOPROF in Bolivia and San Gil in Colombia are not included here since they are considered large enterprises.

Training, advising and follow-up activities for the farmers groups involved in the seed production process were facilitated by organized groups. However, working with groups requires a great investment of time and dedication from technicians, especially during the establishment of the group. This is because, in addition to having to train groups in seed production and conditioning technologies, it is necessary to organize them as small, self-managed enterprises.

Seed producers' cooperatives and associations ensure the capturing of the product and facilitating its distribution and marketing. As groups, they can create or find small funds to be used as investment capital to meet production expenses of their members. The members may choose to repay their debt with the seed they produce themselves and condition on their own farms. As a group, they also have access to credit. Group work in small communities or in small bean-producing regions is easy to publicize, an advantage in seed diffusion and marketing.

Specific experiences with organized seed producer groups have been reported in the Valle de Mairana, Bolivia; Cusco and Cajamarca, Peru; Imbabura and Azuay, Ecuador; and Cauca, Colombia. Even though all these organized groups were involved in seed production, there were important differences in the infrastructure available for seed conditioning to them. The following section describes two examples of successful, small organized groups of seed producers.

The seed producer group based in Psecador, Cauca, Colombia, carries out seed conditioning in producers' homes. Work with this group was carried out by CIAT's IPRA Project. Participatory research activities on beans in Pescador were started in 1987. The objectives were:

a) To accelerate distribution of improved varieties
b) To develop the capacity of local producers for selecting bean seed varieties, including local landraces
c) To identify new bean varieties
e) To multiply seed using participatory methods.

The first activity involved the evaluation of a nursery of 101 lines developed by CIAT. After each successive evaluation, the number of lines was reduced until only three materials were left for seed multiplication in 1990.

The participatory approach to problem solving stimulated producers to form a group of seven people to be in charge of artisanal seed production. They requested training from CIAT and organized a workshop with sessions held every two weeks on the management of the crop, conditioning equipmentand seed quality. Table 4 shows seed production data for this project since 1990.

Each group member produces and conditions their own seed. Drying is done on the patios of members' houses. The raw material is spread on plastic tents or similar material. Selection is done by family members whenever they are free from other work, with the seed being spread over a screen. The group has a warehouse to store conditioned seed. Seed is packaged in bags of 10 kg, marked with the name of the variety and the production lot. Quality parameters have been established (Table 5); these have been accepted by the state entity in charge of supervising seed production. Sales are conducted at the warehouse and in strategic locations in the locality. The quality and quantity of seed quality produced by the Cauca project are so impressive that the project has been given the responsibility for supplying seed to other regions of Colombia.

Table 4. Bean seed production by the seed group in Cauca, Colombia

Year	Month	KG
1990	July	3,080
1991	January	12,302
1991	August	22,000
1992	January	32,000
1992	August	29,000
1993	July	5,000
1994	February	7,000
1994	August	7,000

Source: Roa et al., 1991

Table 5: Quality parameters for artisanal bean seed production in Cauca, Colombia

Parameter	Accepted percentage
Genetic purity	98
Moisture	13 maximum
Germination	85 minimum
Impurity	2 maximum
Mechanical injury	2
Rotten grain	0
Presence of bean weevils	0
Faded grains	10

Source: Roa et al. , 1991

It should be highlighted that seed producers do not deliberately intend all their stocks to be used as seed. The harvest is divided into seed for sale and grain for family consumption. The main purpose of selling grain is for immediate cash, which farmers live on while waiting for profits from seed sales. The group has been able to obtain credit for purchasing a thresher. This became necessary when the area planted to beans for seed increased. The Cauca group has managed to make profits from seed production and sales (Table 6). Profit from two work campaigns paid for the thresher.

The advantage of the group approach to seed production is that minimum infrastructure (warehouse) and equipment (a scale, moisture meter, seed treating machine and bag sealing device) are required. Consequently, only minimal capital investment is required. On the other hand, seed conditioning provides job opportunities for members of the family, and farmers obtain a product with a higher aggregate value and revenue earning capacity.

Table 6. Cost-benefit analysis of bean seed production in Cauca, Colombia

Costs	US$/ha
Inputs	446.71
Labor	398.71
Interest (18% annually)	103.16
Rent on land	35.40
Total	983.98
Gross profit	1,584.00
Net profit	600.02

Note: Wages = US$2.50/day
Price of bean grain = US$0.56/kg
Price of bean seed = US$0.96/kg
Source: Roa et al., 1991

Enterprises with small seed conditioning equipment

The El Vallesito Experiment Station of the Santa Cruz de la Sierra University in Bolivia is the example we will use to illustrate how seed producer groups with small seed conditioning equipment function.

Bean cultivation in Santa Cruz is a relativey new activity, and beans are primarily grown for export. Most farmers sell all the harvest and purchase seed for planting. Seed production is carried out in the mesothermic valleys, such as Mairana, close to the city of Santa Cruz, from December to March (summer). Planting for commercial grain production is carried out in the La Llanura Crucena, from May to August (winter). These consecutive, specialized plantings for seed and for commercial grain avoid seed storage problems.

The potential demand for seed for commercial winter planting in La Llanura is 1000 t per year. In 1992, when production peaked, 390 t of seed was supplied (Table 7). In addition to ASOPROF in Santa Cruz de la Sierra, which produces 200 t of seed per year for its members, other small private enterprises produce bean seed to fill the high demand. One of these is the Association of Beans and Maize Seed Producers (APROSFYM), based in the Mairana valley.

Table 7. Bean seed production the in state of Santa Cruz, Bolivia

Year	Area under seed production (ha)	Area planted by farmers	Commercial planting ares (ha)
1986	20	22	670
1987	12	14	800
1988	16	19	1,500
1989	18	20	7,800
1990	98	143	18,000
1991	311	199	20,000
1992	437	398	8,000*

* The low yields were due to drought.
Source: El Vallecito Experiment Station, Santa Cruz, Bolivia

Activities to form a small group of seed producers were started in 1991. An agreement was signed among the institutions and organizations participating: the El Vallesito Experiment Station of the University of Santa Cruz, to supply basic seed and technical support; CIAT's Seed Unit, to train farmers and finance the construction of the warehouse and purchase of small conditioning equipment; ASOPROF, to cater for managerial and marketing tasks; and the Regional Seed Service, to provide production and quality control technology. The group of 14 farmers who founded APROSFYM accepted to purchase a piece of land for establishing a small seed conditioning plant and to provide labor for constructing the warehouse.

The first planting was done during the summer of 1991-1992. The small conditioning equipment was delivered in April 1992, and conditioning of the raw material already produced started immediately. Seed production data during the three campaigns are shown in Table 8. The last campaign produced 22.3 t of APROSFYM seed. Additionally, 81 t of ASOPROF seed were conditioned at the small plant.

Table 8. Bean seed production by APROSFYM in Santa Cruz, Bolivia

Campaign	Production (t)
1991-92	13.5
1992-93	11.3
1993-94	22.3*

Note:
* 81 t of seed from ASOPROF was also conditioned
Source: EL Vallecito Experiment Station, Santa Cruz, Bolivia

Members produce and then deliver the raw material to the small conditioning plant that is operated by one of the members of the group. Record is kept of the amount of grain delivered by each farmer and of the seed obtained after conditioning. Seed is packaged in 45 kg bags with APROSFYM's logotype. Marketing is done from the plant itself, and the seed is sold to farmers or organizations that promote bean growing in Santa Cruz.

In spite of the fact that the founding institutions continue participating and that all the seed has been sold, representing an economic benefit for the association's members, the enterprise has experienced some difficulties. It does not have funds to meet its members' production costs: they have to meet their own expenses or find money at the local level, primarily for purchasing inputs and for paying labor during harvest time. The thresher, dryer and seed selection equipment have not been working well, and some of the other equipment has been repaired or substituted.

DISCUSSION

Production and use of certified seed is low in the 10 bean producing regions of Bolivia, Peru, Ecuador and Colombia, where 57% of the farmers use thier own seed. In places with high volumes of certified seed production, such as Santa Cruz in Bolivia and the North Coast of Peru, beans are produced basically for selling, and there is considerable demand for technological inputs. This may partially explain the use of certified seed in these few sites.

Data are not available on the real and potential demand of bean seed in these countries. Nonetheless, it is evident that in all cases the current high quality seed production, under any kind of system or modality, is far below the real needs. Evidence shows that seed produced in all the sites by organized groups has been of high quality and that demand surpasses supply. Seed production to support release and diffusion of new varieties has been a real success. Examples are the varieties Kori Inti and Jacinto in Cusco, and Blanco Laran in the Central Coast of Peru; Vilcabamba in Ecuador; and ICA Caucaya in Cauca, Colombia. For this reason PROFRIZA's strategy includes this as a requirement for release of new varieties to farmers.

Non-conventional seed production, commonly known as artisanal seed production, has been accepted by countries where CIAT's regional projects operate and in Colombia. This concept refers to all those methods for producing high quality seed that is not certified, under production and quality norms that are less strict and less bureaucratic than those required for certified seed. In cetain cases, norms and procedures could be similar to those specified for certified seed.

There are other non-conventional seed production methods besides those described in this document. It is also important to note that a country or region should try several complementary options. Groups of farmers organized in small enterprises for producing high quality bean seed seem to be the best option.

The list below contains characteristics that define artisanal or non-conventional bean seed production.

1. Seed production and dissemination involves individual farmers or small organized farmers groups.

2. Producers must receive training in production, post harvest conditioning and marketing of high quality seed.

3. A participatory approach to working with organized groups should be used.

4. A committee is required to advise farmers and to follow up on the group's activities.

5. There must be rules and regulations governing seed production and conditioning to ensure good quality.

6. A minimum infrastructure must be in place, including equipment to receive, condition and store the seed.

7. The small group should have a good internal control mechansim to ensure good management at all stages.

8. The producers should have technical and administrative support from institutions or organizations dealing with similar work.

9. Individual or small group producers should periodically receive basic seed of the produced varieties.

10. The organized seed producers should create or find funds to be used for capital investment to meet production expenses.

11. Each producer should divide the crop into seed, grain for selling and grain for family consumption.

12. To ensure that seed produced is marketed, growers should obtain sale contracts before seeding.

13. An attractive seed price should be guaranteed, and a stable seed supply should be maintained throughout the year.

14. A register of all expenses should be kept, and a cost and profits analysis should be done for each season.

15. The small enterprise activities should not be limited to seed production: bean grain and seed of other crops can also be produced.

The list does not try to simplify a broad concept. However, we consider that certain aspects should be given special attention:

a) Participatory group work with producers
b) Establishment of standards for ensuring quality
c) Technical support from institutions or organizations
d) Maintaining an acceptable price that small farmers can afford.

If artisanal seed production is going to be a successful approach to seed production, it should involve bean producer groups located in bean growing regions, which must be established and organized as small, self-managed enterprises.

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DISCUSSION OF PRESENTED PAPERS

SESSION 1: FARMERS' SEED SYSTEMS

QUESTIONS TO L. SPERLING AND S. DAVID

A. Deressa (question)
In most cases, farmers are not willing to accept unknown varieties, but you said farmers pay high prices for unknown varieties. How could it have happened?

L. Sperling (response)
Our experience in Rwanda and Zaire at several sites suggests that farmers are willing to pay for unknown varieties if they have reason to suspect the genetic quality is superior. Of course, if farmers have a bad experience with some of the varieties purchased, they will cease to purchase the product. The opposite is also true, after a good experience they will buy again.

N. Louwaars (question)
To what extent can Rwandan experiences be extrapolated?

L. Sperling (response)
Certain principles may hold in Rwanda and Zaire, but may not hold geographically and certainly not for all crops. It is the challenge of this workshop to find those principles that will hold.

W. Godderis (question)
If the distribution of bean seed in small packets did not benefit from subsidies, were there no hidden subsidies such as transport costs, staff salaries?

L. Sperling (response)
Many costs, such as cleaning, packing up and labeling, were taken into account, but others such as transport, may be considered as hidden costs. In any large-scale distribution, these hidden costs would have to be taken into account.

W. Godderis (question)
Is the small packet exercise sustainable? Does it take account of recurrent or hidden costs?

L. Sperling (response)
In the overview paper I wrote, you will find two separate economic calculations of the dissemination exercise based on two separate diffusion trials. The CIAT exercise includes all costs except transport; transport was minimal (less than 15-20 km). The PAK exercise also details how it calculated costs. They did subsidize the packets, but to a very small degree.

D. Lemessa (question)
How do you create awareness about the new improved varieties to farmers before distribution of the seeds for higher prices? What information came along with the seed packets? How did farmers become aware of the availability of the packets?

L. Sperling (response)
A single sheet in the local language described the basic characteristics of the variety: growth type, cooking time, good taste, farmer appreciation and, in the case of climbers, management practices.

In terms of finding the varieties, farmers simply discovered them when they visited shops and open markets and the word spread quickly. Obviously, if many varieties are to be released regularly, a more systematic information campaign will have to be launched.

SESSION 2: INTER-INSTITUTIONAL LINKAGES IN SEED PRODUCTION

QUESTIONS TO W. MANGHENI AND R. LEPIZ

R. Kirkby (question)
Has the proposed Uganda seed law taken into account the recent recommendations of FAO for a less stringent category of 'quality declared' seed? Would it be useful to do so?

W. Mangheni (response)
Section 24 of the proposed seed law takes care of the recommendations, and I feel it is useful in the case of seed produced by farmers themselves.

G. Kassaye (question)
The seed industry in Uganda still produces an old variety, K20. Why is such an organization only concentrating on one variety?

W. Mangheni (response)
This is the only variety we got from breeders to multiply. The industry also has not been working closely with the National Bean Program in testing varieties in the pipeline. However, we have now received some breeder's seed of K131 and K132, which we are going to multiply on our foundation seed farm.

A. Deressa (question)
How many certified seed production centers do you have in Uganda? How much do they contribute to solving farmers' seed production problems? How do you relate the question of sustainability with the local seed system?

W. Mangheni (response)
We have one certified bean production center in Kasese on the slopes of Mt. Rwenzori. Most of our seed has been going to places experiencing civil strife or drought. So we supply only a small percentage of our farmers with improved bean seed. Local seed systems, if integrated into the formal system, would avail more farmers with quality seed at possibly an economic price.

L. Sperling (question)
Could you explain the overall objective of your seed program? You produce in large volumes plus you insist on a high (formal) quality standard.

R. Lepiz (response)
The overall objective is to train individual producers or small organized groups of farmers to produce high quality seed. The amount of seed is determined by the demand in a region.

W. Mangheni (question)
What is the pricing policy of these organizations? In other words, who determines the price at which the farmers sell their seed?

R. Lepiz (response)
The small group determines the price of the seed.

M. Banda (question)
You said that part of the seed produced is sold as grain. Roughly what proportion is sold as grain and therefore lost according to the original objective?

R. Lepiz (response)
I don't know how much, but farmers sell part of the seed as food grain to cover costs before selling the seed.

S. David (question)
What was covered in the seed production courses?

R. Lepiz (response)
Aspects of seed training: field management, roguing, timely harvest, post-harvest management (drying and selection) and business management.

N. Louwaars (question)
Do the individuals and groups have their seed certified?

R. Lepiz (response)
Individuals and groups take care of seed quality, supported by the official quality control officers. In the Bolivian case, farmers get advice on seed quality from a formal organization.

N. Louwaars (question)
Was the seed produced by individuals, the groups or the projects in Bolivia officially certified?

R. Lepiz (response)
In the first two cases, quality control is done by the producers themselves based on methods introduced by quality control officers. In Bolivia, complete certification was introduced.

L. Sperling (question)
What is the overall objective of the artisanal seed program? Is it a commercial operation or does it provide beans for exportation?

R. Lepiz (response)
Making money is the objective of the program.

SESSION 3: CASE STUDIES ON ALTERNATIVE APPROACHES TO BEAN SEED PRODUCTION AND DISSEMINATION

QUESTIONS TO D. LEMESSA, A. DERESSA AND G. KASSAYE

L. Sperling (question)
You mentioned you are working in a stress zone and yet you have decided to use the same three varieties that are used in Nazaret and Awassa. Have you considered looking more systematically at local varieties other than Red Wolayta or have you asked researchers to provide some varieties particularly for the stress zones?

D. Lemessa (response)
These varieties have been used due to their wide adaptability. The local varieties were considered; that is why they were included in the trials and the project has continued undertaking participatory on-farm trials for better awareness of the varieties.

N. Louwaars (question)
Repayment was very high with the local variety, over 80% in the first year, and low for the improved varieties (30-40%). What is the reason?

D. Lemessa (response)
Repayment of 80% was during a good year, repayment for all varieties (improved and local) was low in the second year. There was no difference among varieties.

W. Mangheni (question)
Why didn't you include Mexico 142 in your diffusion trials?

A. Deressa (response)
Mexico 142 is an old variety affected by disease. This variety has been replaced by Ex-Rico 23, so we did not include it in the dissemination program.

N. Louwaars (question)
Who produces the seed for dissemination?

Aberra Deressa (response)
For the research phase it is the research institute itself. When larger scale diffusion is done by extension, the Department of Agriculture can contract the Ethiopia Seed Corporation to produce the required quantities.

N. Louwaars (question)
Who should take up diffusion of varieties after the research phase?

A. Derresa (response)
Extension should do it.

Dechassa Lemessa (response)
NGOs can be important.

K. Elukessu (response)
Development projects and women cooperatives are useful.

L. Sperling (question)
A clarification on your testing practices: you mentioned that you demonstrate the improved variety with the use of improved practices. Do farmers also get to see the improved varieties under traditional practices?

G. Kassaye (response)
Yes, both improved and local varieties are demonstrated under both practices, i.e, improved and traditional.

R. Lepiz (comment)
The Southern Region of Ethiopia has good varieties and good technologies for management. If the main objective in the Southern Region of Ethiopia is to disseminate new varieties, I would suggest that first of all, emphasis be put on the varieties because farmers adopt components and not packages. Then the second step can be the agronomic practices.

S. David (question)
Why do you give seed free of charge to farmers?

G. Kassaye (response)
Selling seed will hinder diffusion because the farmer who initially gets the seed will not be willing to give to other farmers, as the next farmer can buy it from the research centers.

D. Lemessa (comment)
It also endangers the commercial seed agencies.

A. Deressa (response)
Research in developing countries is publicly funded, so whatever research is done on farmers' fields, e.g, varietal, fertilizer, etc., should be given free of charge.

M. Mmbaga (response)
Giving seed free of charge to farmers can enable neighbors to learn and be aware of new cultivars and therefore enhance dissemination rather than waiting for farmers to buy seed from research institutions.

N. Louwaars (question)
Should diffusion samples be given free of charge?

A. Deressa (response)
Yes, this is necessary in the research phase in order to get sufficient cooperation.

D. Lemessa (response)
Preferably not, because other farmers may wait until they also get a free sample and they will not buy the new variety. A good alternative is to give seed on loan with repayment in kind.

M. Mmbaga (response)
The advantage of giving seed free is that farmers will share experiences (and seed) more easily than when they have to pay for the sample.

S. David (question)
There appears to be multiple objectives in the Ethiopian studies (dissemination, yield assessment, adoption). Is this not counter productive?

A. Derresa (response)
Dissemination is seen as an extension of demonstrations. The issue of the amount of seed is debatable, but I feel that 5 kg is needed to allow farmers to diffuse seed.

S. David (question)
Is giving out seed free sustainable for national programs especially where more than one new variety is involved?

A. Deressa (response)
Giving seed free of charge is also debatable. Kassaye felt that farmers would not cooperate if seed is sold. This work is part of research which is being subsidized. Giving out of free seed as part of a dissemination exercise would be dangerous.

QUESTIONS TO W. GODDERIS

N. Louwaars (question)
How is seed of released varieties disseminated in Burundi?

W. Godderis (response)
In Burundi, formal and informal dissemination systems are used for bean seed dissemination.

N. Louwaars (question)
Can you disseminate mixtures of cultivars in Burundi?

W. Godderis (response)
No, because varietal mixtures are specific for every farmer.

QUESTIONS TO M. MMBAGA

A. Deressa (question)
The number of farmers who registered for seed distribution fell between 1989 and 1993. Why?

M. Mmbaga (response)
As I pointed out, the decline was due to financial and transport constraints. The whole system of research is now short of funds and hence each project is affected, including the seed distribution scheme.

R. Lepiz (question)
Considering the lack of seed in your country, in order to produce a sufficient volume of seed of the improved varieties, how are you going to do the work with the farmers for multiplication of the seed?

M. Mmbaga (response)
The best way to go about it is for the product to sell itself rather than providing incentives to farmers because that will not be sustainable. Creating awareness and eventually acceptability, accompanied with good selling price due to high farmers' preferences, will enable seed producers to produce more seed knowing that the market is available.

S. David (question)
Why the need to use the loan system or require farmers to give gifts to specific people?

M. Mmbaga (response)
This was to ensure that diffusion actually took place and was not left up to the discretion of the farmers.

M. Mugisha-Mutetika (question)
How do you ensure that farmers pay back the seed?

M. Mmbaga (response)
By monitoring throughout the season to ensure that the farmers' harvest is available.

M. Mugisha-Mutetika (question)
How did you select registered farmers?

M. Mmbaga (response)
Through collaboration.

QUESTIONS TO S. KASOZI/S. DAVID

M. Mugisha-Mutetika (question)
How did you come up with the packaging costs?

S. David (response)
It included both the packets and labor, but not the cost of the informational leaflets.

G. Kassaye (question)
Have you considered farmers' preferences in taste, palatability in your study? What was the farmers' opinion of these two varieties?

S. Kasozi (response)
Farmers were involved in the evaluation of these varieties before they were released and in some regions they preferred CAL 96 because of its red color which gives a dark soup when cooked. In those regions MCM was not preferred because it produces a much lighter color soup.

A. Deressa (question)
You said that one of the new varieties is small and less marketable. Why do you introduce this variety when farmers prefer large seeded ones?

S. Kasozi (response)
There are areas in the country where farmers prefer this variety. Although it is small, it has many other positive characteristics, such as tolerance to drought, resistance to diseases, a very high yield, etc, which some farmers consider important.

QUESTIONS TO K. ELUKESSU

R. Lepiz (question)
In Zaire, are food beans transformed to commercial seed?

K. Elukessu (response)
No. a farmer produces beans for consumption but from his produce he makes seed for planting. That means there are no separate fields for seed production.

N. Louwaars (question)
Is another organization involved in seed dissemination?

K. Elukessu (response)
We work on acceptability trials, where the new variety is accepted or not and seed is kept by the farmer.

L. Sperling (comment)
The research system has the advantage in doing research and we have been discussing ways in which research can hook up with a variety of organizations (NGOs, women's groups, etc) to disseminate research products to a range of clients. Dissemination is not research's strength. But the Burundian dilemma: how to distribute seed relief and how to collect seed mixtures, shows how these channels have to flow two ways. This is true even in routine collaboration: NGOs, women's groups, etc., have to have ways to feedback information, etc. This flow-back may not come naturally! It has to be planned for.

QUESTION TO M. MUGISHA-MUTETIKA

S. David (question)
What is meant by 'informal seed industry'? What was the sample size? In defining adoption, how many seasons were considered?

M. Mugisha-Mutetika (response)
The sample size was 22 for trial farmers and 54 for non-participants. Farmers were asked, "which of the new varieties did you plant again?". No specific question was asked about the number of seasons planted.

QUESTION TO N. LOUWAARS

M. Mugisha-Mutetika (question)
What exactly is the problem of the formal seed system and where does its future lie?

N. Louwaars (response)
The problem lies in the cost of seed processing and distribution. Its future lies in the commercial crops such as maize, but it may be impossible for beans.

QUESTIONS TO M. BANDA

S. David (question)
In Malawi, how many varieties are you multiplying and who determines the varieties?

M. Banda (response)
We started with three improved varieties in on-farm trials. One variety (provided by Bunda College) proved very popular with farmers during trial evaluations, and it is this variety that will be multiplied. It is farmers who determine which varieties will be multiplied. There are no plans to multiply local varieties.

M. Mmbaga (question)
Malawi is well known for growing mixtures. You do not seem to be multiplying mixtures.

M. Banda (response)
What we are going to do this season is to multiply the variety that is widely preferred by farmers as revealed by our on-farm trials. Maybe in future we may get to know what mixtures are popular among farmers and include them in the multiplication scheme.

SUMMARY OF SMALL WORKING GROUP DISCUSSIONS AND GENERAL RECOMMENDATIONS

WORKING GROUP A: PROMOTION OF NEW VARIETIES

Issues to be clarified	Potential and opportunities	Constraints to overcome	Training
Varieties: Who chooses the varieties? Few vs. many; Targeting micro vs. macro levels; Local vs. improved varieties;	Available genetic diversity is high	Promotion	Breeders, seed specialists and policy makers
Approaches to genetic conservation	Potential for ex-situ conservation is high; potential for in-situ conservation is low		
Production: How organized? Who produces? Certified vs. non-certified seed; Localized vs. diverse	Collections are often lost		Train well established seed producers
Distribution: How organized? Quantities? Reimbursement?	Use of diverse channels		

WORKING GROUP B: SEED SYSTEMS FOR RESTOCKING

Key topics

1.To restock bean seed either on a continual basis for resource-poor farmers or the entire bean system in an emergency situation;

2.To collect and introduce or re-introduce local and improved germplasm.

Collecting germplasm

Ethiopia. Collecting seed of crops and varieties is conducted by the Plant Genetic Resources Center (PGRC) on Ethiopia. Red Wolayta, an improved variety introduced some time ago, as well as local haricot beans are grown in Ethiopia. Both local and improved cultivars are screened in on-farm trials.

SOS-Sahel does not collaborate directly with PGRC, so one of the constraints to overcome is improving links between development projects and PGRC.

Burundi. Some collections were made in the past by IRAZ (Institut de Recherche Agronomique et Zootechnique) and ISABU (Institut des Sciences Agronomiques du Burundi), but there should be procedures to feed germplasm to development projects, research, NGOs or IRAZ. The Burundi National Bean Program began collecting bean seed through development projects, church organizations, farmers and also itself directly after the start of the civil unrest in 1991.

Recommendation: ISABU, RESAPAC (Reseau pour l'Amelioration du Haricot Phaseolus dans la Region de l'Afrique Centrale), the Ministry of Agriculture and donors should financially support systematic plant genetic resource collections to be undertaken by bean research projects from different sources such as development projects. Immediate funding to collect plant genetic resources is necessary.

Rwanda. Much of the diversity has been lost and the mixtures being saved are very localized. Collections were made in 1985 and 1991 and are stored outside the country. Two activities are to be undertaken: (1) one more collection is going to be made, (2) the extent of loss and genetic erosion is going to be studied in three areas. However, the methodology to assess the representativeness of the site is a constraint.

Zaire. Collections were made by IRAZ and kept in the germplasm bank at IRAZ and at CIAT. Lack of immediate funding to collect plant genetic resources is a constraint. A working group is needed to study methodologies to collect and indicate provenance of mixtures made in baseline collection.

Conservation

Recommendation: Duplicate collections should be stored externally due to the lessons learned from Rwanda and Burundi where both natural and regional and natural and informal collections were lost (but intellectual propriety rights have to be respected).

Restocking

Ethiopia. Local and improved cultivars could be redistributed to farmers. A variety could be specifically targeted to a particular area but varieties should have wide adaptability like Awash and Roba. About 75% of the farmers have no access to bean seed of some locally grown cultivars such as Red Wolayta. Farmers are involved in every step of distribution.

Burundi. Local mixtures are being multiplied as the dominant varieties just as the adopted released varieties are multiplied inside and outside the country. Information was given to donors about the importance of local mixtures. The mixtures were taken inside the country and distributed to ecologically similar areas. Some provenance studies were undertaken by IRAZ and a frequency study, covering parts of Burundi, was undertaken by ISABU.

Rwanda. Mixtures are multiplied. Separation of the mixtures is undertaken and the components, as well as newly adopted released improved varieties, are being multiplied. A sheet of information was distributed to NGOs at the start of the work. Ideally, seed should be taken from ecologically different areas (e.g, seed from Kabale, Uganda) and redistributed to mid- and high-altitude areas. Mixtures from outside and within the country will be distributed to a similar area, e.g., 600 t of mostly K20 from

Recommendation: A frequency distribution study of the different components should be undertaken (if it was not done) to target distribution to different areas where the components are grown.

Zaire. A frequency distribution study should be undertaken before redistributing local mixtures. The status of the plant genetic resources collection should be verified.

Production

Ethiopia. In an SOS-Sahel Project, individual farmers who multiply a quantity of seed (e.g., 5 kg) give the same amount for redistributing to other farmers the next season. A committee supervises these activities. Quality control (e.g., disease control) is not perfect. Women are involved in this project.

Recommendation: A system of interest rates should be built in, but farmers have to decide on this. Systematic assessment is to be made.

Rwanda. The components of the local mixtures are mostly multiplied by Ugandan, Kenyan, Zaire, Tanzanian and Malawian national programs and in Colombia. Some multiplication is done within Rwanda. Climbing bean seed is being multiplied by CARE in Uganda. The Seeds of Hope Project is meeting the expenses. Sustainability of aid is considered in the regional capacity for emergency work. Distribution may be done through NGOs and churches.

Burundi. Local mixtures are multiplied by the National Bean Program within the country, in Arusha, Tanzania, by RESAPAC and in Colombia. Some of the varieties of the mixtures from Rwanda or outside may also be grown in Burundi. An assessment of the cultural situation was undertaken in March-July 1994. The state of funding rescue efforts for bean seed in Burundi is to be clarified.

Zaire. There is no particular urgent problem of restocking in Zaire.

Other points raised during discussion

Ethiopia. Germplasm collections of beans are kept in a genebank and are used by breeders. During screening, the best local cultivars are used as checks. SOS-Sahel has no interaction with PGRC. There are many different varieties, but some have a better, wider adaptability than others.

WORKING GROUP C: ARTISINAL SEED PRODUCTION

Production

Issues to be clarified	Potential	Constraints
Who should produce? Which kind of seed to produce? What volume? Should production be communal or individual?	Individual farmers, organized groups, new groups; organized groups can produce good seed and high volume	Individual farmers can't produce large volumes/difficult to follow up; small groups require institutional support; high cost of support to large numbers and dispersed individuals/groups
Area: produce in ecologically optimum areas or where demand exists?	In high potential areas production may be easy but competition high; in low potential areas, production may be difficult but demand high.	
What kind of support is needed?		Shortage of capital/credit; technical advice needed; adapted technology and inputs needed
What is the most cost-effective method of production/ organization?		Issues related to volume and production methods give rise to labor, handling, storage, distribution constraints
Who does quality control?	Self-certification? full certification? spot-checks? fully self-checked?	Full certification too costly and may not serve target group; self-certification has advantages and disadvantages; full self-checking is risky
		How do groups know which varieties are available? how do they get initial breeders seed? who multiplies breeders seed and supplies to groups? at what cost?

Varieties

Issues to be clarified	Potential	Constraints
Who selects the varieties? Local vs. improved, few vs. many, individual varieties vs. mixtures?	Farmers can assist in selections (participatory breeding), scope for locally adapted varieties; good varieties can help develop the system; system can be used to introduce new varieties to many farmers Landraces can be produced provided quality control is limited to germination, physical purity (but not varietal purity)	Individual groups cannot produce many varieties but several groups can; varieties should be identifiable (ie. distinct from existing/known ones) Participatory breeding: difficult logistics, need for strong research program, multi-disciplinary approach; methodology not well developed yet; breeding methods for specific adaptation/genetically diverse varieties not well developed yet Flexibility is needed in varietal release laws
Who should pay for breeding (plant breeder's right system- where royalties are paid to breeders for breeders seed)?		Law must be flexible with regard to plant breeders rights

Distribution

Issues to be clarified	Potential	Constraints	Training
Is there demand for the product? Who are the competitors? Who does the demand study? How to gauge demand? Can you create demand? Is demand sustainable? Do distribution channels exit? Which ones are best for reaching different clients? What is the relationship between demand and price and distribution channel?	Demand depends on quality factors, time-recurrent seasonal shortages. Create demand through existing commercial channels; direct institutional contact Farmers can produce good quality seed; organized groups can produce non-conventional seed.	Difficult for small groups to gauge demand; can the formal system produce basic seed for restocking? Availability of seed treatments: identification, safety, price Technology to produce quality seed: drying, roguing, post-harvest, price implications Knowledge to produce quality seed; legal constraints-e.g. seed laws Lack of training materials	Training in business management, quality issues, group management, promotion and marketing analysis

Training

Issues to be clarified	Potential	Constraints
Train who?	Training of trainers Training of farmer producers	Lack of training materials

RECOMMENDATIONS

- •Include representatives of artisinal seed association on varietal release committees;
- •System sustainability has to be a primary concern in the research phase and in the promotion of artisinal seed production;
- •Design training materials;
- •Train trainers in business, quality issues, group management;
- •Set up global, regional and national artisinal seed producer associations and networks;
- •Secure policy support on seed legislation and unfair competition;
- •Support research in seed legislation and institutionalize support to producers;
- •Develop methodologies for market surveys for small seed producer groups and for developing training materials.

PLENARY DISCUSSION

Topics

- •The role of local varieties in breeding programs (why focus on them when their yield is low generally?);
- •Targeting of recommendations;
- •Exchange of information on alternative seed systems.

While participants were interested in non-formal seed production, only a few have worked in it. It was wondered why little work has been done in this area. Is this because there is no need for non-formal bean seed production? For some countries, e.g. Zaire and Uganda, it was felt that alternative seed production is important. It was also seen as important in Ethiopia by NGOs and farmers associations and is already on-going. There is need to systematically assess, across commodities, if seed limits agricultural productivity.

GENERAL RECOMMENDATIONS

- •Conduct and support more studies of local seed systems;
- •An assessment of supply/demand across commodities and in different areas is needed;
- •Develop standardized methodologies of seed system research in the region;
- •Analysis of the efficiency of diffusion/movement of new genetic materials is required;
- •Establish a pan-African working group on seed issues comprising research scientists, NGOs, policy-makers, extension and representatives of the seed industry.

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