Successful Community-Based Seed Production Strategies

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CIMMYT

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Abstract: Designed to address the issues that limit the access of small-scale farmers in sub-Saharan Africa to quality, affordable seed of the crops on which they depend for food security and livelihoods, this collection of articles describes successful principles for and experiences in community-based seed production. Among other things, the manuscripts analyze current seed production systems and models; propose ways to design successful community-based seed production schemes; describe proper seed production practices for selected cereals, vegetatively propagated plants, and other crops; and outline basic business practices for seed producers.

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Foreword

More than 70% of the population in the Southern African Development Community (SADC) region depends on agriculture for household food security, livelihoods, and incomes. Governments are determined to develop and improve this sector to alleviate poverty and hunger.

Seed is an important catalyst for the development of agriculture. The availability of quality seed is the foundation for food production and productivity and a precursor to crop and food diversification—a goal pursued by many governments in the region. Efforts to improve the performance of the agricultural sector should include seed production and delivery systems.

National agricultural research systems and international agricultural research centers have worked together to develop new, stress tolerant crop varieties that are well adapted to smallholder farmers' conditions. However, most farmers in the region have little or no access to improved seed and continue to recycle seed that has been exhausted after generations of cultivation. Yields have remained poor, resulting in persistent food insecurity.

To address this problem, non-governmental organizations (NGOs) have led a number of community-based seed production activities, but many of these projects have achieved only limited success due to several factors, including:

- Lack of sustainable seed production and product markets.
- Lack of access to foundation seed.
- Lack of training on quality seed production.
- Failed or rejected seed crops due to management problem.
- Lack of or poor information about the availability, characteristics, and prices of seed of improved varieties.

This manual is intended to address these issues, strategizing and sharing experiences on community-based seed production. I hope it will contribute to the improvement, efficiency, productivity, and sustainability of seed systems in the region.

Edward Zulu
SADC Seed Security Network Coordinator

Part 1:

Understanding Seed Systems

in Southern Africa

An Analysis of Seed Systems Development, with Special Reference to Smallholder Farmers in Southern Africa: Issues and Challenges[1]

E.S. Monyo, M.A. Mgonja, and D.D. Rohrbach[2]

Introduction

Most smallholder farmers living in drought-prone regions of the Southern Africa Development Community (SADC) continue to rely on drought relief and informal farmer-to-farmer exchange to obtain seed of improved varieties. Well over 90% of smallholder farmers' requirements are met through these channels. It is therefore important to give due recognition to the informal sector a low-cost source of seed, and to use it as a vehicle for providing resource-poor farmers with improved seed of modern varieties at affordable prices.

This raises questions about the viability of commercial seed production and trade for smallholder crops—particularly sorghum, millets, beans, cowpea, bambaranut, pigeonpea, groundnut and open-pollinated maize varieties (OPVs)—in drought prone areas. Hybrid seed of maize and sorghum is more widely produced and marketed throughout the region, but seed of open pollinated varieties is only produced in anticipation of emergency purchases by governments and NGOs. Private seed companies voice concerns about the level and consistency of demand by the smallholder farmers for seed of open pollinated varieties. These concerns are reinforced by the continuing practice of delivering seed through non-commercial channels.

During the past 25 years, national programs in the SADC region, in partnership with international agricultural research centers, have released a number of varieties. Some of these are excellent candidates for regional use and therefore multi-country release, if a regional policy existed. This would create a much larger potential market, making it more economical for the few active private seed companies in the region to deal with smallholder, communal, semiarid tropical crops, as well as maize OPVs. Stringent phytosanitary rules and lack of harmonization of seed regulations across countries have made it harder for the smallholder farmer to gain access to seed of these research products.

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1. Paper presented at the workshop on successful community based seed production strategies, co-organized by CIMMYT and ICRISAT, 3-6 August 2003, Harare, Zimbabwe.

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Innovative, community-based seed production and distribution strategies, coupled with policies supportive of regional variety registration and release, will have a positive effect on smallholder access to the products of international centers and national programs.

Issues in Seed System Development

The objectives of a functioning seed system are to:

- Provide seed of appropriate varieties for use by different categories of farmers.
- Develop and identify new and more productive varieties with traits sought by consumers.
- Multiply and distribute these on a timely basis and at a price acceptable to farmers.
- Maintain quality control through training and regulatory systems.

In the current system, two time lags need to be reduced to improve access by smallholder farmers to seed of new varieties:

1. Delays as long as 10 years in varietal development.
2. A long time lag from varietal release to the stage when seed actually reaches farmers.

Types of Seed Systems

Seed systems can be either formal or informal/local. Formal systems generally consist of public sector research institutions, public and private sector agencies producing and marketing seed, and organizations responsible for seed certification and quantity control. The informal system consists of large number of farmers who produce both traditional and modern varieties, market their own production, and take care of their own research needs. Most government- and donor-supported seed systems in Africa are part of the formal system. Within the formal sector, two models of seed system operate:

1. **State/parastatal model:** Researchers provide breeder seed to a parastatal or state agency to multiply on state farms or through contract seed growers. All activities, including seed cleaning, processing, and marketing, are performed by state agencies.
2. **Private sector model:** The private sector plays an important role. Researchers provide breeder seed to be multiplied into foundation and commercial seed. Seed processing and marketing is done by private companies and farmer cooperatives.

In most developing countries the formal sector is far smaller than the informal seed sector. The latter is the major source of planting materials for smallholder farmers in Southern Africa, serving over 90% of their seed needs. Consequently, there would be very large gains if strategies to improve the quality of seed coming from this sector were properly designed and implemented. NGOs have already made substantial investments in community-based seed multiplication schemes, which are part of the informal sector. Assistance should be targeted at improving the efficiency of these investments, by helping NGO schemes improve their seed quality control and seed marketing. Specifically, NGO seed programs could be provided with technical support to undertake:

- Variety evaluation and selection of the best genotypes.
- Maintenance of improved varieties currently being grown, as well as newly selected genotypes.
- Development of training materials to help farmers produce genetically pure seed of cultivars of their choice.

The informal seed system may be the most appropriate in (1) remote areas, where seed distributors find access difficult and farmers cannot easily reach seed and output markets; (2) a narrow agro-ecological zone, where the seed market is limited and widely marketed varieties may not be suitable; or (3) areas where the major crops have very high seeding rates, implying high transport costs to move large quantities of seed over considerable distances.

Strategies to Improve the Local/Informal Seed System

In spite of massive investments in plant breeding research, the rate of adoption of improved seed in sub-Saharan Africa remains at less than 5%, partly due to the inefficiency of local seed systems. It is rare to find modern varieties bred at research stations being passed on to the informal sector for multiplication and sale, as an essential part of the national seed policy. Yet it is the informal sector that holds the key to improving crop productivity among smallholder farmers. In recognition of this fact, some nations in the region have enacted policies permitting the smooth flow of such seed to the farming community.

The government of Tanzania, in collaboration with Denmark, is implementing a 10-year (1998-2007), on-farm seed production program, aiming to strengthen the informal seed sector. Under this program, the formal system will provide initial seed of various crops, which will then be multiplied and disseminated through the informal system. The initial seed is of known pedigree (that is, an approved variety) so as to maintain genetic identity and purity. The seed produced by the program after multiplication is termed "Quality Declared" (Mbwele et al. 2000): responsibility for quality lies with the seed producer. Official quality control is minimal; the Tanzania Official Seed Certification Agency (TOSCA) inspects only 10% of the crop.

The quality of informal sector seed used by small-scale farmers can be improved in several ways:

- Train farmers in better selection, treatment, and storage of seed from their own farms. Own-saved seed is often the most appropriate, certainly for farmers who cannot afford to purchase seed. The training will help them increase production through better use of their own saved seed.
- Encourage farmers to make their own selection of traditional varieties, to multiply and store seed of such varieties, and to sell this quality seed of traditional varieties to other farmers. This strategy is best suited to farmers capable of some experimentation and who are potential users of modern varieties. Initially they should be encouraged to stabilize varieties they themselves have selected. These are farmers with limited resources, but living in medium to high potential areas.
- Develop modern varieties at research stations, and produce good quality seed of these varieties through either formal or informal channels—whichever provides good (or acceptable) quality seed at affordable prices. This strategy will work best for farmers who can be persuaded to buy inputs, provided seed is available at prices considered worth the risk by those farmers. ICRISAT and partners are implementing several strategies in Tanzania (Rohrbach et al. 2002) and Zimbabwe (Monyo et al. 2003). These strategies are sustained by ensuring a reliable supply of breeder and foundation seed, which is then sold to seed producers, and by providing them with advice on multiplying foundation seed to generate commercial seed. Costs can be kept low if this seed is unprocessed and uncertified (Monyo et al. 2003). Little research has been done in this area to validate the added value of "certifying" vs. "truthfully labeled"[3], beyond the proven genetic potential.

Of these strategies, the first two deal with upgrading traditional varieties and do not depend on any interaction between the formal and informal systems. The third constitutes a bridge linking the formal and informal systems. Germplasm (breeder/ foundation seed) comes from the formal system, and subsequent activities are carried out in the informal system.

Government agencies can assist the informal sector in many ways, the most important being to provide access to foundation seed, extension advice on seed production, processing, treatment and storage, and a legal framework that permits the marketing of "truthfully labeled" seed and "Quality Declared" seed. This will facilitate the growth of small-scale entrepreneurs in the informal seed sector. Referred to as the "decentralized farmer-based model," in this approach researchers' involvement in the seed chain stops at producing breeder/and or foundation seed. This seed is sold to farmers who perform downstream activities of multiplication, harvesting, drying, processing, storage and marketing.

[3] Conforms to all technical requirements in the notification of a variety, but not "certified"

Commercial/Private Sector Seed Supply

Insofar as the main constraint to commercial sector investments is continuing uncertainty about the level of demand for seed, ICRISAT and its partners are implementing special projects targeting linkages with seed companies to help them better estimate demand. These include selling seed in small packages or monitoring sales under alternative retail pricing strategies.

The private sector has the initial capital and capacity to make a difference in seed availability. ICRISAT's Sorghum and Millet Improvement Program (SMIP) works with the private sector to facilitate the servicing of smallholder communities. ICRISAT ensures that the private sector has access to good quality breeder/foundation seed stocks by providing this seed directly, if it cannot be sourced locally from the public sector research. It also works with the private sector to improve the rural retail network for OPV seed (sorghum, pearl millet, cowpea, groundnut, and pigeonpea), and to test the demand for improved seed in the rural communities where these crops are important. Companies are profit motivated, and usually deal in only small volumes for the less profitable crops (OPVs). Seed companies in southern Africa have failed to invest in developing rural retail networks for crops other than hybrid maize, citing uncertainty about the level of demand for OPV seed. They also complain that rural retailers have no interest in stocking seed of subsistence crops. As a result, it is impossible to obtain pure seed of OPVs, except in major urban areas. This severely limits the adoption of new varieties.

Whereas large commercial farmers in South Africa, Zambia, and Zimbabwe are producing hybrid maize and seed of sorghum, pearl millet, cowpea, groundnut, pigeonpea and even maize OPVs, much seed is only produced in anticipation of drought relief emergencies. Private firms and NGOs raise concerns that this demand is not consistent. A number of NGOs in southern Africa now produce OPV seed, but the sustainability of these programs is threatened by a lack of marketing strategies. Almost all sorghum and pearl millet seed adopted by farmers in the three countries targeted under SMIP Phase 4 (Zimbabwe, Mozambique and Tanzania) has been derived from free or highly subsidized seed distribution programs run by governments and NGOs. The common availability of this subsidized seed further limits commercial incentives to develop rural seed markets (Jones et al. 2001). Yet, small-scale farmers commonly cite the lack of access to the seed as the main reason for non-adoption of new varieties.

The SMIP initiated a pilot project to test the commercial demand for seed of OPVs of sorghum, pearl millet, groundnut, and sunflower in rural markets when delivered in small seed packs—a cross-section of 5 kg, 2 kg, 1 kg and 500 g. All were sold at prices reflecting the full costs of packaging and distribution (Monyo et al. 2003 in press). The findings from this study are being used to encourage broader private investment in the development of rural seed trade. This should contribute directly to speeding the adoption of new varieties. The small packs pilot program has not, in itself, contributed significantly to the improvement of adoption rates for these crops in Zimbabwe, because of the low volumes involved. However, if the scheme ultimately proves successful, and the private companies involved increase volumes of seed through this channel, an important breakthrough will have been achieved. Ultimately, the SMIP will attempt to see if this can be an important avenue for the distribution of improved seed commercially to small-scale farmers in the SADC region.

Seed Production and Cropping Systems

Predominantly Self-pollinated Crops

Seed of self-pollinated crops such as rice can be multiplied by farmers with some training, with little risk of admixtures, as off-types can be easily removed. Isolation distances required are minimal and it is not necessary to set up expensive seed processing plants or seed certification units. Breeder seed can be sold to prospective seed producers and the seed system can be an informal one. However it is necessary to set up a legal framework permitting the sale of uncertified but "truthfully labeled" seed of notified varieties.

Predominantly Cross-pollinated Crops

Cross-pollinated crops such as maize are more difficult to manage, since off-types are more difficult to detect. Larger isolation distances are necessary (300 + meters). One option is to select good seed growers who can manage the crop properly, register their plots, and certify only seed grown in these plots. These can be contract farmers producing for private public sector companies. ICRISAT is successfully using this approach, where smallholder farmers produce seed on contract to a private seed company. An alternative is to encourage the development of an informal seed system in which farmers develop faith in the quality of seed produced when they are able to see the seed plot and convince themselves that the seed is of the right quality. Another ICRISAT approach uses progressive villagers or village institutions such as primary schools to introduce new varieties into the village seed system (Monyo et al. 2003). Such a strategy aims to stimulate competition among farmers, some of whom could eventually emerge as reputable seed producers. Where the cropping system is dominated by OPVs and farmers use own-saved seed, a combination of these approaches, with emphasis on a decentralized informal seed system, would meet the requirements of most small-scale farmers.

Crops with High Seed Rate and Low Multiplication Rate

The formal sector has shown little or no interest in seed multiplication for crops like groundnut, with high seeding rates and low multiplication rates. Transport, processing, bagging, and certification costs make the seed too expensive for farmers to purchase. For such crops, the most economical way would be to produce seed of the notified variety and sell it to the local community without incurring the extra costs of processing and certification.

Seed System Linkages to Research and Extension

Two factors determine farmer demand for seed of modern varieties: (1) farmers' interest in the new varieties, and (2) whether the seed system is appropriate for the crop and varieties, and practical for farmers.

Effective extension is important. Extension plays a crucial role in training farmers in seed production and is therefore a pre-requisite to establishing a seed system, particularly informal systems, where farmers need training in various aspects of seed production. Just as it is difficult for a seed system to be effective in the absence of extension, it is equally difficult for farmers to adopt extension recommendations in the absence of a seed system that satisfies the following criteria:

- It covers all of the crops that most farmers grow.
- The varieties are appropriate and endowed with critical traits. For example, for smallholder farmers in high risk areas, yield stability is more important than yield per se (Monyo et al. in press).
- The political and legal environment must allow regular release of new varieties, with high quality seed.
- The system must be compatible with the level of agricultural development. For example in situations where most farmers are poor and infrastructure is lacking, it is not desirable to put in place a sophisticated system involving too many institutions before the "basics" are in place.

The system should be supported by effective research and extension services; availability of inputs such as fertilizer, pesticide, agricultural credit; and an efficient commodity marketing system.

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New Partnerships to Strengthen Seed Systems in Southern Africa: Innovative Community/commercial Seed Supply Models [4]

E.S. Monyo, D.D. Rohrbach, and M.A. Mgonja[5]

To improve the harvest, we must first improve the seed. This is widely recognized by governments, NGOs, and by farmers themselves. New crop varieties are available that mature earlier (escaping end-of-season drought), give higher yields, and are more resistant to pests and diseases. But smallholder farmers in southern Africa rarely have access to seed of these varieties. Relief agencies do distribute seed, but this is, at best, a short-term measure – it addresses emergency needs but does nothing to improve seed supply in the long term. ICRISAT and its partners are helping to design and implement cost-effective, long-term solutions. The aim is two-fold:

- Improve seed availability and thus adoption of new varieties
- Build capacity at the community level to ensure a sustainable supply of high-quality seed at affordable prices.

The partners include national research and extension services, other government departments, NGOs, private seed companies, and most important, the community, because our approaches are based on collective action, with other partners providing support. We are pursuing three alternative approaches, depending on the area and community:

- **Contract seed production.** Smallholder farmers are linked with a private seed company. They produce certified seed of new varieties from international centers for the company, which provides logistical support and credit for inputs. ICRISAT provides the needed technical support for the production of good quality seed. Seed Co, the leading seed company in the region, currently contracts more than 2,400 farmers in Zimbabwe. In the past three years more than 1,000 tons of seed of various crops have been produced.
- **Small seed packs.** Seed is sold in small packs (500 g to 5 kg), instead of the usual 25 kg bags. ICRISAT has demonstrated that farmers who cannot afford the large packs eagerly buy the smaller quantities, paying the full cost, without subsidy. In the past two seasons, over 80% of the seed distributed in rural remote areas through the small seed pack program was purchased, helping to spread new varieties in drought-prone pilot areas.

[4] Paper presented at the workshop on successful community based seed production strategies, co-organized by CIMMYT and ICRISAT, 3-6 August 2003, Harare, Zimbabwe

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- **Seed production and distribution through primary schools.** Primary schools in rural areas multiply seed of improved varieties, with technical and logistical support from ICRISAT, government agencies, and other partners. The schools then distribute this seed to nearby communities, ensuring that smallholder farmers have access to affordable, high-quality seed within a convenient distance from their homesteads.

Each of the models is described below in more detail:

Model I. Smallholder Farmer Seed Production on Contract for Sale to Commercial Seed Companies

Drought-induced food shortages are common throughout the Southern African Development Community (SADC). There are two major reasons for these shortages: crop failures of maize due to insufficient rainfall, and low productivity of alternative cereals and legumes due to the continued use of traditional varieties that give poor yields and are susceptible to late-season drought. Governments and NGOs provide food and seed aid almost every year, but such interventions are neither sustainable nor sufficient to alleviate hunger and poverty in rural areas. ICRISAT and the Seed Co of Zimbabwe are working together to strengthen smallholder farmers' capacity to produce quality seed. ICRISAT is an international research organization specializing in drought tolerant crops; Seed Co is the leading seed-house in Zimbabwe with an extensive retail network. ICRISAT supplies improved, open-pollinated released varieties of its mandate crops and offers training and supervision in seed production. Seed Co offers small-scale farmers contracts to produce seed, and buys it from them subject to meeting specified quality requirements.

Strategy

- The program involves promotion of wide-scale adoption of four new varieties with a regional market (Zimbabwe, Mozambique, and Zambia): one variety each of groundnut, sorghum, pearl millet and cowpea.
- ICRISAT uses a block system led by local supervisors and enumerators to carry out seed production. The local supervisors have some formal training in agriculture, whereas the enumerators are elected by farmers on the condition that they hold at least a master farmer qualification. ICRISAT trains the enumerators and the farmers on procedures for quality seed production, and additionally trains the enumerators to carry out data collection, and disseminate information and program inputs.
- ICRISAT also uses the farmer field schools extension approach to teach farmers the principles of improved crop management and various cost-effective options.

Achievements

- This project proves that smallholder farmers are committed and can grow seed as a commercial crop. Farmers were so eager to maintain the contracts that they were willing to sell some of their harvest even during the 2001/02 drought. This shows that smallholder farmer/ private sector partnership is feasible, if there is mutual trust.
- Smallholder farmers are now familiar with seed production techniques. After four years of the program no farmer is being disqualified for not following the recommended techniques.
- The methodology has been tested and refined in Zimbabwe and can now be applied in other SADC countries.

Reasons for Success, Lessons Learned

- The scheme is profit motivated. Farmers look at seed production as an enterprise.
- Seed production capacity in the smallholder sector has been developed and farmers have been successfully linked to a private seed company.
- The program disseminates improved OPVs to smallholder farmers in dry areas, greatly accelerating diffusion of these varieties.
- In dry areas, frequent drought causes communities to remain food insecure. Consequently, some farmers may renege on contracts in drought years, preferring to retain their harvest for food. We are now thinking of diversifying smallholder seed production to include a few areas with more reliable rainfall.

Examples

Zimbabwe. Sorghum and pearl millet are susceptible to bird damage if grown in isolated blocks. This problem is particularly severe in seed production. Small-scale farmers' small plots do not provide for adequate isolation distances for seed production. However, due to the necessity to separate grazing areas from cropping areas, individual plots are often combined into blocks. This block farming arrangement provided the opportunity to test the feasibility of producing seed for commercial sale in communal areas. For this concept to work, the community must agree to grow only the identified variety of the selected seed crop. Small-scale farmers in two pilot districts in Zimbabwe have successfully produced sorghum and pearl millet seed of designated varieties for private seed companies. (Monyo et al. 2003).

Tanzania. The Christian Council of Tanzania (CCT) and the Diocese of Central Tanganyika (DCT) have mobilized groups of farmers and assisted them to register as seed associations. The DCT operates only in the Dodoma region, but the CCT operates nation-wide and has facilitated registration of 11 farmer seed associations. The CCT supports these associations to produce improved seed of sorghum, pearl millet and maize OPVs for commercial sale (Mwaisela 1999; 2000). These associations rely partly on the local community but mostly on their affiliated churches to provide markets for the seed produced. The CCT retains part of earnings to purchase additional foundation seed for farmers. This model has been in operation since 1995. ICRISAT started working with CCT during the 1998/99 season to provide technical assistance and identify the most successful associations, which can serve as models for improving the operations of others and for scaling up. One example is Mpalanga village in Chipanga division of Dodoma rural district, which has significantly enhanced community seed security through NGO assistance.

Namibia. The Northern Namibia Farmer Seed Growers Coop is another example of ICRISAT technical assistance in establishing viable seed delivery systems to small-scale farmers. Initially the founding members (50 small-scale farmers) were trained on seed production by ICRISAT-Bulawayo with support from FAO-Namibia in 1994. It took only four years for this group to develop into a full-fledged, registered seed cooperative able to produce enough pearl millet seed to meet the country's needs (Lechner et al. 1996).

Model II. Promotion of Improved Seed through Sale of Small Seed Packets

Seed companies in southern Africa have failed to invest in developing rural seed sales networks for crops other than hybrid maize. These companies commonly state their uncertainty about the level of demand for seed of OPVs. They also complain that rural retailers have no interest in stocking seed of these subsistence crops. As a result, it is impossible to obtain quality seed of OPVs, except in major urban areas. This severely limits the adoption of new varieties. Seed of OPVs of sorghum, pearl millet, bambaranut, cowpeas, groundnuts and sunflower is only produced in anticipation of drought for relief programs. Private seed companies and NGOs are concerned that this sort of demand is not consistent. Though a number of NGOs in southern Africa have started production of seed of OPVs, their sustainability is threatened by poor marketing strategies. Small-scale farmers commonly cite the lack of access to the seed of new varieties as their main justification for non-adoption. ICRISAT initiated a pilot project to test the commercial demand for seed of OPVs of sorghum, pearl millet, bambaranut, groundnut and sunflower in rural markets, when delivered in small packages.

Strategy

- The seed company establishes retail sales agents in rural areas. In most instances these are the same agents used to distribute hybrid maize seed.
- Seed of OPVs, including sorghum, pearl millet, groundnut, cowpea, sunflower and bambaranut, is packaged in small packs of 500 g, 1 kg, 2 kg and 5 kg.
- The packs are sold at prices reflecting the full cost of packaging and distribution but targeted to the drought-prone areas where these crops are best adapted.
- The rural retail outlets are linked to urban wholesale centers for input supply.
- ICRISAT conducts closely targeted surveys to monitor the success of the scheme: one for the rural retailers receiving the seed on credit, a second survey for urban consumers buying the seed, and a third survey of rural farmers buying the seed.

Achievements

- Approximately 80% of the seed placed in the urban shops was sold, including all of the groundnut and bambaranut stocked.
- Approximately 55% of the seed placed in the rural shops was sold; sales of sorghum and bambaranut were strongest.
- The main reasons buyers cited for purchasing the seed were to try a new variety and to replenish depleted seed stocks.
- In general, the buyers were satisfied with the prices.

- The variable size of the seed packs allowed farmers with less money to purchase smaller sized packages.
- Most of the retailers stated their willingness to collect the seed on their own from the seed company.
- Farmers buying seed made a number of suggestions for improving the program. These included the need to get the seed into the retail shops earlier and maintain this stock over an extended period.
- Farmers appreciate the opportunity to purchase small pack seed and it is likely that sales will grow over time.

Lessons Learned

This program proves the willingness of small-scale farmers to purchase smaller packages of a range of different open and self-pollinated seed crops. Sales are expected to grow if the seed companies are willing to maintain such initiatives. The findings from this study are being used to encourage broader private investment in the development of rural seed trade. This should directly contribute to speeding the adoption of new varieties. The small packs pilot program has not, in itself, contributed significantly to improving adoption rates for these crops in Zimbabwe because of the low volumes involved in the pilot scheme. However, if the scheme ultimately proves successful and the private companies involved increase volumes, an important breakthrough will have been achieved. Ultimately ICRISAT will attempt to see if this can become an important avenue for distributing improved seed commercially to small-scale farmers.

Example

The Seed Company of Zimbabwe established 14 retail sales agents for small pack seed in the rural areas of Zimbabwe for the first time in 1998. This included seed of sorghum, pearl millet, groundnut, and sunflower in 5 kg, 2 kg, 1 kg, and 0.5 kg packages. In the second year the program added six more retailers and at least one additional crop (cowpea). Small seed packs were also distributed through wholesale trading channels for commercial sale to a much wider range of retailers.

Most consumers expressed a strong desire to purchase small packs of seed and they wanted such arrangements extended to other crops, including maize. Most retailers were willing to collect seed from the company, but wanted to retain the credit component of the program. Sales will grow if the seed company is willing to maintain such incentives but the financial incentive to continue doing so remains unclear, since the company achieves higher returns by selling in bulk to relief programs. As long as large volumes of seed are distributed at subsidized prices through relief and emergency programs, the growth in adoption rates of these improved varieties is likely to be derived from emergency distribution, rather than from the development of a retail seed market.

Model III. Rural Primary Schools as Centers for Production and Dissemination of Improved Seed in Tanzania

Each year many new varieties of crops are released and new technologies developed in research institutes all around the world. Much money, time and effort are spent on research to provide farmers with the means to generate higher yields and increased incomes. These varieties and technologies are tested on research stations and on farm, but few are widely adopted by smallholder farmers. Seed availability is a major problem. To address this issue, ICRISAT and partners in Tanzania are using an innovative approach whereby schools in rural communities serve as seed multiplication and distribution centers (Monyo and Mgonja 2003).

Strategy

- Agriculture is part of the primary school curriculum in Tanzania.
- The project helps pupils in rural schools (who are encouraged to learn agriculture) and their parents benefit from easier availability of improved seed.
- Selected schools are within 15-20 km of each other for easy access by farmers; and typically have over 500 students and serve approximately 500-700 farmers.
- Only schools with adequate, isolated land are selected for seed production.
- All selected schools are provided with enough seed to plant one hectare of the sorghum, pearl millet, pigeonpea, or sesame of the varieties recommended for the area.

Achievements

- The pilot scheme involving 50 schools in one district has expanded to 250 schools in eight districts of Tanzania in four years.
- The scheme has expanded from initially providing only sorghum and pearl millet seed to currently supplying sorghum, pearl millet, pigeonpea, sesame and OPV maize.
- Participating schools supply approximately 500 kg of improved seed of new varieties to the surrounding community every year, at affordable prices.
- The initiative has already been adopted by Malawi NARS in collaboration with World Vision International to move improved sorghum and millet seed to smallholder farmers
- Mozambique NARS have indicated interest in adopting this scheme for sorghum, millet, cowpea, pigeonpea and bambaranut.

Reasons for Success

- The successful schools had one common strategy: they enabled the villagers, through the village government, to "own" the project. The village government was backstopping the schools, ensuring community support.
- A training program on seed production was provided to the participating schools (one teacher from each school) and to Ward Education Officers (WEO) who would supervise project implementation. Each WEO supervised seed production in ten schools.
- Field days were held to popularize the concept and to introduce it to other districts.
- Representatives from the Departments of Research and Seed Services Units from Malawi, Mozambique, Zambia, South Africa and Botswana participated in field days held in Tanzania; thus the concept is being extended to other SADC countries.

Example

Tanzania. One specific target under ICRISAT's Sorghum and Millet Improvement Program is having at least one retail seed outlet within a 25 km radius of each targeted community. After a survey of the CCT's school feeding programs in Tanzania, a feasibility study was carried out to investigate the potential of using primary schools as seed centers. All primary school heads interviewed welcomed the idea; they felt the project would be viable (providing the school with extra income) and useful, teaching pupils practical agricultural applications. A meeting between ICRISAT and district-level officials from the relevant government ministries was organized to discuss modalities of operation. Under the leadership of Commissioners from Dodoma and Singida Districts, 100 primary schools were selected, ensuring one seed retail outlet (school) within a maximum distance of 25 km. The teachers were trained on seed production methods. The District Agricultural Officer, Education officers, and staff from the Tanzania Official Seed Certification Agency acted as resource persons. After training each school was supplied with enough foundation seed to plant 1 ha each of sorghum (variety Pato) and pearl millet (variety Okoa). This initiative is strongly supported by the local authorities as an appropriate model for community seed supply.

Zimbabwe and Tanzania. Introduction of new varieties to village seed systems is part the government's Zunde (King's Granary) Program in Zimbabwe, which combines community food and seed security. New varieties are demonstrated in few targeted areas. The produce harvested from the demonstration plot is kept in the "Zunde" for later use by the community for food and/or seed. In Tanzania this model is in operation under the Ministry's Agricultural Sector Program Support sponsored by DANIDA (Granquist 2000). Under this program, 2-3 progressive farmers are selected per village. These farmers are given the appropriate training, and supplied with good quality foundation seed for multiplication, so that they become the source of improved seed for the entire village. Each season the farmers are supplied with foundation seed of different crops; if they produce, say, sorghum seed for the village one year, the next year they will produce groundnut or another crop, returning to sorghum every third year.

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A Community Based Seed Production System—Schools for Seed in Tanzania[6]

E.S. Monyo and M.A. Mgonja[7]

Each year, many new varieties of crops are released and new technologies developed by scientists in research institutes all around the world. Although these varieties and technologies are extensively tested, only a few are widely adopted by smallholder farmers. In southern Africa over 40 varieties of sorghum and pearl millet have been developed and released by the SADC/ICRISAT Sorghum and Millet Improvement Program (SMIP), and partners, since its launch in 1983. And yet, in most countries within the region, less than 10% of the sorghum and millet area is sown to improved varieties. Farmers are often aware that new varieties are available, but are unable to obtain seed. The problem, however, is not with the farmers or with the researchers but, very often, with the commercial seed companies who do not recognize the potential of these improved varieties. It is frustrating for plant breeders who have developed improved varieties but, more importantly, it is holding back farmers who could benefit from them.

Seed multiplication and distribution of improved varieties is a major problem in many countries. ICRISAT and its partners are using an innovative approach in Tanzania to resolve this issue, which could provide a model for other countries facing similar problems with seed shortages (Monyo et al 2003)

Why Primary Schools?

Rural primary schools were identified in two drought-prone districts (Dodoma and Singida) in central Tanzania. The selected schools are already involved in a school-feeding program initiated by the Christian Council of Tanzania (CCT) to help food insecure families suffering from the effects of prolonged drought. As these communities continue to be threatened by drought, it seemed logical to establish multiplication of seed in these schools as a means of moving improved drought-tolerant varieties of sorghum and millet into the communities. Each school has over 500 students and serves 500-700 families, so there is a substantial demand for seed. Agriculture is part of the curriculum, and trained teachers are already in place. The schools are already engaged in agriculture, growing mainly cereals (sorghum, millet, maize), legumes (groundnuts, cowpea), and vegetables, to feed their students. The children are from farming families and benefit directly from practical experience in seed production. And both children and their parents benefit from the multiplication of improved seed. Many children are unable to continue their education after finishing primary school, which means that the skills learnt during

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this project will benefit the future farming community. Adequate land is available in schools to ensure proper isolation distances.

How the System was Set up

- The initiative was introduced to the stakeholders at district, division, and ward levels.
- Key players and responsibilities were identified.
- Schools were selected using the following criteria: (1) schools are within 15-20 km of each other, so that farmers can get seed without having to travel long distances; (2) approximately 2 ha of land that can be isolated was available; (3) schools should be located in an area where the target crop is important; and (4) schools and the village governments should be willing to undertake the task—community ownership is necessary.
- The Headmaster and the agricultural teacher were trained in seed production and project supervision.
- Training programs were conducted for one teacher per school, plus Ward Education Officers (WEOs), covering seed production techniques, crop management, quality control, certification standards, and storage methods. Project partners provided funding and resource persons for the training; logistics were handled by the schools and the local community.
- The government assigned WEOs to supervise project implementation. Each WEO supervised seed production in ten schools.
- The following issues were addressed: source seed supply, seed distribution, crop monitoring, choice of variety.
- ICRISAT and local researchers provided each school with enough breeder/foundation seed to plant one hectare of seed crop. The crop/variety was carefully selected for adaptability to local conditions.
- Throughout the crop season, ICRISAT, government researchers, and the resident NGO (Diocese of Central Tanganyika) monitored crop management, pest control, and other factors, providing advice on quality control.
- Through the Ministry of Local Government, village government and community elders ensured the program was successful by minimizing cross-contamination from other fields and by organizing seed distribution after the harvest.
- The following crops/varieties were targeted in different areas: sorghum (Pato), pearl millet (Okoa), sesame (Ziada 94), groundnut (Pendo), pigeonpea (Mali) and maize (Kilima).

Achievements

- The program was launched as a pilot scheme 4 years ago, with 50 schools in one district. Today it covers 250 schools in 8 drought prone districts.
- The range of crops has expanded. Initially only sorghum and pearl millet seed were multiplied. Today seed of sorghum, pearl millet, pigeon pea, sesame, groundnut, and maize is being multiplied and sold.

- Each school supplies approximately 500 kg of high-quality seed to the surrounding community every year, at affordable prices. As a result, the area under improved varieties has increased 5–6 fold, pushing the area under improved pearl millet and sorghum varieties in Tanzania from base levels of around 5-7% in 1999 to current levels of 29% for pearl millet and 36% for sorghum (Monyo et al 2002).
- The program has been so successful in Tanzania that it is being replicated in Malawi, and the Mozambique government has expressed interest.

Why Did the Program Succeed?

Partnerships

The program was led by the communities themselves. ICRISAT, government research and extension staff, and NGOs provided support. Two key government departments—the ministry of education and local governments (the district administration)—were closely involved, ensuring that monitoring, logistics, coordination, and other issues (certification, sale permits) were smooth.

Ownership

The community had a clear sense of ownership of the project, which was implemented at the community level with benefits targeted to the community. There was enormous popular support, mobilized by village leaders. For example, farmers with plots adjacent to the school's seed plot agreed to plant different crops to minimize cross-contamination and ensure genetic purity of the seed being multiplied.

Promotion

Field days were held at the schools to demonstrate the benefits of the project. Over 1,000 farmers from the target community, from nearby areas, from other districts in Tanzania, and even from other countries attended these field days last season. The visitors included representatives from the national programs and Seed Services Units from Botswana, Malawi, Mozambique, South Africa, and Zambia. As a result, awareness spread rapidly. So did interest from other communities in implementing similar schemes. Schools-based seed projects are being implemented in Malawi, in partnership with World Vision International; the Mozambique government is planning similar initiatives with an even wider range of crops.

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Choosing the Right Crop and Variety

P.S. Setimela, M. Bänziger, and M. Mwala

Introduction

Over 300 varieties of several crops have been developed by plant breeders from seed companies, International Agricultural Research Centers (IARCs) and the public sector. These varieties are registered in one or more countries of the Southern African Development Community (SADC). Farmers may find it difficult to select an appropriate variety. The choice of a wrong crop or variety has many consequences, such as loss of yield, food security and profit. The choice of an improved but inappropriate variety also makes farmers lose confidence in improved varieties in general and this hampers technology adoption. It is therefore important that farmers are provided with information about varieties so that they can make a sound decision. This paper outlines important considerations in ensuring that farmers choose the right variety and points to the impact of that choice.

Factors that Farmers Consider When Choosing a Crop or a Variety

Many organizations are involved in making recommendations to farmers about suitable crops and varieties. Unfortunately, many of those recommendations do not consider the wide range of factors that influence a farmer's own decision-making. When farmers choose a crop or variety, there are several considerations that influence their choice:

- Household food security is important to farmers as it ensures their livelihood. The combination of crops and varieties chosen has to ensure food security across seasons. Drought or any other calamity must not endanger food security. Risk aversion is an important reason why farmers often choose to grow several crops and varieties.
- Income generation/profitability, because agricultural products are farmers' main source of income and farmers seek to maximize profits. Selection of a particular crop or variety has to ensure that income generation is possible (e.g. product markets available) and the profit is maximized. Profit is to be understood not only in monetary terms but may include other factors that contribute to a farmer's livelihood.
- Labour influences farmers' choice of crop and variety. For example, in Botswana, where Quela birds are a problem, farmers plant sorghum varieties with awns to prevent bird damage, or they chose a crop that is not affected by bird damage.
- Land quality and quantity: when land is scarce or the labor to prepare and manage the land limiting, farmers may choose to plant high value crops (e.g. vegetables in urban agriculture) or the crop that is most important for their food security (often maize). Prime land may be used for high value crops to maximize yields and profits while poorer land is allocated to less demanding crops.

- The need for inputs, because farmers must allocate limited resources among fertilizer, seed, other inputs, and non-agricultural expenses. If farmers can recycle seed without a yield penalty (e.g., OPVs versus hybrids), they may save money for other purposes (such as purchasing fertilizer). When properly managed, on the other hand, hybrid varieties may increase profits and thus provide an attractive option for farmers with more cash and better access to resources.
- Availability of seed and seed prices influence what farmers plant. If there is no seed or the price is too high, farmers may change their choice of crops or varieties, or even plant inferior material (e.g., weeviled grain).
- Consumer preferences and intended use influence choices of crops and varieties. In the case of maize, for example, farmers often prefer different varieties when home-processing and home-storing maize versus when they plan to sell harvests as green maize or grain.
- Varieties names are often complicated. They may confuse farmers when purchasing seed from the market.
- Trust in the seed vender is crucial. Farmers buy seed with expectations of certain varietal characteristics and seed quality. Whether these expectations are met often only becomes apparent long after the seed has been purchased; for example, at harvest. Thus, there is a certain amount of trust involved when acquiring seed and other planting material. If that trust is violated, farmers' livelihoods may be affected. Farmers therefore may prefer to purchase seed from a trusted source; for example, a known seed company or trusted neighbor.

Assessing What Farmers Want

There has been limited adoption of improved varieties by smallholder farmers in the region. One of the reasons for poor adoption of crop varieties has been the lack of understanding what farmers want or how they assess varieties. Learning how farmers choose varieties and crops enables plant breeders and extension and NGO staff to develop better varieties and make more appropriate recommendations. Surveys have been useful in identifying what farmers want, although they often can consider only a sample of a population due to limited resources.

CIMMYT and its partners are promoting an innovative variety testing scheme, mother-baby trials, in an effort to assess what farmers want. The mother-baby trial scheme allows farmers to evaluate new crop varieties in their own environment and under their own management practices. From these trials, plant breeders have discovered that the most important traits to farmers is not only yield but other traits such as taste, storability, and drought tolerance and others.

National and regional variety trials, as organized by the public and private seed sector, also provide information about varieties that are more suitable to farmers' conditions. These trials compare the performance of varieties and the changes that take place from season to season. These trials may be too complicated for non-breeders to understand in detail but the information compiled assists in characterizing varieties for traits that are known to be important to farmers. Based on this information, farmers and organizations may choose varieties that help to spread the risk of pests, disease, and climatic conditions. Ministries of agriculture, seed companies, and international research centers would always have such information.

Seed fairs and demonstration provide some information on how farmers assess crop varieties. However, in many instances demonstrations are planted with the full amount of inputs applied, thereby creating often a very different impression of a variety than when farmers grow them under their own cropping conditions. Similarly, the produce shown at seed fairs is often selected from the best part of a field, implying a very productive variety, and does not represent the average performance of that variety.

The Impact of Choosing the Right or Wrong Variety

The choice of a wrong variety may impact household food security, profits, and future adoption of new technologies (Figure 1.) Agronomic practices (cultivation, application of inputs, etc.) are affected: farmers may invest in fertilizers in the expectation that the chosen variety will make effective use of the inputs. Profits may go down or become negative if those expectations are not met. Also, depending on the variety, the crop may mature earlier or later than expected or convenient, making management difficult.

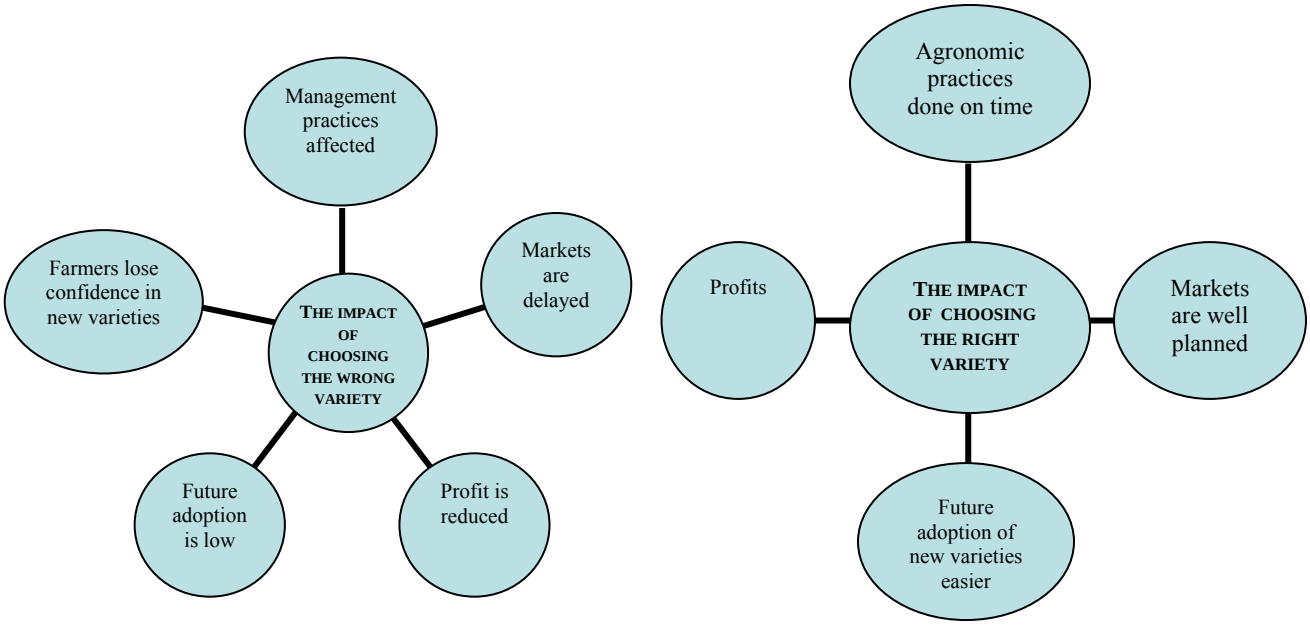

Figure 1. The impact of choosing crop varieties.

Steps in Selecting the Right Variety

The following factors should be considered when selecting a crop variety:

Determine your Agro-ecological Zone

Determine the characteristics of the agro-ecological zone where the variety will be grown. This includes:

- Amount of rainfall and the risk of drought during the season
- The length of the growing season
- Soil type
- Prevalent diseases
- High or low potential area

The characteristics of an agro-ecological zone determine what characteristics a variety needs to perform well, what disease resistance, what maturity group, whether there is need for the variety to be tolerant to drought or low pH etc. Many varieties that are introduced from other parts of the world or even South Africa ("exotic varieties") may not have the appropriate disease resistance or may not be adapted to the prevalent soil types.

Length of Growing Season

The length of the growing season determines the ideal maturity group for a variety. Ideally, you want to have a variety that matures within the growing season (or as long as there is available soil water). Crop varieties can be classified into the following groups:

- An early-maturing variety can be planted early and be harvested before the end of the season or planted late in the season and be harvested by the end of the season. It can also be used in areas where the rainy season is very short.
- An intermediate-maturing variety also does not require a full season to mature. It often can be harvested before the end of the season, or can be grown where rains may stop early. When conditions are good, an intermediate-maturing variety gives typically a higher yield than an early-maturing variety.
- A late-maturing variety is a variety that needs to be planted very early in the season, often with the first rains, so that it can have time to mature before the season ends. When conditions are good, a late maturing variety typically gives a higher yield than an intermediate or early-maturing variety.

Note, some exotic varieties may never mature due to photoperiod sensitivity. This has been a problem when seed of exotic varieties has been used for seed relief.

Type of Germplasm

Determine type of germplasm whether is a hybrid or an open-pollinated variety those seed can be recycled without yield penalty. Farmers often have a pronounced preference for either seed type.

Intended Use

Variety characteristics strongly influence the intended use. Different varieties may be chosen depending on the use of the produce. For example, there are maize varieties that are more suitable for green consumption (sweet and large cobs). Farmers often prefer different grain textures when home-processing and home-storing maize (they choose flint textures) versus selling maize grain (they choose types that give a good price in the market).

Designing A Community-Based Seed Production Scheme

M. Bänziger, P.S. Setimela, and M. Mwala

When designing a seed production scheme, it is important to be conscientious about the purpose of the scheme and its product.

Community-based Seed Production: Purpose

Many community-based seed production schemes are initiated because farmers are concerned about a lack of seed at planting time. Farmers have been recycling grain as seed (or other planting materials) for centuries, so it is important to understand what is meant by "lack of seed". Here are two examples:

1. Seed may be unavailable due to environmental factors (e.g., drought) or civil disturbances, which can cause acute shortages. Training farmers in community-based seed production will have limited impact, unless issues of risk aversion for crop production are addressed first: otherwise the same environmental or civil disturbances that reduce grain production will also reduce seed production. However, risk aversion strategies may include crops for which seed or planting material is not readily available. In this instance, community-based seed production schemes may contribute to increasing farmers' access to such planting material provided the cost involved in producing the planting material or seed is not greater than farmers' willingness to invest in such *planting material.*
2. Seed from the formal sector may be unavailable or at prices deemed too high. In this instance, farmers perceive an added value to seed over grain (otherwise they would be planting grain) and are ready to pay a higher price for seed. The perceived value of seed may consist of varietal characteristics (genetic make-up) and/or its viability. Training farmers in community-based seed production may have an impact on farmers' access to seed, provided seed production costs can be kept lower than those of the existing seed sector price and the quality of the seed produced meets the farmers' expectations.

Outputs of a Seed Production Scheme

Certified seed, quality-declared seed, or standard seed are commodities where the government guarantees seed quality; i.e., genetic value, purity and seed viability. The seed producer needs to follow established regulations; adherence to these regulations is monitored. A farmer paying a higher price for seed over grain can therefore feel confident about obtaining value for money. Requirements are more stringent for certified seed than for standard or quality-declared seed.

Seed from the Informal Sector

The quality of informally produced seed is guaranteed only by its seller. Thus, there is little guarantee other than knowing and having confidence in the seller, or having seen his/her seed production field, that gives an incentive for paying a higher price for seed than grain. Most countries permit the trade of informally produced seed in a community and among neighbors, but have special regulations for formal trade.

Designing a Community-Based Seed Production Scheme

Community-based seed production is not simply about producing seed. Several other aspects have to be considered, including:

- Choice of crop(s) and variety.
- Source of seed.
- Training of seed producers.
- Quality control.
- Need for credit to produce the seed.
- Cleaning, packaging, and marketing of seed.
- Sustainability issues.

Table 1 compares four models of community-based seed production. It highlights the issues of costs involved and sustainability—issues often insufficiently addressed, when designing community-based seed production schemes. Unless the public sector or an NGO is prepared to invest continuously in a seed production scheme, costs for all components (seed production, training, quality control, marketing, transport, credits) must be covered by the price of the seed produced. It is therefore in the interest of all parties involved to design scheme that minimizes costs while meeting the purchasers' expectations for quality (genetic make-up and seed viability).

A Checklist for a Sustainable Seed Production Scheme

- ✓ Define the purpose of you scheme and the intended product(s).
- ✓ Describe how you will select the crops and varieties for which you will produce seed.
- ✓ Identify the source of the foundation seed you will use.
- ✓ How many farmers will be involved?
- ✓ How much seed will you produce?
- ✓ Is the target community well defined?
- ✓ What are the responsibilities of the various partners in this scheme, both in the short term and once the system becomes self-supporting?
- ✓ What are measurable incentives for the various partners to adhere to those responsibilities?
- ✓ What measures can you take to minimize costs while maintaining the quality standards of the targeted product?
- ✓ What guarantee does a potential purchaser or user of the seed have that they get value (genetic characteristics, viability of seed) for investment (seed price)? Are quality control measures in place? What is the incentive for a farmer to buy seed from your seed production scheme?
- ✓ Is a monitoring system well in place?
- ✓ What procedures are set up to ensure sustainability? Has market potential been properly assessed?
- ✓ Are distribution procedures set up?

Table 1. Four model schemes for community based seed production.

	Models 1-3. A farmer group, a school, or an individual farmer catering to the seed demands of neighboring farmers			Model 4. A group of farmers or a farmer with a significant area producing seed for a private seed company
Output	**Model 1. Certified seed**	**Model 2. Quality-declared or standard seed**	**Model 3. Informal seed: the farmer uses proper seed production practices, but there is no external control or monitoring**	**Certified seed produced on contract**
Source of seed	Foundation seed from a seed company or a public sector breeding program	Certified seed from a seed company or a public sector breeding program	Certified seed from a seed company or seed of any other valued variety (e.g. landrace)	Foundation seed from the contracting seed company
Transport of source seed to seed producer	Seed producer or NGO		Seed producer	Seed company
Sourcing of other inputs (fertilizer, land prep etc.)	Seed producer or NGO		Seed producer	Seed producer
Training of seed producers	NGO		NGO	Seed company
Quality control	Seed services paid by NGO or seed producer		Not done	Seed company or seed services paid by seed producer
Cleaning, storing, packaging, and marketing	Seed producer or NGO		Seed producer	Seed company
Price of the seed is kept low because of …	1. A considerable proportion of seed production costs is covered by NGO/public funds. 2. Costs associated with marketing are minimized.		Costs associated with marketing are minimized.	1. Each seed producer (group) is producing a large amount of seed (large area, good crop management). 2. Seed producers are clustered to minimize transport costs.
Sustainability issues	Who is taking over the role (financial support, transport, organization) of the NGO in the long-term?		What is the incentive for the farmer to maintain quality standards that involve costs (e.g. isolation, roguing)?	A mutually beneficial agreement between seed company and seed producer
Other issues	1. Is a private seed company prepared to sell foundation seed? 2. Seed company and public breeding programs need to be advised in time (one year before) about the need for foundation seed. 3. Foundation seed is more expensive than certified seed.	Quality declared or standard seed typically commands a lower price than certified seed	Informally produced seed commands a lower price than quality-declared, standard or certified seed, often little more than grain. A farmer's reputation is the main reason for another farmer paying a higher price for seed than grain.	