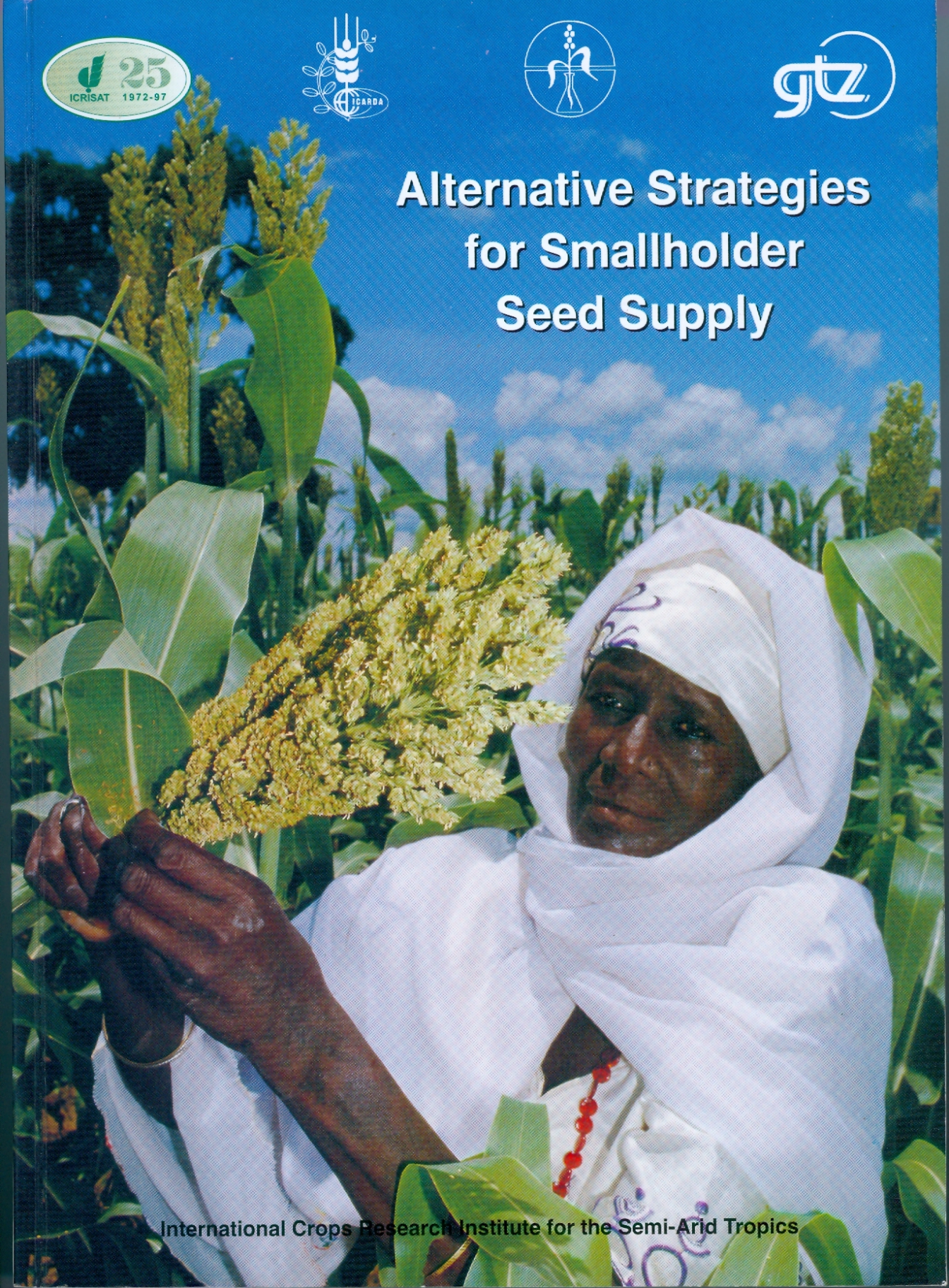
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Alternative Strategies
for Smallholder
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International Crops Research Institute for the Semi-Arid Tropics

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Abstract

Non-availability of seed is the single biggest constraint to smallholder agriculture in large parts of the developing world. This publication reports on a 5-day conference that sought to define seed-supply problems in Africa and West Asia; discuss the current and potential roles of the private and public sectors, NGOs, international research institutes, cooperatives, and farmers' groups; and analyze the working of various seed supply channels, including farmer-to-farmer exchange. The conference was organized by ICRISAT, ICARDA, IITA, and GTZ, and attended by over 70 participants from 18 countries (Algeria, Cdte d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, ,Malawi, Morocco, Namibia, Pakistan, Sierra Leone, Sudan, Syria, Tanzania, Turkey, Yemen, Zambia, and Zimbabwe), 4 CGIAR Centers, and a number of donors, NGOs, regional and international agencies, and advanced research institutes.

The major objective was to develop strategies to strengthen both formal and informal seed distribution channels, particularly for food-security crops where private sector interest is limited. Almost half the conference was devoted to identifying and prioritizing policy and institutional constraints, and on the basis of these discussions, developing action plans to improve seed availability in each of three regions—Southern and Eastern Africa, Western and Central Africa, and West Asia and North Africa. These proceedings contain the papers presented at the conference, and the recommendations and action plans developed through the discussions.

Resume

Strategies alternatives pour la fourniture de semences aux petits paysans: comptes rendus d'une conference internationale sur les possibilites de renforcement des systemes nationaux et regionaux en Afrique et en Asie de l'Ouest. La non-disponibilite de semences constitue la contrainte unique la plus importante a *l'*agriculture pratiquee par les petits paysans dans de vastes regions des pays en voie de developpement. Cette publication rapporte sur une conference de cinq jours qui a eu pour objectifs de: definir la problematique de la fourniture de semences en Afrique et en Asie de l'Ouest; examiner les roles tant actuels que potentiels des secteurs priv6 et public, des ONGs, des instituts internationaux de recherche, des cooperatives, ainsi que des syndicats des paysans; et enfin, analyser le fonctionnement de divers voies de fourniture de semences, y compris l'echange entre paysans.

La conference etait organisee par l'ICRISAT, l'ICARDA, l'IITA, et le GTZ, reunissant plus de 70 participants venant de 18 pays (Algerie, Cote d'Ivoire, Egypte, Ethiopie, Ghana, Kenya, Malawi, Maroc, Namibie, Pakistan, Sierra Leone, Soudan, Syrie, Tanzanie, Turquie, Yemen, Zambie, et Zimbabwe), des quatre centres du GCRAI, ainsique de nombre de bailleurs de fonds, d'ONGs, d'agences regionales et Internationales, et des instituts avances de recherche.

Le but principal de la conference etait l'elaboration des strategies pour le renforcement des canaux formels et informels de distribution de semences, notamment pour les cultures de securite alimentaire qui ne suscitent qu'un interet limite chez le secteur prive. Presque la moitie de la conference etait consacree a *l'*identification et la prioritisation des contraintes institutionnelles et celles relevant de la politique generale. A la suite de ces discussions, la conference s'est penchee sur la mise au point de plans d'action visant l'amelioration de la disponibilite de semences dans chacune de ces regions—Afrique australe et orientate, Afrique occidentale et centrale, Asie de l'Ouest et Afrique du Nord. Cet ouvrage comprend les communications presentees a cette conference, ainsi que les recommandations et les plans d'action elabores au cours des discussions.

See inside back cover for abstracts in Portuguese and Arabic.

Cover: A small-scale seed producer on her farm near Niamey, Niger. Photo by G Venkataramani.

Alternative Strategies for Smallholder Seed Supply

Proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia

10-14 Mar 1997
Harare, Zimbabwe

Edited by
D D Rohrbach, Z Bishaw, and A J G van Gastel

ICRISAT
International Crops Research Institute for the Semi-Arid Tropics
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Introductory Session

Opening Address

The Hon D R Norman
Minister of Agriculture, Government of Zimbabwe[1]

Mr Chairman, invited guests, representatives of the donor community, ladies and gentlemen:

I have the pleasure of welcoming you all to Harare and to this conference on strengthening seed supply systems. I sincerely hope that those of you visiting Zimbabwe for the first time will find the weather pleasant, the conference environment conducive to good work, and that you will be able to participate effectively. Indeed, I feel greatly honored to inaugurate this important conference.

Mr Chairman, the success of agricultural research depends on the development and adoption of new and better technology. The impact of crops research, in particular, depends on the development and distribution of new varieties. This requires the maintenance of strong crop breeding programs as well as a strong seed sector. Zimbabwe has one of the stronger seed systems in Africa. The national seed sector is particularly well developed for hybrid maize, though it also supplies seed for a wider range of crops including wheat, cotton, sorghum, pearl millet, groundnut, sunflower, and vegetables. In fact, on attaining independence in 1980, more emphasis was also placed on sorghum and millet. We view this conference as a valuable opportunity to share experiences gained in developing this seed system, and to identify alternative strategies for strengthening it further.

Zimbabwe's seed sector was originally built on the strength of a cooperative agreement between seed producers' associations and government breeders. Seed producers were provided free access to government-bred varieties in exchange for their agreement to an annual production schedule which assured a minimum national seed supply and seed security stock of 20%. The development of a well organized and efficient seed industry grew slowly from that initiative, but in 1990 the industry began to expand rapidly. In recent years competition in the industry has grown with the establishment of several locally owned seed companies, e.g., National Tested Seeds, Savannah Seeds, and Agricultural Seeds and Services, and the establishment of seed production facilities by international seed companies such as Cargill, Pannar, and Pioneer.

Mr Chairman, so far the greatest success of our national seed industry is hybrid maize seed. More than 90% of national maize area is planted to hybrids, and virtually all maize growers in the country purchase hybrid seed each year. The broad distribution of hybrid maize seed to small-scale farmers at Zimbabwe's independence in 1980 contributed to a tripling of smallholder maize production by 1985. Average maize yields in the smallholder sector have since continued to grow. In addition, small-scale farmers

1. Ministry of Lands, Agriculture and Water Development, P Bag 7701, Causeway, Harare, Zimbabwe

Norman, D.R. 1997. Opening address. Pages 3-6 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

have access to a wider range of maize variety choices than ever before.

Unfortunately, adoption levels of other crops such as sorghum, sunflower, groundnut, and pearl millet still remain low relative to the record of hybrid maize. Only limited quantities of seed of these crops flow through commercial distribution channels. While hybrid sorghum seed (DC 75) has been widely purchased by large-scale commercial farmers, small-scale farmers still tend to plant open-pollinated varieties (OPVs). The same applies to groundnut, sunflower, and pearl millet. In semi-arid areas, sorghum and millets commonly account for more than half the total area under grain production, and yet food insecurity continues to be a problem. This is because most of the seed used is of traditional, unimproved varieties of low productive capacity.

Zimbabwe's research services have developed several new varieties of sorghum, pearl millet, finger millet, groundnut, and sunflower. However, it is not enough to produce top-quality seed. There must be an efficient system of marketing and distribution which ensures that the seed gets to those farmers who need it. It would appear that the present system is working well in meeting smallholder needs in the case of improved maize seed. Several distributors appointed by seed houses countrywide, including rural retail shops, still tend to supply only hybrid maize. I would like to encourage much stronger efforts towards ensuring that smallholder farmers have direct and easy access to seed of improved varieties for other crops.

The Zimbabwe government has promoted the distribution of some of these new varieties through input delivery schemes associated with drought relief programs. But we recognize this is not a sustainable means to channel new seed to farmers in view of fiscal demands and the possibility of creating a dependency syndrome. We all note with growing concern the continuing lack of any formal seed multiplication system for a number of smallholder food crops such as finger millet, bambara nut, cassava, and sweet potato. In this aspect, we are no different from most national seed systems around the world. Seed houses are pursuing a relatively more profitable hybrid seed market wherein farmers are likely to purchase new seed stocks every year. But farmers do not have access to improved seed of the less popular crops. In effect, the argument has been that OPV seed is less profitable to produce and farmers are known to obtain such seed from the previous year's harvest. These are problem areas where we seek advice for improvement.

Given that seed houses have limited interest in the production and sale of OPVs, what alternatives exist for the consistent distribution of this seed? Supply of sorghum and pearl millet OPVs has increased as a result of recent demand for these seeds for distribution under the government and regional drought relief programs. Several seed houses are competitively producing sorghum and pearl millet seed for distribution through these government and donor-assisted channels. However, it is not clear whether retail sales will increase once drought relief deliveries are no longer provided.

Mr Chairman, what we need are consistent efforts from researchers to exploit the genetic advantage of these varieties. Large gains in productivity can be derived from a combination of improved varieties and crop management which can be generated through consultation with farmers. We need to develop input markets for improved seed and product markets capable of storing the produce, especially grain, in areas of surplus production, and moving it efficiently from surplus to deficit households. The combination of improved productivity and strong rural markets will reduce dependency on draught relief and food imports.

In this context, Zimbabwe is interested in learning from the experiences of other

countries in Africa and Asia about strategies for providing a wider range of high-quality seed to farmers throughout the country. We expect this conference to offer specific recommendations on opportunities for improving seed supply in Zimbabwe, the wider Africa, and the West Asia region.

What are the prospects for private sector interest in the production of OPVs, and how might government encourage such investments? Seed houses need better information to judge the retail demand for OPVs of secondary food crops. Is evidence available for evaluating the likelihood that farmers will simply retain seed stocks from their grain harvest each year as opposed to the probability that they will periodically return to the market to purify their stocks? Can this demand be estimated and predicted under variable rainfall scenarios? How can retail traders be encouraged to stock new and often unknown seed varieties? Should we encourage the development of small, localized seed companies with lower overheads to target small market niches for particular crops? Is research producing a complete package, i.e., coming up with new varieties and also giving options for use of the crop? Perhaps some of these questions will be answered during this conference.

Government policy in Zimbabwe is to encourage smallholder farmers to participate in the commercial production of their own seed. There are several ways in which this can be done. One way is to assist smallholder farmers with ideas on seed management practices by setting up demonstration plots in various parts of the country. These plots could be used as "shopping windows" to enable farmers to learn more about varieties and good farming practices.

We note the increasing interest of non-governmental organizations (NGOs) in seed multiplication and distribution. Environment in Development Activities - Zimbabwe (ENDA-Zimbabwe) has recently worked with the Seed Company of Zimbabwe to promote smallholder participation in sorghum and pearl millet seed production. Other NGOs such as the Community Technology Association (COMMUTECH), the Intermediate Technology Development Group (ITDG), and the Organisation of Rural Associations for Progress (ORAP) have sponsored smaller seed production schemes. Other NGOs have taken interest in facilitating the distribution of seed to small-scale farmers. However, let me quickly point out that government, through the introduction of seed legislation, will continue to certify seed to ensure that high-quality seed is available for both local and foreign markets.

What role should research agencies themselves play to improve seed supply for secondary crops? It makes little sense to invest in breeding programs for pearl millet or bambara nut, and to release new varieties if you are not prepared to promote the multiplication and distribution of these seeds. Should public seed production units be maintained for crops of limited commercial interest? During recent years we have been moving away from government involvement in activities best carried out by a competitive private sector. However, just as we recognize the value of maintaining a public sector crop research program targeting the development of technologies of limited interest to the private sector, perhaps we also need to consider the distribution of some of these technologies as a public investment. If the distribution of improved seed can improve production levels and food security, this investment may offset the necessity of future public investments in drought relief.

Finally, let me encourage you to engage yourselves in vigorous discussions on alternative strategies for assuring seed quality in an environment where government seed services need to do more with less resources. The provision of consistent inspection services and analytical support was already difficult when there was only one major seed company in the country. The proliferation of

seed companies, NGOs, and farmers' groups involved in seed production makes strict quality control for all traded seed even more difficult.

Let me end by saying that economic growth in Africa and elsewhere in the developing world depends on the generation and application of improved technology. In most countries this growth is closely linked with the performance of the agricultural sector. Improved agricultural productivity depends, in turn, on the development and adoption of better varieties. Stronger seed supply systems are essential for variety adoption. My ministry notes this conference has targeted the development of action plans for improving seed multiplication and distribution. We also note the broad range of expertise brought together at substantial expense to critically discuss seed supply problems and solutions. We have high expectations that this collective expertise can offer us specific recommendations useful to policy makers and practitioners. We in the Ministry of Agriculture of Zimbabwe look forward to receiving these recommendations. But we also look forward to the opportunity to collectively take responsibility for their implementation.

I wish you progress in your deliberations and now declare this workshop open.

Thank you.

Objectives of the Conference

D D Rohrbach[1]

National and international agricultural research institutes are increasingly concerned about the costs of delays in the period between crop variety release, seed multiplication, distribution, and adoption. Such delays reduce the returns to investments in agricultural research and limit gains in farm productivity. Questions have been raised about the willingness and capacity of commercial seed companies to multiply seed of many new varieties, particularly of open-pollinated crops. In some countries, government seed multiplication units have acted as substitutes for commercial seed production, though with varying success. In parts of sub-Saharan Africa, NGOs have initiated seed multiplication and distribution schemes, most often in response to drought. In both Africa and West Asia, farmers commonly multiply and trade seed on their own.

A number of alternative strategies for seed sector development have been explored, particularly in sub-Saharan Africa, but the strength of most publicly funded efforts remains open to question. The sustainability of NGO commitments is unclear. Private companies seem prepared to sell seed for drought relief programs, but unwilling to invest in developing rural distribution networks for open-pollinated varieties. The financial constraints affecting each of these entities are reinforced by continuing questions about national policies regulating seed production and trade.

In view of these problems, ICRISAT, ICARDA, HTA, and GTZ coordinated efforts to organize a conference aiming to review our knowledge of factors limiting seed supply in Africa and West Asia, and identify opportunities for resolving these constraints. The main objective was to outline a set of regional action plans to improve seed supply systems for crops of limited interest to commercial seed companies.

More specifically, the conference aimed to

- Review the institutional, policy, and regulatory constraints to the multiplication and distribution of new varieties
- Clarify the objectives of an efficient seed multiplication and distribution system
- Evaluate institutional options for seed supply, including the potential roles of small private companies, government seed units, NGOs, and farmers
- Suggest policy and regulatory changes that might improve national and regional seed supply systems
- Outline national and regional strategies for improving seed supply systems.

Just over half the meeting consisted of presentations and discussions on the structure and performance of alternative channels for supplying seed of open-pollinated varieties to farmers in Africa and West Asia. Three regional overview papers were followed by 20 papers on efforts to promote seed supply through small-scale private companies, NGOs,

1. SADC/ICRISAT Sorghum and Millet Improvement Program, PO Box 776, Bulawayo, Zimbabwe

Rohrbach, D.D. 1997. Objectives of the Conference. Pages 7-8 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

emergency relief programs, public seed multiplication units, research agencies, farmers' groups, and individual farmer-to-farmer exchange. Each presentation aimed to identify problems experienced in establishing alternative seed supply systems and strategies for resolving some of these constraints. Finally, four general concept papers were presented by internationally recognized experts on seed marketing. These papers summarized the key issues for consideration during the development of regional action plans. Edited versions of all these papers are presented in this proceedings volume.

The second half of the meeting comprised nine working group sessions targeting the development of regional action plans for seed sector improvement. Six groups were first formed to discuss policy and institutional constraints to seed supply through alternative channels. Each group focused on a specific area: (1) seed regulation and policy, (2) the roles of the private and public seed sectors, (3) the roles of national and international institutes, (4) roles for NGOs and farmers' groups, (5) emergency seed schemes, (6) seed information systems.

The results of these discussions were re-examined by three working groups, each focusing on one region: (1) Southern and Eastern Africa, (2) Western and Central Africa, (3) West Asia and North Africa. Each group first identified a limited subset of the highest-priority problems, then sought to identify solutions—or paths to solutions—to these problems. Each group outlined possible solutions, activities necessary to implement these solutions, who would take responsibility for implementation, and funding implications. The results of these working group discussions are also summarized in this proceedings volume.

Session I
Defining the Problem of Seed Supply

Seed Supply Constraints in Southern and Eastern Africa

S W Muliokela[1]

Abstract

Certified seed use in the SADC region is largely restricted to maize and cotton. For other crops, the majority of smallholder farmers use farm-saved seed, and the use of improved varieties is correspondingly limited. The reasons for low seed sales of improved varieties include high cost (both real and perceived) of seed and associated inputs, and unreliability of returns. More important, administrative or institutional inadequacies (e.g., public sector monopolies, poor incentives for the private sector, lack of policy attention to "minor" crops) limit the production and sale of improved seed. These inadequacies must be resolved through discussions involving both producers and users of seed. In addition, seed regulations (e.g., variety release and certification procedures) are often cumbersome and expensive, and need to be simplified and also harmonized across different countries in the region. Until that is achieved, a transitional arrangement such as the FAO Quality Declared Scheme could be considered. Information exchange is needed among different countries in the region on the performance and potential suitability of imported varieties. Seed certification procedures must be modified to reduce delays and costs, and ensure that quality standards are not excessively strict. These changes could be accelerated by establishing a regional seed fund to finance reviews, seminars, and seed networks, and provide support to NGOs, cooperatives, and farmers' groups.

Introduction

Agricultural productivity in sub-Saharan Africa must improve in order to increase rural incomes and meet the demand for food in both rural and urban areas. Agricultural production has not kept pace with population growth (nearly 3% annually since the end of World War II). Yields and aggregate production of food and export crops have remained stagnant or fallen in many countries. The region already has a large cereals deficit, and if current productivity growth rates do not increase, this deficit will more than triple by the year 2020. It has been estimated that agricultural production in Africa must grow at 4% per year to maintain a satisfactory level of economic development, but average growth rates have been only 1-2% during the last decade.

Previous production increases were achieved largely by bringing in new land into production, but this will no longer work because uncultivated land is no

1. Golden Valley Agricultural Research Trust, PO Box 50834, Lusaka, Zambia

Muliokela, S.W. 1997. Seed supply constraints in Southern and Eastern Africa. Pages 11-17 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

longer freely available. Productivity can be increased through improved varieties and better management, but these benefits will not be realized unless substantial improvements are made in seed production and distribution.

National seed systems

Past experience provides several lessons about the development of national seed programs.

- Government leadership and investment are essential to launch the seed industry and sustain it through the stages of development. Private sector investment in research and development, especially in the early stages, is unlikely.
- Official seed certification systems (developed and supported by the government) protect farmers and reputable seed companies from unscrupulous firms. The "seal of quality" so created is the key to creating seed markets with low transaction costs and encouraging farmers to plant seed whose quality is "guaranteed" in some way. During the 1970s and the 1980s foreign aid, experts, and equipment were brought in to help improve government seed agencies in many countries (Eicher 1984, 1987). These projects often failed because of the lack of workable seed laws and low-cost enforcement.

Private sector participation is encouraged by access to publicly-developed material, transparent rules on evaluation, release, and registration of varieties, minimal government controls on seed import and export, laws protecting intellectual property rights, and minimal subsidies to state-owned seed companies.

Public-private partnerships are generally more effective than either government seed companies or entirely private ventures in marketing certified seed to farmers.

Because of the increasing globalization of the seed industry, domestic seed companies must acquire managerial, financial, and marketing capabilities to compete with multinational companies.

Table 1. Sources of seed for communal farmers in Zimbabwe (% of farmers using different sources), 1991.

Source	Maize	Sorghum	Sunflower	Groundnut	Cotton
Farm-saved	2.1	56.1	50.4	71.5	3.0
Local farmer	-	8.8	19.5	11.1	1.5
Local trader	13.1	5.3	6.5	7.0	1.5
Local store	14.8	3.5	1.2	1.2	13.6
Cooperative Union	13.1	1.8	2.6	4.7	22.7
Urban store	25.9		1.2	0.6	7.6
Farmers' cooperative	25.9	5.3	2.6	1.7	13.6
GMB/CMB[1]					
Seed Co[1]		14.0		0.6	36.4
AFC loan	5.5	-	1.7	-	-
Drought relief	-	5.3	14.3	-	-

1. GMB/CMB = Grain Marketing Board/Crops Marketing Board, Seed Co = Seed Company of Zimbabwe, AFC = Agricultural Finance Corporation

Source: World Bank

Seed supply and utilization

The basic elements needed for a national seed program are in place in all the countries in the region. However, in most countries the public sector until recently has focused only on one crop to the total exclusion of other important food security crops. (Similarly, the private sector too has focused on hybrid seed of one or two crops.) In several countries, crop improvement programs have recently been expanded to include sorghum, pearl millet, groundnut, and in some instances, cassava and sweet potato. In theory, therefore, farmers in the region should have an array of crop and varietal options to choose from. However, even in countries with relatively advanced seed industries (e.g., Zimbabwe, Table 1), certified seed use is largely restricted to maize and cotton. For other crops, the majority of communal farmers use seed saved from their previous harvest. Several reasons are cited for low utilization of certified seed by small-scale farmers.

- Price—although seed is cheap compared to other inputs, money has to be found at the beginning of the season
- Price of other inputs—some modern varieties require fertilizer to achieve significant yield gains
- Uncertain crop marketing arrangements and prices
- Uncertainty in rainfall, particularly after a decade of frequent droughts
- Transport and other costs involved in reaching seed distribution outlets from remote areas
- Yield or quality advantages of new varieties are often unclear or uncertain
- Limited resources—small plots, infertile soils, shortages of labor and capital
- The perception that new varieties are difficult in terms of crop management
- Ineffective extension systems
- National seed programs and monopoly seed agencies focus on hybrid seed at the expense of traditional crops essential for household food security
- Tariffs tend to limit international seed trade
- Complicated phytosanitary regulations hinder regional seed trade.

These bottlenecks need to be removed. But there are even more fundamental reasons for low seed utilization (Table 2), which are administrative or institutional in nature. Any effort to improve seed utilization by small-scale farmers in the region should begin by addressing these issues.

Need for regional cooperation

Structural adjustment programs are encouraging private domestic and multinational investment in the seed industry, expanding regional seed trade, and facilitating the development of a common seed market in southern Africa. However, formidable barriers still remain. The challenge for regional organizations such as the Southern African Development Community (SADC) and the Southern African Customs Union (SACU) is to harmonize seed regulations across different countries.

Procedures for variety release, seed certification, and laboratory testing are increasingly based on standards developed by the International Seed Testing Association (ISTA) and the Organization for Economic Cooperation and Development (OECD). It is therefore feasible to harmonize regulations in these areas—for example, developing a system of regional testing and registration (varieties can be tested and registered in any country, and this registration would be valid throughout the region), a practice used in the European Community. SADC needs to harmonize phytosanitary regulations and introduce plant health passports to reduce the spread of diseases and parasites which are becoming more important as intra-regional seed trade grows. Most countries are thinking

Table 2. Key government policies affecting commercial and non-commercial seed multiplication and distribution in Southern Africa, 1995.

Policy	Botswana	Malawi	Mozambique	Tanzania	Zambia	Zimbabwe	Swaziland	Lesotho	S. Africa	Namibia
Exclusive release of publicly bred materials to only one seed enterprise	✓	✓	✓		✓	✓			✓	
Compulsory variety registration			✓	✓	✓	✓				
Compulsory seed certification	✓		✓			✓				
Licensing of seed sellers, inspection of retailers to check adulteration	✓	✓		✓	✓	✓				
Privatization of seed inspectors		✓	✓	✓	✓	✓				
Privatization of seed testing laboratories		✓		✓	✓	✓	✓	✓		✓
Plant Breeders' Rights legislation		✓		✓	✓	✓	✓	✓	✓	
Devolving seed inspection to extension workers and NGO field officers		✓		✓	✓	✓	✓	✓	✓	✓
Provision of extension advice on seed production, processing, treatment, and storage			✓	✓	✓	✓				
Lifting of administrative controls to allow for both formal and informal seed production		✓		✓	✓	✓				
Removal of subsidies and price controls		✓		✓	✓	✓		✓		
Restrictive controls on import and export of germplasm	✓		✓		✓	✓				
Maintenance of reserve seed stocks		✓		✓	✓	✓				

Source: Adapted from Musa and Rusike 1997

of introducing plant variety protection laws based on the International Union for the Protection of New Varieties of Plants (UPOV) model. Ideally, such protection should be automatically valid in all countries, with regional and/or reciprocal agreements between SADC countries.

Regional programs could help strengthen the seed industry in several countries. For example, South Africa has capabilities for training seed inspectors and analysts, which could be exploited for regional benefit. Regional organizations could strengthen seed inspectorates by developing a regional accreditation system for inspectors. National seed certification organizations such as SANSOR in South Africa could expand seed certification programs in other countries in the region.

The problems summarized in Table 2 need serious consideration. Structural rigidities need to be reviewed and in some cases removed altogether. Some other key issues merit broad consultation among all stakeholders—governments, private and public sectors, farmers, NGOs, etc. These issues are briefly discussed below.

Variety release and registration

Delays. The current testing process for approval of a new variety is often excessively long. In addition, release committees may not meet regularly. If these delays are reduced, new, improved varieties could reach farmers several years earlier than they do at present.

Costs. It is too expensive for the government to maintain an extensive variety testing system. Instead, both public and private plant breeding organizations should bear the cost of testing. Registration requirements—especially those needed to establish plant breeders' rights—are becoming more complicated, time-consuming, and costly. Public-sector institutions often lack the staff and the finances to register their varieties or ensure that their rights are protected.

Extension. Extension and seed production activities are not linked effectively into the process of variety development and release. Extension workers and seed producers usually have inadequate information about new varieties. Consequently farmers tend to be unaware of new developments, and adoption of many new varieties remains poor. Release of a variety should be accompanied by a promotional campaign, disseminating information to extension staff, farmers, and potential seed producers. Unless a deliberate effort is made to this end, extension will continue to remain an academic exercise.

Variety identification. The move towards a more precise characterization of varieties means that an increasing proportion of time during development and evaluation will be spent on establishing varietal distinctness, rather than on useful characteristics per se. In addition, demands for greater varietal uniformity would threaten attempts to improve heterogeneous and composite varieties, for example, exploiting this existing variation to breed for specific local adaptation, which is a critical factor especially in marginal environments.

Variety performance testing. In many countries in the region, performance standards for variety release are usually biased towards broad adaptation rather than on local adaptation and suitability for resource-poor smallholders. Rigid official standards also limit the release of appropriate varieties by private breeders and farmers.

Exchange of information. The flow of information within the region on the performance and potential suitability of imported varieties is limited. Better mechanisms need to be developed for exchanging information and accelerating the release of suitable imported varieties in a number of SADC countries.

Seed monopolies. Many countries have protectionist policies that tend to limit the

participation of foreign seed houses—arid sometimes of farmers and domestic private plant breeders—in variety development.

Minor crops. Variety release procedures are often poorly defined for minor crops, which are critical for household food security. The resulting uncertainty is a disincentive to variety development by NGOs, farmers' groups, and farmers.

Legal standing. In several countries, the mandate and responsibility of variety authorities (e.g., the release committee) is ambiguous. In some cases, the legal standing of these bodies, and thus their power. to create or enforce regulations, is in doubt.

Seed quality control

Seed quality control systems (seed certification) also need a comprehensive review. The key issues are similar to those for variety release and registration.

Delays. Seed certification requires timely field inspections and tests. If quality control staff cannot be mobilized on time, certification will be delayed and seed may reach the market late, or not at all.

Costs. Seed certification implies a very seasonal demand for skilled staff. The costs of multiple field inspections, especially in widely dispersed fields, are considerable. The costs of laboratory testing are also rising. Public sector resources are over-stretched, and the authorities are hardly in a position to do meaningful work.

Standards. Excessively strict seed certification standards are sometimes responsible for keeping appropriate seed out of the market. But simultaneously, public seed companies or government monopolies sometimes sell seed that is of a class below the established certification standards—for example, the government may temporarily suspend certification standards to cope with emergency situations. Such practices are common, and call into question the adequacy of the existing standards.

Fairness. In systems where seed certification is mandatory, commercial firms are rarely allowed to participate in the development of certification procedures and standards. Until recently, there were few instances where private certification or seed testing was allowed. However, the situation is improving in several SADC countries.

Small-scale seed production. Government seed certification agencies are rarely able to service or advise local-level seed production projects operated through NGOs or farmers' groups. On the contrary, seed certification requirements often discourage such projects.

Transparency. Mandatory certification schemes are not free of loopholes. Seed certification rules can be interpreted differently by different inspectors, and provide opportunities for cheating, corruption, and the exercise of political influence. Collusion among public sector entities is also possible. The legal powers of the seed certification authority may be ambiguous. Also, staff and funding are insufficient to monitor seed quality at the point of sale, contributing to farmer uncertainty regarding the nature and purpose of certification.

The FAO seed scheme

The concept of quality declared seed, developed by the FAO, could serve as a good transitional arrangement until governments in the region develop and enact schemes to improve variety testing and release, seed certification, and seed production and distribution. The scheme would not unduly tax the national seed regulatory system. The main components of the scheme are:

- Regional list of varieties eligible for seed production—a variety is considered eligible for production throughout the region if it has been officially released or

registered (or otherwise declared eligible for production) in any one country. A regional authority would be responsible for maintaining the list. Submissions for including a variety on the list would be simple—a morphological description, a statement defining the conditions for which the variety is suitable, and evidence of acceptable agronomic performance.

- Register of seed producers—qualified seed producers must demonstrate that they have suitable land, access to seed for multiplication, qualified supervisory staff, and access to appropriate equipment and seed testing facilities.
- Spot check of seed crops by national regulatory authority—the authority will check at least 10% of seed fields each season and compare them to standards prescribed in the Quality Declared Seed system.
- Spot check of seed offered for sale—the national regulatory authority will sample at least 10% of the seed at points of sale, and test it for germination, purity, and other parameters considered appropriate. The system provides minimum standards.
- Registered seed producers provide a Quality Declared Seed declaration for each seed lot. The national regulatory authority is empowered to penalize anyone wrongfully using this label.

Players in an integrated system

The complete seed system—variety development, seed production, seed marketing, quality control, and farmer utilization—involves a number of players. To be effective, the system must be integrated, responsive to the diverse needs of different players, and should exploit their specialized skills in different areas.

NGOs. The removal of structural and institutional road-blocks would pave the way for increased participation by NGOs in the region's seed delivery system. Many NGOs have a fine record of performance, and have been able to mobilize large amounts of seed during recent droughts. In some countries, many farmers would have been starved of seed but for NGO seed distribution schemes.

National agricultural research systems (NARS). Numerous reviews of NARS performance continue to show low impact, essentially as a result of weak variety absorption systems. NARS need to improve the system's ability to absorb new varieties by removing institutional bottlenecks to adoption and by promoting other seed distribution/adoption channels.

Establishing a seed fund. A case may exist for establishing a regional seed fund, and perhaps even a series of funds at national level. Such a fund would help remove some of the structural rigidities in national seed systems by financing regular reviews, seminars, and information exchange via seed networks. The fund would also support NGOs, cooperatives, farmers' groups, and emerging seed entrepreneurs, accelerating the process of dismantling seed monopolies and replacing them with a more efficient seed industry.

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Seed Supply in the WANA Region—Status and Constraints

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Abstract

Seed is fundamental in the transfer of technology to farmers. If the results of research efforts by international centers and national programs are to be fully exploited, developing countries must have dynamic seed industries that are responsive to farmers' needs. Most formal seed programs in the WANA region have evolved from special projects of recent origin. This paper discusses the status of the seed industry in the region; reviews the performance of the formal sector; identifies major policy, regulatory, and institutional constraints; and makes suggestions for improvement. The paper also synthesizes existing information on the informal seed sector, including the role of NGOs in encouraging local seed production through the use of indigenous knowledge and practices. Finally, an attempt is made to define the respective roles of the formal and informal sectors, and examine how these sectors could be linked effectively to improve seed production and supply at different levels.

Introduction

The West Asia and North Africa (WANA) region extends from Morocco in the west to Pakistan in the east, and from Turkey in the north to Ethiopia in the south, covering a total land mass of 1.7 billion ha. About 128 million ha of this area is arable, of which 35 million ha is irrigated (Schoonhoven 1991). The region is characterized by extremes of climate, ranging from mediterranean to monsoon, and from temperate to tropical. A mediterranean climate with cool to cold winters and hot to extremely hot and dry summers is common across much of the region. There is wide variation in temperature and in the amount and distribution of rainfall in different parts of the region.

Because less than 30% of the arable land is irrigated, agriculture in WANA is heavily dependent on rainfall. A cereal-fallow rotation integrated with livestock is the most common farming system, with wheat and barley as the dominant crops (Pala 1991). The WANA region is the second largest dryland wheat and barley production zone in the developing world, and accounts for 36% of global wheat area.

The farming systems are generally subsistence in nature. The majority of farmers are smallholders (Tully 1990), who obtain low yields but nevertheless make a substantial contribution to the national economy

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in all countries. For example, in Ethiopia smallholders cultivate 82% of the total wheat area and account for 76% of wheat production (Haile et al. 1991).

According to Nordblom and Shomo (1995), most countries in the WANA region are facing increasing problems with food and feed production as a result of rapid population growth, rural-urban migration, and low profit from rainfed agriculture in marginal areas. The population of WANA is projected to reach 1.5 billion by 2030 (Schoonhoven 1991), while food deficits will rise to 70 million tons by 2020 (Nordblom and Shomo 1995).

Most seed programs in WANA were special projects designed originally to address the seed needs of the diverse farming systems in the region. However, these projects have undergone distinct and sometimes overlapping structural changes. Almost all countries have the basic infrastructure needed for crop research, variety development, and seed production and distribution, particularly for the major food crops. These functions are organized in various ways and to different levels of sophistication in different countries. On the whole, seed production and supply channels are a mix of the formal sector (public/private organizations) and the informal sector (farmers' groups, NGOs). The lack of modern varieties in crops like barley, food legumes, and pasture crops is the main limitation to the development of national seed programs (Srivastava 1986, van Gastel and Bishaw 1993).

The formal seed sector

The formal sector has had mixed results in meeting the varietal and seed requirements of a majority of farmers. The public sector focuses on supplying seed of a few varieties of the major food crops, mostly to farmers located in favorable and accessible areas. The private sector concentrates on hybrids, which are profitable but of limited relevance to small-scale farmers, particularly in less favorable areas. Thus, small-scale farmers in low-potential and remote areas have only limited access to improved varieties and quality seed. Much of the discussions about the formal sector relate to adoption of modern varieties and the availability of certified seed.

Adoption rates for modern varieties vary between and within countries and are influenced by several factors including varietal choice, availability of seed and other inputs, price policy, credit facilities, agroecological zones, and rural infrastructure. A CIMMYT survey (Byerlee and Moya 1993) covering 70 million ha or 94% of the wheat area in developing countries indicate that in the WANA region, 42% of the wheat area is sown to modern varieties, with large differences between and within countries (Tables 1, 2). Adoption rates of modern cereal varieties are generally low in many countries: 30% in Jordan (Hasan 1995), 36% in Lebanon, 42% in central Anatolia of Turkey and less favorable zones of Tunisia (cited in van Amstel 1994). However, high adoption rates for wheat varieties have been reported from Egypt, Syria, and Tunisia (Byerlee and Moya 1993) and in two major wheat production zones (Bishaw et al. 1994) and three districts in central Ethiopia (Nigatu et al. 1992).

The legume seed industry is relatively underdeveloped due to the scarcity of appropriate varieties, high production costs, mechanization problems, and seedborne diseases (Erskine et al. 1988), all of which hinder the adoption of legume-based cropping systems (Oram and Belaid 1990). In Ethiopia, farmers in the two most important faba bean production zones grow only local varieties (Bishaw et al. 1994). The formal seed system for forage crops has very limited activity. For example, inadequate production of medic seed limits the large-scale adoption of ley farming in WANA (Christiansen 1993).

Table 1. Maize and wheat area (1990-92 average) and coverage by modern varieties (MVs) in some WANA countries.

Country	Maize		Wheat		
	Area ('000 ha)	% under MVs in 1992	Area ('000 ha)	% under MVs in 1990	No. of wheat varieties released, 1966-90
Algeria	5	na	1633	25	25
Egypt	857	35	877	76	18
Ethiopia	1000	17	687	12	35
Iran	43	na	6357	33	16
Jordan	1	na	59	25	13
Lebanon	2	na	26	50	10
Morocco	404	5	2530	60	28
Pakistan	860	31	7878	91	50
Saudi Arabia	3	na	761	100	9
Sudan	na	na	368	95	34
Syria	63	95	1330	68	11
Tunisia	na	na	954	80	14
Turkey	515	31	9410	31	78
Yemen[1]	na	na	92	50	12
Total	**3753**	**19.5**	**32 962**	**56.9**	**353**

1. former Yemen Arab Republic
na = data not available

Sources: CIMMYT 1993 (wheat), CIMMYT 1994 (maize)

Table 2. Adoption of wheat varieties by rainfall zone, northern Punjab, Pakistan, 1990.

	High-rainfall zone (>500 mm)	Low-rainfall zone (<500 mm)
Local varieties (%)	15	73
First generation semi-dwarfs (%) (e.g. Lyallpur-73)	17	8
Second generation semi-dwarfs (%) (e.g.Pk-81)	68	19

Source: Ahmed et al. 1991 (cited by Byerlee and Moya 1993)

Certified seed production and/or distribution by national programs is limited largely to one or two major food crops for which modern varieties have made an impact and for which rainfall is sufficiently reliable (Table 3). For example, despite the long history of organized seed production in Morocco, in 1996 the formal sector supplied only 11% (66 000 tons) of the total seed requirement for wheat and rice (bread wheat accounts for 64% of the seed distributed). Seed production and distribution programs tend to focus on cereals, particularly wheat and maize, while seed availability is a

Table 3. Seed production and distribution of cereals, legumes, and oilseed crops in six WANA countries.

	Quantity produced/ distributed (t)	Percentage share of different crops						
		Wheat	Barley	Rice	Maize	Other cereals	Legumes	Others
Ethiopia (1995/96)								
Production[1]	20 676	66.5	6.1	-	19.5	5.3	2.1	0.5
Distribution	13 104	71.5	2.1		21.5	3.9	0.9	0.1
Egypt (1994/95)[2]								
Production	686 582	55.4	-	28.5	13.1	-	2.7	0.3
Distribution	621 156	60.5		28.7	8.2		2.2	0.4
Turkey (1996)								
Production	136 849	77.9	12.5	0.2	6.2	.	0.3	2.9
Cyprus(1995)								
Production	10 953	9.2	90.6	-	-	-	0.2	-
Syria (1994)								
Production	187 579	92.9	5.0	-	0.9	-	1.1	-
Yemen (1995)								
Production	1171	84.7	0.7	-	1.3	13.3	-	-

1. Uncleaned seed
2. Quantity in ardab in Egypt

Sources: Gurmu and Gudissa 1996 (Ethiopia), Kutay 1997 (Turkey). For other countries, Focus on Seed Programs published by WANA Seed Network Secretariat—No. 8 (Cyprus), No. 5 (Egypt), No. 4 (Syria), No. 6 (Yemen)

limiting factor in barley, food legumes, and forage crops (van Gastel and Bishaw 1993). Many national programs do not have any pre-release seed multiplication; production often starts only after a variety is released, causing delays in supply of breeder or basic seed to companies that produce certified seed. Seed imports play a significant role in the WANA region. Most vegetable seed and some hybrid maize and sunflower seed are imported each year. In 1996, the region imported seed worth about $200 million, and exported only $25 million worth (Le Buanec 1997).

Limitations of the formal seed sector result partly from the direct application of models based on centralized organization and large-scale production by state monopolies. These models can hamper seed distribution and marketing, and in fact, ignore practices and management skills already existing in traditional farming communities (van Amstel 1994).

Regardless of progress made in the technical aspects of seed production, several important constraints still limit the effectiveness of the formal seed sector:

- Ineffective seed policies
- Inappropriate seed legislation
- Inappropriate approaches to variety development
- Inflexible variety evaluation and release systems
- Seed quality control measures
- Infrastructure and pricing policies
- Weak institutional linkages
- Limited human resource development.

Ineffective seed policies

McMullen (1987) described government seed policies as follows: "Government policies in the developing world created a situation where an inefficient public seed sector dominates, local private companies are struggling entities, and international seed companies operate at sub-optimal levels that cannot properly contribute to the agricultural development of the country." In general, seed polices in WANA lack any force of law. There are no clear guidelines on the provision of credit facilities, and limited incentives to encourage private sector participation. One means of developing a clear strategy is to establish national seed councils (with representation from all sectors of the seed industry) to serve as advisory bodies to the government, and help guide and monitor progress.

Inappropriate seed legislation

Few countries have any form of legislation to regulate the seed sector. In cases where some attempts at regulation have been made, the procedures used are based on seed legislation designed and used in developed countries (Louwaars 1996). Many countries are now drafting new or revising existing legislation in the light of current developments and to meet the requirements of international seed trade, e.g., variety registration, variety protection, plant breeders' rights, seed import/export regulations. What may be required in WANA is an alternative approach, with legislation that is sufficiently flexible to serve both the formal and informal sectors. It is important that all concerned parties from both sectors are involved in revising or drafting such legislation.

Inappropriate variety development approaches

Formal plant breeding, on the whole, has not fully considered the ways in which farmers use indigenous knowledge to exploit crop and cultivar diversity. Rather, the emphasis has been on wide adaptation, high grain yield, large-scale mechanization, varietal uniformity, and grain quality (for commercial and industrial use). This approach has not led to rapid adoption of modern varieties. Consequently, an alternative breeding strategy has been suggested, which involves farmer participation during selection, particularly for diverse or relatively unfavorable areas. There is enough empirical evidence in favor of this approach (Eyzaguirre and Iwanaga 1996).

Participatory breeding using locally adapted germplasm and landraces to exploit specific adaptation has become a focus of the ICARDA barley breeding program for low-input areas (Ceccarelli et al. 1996). Moreover, the barley, lentil, and durum wheat breeding programs at ICARDA have initiated decentralized selection with some NARS. For example, the Ethiopian durum wheat and barley breeding programs are using local landraces, rather than introduced germplasm, to develop varieties at the national level.

Inflexible variety evaluation and release systems

In most cases, distinctness, uniformity, and stability are important criteria in variety evaluation. However, these criteria may not necessarily be relevant in a variable and complex environment in which farmers have diverse requirements. Evaluation and release systems vary considerably, among different WANA countries. A few countries (e.g., Morocco, Pakistan, Turkey) have set up an independent agency responsible for variety evaluation. Most countries either rely on breeders' evaluation and data (Cyprus) or verify data through on-farm trials (Ethiopia). All these arrangements lack flexibility and are not without bias. For example, the trial system may delay release, restrict the number of entries, discriminate against private sector

varieties, or even fail to identify the right varieties.

The variety release committee in many cases is dominated by breeders and officials from the public sector, and excludes the private sector and farmers. In many developing countries, frequent release of modern varieties is essential. A more flexible approach to variety release (for example, approving some varieties that may lack uniformity) together with a shift towards participatory breeding will permit more rapid release, particularly of varieties which would be targeted at marginal areas and multiplied and distributed through the informal seed sector.

Inadequate seed quality control measures

In many countries seed certification is absent, or quality control is carried out by the same organization that produces seed. Independent certification agencies exist in a few countries but lack resources and facilities. For most countries, low-key external quality control with devolution of more responsibility to the producer (whether public or private sector) appears to be an alternative approach. For example, although Pakistan has a comprehensive seed certification program, it allows the private sector to use truth-in-labeling to ensure product quality. In Afghanistan the FAO follows a *quality declared seed* system to encourage local seed production and distribution. Many countries could benefit from adopting this system, which requires less resources and passes on more responsibility to the producer (FAO 1993). However, a well organized internal quality control system is essential before such a scheme can be implemented.

Infrastructure and pricing policies

A seed industry requires investment in research and machinery, seed processing plants and storage facilities, and rural infrastructure (e.g., a good transport network). In WANA, however, facilities, distribution networks, and infrastructure are inadequate. Consequently the majority of farmers have only limited access to high quality seed. Moreover, seed pricing policies do not reflect actual value and thus often hinder the development of sustainable national seed programs. Insufficient price premiums for contract growers have a negative effect on seed quality, while subsidized prices for seed users are a burden on the national treasury and may create dependency on government. In order to improve distribution and marketing, national seed programs should have many distribution outlets, including private seed dealers, and have a realistic price policy to make seed available at affordable prices.

Weak institutional linkages

The performance of the seed sector depends on cooperation and strong linkages between the various institutions involved. There are poor linkages between agricultural research, development, extension, and seed producers who could promote the use of improved seed. Seed supply is a low priority in many extension programs.

Limited investment in human resource development

There is a general lack of trained and motivated staff to lead and manage national seed programs. It is therefore important for each country to develop strategies to correct these deficiencies. Training programs need to focus on several key areas—seed program development, seed enterprise management, seed marketing, privatization of the seed sector, and strengthening of the informal sector.

Table 4. Public and private sector seed supply in Pakistan and Turkey, 1995/96.

	Pakistan			Turkey			
Crop	Total[1] %	Public %	Private % (prod+imports)	Total[1] %	Public %	Private %	Imports %
Wheat	8.89	89	11	40	88	10	2
Barley	-	-	-	18	70	29	1
Rice	5.82	90	10	28	95	-	5
Maize	6.08	44	54	100[2]	1	99	-
Soybean	-	-	-	100	20	80	-
Sunflower	-	-	-	100[2]	-	100	-
Cotton	40.96	49	51	100	99	1	-
Forage crops	-	-	-	20	70	27	3
Vegetables	-	-	-	100	3	72	25

1. Total % shows formal sector seed supply as percentage of national requirement. Public %, private % are percentage shares of public, private sectors in formal sector production
2. Hybrids

Sources: Ahmad 1997 (Pakistan), Kutay 1997(Turkey)

The private seed sector

Although the public sector is dominant in almost all countries, the private sector has a major share in hybrid seed production and in the import and distribution of vegetable seeds. In Turkey, the private sector supplied almost the entire quantity of hybrid maize, sunflower, and vegetables in 1996 (Table 4). Moreover, the share of the private sector is beginning to grow even in self-pollinated crops where national seed companies are involved in seed supply. In 1996 the private sector supplied about 20% of wheat, rice, and faba bean seed in Egypt.

A large number of private firms operate in the region—12 in Egypt, one in Ethiopia, 138 in Pakistan, and over 70 in Turkey. These companies are either subsidiaries of foreign firms working on hybrids and vegetable crops or national enterprises that depend on public-bred varieties and public facilities. Some are essentially seed traders. In Egypt, for example, 53 companies are registered for import and 148 for seed export, and all are involved in wholesale and distribution of seed to farmers.

As part of structural adjustment policies, many countries are attempting to liberalize their national seed programs, which are currently dominated by the public sector. However, particularly in WANA, privatization may not necessarily improve seed supply to resource-poor farmers in low-input areas (van Amstel 1994). Moreover, seed production of self-pollinating crops is not attractive to the private sector and therefore difficult to privatize (Turner 1996).

The experience, progress, constraints, and steps for privatization of the seed industry in WANA have been summarized by van Gastel et al. (1997) and Bishaw et al. (1997). The key points:

- Lack of government commitment to privatization is often reflected in outdated seed laws and regulations, which may be more relevant to the public sector. Governments should have a coherent policy and legal framework to encourage private investment, both national and foreign.

- Unfair competition (subsidies) from the public sector is a major constraint to the emerging private sector. Other constraints include lack of equal access to germplasm and breeder/basic seed, over-regulation of seed import/export, lack of investment and financial laws, absence of credit facilities and incentives, distorting seed pricing policies, the large capital investment required, and lack or inadequate enforcement of variety protection laws.
- Governments should encourage private investment through partnerships with national public or foreign companies to attract foreign capital and better technology. The private sector should have access to low-interest credit, public sector varieties, and breeder seed; should be permitted tax-free import of capital goods, inbred lines, and seed; and should be given additional incentives such as tax holidays. Restrictions on seed import/export and repatriation of profits (for foreign investors) should be removed or reduced. Governments should deregulate and liberalize the seed sector to ensure fair competition.
- Governments should continue basic and applied research in plant breeding with emphasis on low-profit crops, and ensure that farmers in remote areas have access to seed.
- Regional cooperation among WANA countries and assistance from donors and international organizations could strengthen the private sector. The private sector should have equal access to advanced germplasm and training at IARCs. Donors should provide technical and financial assistance through bilateral projects to accelerate privatization.
- A Privatization Committee should be established, composed of representatives from donors, ICARDA, and the private sector, to support national privatization efforts within WANA. The committee could assist countries in their privatization efforts, and study the effect of liberalization or privatization on the seed sector.

The informal seed sector

After three decades of emphasis on and investment in organized seed production and supply, more than 80% of major crops in developing countries are still sown from seed stocks selected and saved by farmers (Osborn and Faye 1991, Bal and Douglas 1992, Cromwell et al. 1993). It is therefore necessary to formulate national policies that focus more specifically on informal seed systems, which are particularly important for resource-poor farmers in less favorable areas.

Local seed systems are characterized by low levels of organization and institutional development (van Amstel et al. 1996). They are known under different names and vary in organization and approach. Experiences from Africa, Asia, and South America show that small-scale farmers in local systems possess an indigenous capacity to produce and distribute good seed. Seed surveys in WANA (Hasan 1995, Bishaw et al. 1994, van Gastel and Bishaw 1994, Abdel Fattah 1994, Tetlay et al. 1991) and elsewhere (Wright et al. 1994, 1995, Wright and Tyler 1994) have suggested ways to investigate and broaden our understanding of the informal seed sector.

Several studies highlight the status and essential features of seed production within the informal sector. Experiences relate to a wide range of issues, which require further investigation and understanding. Some of these ideas and experiences are presented in the following sections.

Support for local initiatives in community seed production

In Ethiopia, the government supports the informal sector at the community/village level for both local and improved cultivars through secondary seed production schemes (Amare and Alemayehu in press). In Pakistan the informal sector is active in seed production of legumes and other crops (Siddiqui in press). In Afghanistan, FAO, in collaboration

with the World Food Program, launched a food-for-seed program under which contract seed growers are given food wheat in exchange for seed, which is then distributed to other farmers. Foundation seed is also supplied to encourage local seed production and lateral diffusion of seed. Mobile seed cleaning/storage facilities and the *quality declared seed* system are used to develop and maintain a flexible seed production system under civil war conditions.

Variety and seed replacement

The decision by farmers to change varieties already adopted is termed variety replacement, whereas the decision to obtain fresh seed stocks of the same variety is termed seed renewal. In both cases the decision to replace seed may be due to perceived reduction in productivity arising probably from genetic change and/or physical contamination through continuous use of the same seed.

Earlier studies have tried to assess the impact of plant breeding by predicting the rate of variety (Brennan and Byerlee 1991) and seed replacement (Heisey and Brennan 1991). In the case of variety replacement, the average age of varieties and the number of years since a variety was released are weighted by the area sown to the variety. The optimal period depends on yield gain of new varieties, yield loss of old varieties, and risk involved in changing the variety (Brennan and Byerlee 1991). In 1990, the weighted average age ranged from 6-8 years in Syria to more than 16 years in Jordan, Lebanon, and Yemen (Byerlee and Moya 1993).

Seed retention

Farmers generally save seed each year for a number of years following an initial purchase of certified or commercial seed. The formal seed sector usually recommends that seed stocks be renewed every year for hybrids, every 3 years for open-pollinated crops, and every 5 years for self-pollinated crops. Yield declines have been estimated at 35% for hybrids (Pray and Ramaswami 1991); zero in dry areas of Australia, 0.25% in Pakistan, and 1.6% in Nepal for wheat; and 1.6% for rice in India (Heisey and Brennan 1991). In Egypt, cotton seed after 7 generations of multiplication from breeder seed showed a decline of 28% in yield and 15% in fiber quality (Gregg 1993). Seed replacement rates are influenced by both yield reductions and the cost of new seed (Heisey and Brennan 1991).

Farmers frequently renew hybrid seed, but tend to retain seed of self-pollinating crops for much longer periods. Evidence from Ethiopia (Bishaw et al. 1994, van Gastel and Bishaw 1994) and Nepal (Cromwell et al. 1993) indicates that farmers retain seed of modern varieties for longer periods than anticipated (Table 5). In developing countries with a low turnover of new varieties, frequent renewal should not be advocated for strictly self-pollinated crops (van Gastel and Bishaw 1993).

Sources of seed

Farmers often have different sources of seed (Table 6) including the formal sector, neighbors, traders/markets, or own-saved seed. A survey in Pakistan (Tetlay et al. 1991) indicated that other farmers are not only major sources of wheat seed (23%), but are also more important than the formal sector as sources of new varieties (on average 50% vs 34%).

Seed quality

Seed surveys in Egypt (ICARDA 1988), Ethiopia (Bishaw et al. 1994), Syria (van Gastel and Bishaw 1994), and Jordan (Abdel Fattah 1994, Hasan 1995) investigated the quality of seed sown by farmers (Table 7). The results showed that seed from the formal

Table 5. Seed retention by farmers (both modern and traditional varieties).

No. of years seed is saved	Ethiopia, wheat (n=388)	Ethiopia, barley (n=314)	Syria, wheat (n=118)
1	1.5	1.0	50.0
2	12.1	4.5	26.6
3	18.3	3.5	9.4
4	11.9	2.2	3.1
5	19.3	4.1	-
6-10	20.6	5.8	3.1
11-15	13.5	2.8	1.6
>20	2.8	76.1	3.1
Total	**100%**	**100%**	**100%**

n = number of farmers

Sources: Bishaw et al. 1994, van Gastel and Bishaw 1994

Table 6. Farmers' sources of wheat seed (% of total) in four WANA countries.

Country[1]	Own	Neighbor	Commercial market	Other
Ethiopia	95.3	1.2	0.2	3.3
Jordan	58.3	7.6	34.1	-
Pakistan	59.0	23.0	9.0	9.0
Syria	55.9	25.4	18.6	-
Average	67.0	14.0	16.0	3.0

1. National data for Jordan, zonal data for Ethiopia and Pakistan, district-level data for Syria

Sources: Bishaw et al. 1994 (Ethiopia), Hasan 1995 (Jordan), van Gastel and Bishaw 1994 (Syria), Tetlay et al. 1991 (Pakistan)

sector had better physical quality due to cleaning, although germination of the majority of own-saved and neighbor-purchased seed was acceptable and in line with national seed standards. Wright et al. (1995) also report good germination—with some exceptions—of seed samples collected in surveys in Ghana, Malawi, and Tanzania.

However, varietal purity and seed health appear to be the main problems associated with seed saved by farmers. The embryo test and washing test showed that a large proportion of seed samples were infected/ contaminated—69.3% with *Ustilago tritici,* 43% with *Tilletia caries,* and 85% with *T. foetida* (Abdel Fattah 1994). Infection was higher in samples collected from own-saved seed and seed purchased from neighbors than in treated certified seed. Simple improvements in local seed cleaning and treatment can help produce good quality seed on the farm.

NGOs in seed supply

Countries in the Greater Horn of Africa—Ethiopia, Eritrea, and Sudan—have become increasingly vulnerable to recurrent drought and human conflict. Several NGOs operate seed programs (generally beginning as relief operations) in these countries. In Ethiopia

Table 7. Quality of seed sown by farmers in selected countries.

Seed source	Physical purity (%)	Below standard (%)	Germination (%)	Below standard (%)
Egypt(n = 362)				
Seed plant (4)	98.8	-	94	-
PBDAC[1] (74)	98.9	-	94	2.7
Cooperatives (154)	98.9	1.3	94	0.6
Own-saved (130)	97.0	16.2	93	6.9
Standard[2]	95		85	
Jordan (n = 379)				
Government (130)	99.4	4.6	84	38.5
Neighbors (29)	96.6	34.5	86	24.1
Own-saved (220)	96.8	41.8	88	22.3
Standard	95		85	
Syria (n = 118)				
Government (22)	98.7	-	84	36.3
Neighbors (30)	94.1	80.0	91	6.6
Own-saved (66)	95.4	62.0	90	6.0
Standard	97		85	

n = number of farmers

1. PBDAC = Principal Bank for Development of Agricultural Credit
2. Standard = minimum quality prescribed for certified seed

NGOs accounted for up to 26% of seed distribution until 1990 and are the main customers of the formal seed sector. NGOs in Sudan depend on the formal seed sector for cleaning, treatment, and testing of grain distributed for seed in emergency operations.

NGOs are adopting several innovative approaches using informal systems. For example, Worede (1992) describes a farmer-based genetic conservation, germplasm enhancement, and seed production program supported by the Unitarian Service Committee/ Canada in Ethiopia to rehabilitate the local landraces lost following drought years. Community seed banks operated by the Tigray Development Association in northern Ethiopia (Indeshaw 1997) and by Oxfam in Sudan (Cromwell et al. 1993) and CARE International's seed recovery project in Sudan (Hashim and Ibrahim in press) are some of the approaches being used to improve local seed supplies in drought-prone areas.

NGOs seem to have a comparative advantage working with small-scale farmers in remote and less favorable environments (Cromwell et al. 1993) and appear strong in organizing farmers and developing participatory methods (Bebbington 1993). However, doubtful sustainability after donor support ends, farmer dependency on free services, loose linkages with the formal sector, and lack of professional and technical expertise are major shortcomings (Cromwell et al. 1993, Bebbington 1993).

A large number of NGOs in Ethiopia (up to 120) seem to work in isolation, lack effective coordination, and do not share information and experiences. The formal sector and NGOs have complementary strengths that need to be combined to develop

sustainable seed supply systems for resource-poor farmers.

The role of ICARDA

Van Amstel (1994) suggests that since international agricultural research centers (IARCs) work on crops that are important to small-scale farmers, these centers could support the development of local seed systems by influencing national policy and linking local systems with public sector institutions. Of all centers supported by the Consultative Group on International Agricultural Research (CGIAR), ICARDA is the only one with a functional seed unit. ICARDA's Seed Unit helps strengthen national seed programs through training, networking, financial/economic analysis of seed systems, multiplication of source seed, studies of the informal sector, and of seed security for drought-prone areas. The Seed Unit has been recognized as the base for the WANA Regional Seed Network and center for training on seed-related issues within and beyond the region.

Conclusions

It is generally accepted that seed sector development requires an integrated national seed system linking the formal and informal sectors. But what mix of formal or informal, public or private sectors is necessary to develop sustainable seed programs? There are no ready-made answers, but there are promising ways of studying and developing national seed systems, taking into account differences in local conditions. The formal and informal sectors will continue to exist, each with a distinct role to play.

In reviewing current situations it is clear that the public sector has a major role to play in basic and applied crop research, source seed production, provision of credit, quality assurance, and training. On the other hand, the private sector (from small scale farm enterprises to multinational companies) has proved to be effective in producing high-value seed and supplying it to niche markets, while the informal sector needs support and strengthening particularly in the development of small-scale seed enterprises that could meet local needs.

In order to develop effective and efficient national seed systems, governments in developing countries need to develop policies and institutional and legal frameworks to complement and link the roles of the formal and informal sectors. One way of doing this is by establishing national seed boards that would define the responsibilities of each sector, and develop ways to link the two sectors to improve seed production and supply. Alongside this is the need for a flexible regulatory framework that accommodates the requirements of different sectors of the seed industry. The work of IARCs is vital in this respect, since they work on crops essential to small farmers and will continue to generate technology suited to the needs of small farmers and to support national seed systems.

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Constraints to Variety Release, Seed Multiplication, and Distribution of Sorghum, Pearl Millet, and Groundnut in Western and Central Africa

J Ndjeunga[1]

Abstract

During the past 20 years, donors have invested more than US$ 100 million in seed projects in the semi-arid tropics of Western and Central Africa. A number of improved varieties (31 sorghum, 36 pearl millet, 33 groundnut varieties) have been released in the region. Despite the availability of improved varieties and massive investments in seed multiplication and distribution, formal seed supply systems have failed to ensure that farmers have access to high quality seed of improved varieties. Adoption of such varieties—and thus the returns to investment in research and seed multiplication—is very low. This paper analyzes the constraints to variety release, seed multiplication, and distribution of sorghum, pearl millet, and groundnut in four countries in the region—Burkina Faso, Chad, Niger, and Senegal. The primary constraints are limited supply of breeder seed, poor seed quality control, poor demand estimation, and inadequate distribution systems. Secondary constraints include the lack of national variety release committees, variety development without consideration of farmers' preferences, poor linkages between institutions and lack of institution building, and lack of seed laws.

Introduction

Countries in the semi-arid tropics of Western and Central Africa have an agriculture-based economy. The agricultural sector employs more than 70% of the labor force and contributes over 30% of the gross domestic product. Yet, food production is not sufficient to ensure self-sufficiency; most countries in the region rely heavily on food aid. Yields of the major crops (pearl millet, sorghum, groundnut) are low, and declining in many areas. Adoption of improved varieties is low.

During the past 20 years, governments and external donors have invested over US$ 100 million in seed projects in the region (Table 1), but this investment has not improved seed availability, adoption rates of improved varieties, or productivity. State seed industry infrastructure has been established but not maintained. This paper examines the possible reasons for this failure, and suggests areas that need more careful examination while formulating plans for agricultural development.

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Table 1. External donor funding for seed projects in four countries.

Country	Donor funds (US$ million)	Period	No. of projects'
Burkina Faso	20.30	1974-1995	7
Chad	8.86	1984-1994	6
Niger	45.76	1976-1993	3
Senegal	33.34	1976-1995	3

1. Independent projects only; does not include rural development projects with seed components

Major crops, areas, and yields. Sorghum and pearl millet are the main staple crops in Western Africa. Area and production (1992-94 average) are estimated at 14.9 million ha, 10.2 million tons of pearl millet, and 12.5 million ha, 9.5 million tons of sorghum (FAO/ICRISAT 1997). Yields are poor and declining. In Niger, between 1986 and 1994, yield decline was estimated at 2.9% in pearl millet, 10.2% in sorghum, and 3.9% in groundnut. Similar trends are observed in other countries in the region. Particularly in the context of rapid population growth, this yield decline represents a serious threat to food security. In contrast to sorghum and pearl millet, which are essentially subsistence crops, groundnut is a cash and export crop in many countries in the sub-region, notably Senegal and Burkina Faso. But even in these countries, groundnut yields are low (e.g., 900 kg ha^{-1} in Senegal), partly because of poor adoption of improved varieties, which in turn is due to poor seed multiplication and distribution systems.

Variety development. International research centers have invested heavily in providing support to national breeding programs. ICRISAT has played a significant role in developing about half of the released improved pearl millet varieties. The Institut de recherche pour les huiles et oleagineux (IRHO, France) has helped develop 90% of the released groundnut varieties; and the Institut de recherches agronomiques tropicales et des cultures vivrieres (IRAT, France) has developed about half the sorghum varieties released (Table 2). Three regional research networks—West and Central Africa Millet Research Network (WCAMRN), West and Central Africa Sorghum Research Network (WCASRN), West and Central Africa Groundnut Research Network (WCAGRN)—have played significant roles in developing and strengthening cooperation between national and international research institutes, encouraging multidisciplinary research, assisting information dissemination, and facilitating better use of human and material resources to extend improved technologies.

Adoption patterns—major and minor constraints. In general, the area sown to improved varieties is low. However, there are differences in adoption levels between and within countries which are largely explained by the availability of breeder seed, seed quality, and the effectiveness of distribution systems. For example, in Niger, government funding for breeder seed production is very limited; quality control, demand assessment, and distribution systems are poor. Correspondingly, the level of adoption for new varieties of most major crops is very low—only 1% of sorghum area, 5% of pearl millet area, and 15% of groundnut area are sown to improved varieties. In contrast, in Senegal, the government places a priority on breeder seed production, and quality control

Table 2. Adoption of released pearl millet, sorghum, and groundnut varieties developed by different research institutions in four countries.

Research institution	Number of released varieties		
	Pearl millet	Sorghum	Groundnut
Burkina Faso (9+10+9 varieties)			
IRAT/NARS	4	7	0
ICRISAT/NARS	5	3	0
IRHO	0	0	9
Adoption (% of area)	2	2	80
Chad (6+6+6 varieties)			
IRAT	0	3	0
ICRISAT	6	3	0
IRHO	0	0	6
Adoption (% of area)	4	6	10
Niger (17+9+9 varieties)			
IRAT	0	4	0
ICRISAT	3	1	0
IRHO	0	0	9
INRAN (national program)	14	4	0
Adoption (% of area)	1	5	15
Senegal (4+6+9 varieties)			
IRAT	1	1	0
ICRISAT	3	1	0
IRHO	0	0	6
ISRA (national program)	0	4	3
Adoption (% of area)	8	7	100

IRAT = Institut de recherches agronomiques tropicales et des cultures vivrieres (France), IRHO = Institut de recherche pour les huiles et oleagineux (France), INRAN = Institut national de recherches agronomiques du Niger, ISRA = Institut senegalais de recherches agricoles

and seed distribution systems are relatively well developed, especially for cash crops. The entire groundnut area (but only 8% of sorghum and 7% of pearl millet area) is sown to improved varieties.

Other (less important) factors also hamper seed systems in the region. These include delays in variety release because there is no formal national variety release committee or no standardized release procedures; poor linkages between research centers, seed multiplication units, and extension units; and a restrictive regulatory and legal environment that does not encourage growth.

Sustainability of seed projects. There are no ongoing seed projects in the four countries. The lack of donor interest is perhaps due to poor performances and lack of sustainability in the earlier projects. These projects, which dealt almost exclusively with the formal seed sector, were funded primarily by external donors. Their operations were heavily subsidized and thus financially unsustainable. Seed was produced only so long as donor funds were available; subsequently the projects collapsed. This is true particularly for pearl millet and sorghum, where seed is of low commercial value. In groundnut, in

contrast, parastatal institutions and donors are more likely to provide funding for seed production, and extension and marketing infrastructure are more developed. In Burkina Faso, between 1986 and 1990, the Banque Ouest Africaine de Developpement (BOAD) funded a groundnut seed project that sought to increase groundnut production through investment in breeder and basic seed production with the Institut national des etudes et de la recherche agronomique (INERA), and support for strengthening groundnut markets.

Objectives, methodology, and study area

The objective of this study was to identify and analyze the reasons for the failure of seed systems in Western and Central Africa, specifically with reference to three ICRISAT mandate crops, sorghum, pearl millet, and groundnut. Field surveys were conducted in four countries—Senegal, Burkina Faso, Niger, and Chad, the major producers of these three crops in Western and Central Africa. These crops together occupy more than 50% of the total cultivated area in each country.

The surveys were conducted during Sep-Dec 1996. Structured interviews were used to obtain information from a range of seed industry participants—researchers (breeders, agronomists, socioeconomists), managers of public and private seed multiplication units, merchants, traders, NGOs, contract farmers, and policy makers. Data on seed production and varietal characteristics were obtained from research institutes and seed multiplication units in each country. Information on variety release procedures, government policies affecting seed multiplication and distribution, and constraints to seed multiplication and distribution was collected through interviews.

Table 3. Primary and secondary constraints as cited by respondents.

Constraint	Percentage of respondents
Lack of breeder seed	90
Poor quality control	90
Poor demand assessment and distribution systems	95
Lack of national variety release committee	60
Unsuitability of varieties	40
Poor linkages and institution building	60
Lack of seed laws	40

Primary constraints to variety release, seed multiplication, and distribution

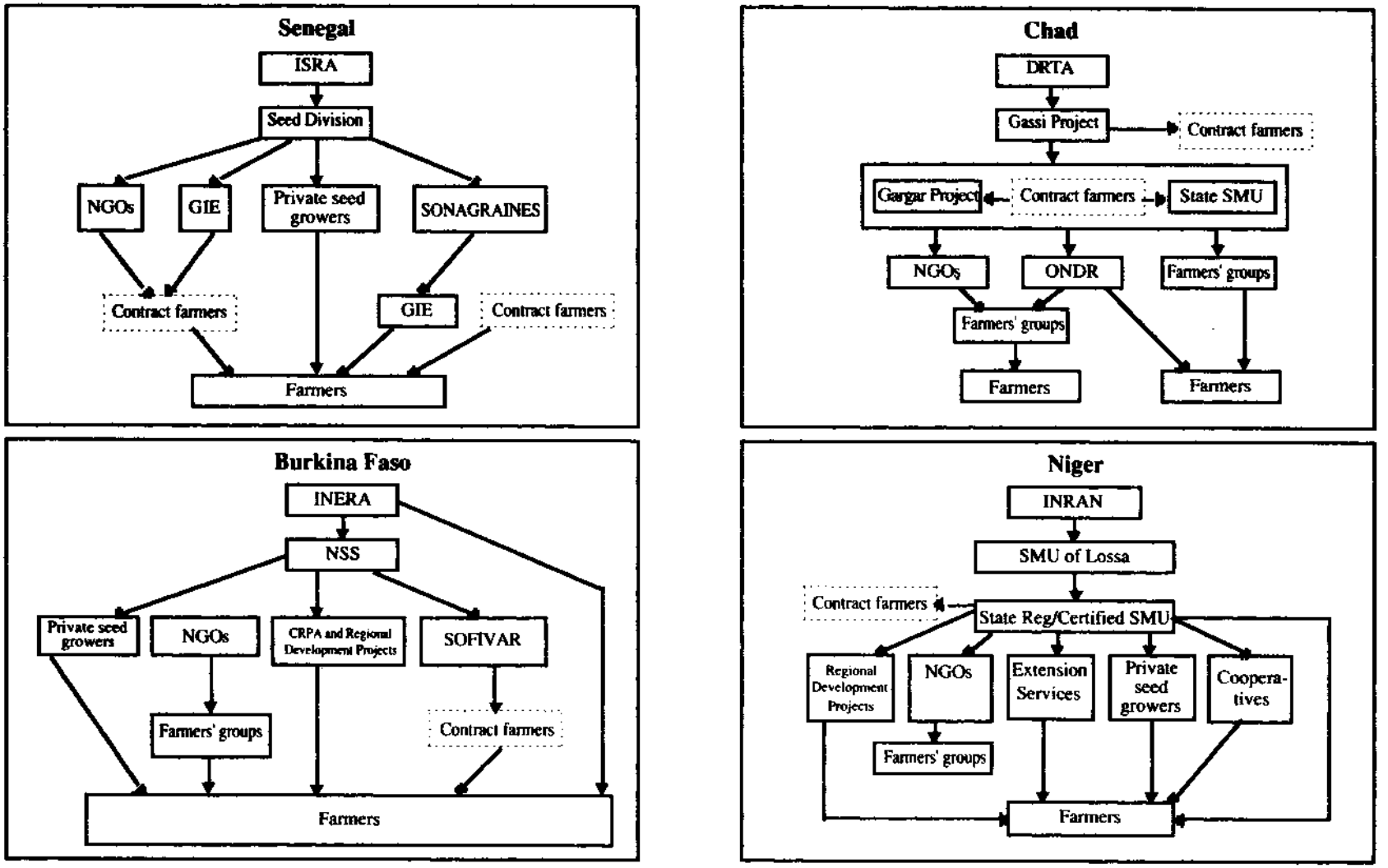
In all four countries, the national programs are responsible for variety maintenance and production of breeder seed. Responsibility for the production of foundation seed varies by country. In Niger, the state seed multiplication unit of Lossa produces foundation seed. In Senegal, production is contracted out to farmers' groups through Groupes d'interet economiques (GIE). In Burkina Faso and Chad, research institutes are responsible for the production of basic seed. Registered and certified seed are produced by state seed multiplication units through contract farmers. Certified seed is distributed by extension services, rural development projects, NGOs, and merchants (Fig.1). Seed imports of pearl millet, sorghum, and groundnut are not significant.

More than 75% of respondents reported that limited supply of breeder seed, poor quality control, and poor distribution systems were the primary constraints faced by formal seed supply systems in the region (Table 3).

Limited supply of breeder seed

Breeder seed is the basic input for seed multiplication; high-quality breeder seed must therefore be produced in adequate

Figure 1. Pearl millet, sorghum, and groundnut seed distribution channels in Western and Central Africa, 1996.



Acronyms: ISRA = Institut sénégalais de recherches agricoles, GIE = Economic Interest Group of contract farmers, SONAGRAINES, SOFIVAR = groundnut parastatals, DRTA = Directorate of Research and Agricultural Technology, SMU = Seed Multiplication Unit, ONDR, CRPA = extension services, INERA = Institut national des études et de la recherche agronomique, NSS = National Seed Service, INRAN = Institut national de recherches agronomiques du Niger.

Table 4. Certified seed production and national seed requirements in four countries in Western and Central Africa, 1991-95.

Crop/Country		Production/requirements (tons) in different years				
		1991	1992	1993	1994	1995
Sorghum						
Chad	Production	8.9	6.9	6.4	2.0	3.6
	Requirements	1172.4	1220.7	1156.8	1443.2	1575.5
Burkina Faso	Production	22.4	8.3	10.9	10.9	4.8
	Requirements	3178.0	3300.0	3444.0	3614.0	3373.3
Niger	Production	0	0	0	11.4	0
	Requirements	4831.9	5904.5	5223.9	4703.7	4514.8
Senegal	Production	62.1	8.4	10.9	14.1	9.7
	Requirements	233.2	306.6	294.8	331.2	346.3
Chad	Production	1.3	2.4	3.3	0.8	0.05
	Requirements	944.8	945.3	849.0	1081.2	1066.4
Burkina Faso	Production	8.9	0.9	2.4	3.1	1.7
	Requirements	2014.0	2006.0	2155.0	2185.0	1699.0
Niger	Production	177.4	42.4	53.9	187.6	77.5
	Requirements	7309.0	8231.0	6433.8	8224.4	8715.7
Senegal	Production	29.2	65.1	31.0	74.2	59.0
	Requirements	1465.3	1289.5	1623.0	1559.6	1484.8
Groundnut						
Chad	Production	121.2	131.9	194.8	97.1	88.1
	Requirements	3761.7	4579.8	4469.5	4621.7	5311.2
Burkina Faso	Production	2599.8	2708.6	2825.1	2124.5	2113.8
	Requirements	2938.3	3817.2	3622.3	4040.0	4572.5
Niger	Production	21.8	0	0	313.4	52.2
	Requirements	1725.5	2919.7	1411.7	2517.3	4488.2
Senegal	Production	16782.5	15174.0	22898.0	11297.3	14733.6
	Requirements	14526.9	15946.3	12738.1	15466.9	14689.5

Sources: Centres de Multiplication des Semences (Niger and Burkina Faso), Seed Division (Senegal), Gassi Project (Chad)

quantities. More than 90% of respondents indicated that shortage of breeder seed was a key constraint to the production of certified seed. National agricultural research systems (NARS) claimed that the government provided very limited funds for breeder seed production. This problem is particularly serious in pearl millet and sorghum, but less so in groundnut, which is of greater commercial value and has an active production market. In Senegal and Burkina Faso, parastatal seed companies provide funding to research institutes for groundnut breeder seed production.

Table 4 shows the production of certified seed in the four countries surveyed. Production of certified seed is inadequate, partly due to shortage of breeder seed. The seed coverage, i.e., the percentage of area sown to certified seed, was calculated for each crop, assuming that all certified seed produced was sold, that farmers purchased

fresh certified seed every 3 years for sorghum and millet and every 6 years for groundnut, and that farmers used the seed rates recommended by extension services[1]. Between 1991 and 1995, average certified seed coverage was generally less than 1% for pearl millet and sorghum, but over 60% for groundnut in Burkina Faso and Senegal, where governments provide marketing infrastructure through parastatal institutions. For example, seed coverage (1991-95 average) for sorghum, pearl millet, and groundnut was 0.5%, 0.2%, and 2.8% respectively in Chad, and 8%, 4%, and 100% respectively in Senegal.

The organization of seed supply systems is too inflexible and bureaucratic to deal with demand for all classes of seed. Poor communications and weak linkages between institutions frequently cause delays and shortages. In Niger, for example, research institutes complain of lack of funding for breeder seed production. The seed multiplication unit, which is responsible for bulking breeder seed into basic seed, complains of delays and inadequate supplies of breeder seed from the national research institute (Institut national de recherches agronomiques du Niger, INRAN). Seed multiplication centers (SMCs) which are responsible for registered and certified seed production complain of non-availability or delayed deliveries of basic seed. In return, the seed multiplication unit of Lossa, which is responsible for the production of basic seed, claimed that SMCs often place their orders late, giving insufficient time to produce adequate quantities of basic seed. Managers of all categories of institutions and seed production centers also complained that budget allocations (from the government) were generally insufficient and delayed, preventing them from planning production in advance.

Throughout the region, formal seed schemes depend on external sources of funding. Donor-funded projects between 1974 and 1995 commonly provided funds to NARS to produce breeder seed. When these projects were phased out, breeder seed production fell significantly. For example, in Niger, a USAID project was established in 1975 solely to develop seed infrastructure. The project set up six seed multiplication centers with well-equipped laboratories and provided funding to the NARS for breeder seed production. Between 1985 and 1988, an average of 1500 tons of certified pearl millet seed were produced each year through contract farmers. At the end of the project in 1989, this fell to 108 tons per year. Similar cases are reported from other countries.

In some cases, breeder seed production has been hampered by poor variety maintenance by NARS. For example, a United Nations funded seed project in Burkina Faso was forced to obtain seed of the pearl millet variety CIVT from ICRISAT, because genetic purity of the variety had not been maintained. Because of lack of variety maintenance, NARS often turn to ICRISAT for repeated supplies of breeder seed of varieties developed by ICRISAT. For example, 193 kg of breeder seed of the millet variety ZATIB was provided to the NARS in Niger in 1996.

IARCs have also played a significant role in breeder seed production in the region. During the last 3 years, ICRISAT has provided on average 300 kg per year of pearl millet breeder seed (all varieties combined) to NARS for research and multiplication (ICRISAT 1994, 1995, 1996).

Poor seed quality control

Seed certification, licensing of seed producers, and quality control are performed either by a government department or by individual seed production units (usually parastatals). However, quality control regulations are not enforced,

1. Recommended seed rates are 5 kg ha^{-1} for pearl millet, 7 kg ha^{-1} for sorghum, and 100 kg ha^{-1} (in-shell) for groundnut

and seed of all classes is poor in quality. Farmers' groups in parts of Senegal withdrew from contract production of basic, registered, and certified sorghum seed because of low germination rates in breeder seed. More than 90% of respondents interviewed during this study considered poor seed quality to be an important constraint to the wider use of certified seed and adoption of new varieties.

The lack of quality is apparently due to lack of funding and/or personnel for field inspections and post-harvest tests. Without staff and funds, regulatory authorities are unable to monitor seed producers or enforce standards. In Senegal, the seed division has been unable to monitor quality for the past 5 years due to funding constraints. One consequence is decline in production of 55-437, an important export variety of groundnut. The Interprofessional Union for Groundnut Grains (UNIA) has promised to pay the seed division 0.5% of the value of groundnut seed produced by Union members, in order to provide operating funds for seed quality control.

Training and infrastructure development for quality control has depended almost entirely on projects funded by external donors. These projects provided training for large numbers of technical staff. Unfortunately, once the project concluded, many of these trained staff left the seed division to join rural development projects where they were offered higher salaries and incentives. In Niger for example, out of the 4 seed technologists, 8 seed inspectors, and 6 laboratory technicians who were trained during the USAID project, only 2 inspectors and 2 technicians remain in the seed division. In Burkina Faso, out of the 4 seed technologists, 7 seed inspectors, and 5 laboratory technicians trained during the USAID seed project, only 1 technologist, 4 inspectors, and 2 technicians remain in the seed division.

Quality control infrastructure is weak in some countries. In Chad, for example, there is only one poorly equipped seed laboratory and no seed technologist (Table 5). However, the main problem is lack of trained staff rather than shortage of equipment. In addition, management of existing staff and facilities is poor. Unless these areas are addressed, government investments in new infrastructure will probably yield only marginal benefits.

Even during the period of involvement of seed projects, when quality control units were relatively well equipped, seed quality was poor. For example, in Niger, certified seed produced by contract farmers was not inspected; quality was correspondingly poor (Couvillon 1985). In Burkina Faso, contract farmers in a United Nations funded seed project indicated that the government multiplication unit provided them with registered pearl millet seed of poor quality with a low germination rate. Despite the relatively high level of quality control infrastructure, seed projects were unable to adequately conduct field inspections and post-harvest tests.

Table 5. Seed quality control staff and infrastructure in four countries in Western and Central Africa.

	Burkina Faso	Chad	Niger	Senegal
No. of seed inspectors	4	1	2	240
No. of laboratory technicians	2	1	2	16
No. of seed technologists	1	0	0	12
No. of seed laboratories	6	1	12	8
Laboratory equipment	Fair	Poor	Fair	Good

Quality control is essential to ensure that certified seed is indeed of high quality. In addition, wide availability of high-quality seed may induce farmers to purchase larger quantities of commercial seed. Poor quality discourages farmers from buying certified seed, thus reducing demand and seed producers' profits.

Poor demand assessment and distribution systems

More than 90% of respondents point to poor demand assessment and distribution systems as key constraints.

Demand assessment. Demand assessment is an essential component in seed production planning. Poor demand estimation may result in over- or under-supply of seed to farmers. Essentially, seed producers do not know how much to produce because they do not know how much they will be able to sell. This weakens every link in the "seed chain", including seed distribution (deciding how much seed to distribute and where, and planning the logistics), extension (seed for demonstration plots), and the wholesale and retail sale of seed.

Seed demand can depend on many factors, including the prices of seed available from alternative sources, farmers' incomes, tastes and preferences, and the type of crop. In many countries in the region, demand is assessed simply on the basis of cultivated area and the recommended seeding rate, without accounting for other factors. This often results in overestimation of demand. For example, in Burkina Faso, project targets for foundation seed production were exceeded. Much of the excess seed was used as certified seed, increasing costs and reducing efficiency. The National Seed Service was required to buy all foundation seed produced by the research stations and sell this at a loss (USAID 1987).

Another problem is inefficient multiplication. For example, in 1985/86 the Burkina Faso project produced 11 t of sorghum and 26 t of groundnut foundation seed, but multiplied this into only 31 t of sorghum and 65.5 t of groundnut certified seed. Using standard procedures, the 11 t of sorghum foundation seed should have been multiplied into more than 22 000 t of certified seed.

Seed distribution. Seed is distributed through various channels—extension services, national and regional development projects, NGOs, and merchants (Fig. 1). While distribution channels are fairly efficient in Senegal, this is not true of the other three countries, where less than 40% of sorghum and pearl millet certified seed produced was eventually sold (Table 6). One major problem is that there are too few wholesale and retail points; in Chad for example, there are only two wholesale points in Djamena and Gassi, both located far away from farmers.

Farmers are willing to purchase groundnut seed (because the crop is easy to sell and highly profitable), but not seed of sorghum and pearl millet, which are subsistence crops. During the last 5 years, seed production units have sold, on average, 70% of the certified groundnut seed produced, but less than half of the certified seed produced for sorghum and pearl millet (Table 6).

Respondents also indicate that seed distribution involved very high transportation costs as farmers are widely scattered, and often located in remote areas with poor road access. In Niger, Couvillon (1985) noted that due to high transportation costs, seed could reach only a few large markets. The most frequent answer given by farmers as to why they did not purchase seed of improved varieties was unavailability—seed distribution points were too few and located too far away from their farms.

Poor distribution has a number of interrelated effects. Because farmers have limited access to improved varieties, seed demand is low, and as a result sales volumes and profits by seed production units are low. This,

Table 6. Production and sale of certified seed in four countries in Western and Central Africa, 1991-95 average.

	Annual production of certified seed (t)			No. of wholesale outlets
	Pearl millet	Sorghum	Groundnut	
Niger	108 (30)	2.28 (40)	77.5 (80)	7
Burkina Faso	3.4 (50)	11.45(50)	2474.4(100)	10
Senegal	51.7(100)	21.04(100)	16 176.9(100)	250
Chad	1.57(30)	5.56 (30)	126.6(70)	2

Figures in parentheses show what percentage of the certified seed produced was eventually sold

together with the high transport costs, makes seed production financially unviable.

Secondary constraints to variety release, seed multiplication, and distribution

A number of secondary factors constrain variety release, seed multiplication, and distribution in the region. These factors, which were listed by less than 60% of respondents (Table 3), include lack of a national variety release committee, unsuitability of varieties, poor linkages between research, extension and seed multiplication units, lack of institution building, and lack of seed laws.

Lack of national variety release committees. Countries in the region have similar procedures for variety evaluation, involving research station testing, multilocational on-farm trials, and then review of performance data to decide on the release of a variety. However, this review is conducted not by a formal variety release committee but by ad hoc release committees which meet infrequently (in Burkina Faso, for example, there have been no meetings in the last 3 years). This has significantly slowed the rate at which new varieties are released, and increased the time lag between variety identification and release. Promising materials (e.g., the sorghum series SARIASO in Burkina Faso) have been successfully tested on farmers' fields, but are still awaiting formal release.

Unsuitability of varieties. Robins (1995) surveyed four villages in Burkina Faso to obtain farmers' opinions on improved varieties of sorghum, pearl millet, and groundnut. The results showed that farmers were willing to replace local varieties with improved varieties in groundnut, but not in pearl millet and sorghum. Essentially, profitability (yield) was the key issue in groundnut adoption. In the subsistence crops, additional factors are important. For example, the pearl millet variety ICMV 8201 was appreciated for its high germination rate and resistance to diseases and drought, but was not adopted because it was not suitable for making *to,* the traditional millet food.

Poor linkages and institution building. Few countries in the region have a coherent seed strategy. The four countries surveyed have no national seed committee, no national seed policy, no national seed plan, no national release committee, and no seed laws and regulations. There is a lack of coordination and planning for seed activities, and of information on released varieties. Almost all countries have poor management information systems. In Niger and Burkina Faso, for example, data on national seed production are not available, even to seed policy planners.

Some production data are available from individual seed production units but mainly in annual reports and receipts from sales, not in readily usable form.

Linkages between the national research systems, national seed services, seed multiplication units, and extension services are weak. In Niger, Burkina Faso, and Chad, no formal meetings have been held between extension agents and researchers for the past 2 years. Requests for breeder and basic seed made by state seed multiplication units were not met on time by research institutes. Extension agents were unaware of varieties that had been released.

In Burkina Faso, there is almost no interaction between research stations and the Seed Division for monitoring the quality of breeder seed produced by research stations. In Senegal, relationships between the extension services, Seed Division, and the research institute are weak. Extension agents are generally unaware of the characteristics of released varieties. For example, they are unaware of the newly released groundnut variety Fleur 11, and do not include it in their promotion programs. Extension services are not involved in seed promotion and marketing. The Senegalese government is currently restructuring its extension services in order to facilitate the flow of information between researchers and farmers.

In three countries (Senegal is the exception), seed-related issues are given low priority. The national seed services are ranked low in the organization charts of the Ministries of Agriculture, and headed by individuals who have received little formal training on seed technology, laws and regulations, and planning.

Lack of seed laws. In all four countries, consultations between the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Program (UNDP), and the government led to the development of a draft national seed policy. These drafts have yet to be approved by the governments. In Niger and Senegal, national seed laws and regulations have been approved, but have not yet been enacted. These regulatory and legal issues are not the primary constraints in Niger, Chad, and Burkina Faso. However, they become more important as seed industries are commercialized. In Senegal, for example, numerous cases of individuals trading falsely labeled, poor quality rice seed have been reported to the Seed Division, but the Seed Division is unable to prosecute these traders because the relevant laws do not exist.

Conclusions

Countries in the semi-arid tropics of Western and Central Africa face similar constraints to variety release, seed multiplication, and distribution. Lack of funding for breeder seed production, poor quality control, and poor seed distribution systems have severely limited farmers' access to high-quality seed. These constraints have also limited seed demand for improved varieties, thus reducing the market size and profitability for existing firms and potential entrants. Seed production units have historically operated with significant losses that were covered by huge donor subsidies. Once external funding ceased, seed units were forced to shut down or scale down operations.

In order to alleviate these constraints, governments in the region must show a greater commitment to seed sector development. It is essential to increase funding for breeder seed production. Quality control is important, and can best be implemented by spot checks of retailers and seed warehouses to ensure quality and truthful labeling. Detailed certification requirements may not be necessary at this stage of development of the seed industry, and in fact are likely to be counter-productive. Governments should provide tax breaks and other incentives to

encourage private sector investment. Centralized seed distribution schemes involve very high transport costs, especially when they serve farmers in remote communities. One possibility would be to enlist NGO support for seed production schemes that are located in the rural areas, near farmers.

In view of the poor performance of seed systems, the role of government needs reconsideration, particularly in the context of structural adjustment and liberalization policies that stress reduction of subsidies and government control and emphasize greater competitiveness through privatization. Current seed schemes are more institution-focused than farmer-focused.

The poor performance of the seed system as a whole is partly because farmers—who ought to be the centerpiece of the seed system—are neglected. "Farmers must be the basis of seed policy. Any effective seed policy must recognize what farmers can and cannot do. Farmers can efficiently reproduce and store seed of most self-pollinated crops, such as wheat, rice, and groundnut. They can reproduce and store some varieties of open-pollinated crops and some clonal varieties. Many farmers will experiment with new varieties in small plots in their fields. They can learn of new varieties from relatives, neighbors, and merchants who sell agricultural inputs. Even poor farmers can afford to buy small amounts of expensive seed, which they can use to reproduce enough seed to plant their entire farm with a new variety in a few years." (Pray and Ramaswami 1991).

Very little information is available on the informal seed supply system. As a prerequisite to improving seed availability, more information must be collected on farmers' sources of seed, their perceptions of seed quality, the factors that determine when they buy seed, and how informal community seed traders operate. This information could help reduce quality control and distribution costs incurred by current seed schemes. Information is also required on farmers' resource levels, levels of seed production, seed market infrastructure, and price and trading patterns. This information is needed for a cross-section of communities and for each of the major crops. NGOs and farmers' groups will play an important role in seed industry development and technology diffusion. Therefore, information is needed on both these groups as well. National seed systems will need to be built based on the strengths and comparative advantages of both formal and informal market systems.

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Session II
The Role of the Private Sector

The Private Seed Sector in Turkey

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Abstract

There are approximately 80 private seed companies in Turkey, of which 34 are registered with the Seed Industry Association. Seed production in the formal sector (public and private) is sufficient to satisfy demand in hybrid maize, hybrid sunflower, cotton, soybean, and vegetable crops. Seed of some crops (potato, melons, hybrid vegetables) is imported. The Turkish government has taken a series of steps to improve private sector research and development, and public organizations are gradually being withdrawn from seed supply activities. However, the private sector still faces a number of constraints—difficulties in production, cumbersome variety registration and seed certification procedures, lack of effective plant breeders rights, unrealistic government pricing, frequent changes in export and import regulations, excessive quarantine regulations and mandatory laboratory tests, and high value-added tax on seed.

In addition to the mainstream private sector, opportunities and a favorable operating environment exist for small-scale seed traders, for example in areas not serviced by large companies. These firms could supply seed at affordable prices to smallholder farmers by entering into partnerships with government research institutes or private seed firms.

National objectives

The objectives of the national seed supply system in Turkey are in the short term to be self-sufficient in seed of field, industrial, and vegetable crops; and in the medium term to become a reliable supply point for seed markets in Europe and the Middle East. At present, seed production is sufficient to satisfy demand in hybrid maize, hybrid sunflower, cotton, soybean, and standard vegetables and crops (Table 1). For some crops (potato, melons, hybrid vegetables), seed is imported. The aim is to increase production and strengthen seed production technology by improving private sector research and development. The government is taking steps to achieve this goal; public organizations are gradually being withdrawn from seed supply activities, and the private sector is playing a progressively larger role. Currently, there are about 80 private seed companies in Turkey, of which 34 are registered with the Turkish Seed Industry Association.

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Table 1. Seed supply and demand of major crops in Turkey.

Crop	Total cultivated area ('000 ha)	Annual seed requirements ('000 t)	Formal sector production as % of requirement	Share (%) of different components of the formal sector		
				Public	Private	Imports
Wheat	9500	310	40	88	10	2
Barley	3500	100	18	70	29	1
Rice	50	1	28	95	-	5
Soybean	60	4000	100	20	80	-
Maize[1]	200	5000	100	1	99	-
Sunflower	420	4000	100	-	100	-
Forage crops	550	3000	20	70	27	3
Cotton	700	50 000	100	99	1	-
Potato	200	135 000	20	1	60	-
Vegetables	700	3	100	3	72	25

1. Total maize area is 400 000 ha, of which 200 000 ha is sown to hybrids

Seed supply in Turkey

Seed production by the formal sector (i.e., public/government organizations and commercial private firms) is sufficient to satisfy demand in several crops, including hybrid maize, hybrid sunflower, cotton, soybean, and vegetable crops (Table 1). Processing and storage capacities are adequate for these crops (Tables 2, 3). However, seed supply in inadequate for some crops, especially cereals and some industrial crops. For instance, annual requirement for certified wheat seed is 370 000 t, whereas the formal sector supplies only 100-150 000 t. The remainder comes from the informal sector, i.e., farmer-saved seed. A similar situation is found in other crops (barley, rice, fodder crops, open-pollinated crops) and to some extent in potato.

In order to increase seed supply through the formal sector and promote the use of certified seed of these crops, the government is taking a series of steps.

- Develop appropriate legislation, incentives for local and foreign investors, and financial regulations to liberalize the seed market, encourage genuine private sector competition, and thus increase production
- Provide subsidies for seed of some crops, e.g., hybrid sunflower, soybean, and fodder crops
- Enact variety protection laws and plant breeders' rights to encourage private firms to enter the market for open-pollinated crops.

Major constraints

The development of the seed sector in Turkey is hampered by a number of constraints. The major constraints are discussed below.

Legislation. Some seed laws do exist, but do not conform to international regulations and do not clearly address the changing needs in Turkey's seed sector. Revised seed laws are being formulated but have not been finalized. The new regulations on variety registration, seed certification, market quality controls, and most important, on variety protection and breeders' rights, are still being discussed. No effective market control systems exist. Significant improvements in the private sector can occur only after the laws are in place and an effective market control system is established.

Table 2. Seed processing capacity and utilization[1] in Turkey.

Crop	Processing capacity available (t, annual)		
	Public sector	Private sector	Total
Wheat + barley	400 000 (30)	25 000 (54)	425 000(31)
Maize	50(100)	31 500(53)	31 550(53)
Sunflower	0	11 700 (56)	11 700 (56)
Soybean	50(100)	9 500 (86)	9 550 (86)
Cotton	124 000(100)	0	124 000(100)
Sugar beet	0	3000(100)	3 000(100)
Potato	2 500(100)	20 500 (90)	23 000(91)
Vegetables	20(100)	8 000 (45)	8 020 (45)
Fodder crops	0	2 000 (63)	2 000 (63)
Total	**526 620 (47)**	**111 200(64)**	**637 820 (50)**

1. Figures in parentheses show percentage of capacity utilized

Table 3. Seed storage capacity and utilization[1] in Turkey.

Crop	Storage capacity available (t, annual)		
	Public sector	Private sector	Total
Cereals	155 000(77)	41 500(98)	196 500(82)
Industrial crops	286 550 (65)	61 000(51)	347 550 (63)
Vegetables	50(100)	8 000 (45)	8 050 (45)
Fodder crops	0	2 300 (72)	2 300 (72)
Total	**441 600 (69)**	**112 800(68)**	**554 400 (69)**

1. Figures in parentheses show percentage of capacity utilized

Variety registration. Registration procedures are slow and often bureaucratic. The seed industry would benefit from more liberalized procedures, particularly since the "life span" of some commercially attractive varieties is very short, e.g., 3 years for cucumber varieties. The private sector has recommended that there be two lists—one list of registered varieties (with some form of voluntary registration) and another of government-recommended varieties that are officially tested and approved.

Seed production. Lack of large farms is making it increasingly difficult to maintain adequate isolation distances in some crops. In hybrid seed plots, particularly sunflower and maize, this is a major problem, since plots tend to be close together. Many seed growers lack modern cultivation and planting equipment.

Crop pricing. Crop prices (wheat, maize, sunflower, cotton) are determined by the government, and are often unrealistic and below world prices. In order to encourage the wider use of certified seed, crop prices should be determined by the market—not by the government, which may make decisions based on political factors. For example, the

government fixed unrealistically low prices for soybean in 1995/96. Seed companies could not find growers, and as a result the government was forced to import large quantities of maize and soybean the following year. The ideal system is the establishment of a crop bourse where current and future prices of different crops will be established. This will allow farmers to make informed decisions on which crops to grow and whether to use certified seed to get higher returns.

Subsidies. In principle, seed subsidies can encourage farmers to use certified seed. However, the present system of subsidies is not effective enough. Under the present system, dealers sell seed to farmers at the subsidized price and send copies of the invoices to the seed company, which then recovers the subsidy amount from the government. Instead of paying the subsidy to the seed company, it should be paid directly to the farmers on submission of an invoice. This will streamline the process, and also make farmers aware that they are, being supported.

Other agricultural and seed policies. There is instability in exports and imports, caused partly by changes in implementation of regulations. Quarantine regulations also need to be modified, especially to reduce the number of mandatory laboratory tests. Seed registration and certification procedures (e.g., permission needed to produce and sell commercial seed) are cumbersome.

Financial laws and regulation. High tax rates—value added tax of 15% both on imported and locally produced seed—are encouraging "unbooked" seed sales.. When taxes are added, the cost of vegetable seed becomes prohibitively high. Farmers would prefer to buy "unbooked" seed that has been imported or locally multiplied illegally. Export incentives are not available. Credit for seed companies is available but involves complex procedures that lead to delays.

Poor seed demand. Most farmers operate at subsistence levels, on small farms, and lack training in modern farming methods and/or the resources to invest in certified seed and other inputs. Consequently, demand for high-quality, relatively expensive seed comes only from innovative and large-scale farmers.

Market information. Reliable statistics on seed supply and demand are not available. The development of a comprehensive database containing information on production, processing, and market opportunities would improve efficiency in seed supply, and open up more opportunities for public and private sector organizations.

Lack of training. The Turkish seed sector is still developing. The next stage is to improve research capabilities by building up a cadre of highly competent staff. However, no local institution conducts either pre- or post-graduate training in seed technology.

Recommendations for improvement

- The government should continue to encourage the participation of private seed companies, both domestic and foreign
- The public sector should continue its gradual withdrawal, where appropriate, from the seed market
- Seed laws and regulations must be revised in line with national needs and international conventions as soon as possible
- A strict and effective market control system must be established to reduce the flow of low-quality seed through unauthorized channels
- Crop prices should be made more attractive and subsidies provided to small-scale farmers to promote the use of quality seed
- Value-added taxes on vegetable seed should be lowered (the government has responded to this need, and plans to lower VAT rates from 15% to 6% next year)

- Procedures for issuing low-interest credit for seed production, processing, and marketing should be simplified
- Restrictions on seed export and import must be liberalized to create a stable platform for private sector investment
- Local institutions must be established for pre- and post-graduate training in seed technology.

The role of small-scale seed companies

In Turkey the seed sector can be grouped under three broad categories.

- Research and development institutions (government research institutes, private seed companies)
- Seed producers, which may have both R&D and commercial components (state farms, private companies)
- Traders, classified as either distributors or dealers depending on their scale of operations.

Small-scale companies (the dealers in the third group) generally operate with limited amounts of capital. They do not undertake R&D, nor do they have production and processing facilities. Therefore, they cannot exert a "marketing pull" effect, but must depend on trading opportunities. These companies import seeds or procure them from local producers. Since specialty products often involve royalty payments, such companies deal mainly with self-pollinated and minor crops.

Since Turkey is a large and diverse country, there are adequate niches for small-scale seed traders, for example in areas not covered by large companies due to remoteness (poor access) or insufficient demand. And there are no serious institutional or regulatory constraints that prevent small-scale companies from operating efficiently. These companies would be in a position to supply seed at affordable prices to smallholder farmers. Therefore, it would be worth considering the possibility of supporting such firms through government or other means, so long as they can supply high-quality seed. These companies could also benefit from entering into partnerships with government research institutes or large private companies which provide improved varieties and technical support. The emergence of a strong small-scale sector would greatly improve seed supply and make the market more competitive.

The Involvement of Small-Scale Private Companies in Seed Multiplication and Distribution in Southern Africa—a Case Study, Agricultural Seeds and Services (Pvt) Ltd

R D Kelly[1] and J Rusike[2]

Abstract

A number of factors limit the involvement of Zimbabwe's small-scale farmers in producing seed of hybrid crop varieties. However, they are in a position to produce seed of open-pollinated varieties. Agricultural Seeds and Services, a small seed company, has established successful seed production of a number of crops (cowpea, sorghum, pearl millet, groundnut) with these farmers, totaling some thousands of tons per year. Various difficulties encountered by the company with respect to the farmers themselves or in other areas such as government regulations, finance, and marketing are reviewed. The present position of the company, and directions it might take in the future, are discussed.

The niche for small-scale seed companies

What niches can small-scale companies fill, and what difficulties do they face in pursuing these niches? Agricultural Seeds and Services (Agriseeds), a private company in Zimbabwe, was founded in 1988. Today the company tests, produces, processes, and markets seed of open-pollinated varieties in the domestic and regional markets. Agriseeds started experimenting with seed production on contract with smallholders in 1992 for beans, cowpea, sorghum, and pearl millet. It is different from most other seed companies because its core business is the production and marketing only of open-pollinated varieties. Seed production of open-pollinated varieties is unattractive to large-scale commercial farmers because both yields and unit selling prices are lower than for hybrids. Profitability therefore does not compare well with other agricultural alternatives. For this reason Agriseeds started exploring ways to produce seed through small-scale and communal farmers.

The company began to promote smallholder seed growers by entering selected villages in different parts of the country through village-level governance structures (Chief, Village Headman) and the Department of Agricultural, Technical and Extension Services (AGRITEX). We established contracts with farmers, identified (in consultation with

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Kelly, R.D. and Rusike, J. 1997. The involvement of small-scale private companies in seed multiplication and distribution in Southern Africa—a case study. Agricultural Seeds and Services (Pvt) Ltd. Pages 54-60 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

local authorities) as good growers. Agriseeds supplies seed to these farmers without asking for immediate payment, provides technical advice and supervision through its own staff and government extension workers, negotiates prices with farmer representatives, and contracts to buy all the seed crop at the agreed price.

A major problem with smallholder seed production is that it is difficult to prevent cross-pollination because of the close proximity of multiple holdings. Also, farmers are not always reliable—they will often sell the seed crop to other buyers even when there are written agreements, despite the fact that Agriseeds supplied the initial seed and provided technical services. Because of this unreliability, smallholder farmers are generally regarded as too risky; but the experience of Agriseeds demonstrates that this is not an insurmountable problem.

Success has been achieved by developing mechanisms that accommodate smallholder needs. The company sends its buyers to purchase seed from points within the villages, provides its own bags so that farmers can take their containers back, and pays farmers on the spot in cash. In addition, as a service to farmers, the company buys other crops such as sunflower for sale to oil expellers even though it is not engaged in the marketing of sunflower seed. As a result, farmers do not incur transportation costs, need not spend time and money on marketing, save money on grain bags, do not wait long periods to be paid, and are able to sell other crops in addition to the seed crop. Farmers have realized the advantages of this system.

Trucks are sent regularly to collect the seed and transport it to Agriseeds' cleaning plant in Harare for processing. In 1994/95 the company produced 150 t of groundnut, 140 t of bambara nut, 400 t of pearl millet, 500 t of sorghum, and smaller quantities of various other seed, e.g., sunhemp, beans, and sesame.

Agriseeds also purchases grain of some crops and cleans it into seed. Production in each year is different depending on rainfall and other factors, so Agriseeds works closely with AGRITEX extension workers. Using crop forecasts and our own experience, the company is able to identify (even before the harvest) areas where seed production is adequate, and plan buying points, transportation routes, and production quantities before it buys seed. The extension workers enjoy working with the company because they feel they are doing something useful. Whenever Agriseeds personnel are in the area they provide transport for AGRITEX field staff.

Agriseeds has also benefitted by working with farmers' groups already established by Cooperative Development for Rural Communities (COOPIBO), a Belgium-based NGO that operates in Mudzi, Mutoko, Uzumba, Maramba, and Pfungwe Districts. COOPIBO makes the initial investments in organizing farmers into groups, constructing sheds, storage space etc., and developing an administrative structure and organizational routes that could facilitate further development work. Agriseeds can enter an area, identify groups that COOPIBO has helped put in place, and work with committee members. For example, during the 1996 agricultural marketing season, Agriseeds reached agreements with farmers' groups in Mutoko and Mudzi to purchase sorghum and pearl millet seed at Z$ 1 kg^{-1} and shelled groundnut seed for Z$ 5 kg^{-1}, compared to Z$ 0.85 kg^{-1} for sorghum and pearl millet grain and Z$ 3 kg^{-1} for shelled groundnut grain offered by the Grain Marketing Board.

Although Agriseeds incurs additional costs in better meeting the needs of its smallholder seed growers, the company obtains products that it requires and farmers get services that they want. At first farmers did not believe that the company would actually come to buy their crops on the agreed dates. They had been let down by

others on many occasions and were reluctant to trust any buyers from "town". Reliability on the part of the purchaser is extremely important to smallholders.

Agriseeds has recently begun to develop formal forward contracting arrangements with smallholders in irrigation schemes and small-scale commercial farm areas. The company had some initial success with farmers in the Nyanyadzi Irrigation Scheme. Because these farmers use flood irrigation, they can produce high-quality, disease-free bean seed. In 1994/95 Agriseeds established production contracts with farmers in Nyanyadzi and provided seed and seed inspection services. However, the farmers sold part of the seed crop as food grain to commodity traders. Therefore, the company terminated the relationship in 1995/96. Farmers interviewed in this study explained that they could no longer obtain access to large-seeded, better tasting, high-yielding varieties as a result of the cancellation of these contracts. From this it is clear that reliability on the part of the farmer as well as the buyer is important.

Agriseeds launched cowpea seed production on contract with 40 small-scale commercial farmers in Dewure during the 1993/94 season. Because of drought, the company hardly obtained any production in its first year of operation. In 1994/95, 47 t of cowpea seed was produced from 460 ha planted. The company then started to negotiate incentive contracts with farmers under which the quantity of seed supplied to each farmer depended on his performance the previous season. This resulted in 1995/96 in the planting, of 650 ha and delivery of 400 t of seed. In 1996/97 over 1700 ha was planted and 1000 t is expected to be harvested. Farmers in Dewure interviewed in this study reported that they have benefited from Agriseeds' activities because cowpea is a crop they can easily grow, it is early maturing, and brings in cash early during the season to meet household cash requirements for school fees, hired labor, and fertilizer for the maize crop.

During the 1995/96 season Agriseeds expanded its seed production operations in Dewure to include pearl millet PMV 2 and sorghum SV 2. However, both varieties proved difficult to produce because of heavy predation by birds. One constraint during the season was the temporary ban on exports of sorghum and pearl millet seed at a critical time by the Ministry of Agriculture even though there was a surplus in the country. Agriseeds was forced to stop buying sorghum and pearl millet that season to avoid ending up with carry-over stocks. This created serious cash flow problems for the farmers.

Agriseeds sells most of its seed to donors who give the seed away for free. The market through normal commercial channels for sorghum, pearl millet, groundnut, and most other open-pollinated seed is small. In contrast, maize seed is sold on a large scale. This is because almost all available maize varieties are hybrids, maize is easier to grow than small grains (no bird predation), yields are higher when rainfall is good, and a large number of people seem to prefer to eat maize rather than sorghum or pearl millet.

Institutional constraints to small-scale companies

There are six institutional constraints that prevent small-scale companies from operating efficiently.

- Regulatory obstacles, including compulsory seed certification, and uncertainty about current regulations
- Restrictions on seed exports
- Seed technology constraints
- Difficulties with enforcing contracts
- Lack of finance
- Undeveloped marketing infrastructure.

Government regulations—compulsory seed certification and uncertainty

To protect farmers from being sold poor quality seed and to ensure that all seed companies offer one class of high quality seed, the Zimbabwe government's Department of Seed Services introduced compulsory certification in Jan 1994 for 10 crops. The 10 crops were maize, sorghum, pearl millet, wheat, barley, soybean, groundnut, sunflower, tobacco, and potatoes. This made farmer-to-farmer seed sales and exchange technically illegal. When certification is compulsory, small-farmer seed groups have to hire their own seed inspectors, develop an administrative structure, and thus incur high overhead costs like commercial seed companies.

Small-scale seed production is further constrained by the fact that self-help groups have limited access to Seed Services inspectors and to the national seed testing laboratory—under the existing legislation there is only one officially acceptable seed testing and analysis laboratory that can certify seed as meeting acceptable standards. Perhaps the greatest obstacle in the way of small-scale and communal farmers producing certified seed is that certification involves verification of genetic purity, seed purity, and germination. This means that only registered varieties can be grown, and the seed to plant the seed crop must be from approved "mother stock". This makes the task virtually impossible for such farmers. It also precludes the production of unregistered landrace material.

Currently there is considerable uncertainty and confusion about regulations, procedures, and requirements in force because numerous changes have been made to the Seed Regulations and Seeds (Certification) Notice of 1971 but have not been gazetted. In practice, noncertified seed continues to change hands out of necessity. Further confusion was caused when the Ministry of Industry and Commerce sent a letter to seed companies instructing them not to sell open-pollinated maize seed in Zimbabwe. This regulation was never gazetted; it is not law and creates the question in the mind of anyone wishing to trade in open-pollinated maize seed as to what measures will be instituted against them should they do so. It is difficult to understand why there should be an official desire to prevent the sale or cultivation of open-pollinated maize varieties.

Restrictions on seed exports

Recently, Seed Services has started insisting that companies obtain International Orange Seed Lot Certificates before they can export seed, even when these are not required by the importing customers or country. To export any seed it is mandatory for a company to obtain an International Orange Certificate issued by Seed Services, a Phytosanitary Certificate from the Plant Protection Research Institute, and an export permit from the Economics and Markets Branch of the Ministry of Agriculture.

Because of shortages of personnel, transport, laboratory facilities, and funds and the reluctance of Seed Services to authorize private laboratories to issue seed analysis certificates, a company can wait for up to 16 weeks to obtain an International Orange Certificate. Even in cases where the variety has not been officially released in Zimbabwe, has not been certified (and therefore cannot be sold into the local market under the existing legislation) or has been produced specifically for export, an International Orange Certificate is still required. Further, the Economics and Markets Branch may refuse to issue an export permit if the seed is perceived to be required for the government Drought Relief or Crop Pack Programmes.

Restrictions on seed exports are a constraint to expanded seed production by small-scale farmers because, until they were

introduced 3 years ago, communal farmers were able to sell (amongst other seed) thousands of tons of pearl millet grain annually to commodity traders. The traders then cleaned the grain to seed standards and exported it to South Africa, where it was sold as a forage crop known locally as *babala.* Partly as a result of these export restrictions, traders have stopping buying pearl millet grain from smallholders. This has reduced interest in the crop and resulted in a shrinkage of the domestic demand for seed.

Restrictions on seed exports have similarly constrained small-scale production of other crops such as short-season groundnut. Until the restrictions were introduced, production by smallholders was sold to seed companies who cleaned, treated, tested, and packed it for export markets. However, due to increasing government restrictions buyers outside Zimbabwe have begun to switch to alternative suppliers in the region.

Seed technology constraints

There are sometimes technology constraints to seed production, for instance for certain sorghum varieties. Seed of the sorghum variety SV 1 has been difficult to produce at acceptable germination standards because of physiological problems. Similarly, seed of the sorghum hybrid ZWSH 1 suffered from poor synchronization between parent lines.

Difficulties with contract enforcement

Smallholder farmers engaged in seed production do not always honor their contracts. If spot market prices exceed forward contracted prices, farmers will sell the crop to other buyers with cash in hand. In a drought year, farmers may consume seed crops even when the seed contractor has provided planting seed and services free of charge. This results in high uncertainty about delivery, even with signed contracts, and discourages seed companies from working with smallholder seed growers.

Lack of financing

To produce seed, farmers require considerable capital outlay for purchasing fertilizer, fungicides, insecticides, and sprayers, and for casual labor. Most small-scale farmers do not know how to go about finding finance. And even if they do, the difficulty they face in obtaining credit is a major limiting factor in small-scale seed production (and in the development of small-scale agriculture in general). Problems have arisen in the past because farmers have not repaid loans taken from the Agricultural Finance Corporation and debt collection costs are very high. Understandably, financial institutions are not willing to lend money where they deem the risks are too great. Also, smallholders generally lack suitable collateral. Several credit systems, including group lending schemes, have been tried but these have failed. In addition, the high rate of interest on borrowed capital mitigates against success unless the season is good and there is no difficulty in marketing.

Undeveloped marketing infrastructure

Because of poor marketing infrastructure—lack of information on demand for open-pollinated seed, lack of warehousing facilities, limited and unreliable postal and telephone services, lack of transport facilities, high transportation costs—it is difficult for small-scale seed producers located in a surplus area to sell their seed to deficit areas. Seed firms generally sell through middlemen such as traders and dealers with accompanying difficulties, increase in price of seed, and other financial problems.

Earlier, supply and marketing cooperatives existed, which had depots throughout smallholder areas; these depots were used by companies to retail seed to farmers. The recent collapse of these cooperatives has left a void in the marketplace that is proving difficult to fill.

Open-pollinated crops present a marketing problem in themselves for several reasons—they are mostly minor crops; a large part of their production is consumed at home by the producers themselves; farmers retain a part of their crop for seed and therefore have no need to purchase commercial seed. The commercial markets for both seed and grain are thus small and provide little incentive to anyone to become involved in the production and marketing of seed. In addition, it is relatively easy for traders to deal in and sell open-pollinated grain as seed to unsuspecting buyers. This makes it difficult for specialist seed companies, which have much higher overhead costs.

Historically, the main markets for seed of open-pollinated crops have been exports to neighboring countries. These markets are unstable because they are funded by NGOs whose activities are dependent on disasters and the availability of donor funds. They are not sustainable because donors are unwilling to fund free seed distribution except to alleviate human suffering in times of disaster. For instance, donor-driven seed markets in Mozambique, which were once large, have disappeared because of the restoration of peace. Furthermore, recent droughts in Zimbabwe have led the government to restrict exports of various seeds, leading potential customers in neighboring countries to turn to other countries for seed, thereby further reducing market size. Nor are the Zimbabwe Drought Relief or Crops Packs Programmes a long-term market.

Operational constraints and opportunities for small-scale companies

How do small-scale companies compete effectively with larger firms including international seed companies? Although large firms hold the greater part of the market share in hybrids, there are many segments where smaller companies have a role to play. The turnover of certain crops and varieties is too small to be of interest to large companies; and the profits from the sale of open-pollinated varieties may be unattractive in comparison to profits from hybrids. Smaller companies also enjoy other advantages, for example lower overhead costs, the ability to rapidly adapt to change in the market place, and the ability to offer customers more personalized service.

Identifying and evaluating the market. Small companies do not have the resources to undertake costly market research as the large companies do. In general, however, there is no need for them to do so since their niche markets are more easily identifiable and market growth is through personal contact, by word of mouth, and by limited advertising.

What can be done to facilitate more small-scale seed companies?

As for most new developments in the private sector, the establishment of a new seed company is the result of the initiative and entrepreneurship of an individual or a group. Government assistance in some specific areas would improve the probability of success of such initiatives:

- Provision of adequate low-interest finance
- Training in specific areas such as crop inspection and seed processing techniques
- Making available the parent material of government-bred or other varieties for bulking and sale. Small seed companies

do not have the ability to conduct research and breed their own varieties and are therefore dependent on government or other public breeding programs.

Current position and future for Agriseeds

Due to three principal reasons—the small and unpredictable market for open-pollinated seed varieties, declining funds from NGOs and government for seed distribution programs, and the limitations and difficulties resulting from restrictive seed and export regulations—Agriseeds has had to examine its business prospects very carefully in order to reduce risk and enhance stability.

Decisions have been made to:

- Tread extremely carefully with respect to those seeds regarded by government as strategic
- Concentrate on smaller volumes of high-value seeds and thus achieve the same financial turnover and profitability as much greater volumes of low-value seeds
- Increase business in those seeds for which there is low marketing risk
- Maintain involvement in a wide range of seed types.

The result of these decisions will be a greatly reduced involvement in sorghum and pearl millet (being "strategic" and low value) and increased business in such seeds as cowpea, groundnut, bambara nut, and beans, all of which can be sold as food if problems are experienced in the seed market. The company will continue its interest in pasture grass and legume seed as well as in many minor crops such as sesame, okra, and sunhemp. The use of small-scale and communal farmers as seed producers will be continued and expanded because the company believes that many crop types and varieties are well suited to their situation and cannot be adequately produced by large-scale commercial farmers.

Seed Systems and the Role of the Private Sector in the ECOWAS Region

A Joshua[1]

Abstract

This paper reviews the basic features of seed systems in African countries and the constraints and opportunities for private seed companies. It highlights the need to encourage privatization and develop viable commercial seed operations as the basis for a strong national seed industry. A case study of the Nigerian seed system is presented. Strategies for strengthening both formal and informal seed systems in the ECOWAS (Economic Community of West African States) region are discussed, including the roles that donor agencies and international research centers should play. The paper argues for a unified seed system model, in which government, the public sector, private firms, NGOs, and farmers' organizations all have distinct and complementary roles.

Basic features of seed systems in the ECOWAS region

With some exceptions (e.g., Nigeria), seed systems in the ECOWAS (Economic Community of West African States) region in Africa are generally inadequate. Public sector or parastatal agencies play a dominant role. Simultaneously, the government regulates seed production and pricing, inhibiting the emergence of private firms. Breeding and variety testing programs are poorly funded, and are often limited to testing varieties developed by international research centers or by other countries. Most research and seed production programs focus mainly on food crops (maize, sorghum, rice) and to a much smaller extent on horticultural crops.

Farmer involvement in variety development and testing (even in on-farm trials) is limited, with correspondingly poor adoption of improved varieties. In many countries, there is neither a national seed policy, nor a coordinated seed development strategy involving the different agencies. Quality control is inadequate. There are no clear certification procedures and seed legislation is either non-existent or poorly enforced. There is also an acute shortage of trained staff (plant breeders, seed technologists).

International research centers (e.g., IITA) have developed a number of high-yielding varieties, many of which have been released. Although there is a growing awareness of the benefits from improved varieties, seed supply continues to be problematic.

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The seed system in Nigeria

Both the ADP and the National Seed Service conduct seed promotion activities through on-farm demonstrations, field days, advertisements, and awareness campaigns on improved varieties. Recent efforts to develop Nigeria's seed sector use four strategies.

- Support for variety development, registration, release, and multiplication
- Improvement in the quality of seeds sold to farmers
- Re-orientation of public sector agencies along commercial lines, with a cost-recovery pricing policy
- Encouragement of private sector participation.

While considerable progress has been made, seed availability continues to be inadequate, for a number of reasons. Farmers differ widely in wealth and resource availability and no single approach is effective for all categories. Pricing is an important factor. The marketing network is poor. Many farmers are still unaware of the benefits of improved varieties. Farmers tend to save their own seed and/or obtain seed (of traditional varieties) through farmer-to-farmer exchange. Where hybrid seed is distributed, farmers commonly recycle seed, planting F_1, F_2, and even F_3 seed. As a result of these factors, private and public sector seed companies, seed projects, and ADP Seed Units sometimes reported stocks of unsold seed. While lack of demand could be due to a combination of lack of awareness and high seed prices, another important factor is mismatch between production and demand—a shortage of popular varieties and lack of demand in other varieties.

The national seed strategy has been modified to further improve seed availability and meet the needs of different categories of farmers (Table 1). The poorest farmers are targeted by extension staff. Public sector agencies focus on the next category (still mainly resource-poor farmers who generally use the informal seed sector). Private companies target community-based systems, ensuring moderate production costs and timely supply through distributors at affordable prices. Large private firms and multinationals target commercial farmers, who are willing to invest in new varieties and hybrids.

Premier Seed Nigeria Limited

Established in 1984, Premier Seed is the oldest private seed company in Nigeria. It was formerly a subsidiary of the American-based Pioneer Seed Company, known as Pioneer Hi-Bred Seed (Nigeria) Ltd. The company produces, packages, and markets maize, soybean, sorghum, wheat, cotton, rice, and cowpea seed, as well as about 20 varieties of local and exotic vegetable seeds (tomato, olga, onion, pepper, cabbage, cucumber, carrots, lettuce, egg-plant). The company's products include cultivars developed by IITA, ICRISAT, CIMMYT, and national research institutes as well as a few privately bred proprietary lines. Facilities include a 34-ha research farm. All seed produced is field-inspected, lab-tested, and certified by the National Seed Service. We collaborate with ADP on multilocational testing and on-farm demonstration plots throughout Nigeria. The company markets seed in Nigeria through a network of distributors. In addition, it exports seed to other ECOWAS countries, and is planning to set up dealerships and seed production operations in collaboration with private firms and government agencies in other ECOWAS countries.

The experience of Premier Seeds in Nigeria has shown that, to succeed, a private seed company must provide high-quality, moderately priced seed, and must be able to effectively market its quality advantages. Simultaneously, it must be cost-conscious, and flexible to respond to market demand. It

Table 1. Strategies for improving seed availability for different categories of farmers in Nigeria.

Category	Action plan	Remarks
Farmers who cannot purchase seed	Responsibility of extension staff. Extension concentrates on farmer seed situation	Informal seed system
Farmers who could buy seed if it were available on time	Serviced by local seed producer/seller, i.e., community-level seed production and marketing	Informal seed system, non-certified seed
Farmers willing to purchase certified seed/hybrids	Serviced by private seed companies, which use their own dealers or public sector marketing institutions	Farmers operate on a larger scale with higher investment, than previous category
Small-scale but "high technology" farmers, medium and large-scale farmers	Serviced by private seed companies and multinationals	This category has the highest levels of investment in new varieties and technology. Brand names become important

must have a sufficiently long-term commitment to withstand business cycles. In addition, it must work closely with national and international research centers and with extension staff. Multinational firms in particular should give a priority to hiring and training local staff.

Premier Seeds has been able to create a market (e.g., for hybrids), producing enough seed to meet demand, even though profit margins are very small initially. The company has launched community-level pilot projects to produce and deliver seed, which have shown encouraging results.

Based on our 12 years of experience in Nigeria, the question for seed companies is not whether they have problems, but rather how to minimize these problems, how to work more closely with government institutes and agricultural departments, and what crops to focus on to ensure profitability and survival.

Development of the private sector

The development of private seed companies is vital for many reasons—reliability, sustainability, cost-effectiveness, responsiveness to farmers' needs, greater commitment to quality, and generation of employment. Privatization is particularly urgent in the context of liberalization and structural adjustment programs in many countries. Joint ventures between international companies and local firms will be particularly beneficial. This will provide an infusion of new technology, the experience of trained researchers, and materials with genetic diversity for the development of more improved varieties. In addition, such ventures will increase the pool of investment in African seed supply systems, increase regional (and international) seed imports and exports, and force local firms to improve not only quality but also marketing and sales promotion.

Governments must therefore develop concrete, time-bound programs to phase out costly and inefficient direct public sector involvement in seed production and processing. However, turbulent change (over-rapid privatization) can be equally disruptive, and must be avoided. We suggest a system in which the public and private sectors both play important roles, as in the "unified system" discussed below.

Governments can encourage private sector development in several ways. For example, they should make firm indents for the purchase of seed from private firms (a predetermined proportion, say 10%, 20%, or 30%, of national seed requirements). This will stimulate growth and simultaneously ensure the timely availability of seed for government distribution programs. The government should concentrate on creating a positive environment for private sector expansion by resolving the many constraints that impede private investment.

Constraints to private seed sector development

Private sector involvement in the ECOWAS region is constrained by a number of factors, many of which could be addressed by appropriate seed policies and government action. Governments (and international development agencies) often view private firms with suspicion about their profit motives. The market is often too small to attract significant private investment. Inputs (fertilizer, herbicides, seed bags) are in short supply. Facilities and equipment for seed treatment are limited. On the output side, marketing and distribution systems are often under government control. In many cases, poor adoption of hybrid seed is due to poor extension (sometimes because extension staff have misconceptions about hybrids).

Plant breeders' rights legislation either does not exist or is poorly enforced. This keeps firms from investing in variety development or even in seed trading. Many regulations on importing and exporting seed (e.g., phytosanitary and quality requirements) are unrealistic and need to be liberalized. Seed legislation and rules must be clear and reasonable. A major problem for the emerging seed industry is lack of a stable, transparent set of rules. Business cannot succeed if private firms have no recourse to appeal against government decisions they see as being arbitrary or unfair.

The government should support the private sector and the private sector should, in turn, respect government priorities. The best solution would be to constitute a national seed council, with representation from government, public and private sectors, and NGOs involved in seed projects. Discussions within the council would help identify and remove barriers to private sector expansion.

Strengthening national seed systems

Modern varieties will have little impact unless high-quality seed is freely available, on time and at moderate prices. The traditional "informal" system has many merits, but also disadvantages of limited impact in terms of diffusion of improved varieties. Often, this system is unable to guarantee quality or ensure varietal purity. Thus, an alternative system is needed, which will involve all possible players—seed producers at all levels (small-scale, private firms, parastatals), research, extension, government agencies, and farmers, working together.

In the envisaged "unified system", public sector institutes will support applied research and development, while the private sector focuses on production, processing, and marketing. It is not a question of whether the private sector or the public sector is better at developing a country's seed industry, but rather how the two sectors can best complement each other's expertise. The government will enforce quality standards, oversee

private competition, ensure that extension services are adequate, and provide financial support for private firms and small-scale seed growers. Most important, it will provide a clear and reasonable set of rules to encourage the private sector. The public sector will work closely with extension staff to transfer technology developed by both the public and private sectors. NGOs will act as a bridge between the public and private sectors, providing technical assistance to small-scale seed projects, improving the supply of inputs, and bringing farmers' groups into the commercial system. Farmers' organizations will participate in producing, distributing, and promoting improved seed.

At a regional level, periodic workshops/ seminars need to be held, to meet four key objectives:

- Identify priorities for collective action
- Identify variety requirements and thus clearly define research targets
- Develop closer research collaboration with ICRISAT, IITA, and other international research centers
- Attract more donor support.

These workshops (which could be organized separately for English- and French-speaking countries), will help enunciate a regional policy, strengthen research and technology transfer, and exploit the strengths of international institutes and some national programs for mutual benefit. Even more important, they will ensure that seed production and distribution is a high priority in all ECOWAS countries.

Elements of a seed policy

What seed policy is most appropriate for a particular country will depend on the stage of development of seed markets and the seed industry in that country. But broadly, all policies must consider the following aspects.

Forecasting

- Build a database of past history to analyze trends and account for abnormalities
- Study farmers' preferences and past record of adoption, compare what farmers say they will do with what they actually did
- Evaluate seasonal effects
- Improve researchers' knowledge of demand-forecasting methods
- Study economic components—effect of pricing pattern, effect of policy decisions, correlation between economic indicators and seed uptake.

Production

- Maintain high quality standards through training for technical staff and investment in processing equipment and laboratory testing facilities
- Offer clear-cut contracts and viable pricing to attract high-caliber farmers, build up a stable and reliable base of seed growers
- Increase breeding research and testing to ensure a continuous flow of improved varieties
- Hold down costs through improvements in technology and efficiency
- Target export markets by developing and promoting high-quality varieties with specific traits.

Packaging and distribution

- Ensure that packaging provides adequate protection
- Provide a range of pack sizes
- Provide labels that not only conform to legislation, but also include information on seed dressing, sowing rate, special plant protection requirements, etc
- Educate wholesale and retail distributors about seed care and storage
- Increase promotional efforts, educate farmers on the cost/benefit ratios of new varieties
- Encourage bulk buyers (e.g., farmers' groups).

The role of international institutes

Both the public and private sectors have ready access to germplasm and improved varieties and hybrids developed by international research institutes. This factor has helped public sector seed organizations, and was equally crucial for private seed companies (for example, more than 85% of the improved varieties seeds sold by Premier Seeds were developed by ICRISAT, IITA, and CIMMYT). Without this access, it is doubtful whether any seed company would have begun operations in Nigeria due to the heavy investments (and high risk) needed to develop proprietary lines. IITA and ICRISAT have provided seed production training courses and study visits in Nigeria to staff from the national program and private firms. However, international research centers must expand their activities in Nigeria and throughout the ECOWAS if strong national seed systems are to develop.

Breeder seed production is often a bottleneck. These institutes must greatly expand their efforts to produce and supply breeder seed of the varieties they develop, and provide training on seed production. International institutes should work not only with public research institutes but also with private seed companies, NGOs, and extension staff to overcome seed shortages and stimulate the adoption of improved varieties. Ideally, international institutes should set up seed units to work on seed technology research, training, seed production, and provide advice on seed policy issues. Other areas of collaboration are the design and implementation of regional trials, and collection and dissemination of regional data on seed trade and variety performance.

Roles for donor agencies

Donor agencies can play a crucial role in helping to develop a strong private sector. Among other ways, they can:

- Help governments develop national seed policies
- Support the restructuring of public seed corporations and retraining of their staff
- Encourage policy changes that will reduce or eliminate barriers faced by private firms
- Link donor support for seed programs more closely to ongoing or planned support for other agricultural services, including research and extension
- Provide greater support for research (including testing and variety maintenance)
- Create regional seed technology centers and promote regional seed associations and regional seed trade
- Strengthen training programs by providing support for training institutions, and sponsorships for seed technology training courses and study tours
- Design and support programs for better coordination between the formal and informal sectors
- Support pilot projects to strengthen informal, village-level seed production
- Provide foreign exchange for the import of seed processing equipment.

Models of seed production systems

Four alternative models of seed production systems are discussed below.

State/Parastatal—contract seed grower model. This is a "formal" seed production model suitable for both low- and high-risk crops. In this model, the public sector is involved more in coordinating production rather than in actual production. Researchers provide breeder seed to parastatals or state seed agencies, which then multiply the seed on their own farms and/or through contract growers. Subsequently, seed cleaning, processing, and marketing are done by the parastatal or state agency.

Private sector—seed cooperative model. This model is more commercial or profit-oriented than the previous model, with the private

sector (including cooperatives) playing the key role. Public researchers and private seed companies provide breeder seed to the private company that will multiply it to produce foundation seed and produce and sell commercial seed. Processing and seed marketing are performed by the private firm.

Decentralized, farmer-based seed production. This is a bridge between the formal and informal seed systems—essentially informal production and distribution of improved varieties, using breeder/foundation seed purchased from research institutes. It combines the technical advantages of research (improved varieties) with the cost advantages of farmer-management. Researchers' involvement stops at producing breeder/foundation seed. All downstream activities—multiplication, cleaning, marketing—are done by the seed producer/seller (e.g., farmers' group). Seed processing is done locally or subcontracted to a (small-scale) commercial processor. The end product is non-certified but truthfully labeled seed that conforms to prescribed standards, and is sold to farmers. In addition, producers under this system can produce seed on contract for private seed firms (the second model) or unite to form a small-scale private firm.

Unified system. A "unified system" that combines the three models discussed above, will help meet national seed requirements and enhance the impact of research results through improved seed supply. It must be noted that to ensure sustainability, all models (or all components of a unified system) must follow a cost-recovery pricing policy. The unified system would involve registration of seed growers (the possibility of being delicensed will force growers to maintain quality), and would encourage rural seed enterprises to function as contract growers to large private companies. Simultaneously, the private sector could be encouraged, through associations and partnerships, to integrate vertically (research, production, processing, distribution, promotion) to improve the movement of seed to farmers.

Session III
The Role of International Agricultural Research Centers

The Role of International Agricultural Research Centers in Supporting the Seed Sector

A J G van Gastel[1], Z Bishaw[2], and E Asiedu[3]

Abstract

International agricultural research centers (IARCS) have been successful in developing new varieties in partnership with national agricultural research systems (NARS). However, adoption of these varieties has been low, particularly in Africa, where seed production and distribution systems are generally inadequate. IARCs have much of the infrastructure and staff needed to help improve the seed sector, but historically have focused on their core area of competence—research—rather than on development work (extension, seed production). These priorities are unlikely to change, in view of recent and continuing budget cuts.

This paper discusses efforts made by six IARCs (CIAT, ICARDA, ICRISAT, IITA, ILRI, WARDA) to support the seed sector in their respective mandate regions. ICARDA is the only IARC with a currently functional seed unit. However, all IARCs participate in seed sector improvement in various ways, e.g., production of small quantities of breeder/basic seed; technical advice on seed production to NARS, public and private companies, NGOs, and farmers' cooperatives; monitoring adoption and seed production of released varieties; assessing constraints to seed multiplication and marketing; training of seed sector staff; information dissemination through brochures and seed production manuals; and provision of policy advice to governments.

Introduction

The need for strong seed programs has long been recognized by national and international organizations, because only with efficient seed programs can plant breeding research lead to improvements in crop production. The strength of seed programs varies from one country to another. But in general, with some exceptions in North and Southern Africa, seed systems in Africa are not as well developed as those in South America and South East Asia.

In Africa, large areas are still sown to traditional varieties. Seed production and marketing is often affected by inadequate policies, poor management skills, and the lack of incentives, trained manpower, and facilities.

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van Gastel, A.J.G., Bishaw, Z., and Asiedu, E. 1997. The role of international-agricultural research centers in supporting the seed sector. Pages 71-79 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D. Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

- Dissemination of improved varieties developed by national and international research institutions is too slow. (This is not necessarily due to deficiencies in the seed system, but also because the varieties do not meet farmers' needs.)
- Procedures for evaluation and release are often bureaucratic and inappropriate, and hamper the release of new varieties.
- When new varieties are released, research programs often produce insufficient quantities (and poor quality) of breeder and/or foundation seed.
- Several national programs (e.g., Namibia and Botswana) have seed multiplication schemes on research farms or by contract growers. When well managed, these schemes have been reasonably successful. However, these schemes are generally subsidized by governments and effectively discourage genuine commercial production. In addition, these programs have limited future prospects due to budget uncertainties.
- Governments and donors have funded seed distribution programs for drought and refugee relief, e.g., sorghum and pearl millet in Zimbabwe, Zambia, Mozambique, and Angola. The commercial sustainability of these programs is not guaranteed.
- Many governments are gradually restricting their activities to variety development and quality control, leaving a vacuum in the production and marketing of seed of improved varieties.
- International seed companies have invested in a number of countries (Nigeria, Zimbabwe, Zambia, Malawi, Tanzania, Mozambique), often in joint ventures with national seed companies. However, in some countries (Ivory Coast, Ethiopia, Sudan) these companies have scaled down or suspended operations because of difficulties (e.g., small markets, high operating expenses, poor profitability, government regulations).
- Smaller private national seed companies are also being established, for example in Nigeria and Zimbabwe. However, some of these firms rely on government and donor orders for seed for relief programs; the quality and sustainability of some of these operations remains in doubt.
- Most private companies, whether international or otherwise, produce seed only of the most profitable crops (hybrid seed, vegetables). Seed production of the many self-pollinating food crops (bean, cowpea, sorghum, millet, pigeonpea) is less profitable, because the market is small—most farmers use farm-saved seed—and demand is inconsistent due to unreliable climatic conditions. Varieties with narrow local adaptation, targeted at specific areas, are of least interest to seed firms, although they are vital for small-scale farmers.
- The formal (public and private) seed sector does not effectively meet the seed needs of smallholder farmers. Supplies are generally restricted to a few varieties, and cannot meet the specific varietal requirements of the many different ecologies in which smallholder crops are produced.
- More and more emphasis is being placed on seed production in the informal sector. Small-scale, decentralized producer cooperatives have been established in several countries, but have rarely been successful (Ghana, Mali, and Uganda are exceptions).
- A number of NGOs have invested in small-scale village seed production schemes (e.g., in Nigeria, Ghana, Zimbabwe, Malawi, and Tanzania), often as a development activity after the recent droughts. The sustainability of these schemes when donor/NGO subsidies are withdrawn is not ensured.

Even in countries where the seed sector appears to function well, large numbers of low-income, resource-poor farmers have no access to quality seed.of improved varieties and are unable to utilize the fruits of crop improvement research. This situation is even worse for root and tuber crops such as

cassava, yam, banana, and plantain. A sustained effort to support the formal and informal seed sectors is required to ensure that food production does not deteriorate further.

This paper tries to assess what the institutions of the Consultative Group on International Agricultural Research (CGIAR) are doing in Africa in the area of seed. Can they do more? Should they do more?

The CGIAR

The CGIAR is an informal association of countries, international organizations, and private institutions. It is cosponsored by the World Bank, the Food and Agriculture Organization (FAO) of the United Nations, the United Nations Development Program (UNDP), and the United Nations Environment Program (UNEP). The CGIAR's main objectives are to sustain food security in developing countries through support to the international agricultural research system.

There are 16 international agricultural research centers (IARCs), located in different countries. Fourteen of these have a commodity orientation, and conduct research and training on crop improvement and natural resource management and conservation. The mandates of the other two IARCs are more general. The International Food Policy Research Institute (IFPRI) deals with food policy issues, while the International Service for National Agricultural Research (ISNAR) focuses on the management of agricultural research and on strengthening national programs.

IARCs and seed program development

Improved germplasm developed and supplied by IARCs has been widely released by national agricultural research systems (NARS) in a number of developing countries, but the impact of these materials has been limited by seed production and marketing constraints. Johnson Douglas, one of the pioneers of seed program development, commented in 1988 that "To reach the CGIAR's goal of contributing to increasing sustainable food production... requires the development of a more effective seed supply system than exists now... IARCs have much of the infrastructure and staff needed to make an impact in seed sector improvement." This is as valid today as it was during the 1980s.

IARCs can contribute significantly towards seed sector development because they have considerable expertise in initiating and managing or backstopping seed programs in developing countries; are committed to long-term involvement; and can utilize networks (often developed or supported by them) to deliver genetic material and other technology to almost all developing countries.

This paper discusses efforts made by the different IARCs to support the seed sector in their respective mandate regions. Information was sought from eight Centers, of which six—CIAT, ICARDA, ICRISAT, IITA, ILRI, WARDA—responded. No response was received from CIMMYT and IRRI. This information was supplemented with personal observations and the authors' experiences.

Generally, all IARCs working with commodities encourage and promote new technologies which they develop in cooperation with national programs, with the aim of ensuring that these technologies reach farming communities. IARCs, as a matter of policy, are not involved in large-scale seed production. However, they participate in seed sector improvement in various ways.

- Production of very limited quantities of breeder/basic (foundation) seed for distribution to NARS (mainly for evaluation), public and private companies, NGOs, and development agencies
- Assistance to NARS in the production of small quantities of breeder seed of released and promising varieties
- Technical advice on seed production to

various organizations (public and private companies, NGOs, cooperatives)
- Monitoring adoption and seed production of released varieties, assessing constraints to seed multiplication and marketing
- Training NARS and seed sector staff in variety maintenance, breeder seed production, and other areas of seed technology
- Preparation of training materials (slides, audio-tutorials, videos), brochures, and seed production manuals
- Policy advice to governments on seed program development to ensure a continuous flow of improved varieties from researchers to farmers.

Some IARCs support special seed production projects. For instance, IITA has a German-funded special project, Promotion of Seed Production and Marketing in West Africa. WARDA has a seed project, Research on Accelerated Diffusion of Rice Technologies (RADORT).

Very few IARCs employ seed scientists or seed program development specialists through their core budgets. CIAT and ILCA (now ILRI) did so in the past, but CIAT's Seed Unit was closed down in 1992, while ILCA's Seed Unit was merged with their Forage Genetic Resources Unit. At present, ICARDA is probably the only IARC that employs (some of the) staff of its Seed Unit through its core budget. In most cases, seed-related activities are implemented by an individual scientist or a small team whose primary task is different (breeding, pathology, impact assessment, etc).

WARDA

The West African Rice Development Association (WARDA), headquartered in Cote d'Ivoire, produces breeder seed for supply to national programs of member countries, NGOs, and development agencies. Sometimes WARDA, through its Task Force mechanism, provides small grants to national programs which submit projects to multiply seed of promising varieties for on-farm trials. WARDA provides technical support to NARS to set up or strengthen variety release and seed production schemes and is currently part of a panel responsible for establishing a variety release and seed multiplication scheme in Cote d'Ivoire. WARDA has also developed technical seed production manuals that are distributed to NARS partners.

Regional surveys are conducted of the different variety release mechanisms and seed production schemes in the subregion. WARDA has recently initiated a project on Research on Accelerated Diffusion of Rice Technologies (RADORT), which will work with extension agencies in Cote d'Ivoire, Gambia, and Senegal to train contract farmers and technicians in seed multiplication.

ICRISAT

Scientists at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) have proposed a strategy with the following components.
- Breeder seed—assist NARS with the production of breeder seed of released varieties, mainly through training of NARS staff. However, ICRISAT may directly produce limited quantities (up to 100 kg) on behalf of a NARS for a period of not more than 2 years.
- Foundation and commercial seed—should not be involved in the production of foundation or commercial seed, but could provide technical advice or training to public and private companies, NGOs, and small-scale seed companies willing to multiply and distribute newly released varieties. This involvement would also help ICRISAT verify the performance and acceptability of released varieties.
- Monitoring seed production—develop and maintain a database on seed multiplication and distribution of released varieties of its mandate crops.

- Evaluating seed market constraints—periodically assess constraints to seed multiplication and distribution, by analyzing the structure of seed demand, the commercial constraints to seed supply, the relative contributions of public and private seed supply channels, and national seed security strategies.

The Institute's breeders, economists, and technology transfer specialists are involved in these efforts, but as a secondary activity, in addition to their normal tasks.

CIAT

The Centro Internacional de Agricultura Tropical (CIAT), based in Colombia, was the first IARC to establish a Seed Unit. This was done in 1971, with support from the Swiss government, to strengthen the national seed programs primarily in Latin America and the Caribbean region. The Seed Unit, led by the late Johnson Douglas, was active in training (including development of training materials), breeder and basic seed production, and seed technology research, and forged strong technical cooperative linkages with national seed programs in the region. It is also well known for its pioneering work focusing on seed supply for small-scale farmers.

In the authors' opinion the CIAT Seed Unit contributed significantly to seed sector development, and it was rather unfortunate that it was closed down in 1992. The closure was due to funding constraints, and because CIAT felt that support to the informal sector could be provided more effectively by decentralized activities rather than through a centralized Seed Unit. CIAT's strategy now centers on stimulating seed production of crops that are poorly served by the formal sector, particularly smallholder food crops and low-value crops.

ILRI

The International Livestock Research Institute (ILRI), Kenya, set up a Herbage Seed Unit in the late 1980s with financial support from the Swiss government. The Unit produced seeds of promising forage grass, legume, and fodder tree genotypes for distribution to national programs for research and to establish national forage seed production capacity. It also conducted training courses in forage seed production, and developed training materials including a seed production manual. Once Swiss funding ended, the Seed Unit was amalgamated with the Forage Genetic Resources Unit in the mid 1990s. ILRI continues its seed production and training activities under the Genetic Resources Unit, but with far lower priority than before.

IITA

The International Institute for Tropical Agriculture (IITA, Nigeria) initiated a special project in 1996 to support the seed sector in Western African countries, with financial assistance from GTZ. The project has begun training national seed staff in production and seed marketing. In collaboration with researchers, seed specialists, and the extension service, the project also supports the informal sector in northern Nigeria and Ghana. Seed of improved varieties is distributed to farm communities, and these communities are provided support to enable them to grow their own seed. Future plans are to set up a seed center (along the lines of ICARDA's Seed Unit) to support national and regional production of seed and planting material and promote further regional development and dissemination of know-how in the seed sector. Key areas of work will be:

- Transfer of existing know-how through networking, training, information exchange, and provision of advisory services to all sectors (national seed organizations, seed producers, seed societies, farmers, NGOs, marketing organizations)
- Strengthen the capacity of various organizations to produce seed and planting material

- Improve regional cooperation among countries through networking of national seed systems
- Promote the development and introduction of appropriate varieties of seed and planting material
- Promote propagation of root and tuber crops and plantain/banana.

ICARDA

The rest of this paper describes efforts by the International Center for Agricultural Research in Dry Areas (ICARDA) to strengthen the seed sector in the West Asia and North Africa (WANA) region. These efforts provide a model for what should be done in certain other parts of the world, of course after modifications to suit local conditions. ICARDA is the only IARC with a currently functional Seed Unit. This is an independent unit within ICARDA, established in 1985, supported by the Center's core budget and by the governments of the Netherlands and Germany for the past 10 years.

The Head of the Seed Unit is assisted by three senior staff and technical staff. The Unit is widely recognized throughout the region as a source of information on seed; it provides technical advice on production problems, conducts practical seed technology courses, and hosts the secretariat of the WANA Seed Network. In addition, the Unit also works in close collaboration with ICARDA's commodity programs.

The Unit's overall objective is to strengthen national seed production organizations in WANA. Specific objectives are to:

- Train public, private, and NGO staff in seed technology, develop training materials, and disseminate information
- Strengthen national seed production infrastructure
- Make available high-quality seed of ICARDA-related varieties
- Conduct seed technology research related to the WANA region
- Networking, informal seed sector activities, economics studies on seed and seed security (recently added).

Training. Because well trained and educated staff are the "engine" that drives any successful seed program, ICARDA's Seed Unit allocates a major part of its resources to training. Over 100 staff from the region are trained every year. Several seed production training manuals and audio-tutorials have been produced; some have been translated into Arabic. Experience over the last 10 years has shown that a three-pronged approach is best—train-the-trainer courses for technical managers and technicians; training seminars for seed program managers; and post-graduate studies in seed science and technology.

Seed production. To stimulate seed production of ICARDA-related varieties, the Unit produces small quantities of breeder and basic seed for distribution in the region. This material is used for research purposes and to initiate seed multiplication of newly released varieties in WANA countries. On average, 30 t of seed have been produced each year during the last 10 years.

Institutional support. The Unit carries out a variety of activities aimed at strengthening national seed systems in the region. These activities include: workshops and discussions on specific problems and to formulate action plans; small country projects to support seed production; consultancies to advise governments on specific aspects (e.g., field inspection methods, seed and field standards, seed cleaning, seed treatment, strategies for developing the informal sector); assistance in morphological variety description; and seed surveys to determine farm-level problems.

Seed technology research. Seed technology problems under harsh environments are often not well understood; there is a need for

additional research to address these problems. However, because training and infrastructure development was considered more critical than research, only a limited amount of practical seed-related research was conducted, mainly through post-graduate students.

Networking. Cooperation among WANA countries on seed production and marketing is limited, and ICARDA's Seed Unit is playing a catalytic role to strengthen mutual cooperation through the creation of the WANA Regional Seed Network. This Network was established in 1992 and has 18 member countries (Fig. 1) which make up the Network Council, as well as 10 regional and international organizations as observers. The 18 members are—Algeria, Cyprus, Egypt, Ethiopia, Iran, Iraq, Jordan, Lebanon, Libya, Morocco, Oman, Pakistan, Saudi Arabia, Sudan, Syria, Tunisia, Turkey, and Yemen. The objectives of the Network are to promote cooperation and information exchange, and standardize seed production and control procedures to integrate national seed systems and promote regional seed trade. These objectives are achieved through:

- Coordination and implementation of seed-related activities among member countries
- Promotion of cooperation among member countries for efficient use of resources, to ensure adequate seed supply through cooperation
- Standardization of seed policy and the regulatory framework to harmonize procedures and operations across the region.

Informal seed sector. The formal seed sector has been unable to deliver the results of crop improvement research to many farming communities in developing countries. In general, it is large-scale farmers rather than resource-poor smallholders who have benefitted from investment in the development of improved varieties. Whether this is due to the inefficiency of the formal seed sector or because the approach to variety development was inappropriate for small-scale farmers is a matter for debate. In any case, participatory plant breeding may well be a more suitable approach to reach the small-scale farmer.

Although considerable information is available on variety development, seed production, and quality control in the formal

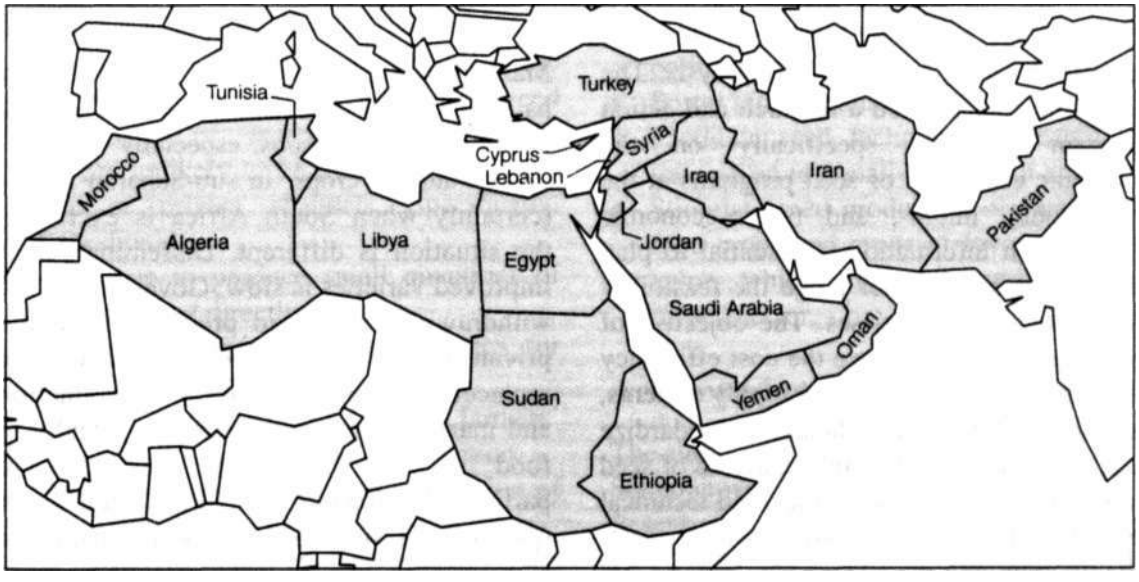

Figure 1. Member countries of the WANA seed network.

seed sector, we lack information on traditional methods of plant selection, variety maintenance, and seed production and handling. Indigenous knowledge can be exploited, and local seed supply mechanisms studied and adapted to develop sustainable informal systems that meet the needs of small-scale farmers in developing countries.

To understand the dynamics of seed supply (particularly the informal sector) in developing countries, it is necessary to study farmers' perceptions of modern varieties and seeds, and measure the adoption/impact of new technology. The Seed Unit has initiated several surveys in WANA (Egypt, Ethiopia, Jordan, Lebanon, Syria, Sudan) and intends to emphasize this aspect vigorously in the coming years. The objectives are to study various key parameters—adoption of modern varieties and technology; varietal and seed renewal rates, varietal change/deterioration, seed sources and seed quality, distribution of seedborne diseases and pests, local seed management and storage practices, and socio-economic constraints to technology adoption. Preliminary results from these surveys provide interesting comparisons of quality of seed obtained from different sources.

Economics of seed production. Seed programs are often implemented without a proper economic and financial analysis. The Seed Unit has initiated a research and action program focusing specifically on the economic efficiency of seed programs at the institutional, micro-, and macro-economic levels. Such information is essential to plan seed sector activities or judge the feasibility of private seed enterprises. The objective of the program is to improve the cost efficiency of national and regional seed supply systems, develop performance indicators, standardize methodologies for economic analyses of seed programs, and formulate policy and technical recommendations to improve seed supply. The program will include country surveys and case studies in seed production economics.

Seed security. Access to seed after disaster situations (e.g., drought) is critical to the success of rehabilitation efforts. Seed security strategies need to be in place in anticipation of such situations. The available resources and infrastructure are not sufficient to produce and store large quantities of seed of different varieties. However, seed security can be built into national seed programs by maintaining carry-over seed or buffer stocks of early-generation materials. It can also be strengthened by networking the national systems and sensitizing policy makers at the regional level.

The ICARDA Seed Unit has commissioned a study on seed security and has received funds from the United States Department of Agriculture to implement a small pilot project to study seed security in the region. The main aim of the project is to provide information on seed (availability, producers, varieties) and regulations (variety release, quarantine, seed trade) so that governments, donors, and NGOs can respond quickly in emergency situations. Country case studies have been completed in five countries—Eritrea, Ethiopia, Pakistan, Sudan, and Yemen.

Conclusions

Many countries in Asia and Latin America have reasonably well-functioning seed systems for at least some crops, especially commercially valuable crops. In sub-Saharan Africa (certainly when South Africa is excluded) the situation is different. Dissemination of improved varieties is slow. Governments are withdrawing from seed production but the private sector has not been successful as a replacement. Consequently, seed production and marketing is very limited, especially in food crops. Smallholder farmers are particularly affected. The formal seed sector (public and private) has been unable to significantly improve seed supply to these farmers, and the informal sector (e.g., small-

scale, decentralized, producer cooperatives) can only supply small areas with a few location-specific varieties. A sustained effort to support both the formal and informal sectors is required to ensure that food production does not further deteriorate.

Recommendations for IARCs

Non-availability of seed remains one of the largest constraints limiting the impact of IARC research. IARCs have much of the infrastructure and staff needed to help improve the seed sector, but priorities need to be refocused. Currently, seed-related activities are considered of secondary importance, and implemented by scientists whose main task is different (e.g., breeding, pathology). Very few IARCs have seed scientists or seed program development specialists employed through their core budget. The seed units at CIAT and ILCA have been closed down, and ICARDA is the only IARC with a functional seed unit (IITA is initiating a West African seed project with support from GTZ).

One problem throughout the CGIAR network is that seed-related activities are considered to be outside the core area of focus, and therefore receive little or no funding. Nevertheless, some way must be found to intensify IARC involvement in the seed sector, particularly because seed requirements of low-value food-security crops are unlikely to be met through formal public or private channels. Specifically, IARCs should:

- Continue to produce small quantities of breeder seed directly
- Provide technical support to NARS for breeder seed production
- Provide support to NGOs and farmers' groups for small-scale seed production
- Monitor adoption and seed production of released varieties of their mandate crops
- Assess constraints to seed multiplication and marketing
- Provide policy and technical advice to govern-ments and other actors in the seed sector.

To strengthen national seed systems, IARCs must support both the formal and informal sectors. Support to the formal seed sector could be targeted at favorable areas and (mandated) "commercial" crops such as maize, wheat, and rice. This approach has already led to a number of successes with "better" farmers. Support to the informal sector—where IARC mandate crops play a vital role—would ensure that small farmers in remote areas or unfavorable environments also benefit from research results.

In some regions (South America and South East Asia), the seed sector is relatively well developed. Private companies or joint private-public ventures are viable and self supporting, at least for the major commercial crops, and there is no need for centralized regional seed units. However, this is not the case in most countries in Africa, where national seed systems would benefit from the establishment of regional seed centers. Such centers, established with technical support from IARCs, would help to:

- Develop coordinated seed strategies at national and regional levels
- Link national seed systems into a regional network, and develop uniform seed policies and regulations across a region
- Foster intra-regional seed trade
- Facilitate seed technology research and training on regionally important areas
- Stimulate seed production of smallholder food crops and crops of low commercial value, which are poorly served by the formal sector.

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ICRISAT's Seed Multiplication Policy[1]

D D Rohrbach[2]

Abstract

ICRISAT receives frequent requests from national research institutes, commercial seed companies, and NGOs for assistance with the supply of breeder, foundation, and commercial seed. This paper summarizes the Institute's recently drafted policy on seed supply. In keeping with its comparative advantage as a research institute, ICRISAT primarily targets the production and distribution of limited quantities of breeder seed. The Institute directly supports seed multiplication necessary for crop breeding and variety testing programs, but seeks to avoid involvement in the multiplication of larger quantities of seed for direct distribution to farmers.

Technical assistance and training courses in seed production are available to scientists and technicians in national research institutes, NGOs, and small commercial firms. Simultaneously, ICRISAT aims to expand its role in the evaluation of seed supply constraints by monitoring variety release, seed production, and market problems affecting its mandate crops.

Introduction

ICRISAT serves as the world repository for germplasm of five mandate crops—sorghum, pearl millet, groundnut, chickpea, and pigeonpea. Each year, thousands of kilograms of this germplasm are provided to breeders in public and private crop breeding programs throughout the world. As varieties are released, requests mount for assistance with the supply of breeder seed. In recent years, ICRISAT has also been receiving requests for foundation or commercial seed for distribution to farmers. These requests have increased as the range of agencies involved in seed multiplication and distribution has expanded.

ICRISAT has an interest in facilitating the multiplication and distribution of seed for its mandate crops in order to increase the investment returns to national and international crop improvement efforts and the impact of these

1. This paper draws from three regional ICRISAT discussion notes making suggestions for the Institute's seed multiplication policies

2. SADC/ICRISAT Sorghum and Millet Improvement Program, PO Box 776, Bulawayo, Zimbabwe

Rohrbach, D.D. 1997. ICRISATs seed multiplication policy. Pages 80-86 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

programs. Further, ICRISAT's mandate is to improve the productivity of farmers who grow our mandate crops. This requires not simply the development but also the widespread adoption of better varieties of these crops.

The growing number and size of requests for seed, in part, reflect the limitations of national seed multiplication and distribution systems for our mandate crops. The private sector is generally not interested in multiplying seed of open-pollinated varieties of sorghum, pearl millet, groundnut, chickpea, and pigeonpea. The public sector tends to be inefficient at this task. Yet ICRISAT's comparative advantage is as a research institute, not a seed multiplication program. As a result, the Institute is in the process of reassessing how it should best contribute to the diagnosis and resolution of seed multiplication and distribution constraints. A policy statement has been drafted that restricts our direct involvement in seed production to the provision of limited quantities of breeder seed. The policy, outlined below, also supports the provision of technical assistance to help other institutions produce seed. And it supports an expanded role in helping to evaluate seed supply constraints.

The seed supply problem

Poor seed multiplication and distribution is one of the largest constraints limiting the impact of ICRISAT's crop breeding research in Africa. New varieties of sorghum and pearl millet, in particular, have been widely released. However, most small-scale farmers still have no access to these varieties. Seed companies complain about the lack of consistent demand for open-pollinated varieties. They believe that once farmers obtain seed, they will not return to the market to purchase new supplies; and that consequently, commercial markets for sorghum and pearl millet seed are too small to justify investment in multiplication and distribution. Yet farmers continue to complain about their lack of access to new seed, and varietal adoption rates are low.

Production of groundnut seed remains similarly constrained by uncertainty about commercial demand. In addition, low multiplication ratios, storage constraints, and difficulties in competing with commercial demand for high-quality grain limit commercial seed supplies. While adoption levels for groundnut seed are reasonably high in some countries in Western Africa (e.g., Senegal) due to government support for the commercialization of the crop, the adoption of new varieties remains limited in much of Southern Africa. The production of pigeonpea seed attracts even less interest.

In recent years, several alternative seed supply channels have partially substituted for the lack of commercial interest in these crops. In some countries (e.g., Zimbabwe, Zambia, Mozambique, Angola), government and donor investment in seed distribution under drought relief and refugee resettlement programs has reduced the severity of seed constraints. These emergency programs have even encouraged a degree of private sector investment in the provision of sorghum and pearl millet seed—some produced on company farms but much purchased from farmers for resale once the demand for seed becomes apparent. Responsibility for distributing this seed remains with government and donor-funded programs. Distribution is done through extension agencies or NGOs. While offering the opportunity to distribute substantial quantities of seed quickly, such programs have not translated into the development of a commercial seed market.

Several national agricultural research systems (NARS), for example Namibia and Botswana, have invested in seed multiplication on research farms and through contract farmers. These schemes are generally subsidized by governments to varying degrees. Where these schemes are well managed, they have had reasonable success. Seed of new varieties has been quickly and widely distri-

buted to small-scale farmers. However, the prospects for further investment in such programs remains limited by government budget deficits and reductions in budget allocations to agricultural programs.

A number of NGOs have begun to make small investments in village-level seed production schemes (e.g., in Zimbabwe, Malawi, and Tanzania), again as a development activity in response to the recent droughts. These schemes badly need technical support and a consistent source of foundation seed. And the sustainability of these schemes when donor/NGO subsidies are withdrawn remains open to question. A few NGOs have also invested in promoting village seed banks as a means to promote the preservation of genetic diversity. However, such NGOs tend to be less interested in new varieties.

International seed companies have started investing in a number of countries in Southern and Eastern Africa (e.g., Zimbabwe, Zambia, Malawi, Tanzania, Kenya, Mozambique), commonly in joint ventures with national seed companies. But these investments are targeted primarily at hybrid seed, particularly hybrid maize.

In sum, the African seed sector is evolving, but commercial interest in multiplying and distributing seed of ICRISAT's mandate crops remains limited. Investments by NGOs and special seed projects have contributed to short-term improvements in seed supply. However, the sustainability of such non-commercial channels is questionable. Within this context, ICRISAT needs to carefully evaluate its role in assisting national and regional seed supply programs. This task has become more pressing as a result of the rising demand for direct assistance with training and the provision of seed stocks.

ICRISAT's draft seed multiplication policy

ICRISAT seeks to pursue a seed multiplication policy consistent with its comparative advantage as a research institute. Correspondingly, we expect to directly support seed multiplication necessary for crop breeding and varietal testing programs. ICRISAT will facilitate seed multiplication and distribution for on-farm trials and related demonstrations viewed as being necessary to verify variety performance and acceptability.

ICRISAT will not become directly involved in the multiplication of larger quantities of seed for distribution for commercial production by farmers. The Institute may encourage and even promote multiplication and distribution of released varieties of its mandate crops in order to achieve research impact. This may involve the provision of training in variety multiplication and hybrid seed production as well as the analysis of seed supply constraints, but the Institute seeks to avoid large commitments to seed production per se.

The specific components of the proposed seed multiplication policy are as follows.

1. Production of breeder seed. *ICRISAT will assist NARS with the production of breeder seed of released varieties. ICRISAT may directly invest in the production of this seed on behalf of a NARS for a period of not more than 2 years. Quantities would be limited to less than 100 kg. ICRISAT should provide training to NARS to produce their own breeder seed.*

ICRISAT receives requests for seed from NARS, NGOs, private firms, farmers' organizations, and directly from farmers. Rather than producing this seed itself, the Institute seeks to develop national capabilities to produce and maintain breeder seed stocks. The Institute may help a national program build up a limited breeder seed stock for 1-2 years. However, repeated requests for seed over multiple years are discouraged.

NGOs, in particular, are requesting re-allocations of pure seed for their community seed distribution programs. Many of these schemes depend on the provision of pure

breeder seed either every year or every 2-3 years. The Institute encourages national research programs to set up systems to maintain and distribute such seed stocks, ideally on a cost-recovery basis. However, this requires closer coordination between NGOs and national breeding programs or perhaps commercial seed companies. A frequent problem is that NGOs fail to look for seed until the beginning of the planting Season, and then complain about limited seed stocks.

Periodic training courses on the mechanics of seed production are run for national scientists. Such courses may be backed by occasional field visits to national multiplication sites to check seed quality. The timing of these courses depends on NARS demand. During the past few years such courses have been run in Zimbabwe and Mozambique.

ICRISAT will maintain minimum nucleus seed stocks that can be provided to national breeders in the event that national seed stocks are completely lost or contaminated. In addition, the Institute may provide assistance to re-establish breeder seed stocks following periods of civil strife.

2. Production of foundation or commercial seed. *ICRISAT should not be involved in the production of foundation or commercial seed. However, ICRISAT may provide technical advice or training to NGOs and small-scale private seed companies willing to multiply and distribute newly released varieties. This investment should he justified on the basis of the need to verify the performance and acceptability of released varieties.*

ICRISAT receives periodic requests for larger quantities of seed principally from NGOs and donor-funded drought relief or refugee resettlement programs. For example, in recent years we have helped provide commercial seed to Rwanda, Angola, and to Zimbabwe (after the severe 1991/92 drought). The Institute may produce limited quantities of such seed on its own farms or contract national seed companies to produce larger quantities. However, these are generally viewed as unique efforts based on unusually pressing needs and special development funding. As with the production of breeder seed, the Institute seeks to encourage other agencies to produce commercial seed stocks.

In this context, ICRISAT periodically offers short training courses and limited technical assistance to new agencies (such as NGOs) interested in commercial seed production. The courses cover the mechanics of crop production as well as the requirements for maintaining varietal purity. Such training may be backed by a field visit by ICRISAT staff during the course of the season to check the seed crop. But this assistance cannot extend to the full range of inspections necessary to ensure seed quality and certify the crop. ICRISAT has neither the manpower nor the comparative advantage to pursue such functions. Nor can we provide field visits to all NGOs interested in such assistance. Ultimately, this must be the responsibility of national research programs and seed quality/certification units.

Nonetheless, we are concerned about the possibility that under-qualified NGOs (and perhaps small-scale seed companies) may market or distribute poor quality seed of varieties developed and released with ICRISAT assistance. The release of poor quality seed, which has poor germination or is contaminated, threatens the name of the variety and the reputation of the institutions responsible for developing it. This may limit the acceptance of varieties released and multiplied in the future. Thus, we are particularly inclined to monitor, as time and resources permit, NGO involvement in seed production, in collaboration with NARS in different countries.

In addition, in Southern Africa, ICRISAT has been sponsoring national workshops targeting the development of action plans for

resolving seed multiplication and distribution constraints for sorghum and pearl millet. Thus far, workshops have been held in Tanzania and Zimbabwe. Discussions with multiple stakeholders about seed supply constraints have been held in Mozambique and Malawi.

3. Monitoring seed production. *ICRISAT will develop and maintain a chronological database on the levels of seed multiplication and distribution of released varieties of its mandate crops in order to assess multiplication efficiency and adoption.*

ICRISAT is making a substantial commitment to impact assessments both as a means to justify continuing investments in national and international research and as an opportunity to diagnose constraints to technology adoption. The primary targets for such impact assessments are crop breeding programs. These studies start with questions about the determinants of varietal adoption and the extent of adoption to be expected. Seed supply constraints are then evaluated, though the depth of such evaluations varies. Recent work in Zimbabwe has verified the acceptability of new sorghum and pearl millet varieties while highlighting the continuing limitations of seed accessibility (Friis-Hansen and Rohrbach 1995, Rohrbach and Mazhangara unpublished). Early analysis of the impact of a pearl millet variety in Namibia highlighted concerns about crop lodging in the event of heavy late-season rains and farmer complaints regarding grain storability. A study of pigeonpea impact in India noted the significance of varietal spillovers between neighboring states (Bantilan 1996).

These initiatives are backed by efforts to maintain broadly focussed regional databases of technology development and adoption. These include information on seed release, and provide a comparison of actual versus target areas of adoption. In Africa, related studies are also collecting specific data on seed multiplication and distribution. Such data provide a useful basis for encouraging N ARS to make greater efforts to resolve seed multiplication and distribution constraints.

4. Evaluating seed market constraints. *ICRISAT should periodically assess constraints to the multiplication and distribution of seed of its mandate crops. This may involve analyses of the structure of seed demand, commercial constraints to seed supply, the contributions of public versus private channels of seed supply, and national seed security strategies.*

During the last 2 years ICRISAT has expanded its efforts to diagnose adoption constraints and evaluate seed supply options through alternative delivery channels. Studies would first assess whether low adoption levels are a result of the limited acceptability of new varieties or genuinely due to non-availability of seed. Numerous examples exist of the release of varieties that ultimately prove of limited interest to farmers. This could occur particularly where varietal performance and release are judged purely on the basis of yield and related productivity factors.

ICRISAT's technology transfer programs encourage a more broad-based evaluation; a range of grain and plant traits, including taste and ease of processing, are considered. Breeders can use information from such evaluations (both positive and negative feedback) to target specific variety trait priorities while developing the next generation of variety releases. ICRISAT can facilitate these broad-based assessments both through participatory breeding (involving farmers in variety selection at an early stage of the breeding cycle) and through on-farm trials preparatory to variety release.

Recent surveys have begun to assess the commercial demand for new seed. It is commonly said that farmers ought to replace sorghum and pearl millet seed every 2-4 years. Yet we have no data on the rate of variety degeneration, nor on the structure of demand for fresh seed. Commercial seed

companies continue to question the likelihood that farmers will consistently return to the market for pure seed. Collaborative surveys in Zimbabwe evaluate the willingness of farmers to purchase seed. This analysis is extended with a review of the structure and conduct of informal seed market transactions between farmers.

Recognizing the limited incentives to pursue commercial seed production, ICRISAT economists are particularly interested in evaluating alternative marketing strategies for open-pollinated varieties of the Institute's mandate crops. These include seed supply through small private companies, government multiplication units, seed cooperatives, and NGOs, as well as informal farmer-to-farmer seed exchange. In Southern Africa, we are particularly interested in assessing whether historical patterns of community seed supply can be improved by encouraging better seed quality and sale on semi-commercial terms. Will farmers who are already known for their relatively higher quality seed stocks be willing to differentiate varieties and seed of varying quality for a cash market? The evidence on this question thus far is mixed.

Finally, ICRISAT has supported preliminary investigations of seed policies in Southern and Western Africa (e.g., Musa and Rusike 1997). These studies identify policy and institutional constraints to seed access. When these studies began, we were particularly concerned about variety release policies, because in many countries new varieties were simply not being released for multiplication. We have since determined, however, that release policies are less to blame than the limited initiative of national breeders or inconsistency of data to justify release. These problems can be resolved with additional technical support. Several other policy problems have been highlighted, however, which raise concerns.

For example, conflicts appear possible between ICRISAT's policies of open access to the germplasm of its mandate crops and national efforts to enforce plant breeders' rights or intellectual property rights. National research programs seek intellectual property rights in order to obtain royalties for seed multiplication. These rights may be granted in the context of variety registration procedures or through contracts with parastatal seed companies. If a single organization has monopoly rights over a variety, this could restrict seed access. In principle, ICRISAT provides germplasm to any party on the understanding that access to this germplasm will not be restricted.

From time to time we receive requests from national and international seed firms asking for monopoly rights to particular varieties. Companies suggest the return to their investments in multiplication and sale depend on such rights because seed markets are not large enough to support multiple sources. Nonetheless, these requests have consistently been declined.

In a related issue, ICRISAT is concerned that some countries demand tight restrictions on seed certification though they do not have the inspection services necessary to cope with the widening needs of the seed sector. In Zimbabwe, for example, no non-certified seed may be sold. Strictly speaking, this restricts NGO involvement in seed production. Seed companies have an incentive to restrict multiplication to sites readily accessible to seed inspectors. While we remain concerned about seed quality, we encourage the consideration of "truthfully labeled" seed and the licensing of private seed inspectors.

Finally, given the prominence of seed flows through drought relief programs, we have initiated an analysis of the impact of recent programs in Zimbabwe. This will identify options for improving the efficiency of this seed supply channel.

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Session IV
The Role of National Seed Multiplication Units

The Role of the Public Seed Sector in Syria

J E Radwan[1]

Abstract

Agriculture forms 20-25% of the Syrian economy. A major government objective is to achieve self-sufficiency, particularly in major crops like wheat, barley, potato, sugar beet, and cotton. Seed of the major crops is produced almost exclusively by the General Organisation for Seed Multiplication (GOSM), a public sector organization established in 1975. Seed requirements of self-pollinated crops are generally met through domestic production. For crops like potato, sugar beet, and sunflower GOSM production is supplemented with imports. Seed prices are fixed by the government, and certified seed is sold at typically 60% above the price of grain. Seed quality control is GOSM's responsibility, and is carried out at various stages during seed production, processing, storage, and before distribution. Seed distribution in Syria suffers from several constraints. For vegetables and ornamental plants, and crops for which GOSM does not produce seed, private firms and private-public partnerships should be encouraged within the general framework of the government's agricultural policy. The government should review existing seed policies, and seek to eliminate some of the problems that hamper seed production and distribution.

Introduction

Syria covers an area of 18.5 million ha, of which about 5.7 million ha is cultivated. Most of the cultivated area (83%) is rainfed. Agricultural production forms 20-25% of the national economy. A major government objective is to achieve self-sufficiency, particularly in wheat, barley, potato, sugar beet, and cotton. Table 1 shows the area and production of the major winter and summer crops.

The government considers agriculture to be of strategic importance, and has therefore taken responsibility for production and supply of inputs, including seed. Seed production of the major food crops is exclusively a public sector activity, with no private or semi-private firms (the private sector is active mainly in vegetable and flower seed). This was a conscious decision taken in order to avoid fluctuations and shortages in food production, which could have serious repercussions. Seed is produced by the General Organisation for Seed Multiplication (GOSM), which was established in 1975 by the Ministry of Agriculture and Agrarian Reform (MAAR).

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Radwan, J.E. 1997. The role of the public seed sector in Syria. Pages 89-93 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

The objectives of GOSM are to:

- Organize seed multiplication of released varieties and establish seed processing and storage facilities
- Market and distribute seed directly or through the Cooperative Agricultural Bank
- Provide training on seed production and advisory services for farmers through field demonstrations.

GOSM produces seed of wheat, barley, maize, chickpea, lentil, bean, soybean, cotton and potato; and imports seed of sunflower and (in limited quantities) sugar beet. Table 2 shows seed sales by GOSM in relation to Syria's annual requirements in recent years. Seed requirements of self-pollinated crops are generally met through domestic production. For potato, sugar beet, and sunflower GOSM production is supplemented with imports. Seed production figures for the period 1985-94 are shown in Table 3.

Seed prices are fixed by the government. Seed is sold on a no-profit basis, but production and processing costs are recovered. Certified seed is sold at typically 60% above the price of grain.

Table 1. Major crops in Syria, 1994/95 season.

Crop	Area ('000 ha)	Production ('000 t)
Cotton	207	651
Wheat	1523	3862
Barley	1663	1587
Chickpea	81	81
Lentil	165	155
Broad bean	9.5	18
Potato	25	530
Maize	90	359
Sugar beet	33.5	1340
Soybean	11	27.5
Sunflower	10	-

Variety development

Agricultural research in Syria is the responsibility of the Directorate of Agriculture and Scientific Research (DASR). Modern varieties

Table 2. Seed sales compared to national requirements[1] in Syria, 1990-94.

Crop	Seed sales (t) in different years				
	1990	1991	1992	1993	1994
Wheat	146 000(72)	132 115(65)	163 282 (69)	162 665(67)	174 181 (66)
Barley	11 649 (46)	5083 (2)	10 420(4)	13 812(7)	9600 (6)
Maize	2850(117)	2416(92)	3285(127)	2054 (77)	1800(57)
Faba bean	501(20)	774 (28)	2002(105)	1015(52)	130(4)
Chickpea	690 (20)	183 (6)	916(22)	587(17)	253(11)
Lentil	1344(10)	1171 (8)	2336(17)	1975(12)	1615(10)
Groundnut	210(38)	86(16)	128(23)	14(2)	-
Soybean	1263 (54)	1085 (83)	829(91)	544(61)	257 (27)
Sesame	13(3)	18(6)	8(1)	-	-
Vetch	3169(143)	-	-	-	-
Cotton	25 200(161)	25 400(142)	29 250(195)	28 763 (148)	28 000(137)
Potato[2]	35 987(56)	50 935	52 294(100)	34 500 (64)	36 284 (63)
Sugar beet[2]	-	-	45(5)	235 (29)	462 (56)
Sunflower[2]	-	-	70	82	92

1. Figures in parentheses show seed sales as a percentage of requirement
2. Part of potato and sugar beet seed, and the entire quantity of sunflower seed, is imported

Table 3. Seed produced by GOSM, 1985-94.

	Seed production (t) in different years									
Crop	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Cereals	89 500	94 100	141 535	174 364	163 510	160504	139614	178 437	178 534	185 581
Legumes	42	760	1857	3208	3848	4013	3299	6211	4135	1998
Pea		-	-	-	-	-	5	69	270	
Cotton	27 056	26 971	23 307	26 000	24 000	25 200	25 400	29 250	28 763	28 000
Potato	27 266	28 967	32 693	39 556	46 377	35 987	50935	52 294	34 500	36 284
Sugar beet		-	-	-	-	-	-	45	235	462
Vegetables		-	-	20	333	628	983	24	-	
Total	**143 977**	**151 004**	**199 734**	**245 086**	**239 310**	**229514**	**220 254**	**264 894**	**246 437**	**252 325**

multiplied by GOSM are developed by DASR and the Cotton Bureau in Aleppo, and in collaboration with international centers like the Arab Center for Studies in the Arid Regions and Dry Lands (ACSAD) and the International Center for Agricultural Research in Dry Areas (ICARDA), both of which are based in Syria. GOSM also maintains old improved wheat varieties and multiplies seed of some local landraces of chickpea, sesame, and vetch for distribution to farmers. The source and number of varieties multiplied are indicated in Table 4.

Variety release

New varieties are released by the National Release Committee chaired by the Minister of Agriculture and Agrarian Reform. The committee is composed of representatives from universities, GOSM, DASR, the Department of Plant Protection, the Department of Agricultural Affairs, and the Directorate of Planning and Statistics in MAAR. Promising varieties are tested (and compared with well-adapted commercial varieties) in yield and verification trials in

Table 4. Number of varieties multiplied by GOSM.

	No. of varieties from each source[1]						
Crop	DASR	ICARDA	ACSAD	GOSM	CB	Imported	Total
Wheat	8	6	1	3	-	.	18
Barley	2	4	3	-	-	-	9
Maize	2	-	-	-	-	-	2
Faba bean	2	-	-	L[2]	-	-	3
Lentil	4	1	-	-	-	-	5
Soybean	-	-	-	-	-	1	1
Pea	-	-	-	2	-	-	2
Groundnut	3	-	-	-	-	-	3
Cotton	-	-	-	-	4	-	4
Potato	-	-	-	-	-	11	11
Total	**24**	**14**	**4**	**8**	**4**	**12**	**60**

1. DASR = Directorate for Agriculture and Scientific Research, ACSAD = Arab Center for Studies in the Arid Regions and Dry Lands, CB = Cotton Bureau
2. L = Landrace

different agroecological zones. These trials are conducted by DASR in collaboration with ACSAD and ICARDA. A detailed report of the performance of the variety is prepared by the Directorate and submitted to the National Release Committee, which recommends the release of superior performers. There are no obvious bottlenecks in the release system. However, the entire process of variety development, evaluation, and release can take up to 14 years in wheat. After a variety is released, GOSM obtains breeder seed from the concerned research center to start initial seed multiplication.

Seed production

Breeder seed is supplied by research centers and then multiplied by GOSM on contract with private growers, farmers' cooperatives, and state farms. The stages in the multiplication cycle are breeder seed, basic seed, registered seed, certified seed 1, and certified seed 2. For self-pollinated crops, certified seed 2 is sold to farmers. For cross-pollinated crops the multiplication ends one stage earlier—at registered seed, which is sold to farmers. In potato, imported elite seed is used to produce Class A seed.

Quality control

Seed quality control is GOSM's responsibility, and is carried out at various stages during production, processing, and storage. Seed growers and fields are selected based on specific requirements to ensure proper crop rotation, isolation, etc. The selected fields are inspected at several stages—before sowing, during the growing period, and finally at full maturity, before the harvest. Harvesting, labeling, and transportation to processing centers are supervised by field inspectors.

After harvest, samples are drawn from each seed lot in the field, tested, and compared with standards that are specified in the contract. Based on the results of these tests seed lots are accepted or rejected, and the price determined. A "price incentive" system ensures that growers get higher prices for high-quality seed.

At receiving points and processing plants, all seed lots are tested for physical purity, other seeds, and noxious weeds before being cleaned. The results are compared with results obtained from samples drawn in the field. After processing, representative samples from each seed lot are analyzed for physical purity, germination, seed health (e.g., bunt), insect infestation, and treatment coverage.

Seed processing

Seed processing (for wheat, barley, maize, chickpea, soybean, and lentil) is carried out by GOSM at 11 plants in different agricultural zones of the country. These plants, with capacities of 8-10 t h^{-1} are located in Hassake (5), Raqqa (2), Aleppo (1), Hama (2), and Izra'a (1). The seed is cleaned, treated, and packaged in 50 kg polypropylene bags.

Seed export and import

During the past 5 years, GOSM has exported seed of wheat, barley, faba bean, chickpea, pea, maize, lentil, and potato to several countries; Algeria, Jordan, Lebanon, Libya, Saudi Arabia, the United Arab Emirates, and Turkey. On the other hand, Syria has imported seed of sugar beet, sunflower and elite seed of potato from western Europe to produce Class A potato seed. Moreover, private firms also import vegetable seed.

Marketing and distribution

After processing, seed is distributed through two main channels—GOSM branches and seed stores, which are spread all over the country; and the 108 branches and stores of

the Cooperative Agricultural Bank. The bank offers loans (at 7% annual interest) to farmers for seed purchase, and pays the money not to the farmers but directly to GOSM.

Seed distribution suffers from several constraints.

- Although seed is sold at cost price in order to encourage the use of certified seed, farmers still consider the price too high
- Very large quantities of seed are required, and must be prepared and distributed within a short time
- Neither GOSM nor the Cooperative Bank have enough storage facilities to store the processed seed until it is distributed
- Shortage of transport vehicles causes delays in seed delivery to farmers
- Seed processing plants are old, with obsolete or poorly maintained equipment.

Achievements of GOSM

GOSM has played a significant role in improving agricultural productivity in Syria by promoting the use of high-quality seed of modern varieties. For example, seed of high-yielding varieties resistant to diseases (smut, septoria, etc) is available at relatively low prices—approximately 60% higher than grain price. GOSM has been able to meet the country's entire seed demand for some strategic crops (cotton, sugar beet), and about 70% of demand in wheat and potato.

Conclusions and recommendations

In Syria, seed of the major crops is produced almost exclusively by the public sector. For strategic crops that are crucial to the predominantly agriculture-based economy, the public sector should be given additional financial support, allowing it to play an even greater role in improving seed supply. For vegetables and ornamental plants, and crops for which GOSM does not produce seed, private or joint private-public seed companies should be encouraged within the general framework of the government's agricultural policy. One possibility is to develop a "semi-private sector" through partnerships between government seed agencies and a group of private firms (e.g., seed associations). These partnerships could be supported where appropriate with loans and access to processing facilities.

The government should review the existing seed policies, and seek to eliminate some of the problems that hamper seed production; in particular, it should establish an independent seed certification agency. Such a review would also evaluate the effectiveness of existing multiplication and distribution systems, and identify areas where they can be strengthened. For example, private companies and NGOs could supplement the activities of government seed units. An integrated strategy that encourages exchange of seed between different areas, and focuses on both local and national issues, can help strengthen the seed sector throughout the country.

Regional cooperation. National seed programs in the WANA region would benefit greatly if the various national programs were more closely integrated. For example, WANA countries with favorable environmental conditions and adequate expertise could supply high quality seed to other countries. GOSM is committed to this approach, and is willing to provide support for integration initiatives.

Session V
The Role of NGOs

The Role of NGOs in Crop Improvement and Seed Multiplication

J D DeVries and J O Olufowote[1]

Abstract

World Vision International (WVI) operates in 28 countries in Africa, with over 5000 staff. Significant adoption and productivity gains have been obtained in a number of countries by obtaining seed of improved, adapted varieties from national and international research centers, testing them widely (both on-station and on-farm) in food- and seed-deficient areas, and facilitating the multiplication and distribution of farmer-selected varieties. WVI focuses on resource-poor smallholder farmers, providing support in various ways—training in seed selection, multiplication and storage, seed distribution in emergency situations, technical support to farmers able to experiment with new varieties, and facilitation of seed multiplication and exchange or small-scale trade through producer associations and farmers' groups.

WVI conducted a survey to identify the factors that contribute to the success of seed programs. The results show that diploma-level staff, i.e., those directly involved in seed multiplication and on-farm trials, are the most critical component in such programs. The presence of at least one qualified scientist within the program, and interaction with national and international research centers were also important factors.

Introduction

World Vision International (WVI) recognizes that seed availability is a crucial factor in any efforts to ensure food security in Africa. Appropriate seed of varieties with genetic purity must be made available to farmers at affordable prices. The recent upsurge in research efforts to resolve stress-related productivity constraints is creating a new generation of products for African farmers, which need testing and dissemination. Sadly, in spite of widespread recognition of the problem, funding by national programs for technology transfer has not increased significantly. As a result of structural adjustment programs and continued under-investment in the agricultural sector, national research and extension services responsible for technology transfer are at a low ebb in many countries.

Although a range of productivity-enhancing technologies is available, these technologies are simply not reaching the farmer. Spencer

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DeVries, J.D. and Olufowote, J.O. 1997. The role of NGOs in crop improvement and seed multiplication. Pages 97-102 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

(1986) estimated that less than 2% of the total sorghum, millet, and upland rice area in Western Africa is sown to varieties developed through modern research. This is the situation despite the involvement of bilateral donors for more than 30 years. The major objective of WVI's food security program in Africa is to make these improved varieties available to farmers through identification, multiplication, and distribution.

Results from WVI programs

WVTs agricultural recovery programs in several countries have helped improve the quality and availability of planting materials. The first successes were achieved in Mozambique during the late 1980s and early 1990s. Since then, positive results have been obtained from concerted, NGO-promoted crop improvement programs in Angola, Eritrea, Liberia, Rwanda, Sierra Leone, Somalia, Sudan, and Zaire. WVI was able to obtain good results (Table 1) simply by obtaining seed of improved, adapted Varieties from national and international agricultural research centers and testing them both on-station and on-farm in food- and seed-deficient rural areas.

There has been speculation, both within and outside the organization, that these successes were not representative of results obtainable from other African countries, for two reasons. First, the dramatic percentage increases are due to low initial levels of agricultural development (because of disasters, civil strife, etc). Secondly, because of the emergency situations under which the programs were operating, bureaucracy was reduced, and WVI staff were able to interact directly with target farmers. However, these data cover a wide geographical area and we believe they provide clear evidence that high returns to development investment are possible in large parts, if not all, of sub-Saharan Africa.

WVI's role in seed supply

WVI operates agricultural programs in 28 African countries. Most of our technology transfer efforts involve identifying and disseminating seed of improved varieties. WVI operates at the grassroots level, employing some 5000 staff in broad-based rural projects. These include 15 PhD-level and 20 MS-level agronomists, and about 100 BS-level agriculturists.

Since most of the farmers we work with are not serviced by extension agents and are unaware of varieties appropriate for their locality, we carry out wide testing of candidate materials along with farmers, and on their farms. Multilocational testing allows large numbers of farmers to become aware of

Table 1. Impact of World Vision International's agricultural recovery programs.

Country	Crop	Increase in yield	Source
Angola	Maize	46%	Nankam et al. 1996
Mali	Sorghum	24%	Dembele et al. 1997
Mozambique	Sweet potato	61%	White and Sitch 1994
	Maize	71%	White and Sitch 1994
	Sorghum	133%	White and Sitch 1994
Senegal	Cowpea	100%	University of California 1994
Sudan	Maize	53%	Janson and Kapukha 1995
Zaire	Maize	18%	Asanzi and DeVries 1995
	Cowpea	108%	Janson and Kapukha 1995

new technology, acting as a powerful tool for extension without the administrative and personnel costs of full-fledged extension programs. Farmers guide this process, ensuring that we are always aware of exactly the type of seed they need.

Results and ideas from these trials are disseminated through a network of "contact farmers". Contact farmers receive training at field stations and at contact farmer demonstration sites, and are thus able to understand the significance of the trials and the extension activities they undertake. This network approach is particularly important given the diffused nature of these trials and the multiple varieties and methods being tested. Over time, the network also leads to the evolution of farmers' associations that can play crucial roles in marketing and information exchange. The decentralized nature of the trial network also provides regular opportunities for WVI agronomists and technicians to interact with farmers—in effect an institutionalized system for obtaining feedback that can be relayed to national and international researchers, and help identify specific research needs.

Once a farmer-selected variety has been tested and found acceptable, WVI is often actively involved in multiplication and distribution. Many of the countries where we operate do not have a viable private seed supply system. Farmers' associations, individual farmers, local NGOs, and other organizations are therefore identified and contracted to produce seed.

Recommendations for a new model

Although considerable research has been conducted in Africa, large expanses of cultivated area have never been the focus of intensive multilocational testing programs of the type implemented in Mozambique, Rwanda, and Angola following their respective disasters. If donor funding and government support were to be made available for prioritized, well designed programs, positive results could be obtained elsewhere as well WVI's program "The Year of the Seed"aims to extend such programs to new areas. Through this privately-funded program, seed-based development initiatives will be launched in 15 countries where WVI operates. In all such ventures, WVI will make use of the NARS-NGO-IARC (national agricultural research system, nongovernmental organization, international agricultural research center) model used in previous initiatives. The priority will be to channel resources to farmers through WVI's Area Development Program.

Characteristics of effective programs

In preparation for an Africa-wide crop improvement campaign, WVI conducted a survey of its more successful seed-based programs to determine the key factors that contribute to success. Rating the success of agricultural recovery programs is a highly subjective task, partly because the success of a development initiative can be as much mental as physical—consensus among the community that success has been achieved creates momentum that will strengthen future activities. For example, in spite of a lack of concrete evidence of success from a seed distribution program in Sierra Leone (full evaluation was impossible at the time due to security concerns), a recent USAID assessment recommended a continuation of funding for seed activities, based largely on the perception that positive progress was being made towards project goals.

Success or failure must also be judged in the context of working conditions. For example, the level of success attached to the program in Liberia depended largely on results obtained at a single, central agricultural research facility. But an important moral victory was gained by making that one, highly visible facility functional despite ongoing fighting in large parts of the country. Thus,

for the purposes of this paper, program success was measured with a mixture of tangible and intangible evidence. Six managers of seed-based initiatives currently being implemented by WVI in Africa were asked to rate the importance of 20 aspects of their projects on a scale of 1-5 (1 = most important, 5 = least important).

The results of the survey (Table 2) show that diploma-level staff, i.e., those in front-line duties, directly involved in seed multiplication and on-farm trials, are the most critical component in such programs. Likewise, the presence of at least one qualified scientist within the program, and interaction with IARCS and NARS, scored high. In contrast, international input (support from multiple donor agencies, visits by consultants, presence of expatriate staff) was considered less relevant to the success of NGO-sponsored seed programs.

WVI's approach to seed dissemination

World Vision's NARS-NGO-IARC model focuses on resource-poor smallholder farmers normally not reached or targeted by commercial seed systems. These farmers are unable to benefit from conventional systems because they lack resources or are located in remote areas, or because normal seed support systems have been disrupted by war or natural disasters. These farmers fall into three broad categories.

Resource-poor farmers in settled situation. These farmers simply cannot afford to buy commercial seed. Our emphasis here is to help them make the best use of their own seed stocks by training them to make good selections from their fields, multiply these selections, and store them properly. Given that an estimated 90% of farmers in most

Table 2. Factors determining the success of World Vision programs.

Factor associated with success	Importance[1]
Effective diploma-holder staff	1.0
PhD level program leadership	1.2
Strong on-farm research	1.2
Effective BS/MS level staff	1.2
Seed multiplication capacity	1.4
Regular interviews with farmers	1.4
Active field station research	1.4
Collaboration with IARCs	1.5
Comprehensive production packages relevant to the farming system	1.6
Memorandum of understanding with NARS	1.6
Regular contact with NARS	1.6
Efficient commercial seed sector	1.8
Active support of Ministry of Agriculture	2.0
Farming systems training workshops	2.2
Existing national database	2.4
Support from multiple donors	2.6
Secondment of Ministry of Agriculture staff	2.8
Presence of expatriate team	3.2
Involvement of other NGOs	3.4

1. Rated on a 1 -5 scale, 1 = most important, 5 = least important

developing countries use farm-saved seed, this approach is the most cost-effective.

Resource-poor farmers in crisis situation. Most WVI intervention in Africa is in this area. Crises could be the result of natural disasters (e.g., drought) or civil strife. There are two modes of intervention.

- Direct donation of seed in the form of "Agpaks", preferably using varieties with proven adaptation to the area
- Direct production of seed by WVI. This is done in two ways. For local varieties, seeds are selected for genetic purity and yield potential, multiplied, and distributed. For example, WVI staff visited Somalia, made selections, multiplied the seed elsewhere, and later distributed it in Somalia. For improved varieties, WVI multiplies breeder seed (obtained from diverse sources) to produce foundation seed. Certified seed is then produced either on WVI stations or through contract farmers.

Farmers in non-relief countries. In most non-relief countries, farmers can easily be persuaded to experiment with new technologies. WVI makes available selected varieties from different sources, for experimentation by farmers under the guidance of WVI technicians or extension agents. Farmers select preferred varieties, and either multiply them for their own use and sell the surplus to other farmers, or purchase seed of these varieties from seed companies. In some instances WVI provides foundation seed and technical advice to seed producers, who multiply it into commercial seed for sale to other farmers. This seed is essentially unprocessed and uncertified, but of good quality and genetic potential, comparable to but cheaper than certified seed.

Seed production

World Vision emphasizes two main methods of intervention: through producers' associations and through a decentralized farmer-based system.

Producer associations. WVI facilitates seed production by farmers' associations or cooperatives. We obtain breeder seed from IARCs and some NARS and distribute it to cooperatives for multiplication into foundation and commercial seed. All other associated duties (e.g., processing, storage, marketing) are done by the cooperative. The members of the cooperative produce the seed themselves, and in effect trade or exchange seed amongst themselves. Since the operation is based on specific needs of members, there are no problems of unacceptable varieties or excess/shortages of seed.

Decentralized farmer-based approach. This approach is similar, combining the advantages of new technology with the cost advantages of farmer management. WVI obtains breeder seed from research institutions, produces foundation seed on WVI stations, and distributes it to individual farmers, who then produce commercial seed for sale to other farmers. Multiplication, harvesting, drying, processing, storage, and marketing are done by individual farmers under the guidance of WVI technicians (e.g., ensuring proper isolation distances).

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ENDA-Zimbabwe's Experience with Small-Scale Seed Production and Distribution

D Shumba-Mnyulwa[1]

Abstract

A number of NGOs in Zimbabwe are involved in seed multiplication and distribution programs targeted at smallholder farmers. ENDA-Zimbabwe's seed-related activities include a collaborative project with the Seed Company of Zimbabwe (Seed Co), the country's largest seed producer. Seed Co provides breeder seed of improved varieties of sorghum, pearl millet, open-pollinated maize, short-season groundnut, and cowpea. ENDA subcontracts smallholder farmers on Seed Co's behalf to multiply this seed into certified seed, and coordinates seed production, delivery, and payment to growers. Seed quality is monitored by Seed Co and the government's Seed Inspection Services.

The project, launched in the 1992/93 season, uses a participatory approach. A seed committee in each project area is responsible for selection of farmers, seed distribution, monitoring, and liaison with ENDA staff. Training (not only on seed crop management, hut also on project implementation and business management) constitutes 60-70% of the project staff time and budget. The issue of long-term project sustainability is being addressed in two ways—by building up local skills and organizational structures for seed production, and exploring the possibility of forming a small seed company with shares owned by Seed Co, ENDA, and the farmers.

Introduction

The private seed sector will generally concentrate on profitable crops. These are high-value, cross-fertilized crops with low seeding rates. The emphasis is usually on commercial farmers in easily accessible, high-potential areas. Most drought-tolerant crops, which are suitable for semi-arid areas where the majority of resource-poor farmers reside, are either self-pollinated or open-pollinated, and on-farm seed retention of such crops is very high. Improved varieties of sorghum, finger millet, and pearl millet were released in Zimbabwe in the late 1980s, but the seed companies responsible for multiplication and distribution have found it difficult to market them within the country. As a result of these three factors—low profitability, low adoption rate of improved varieties, and marketing problems—a number of "minor" crops (sorghum, pearl millet, finger millet, cowpea, bambara groundnut) have not received sufficient attention.

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Table 1. Seed production under the ENDA-Seed Co project, 1992/93 to 1995/96.

Crop	Variety	Production (t) in different years			
		1992/93	93/94	94/95	95/96
Sorghum	SV 2	30	4	116	313
Pearl millet	PMV 2	15	20	35[1]	14.4
Finger millet	FMV 2	10	0.4	5	10
Groundnut	Bebiano Branco	10	13	10.8	-
	Falcon/Plover	-	66	112.9	143.3
Cowpea		-	-	131	-[2]
Maize open-pollinated	Matuba	-	-	28.1	-

1. Entire crop rejected due to smut infestation

2. Seed Co did not provide seed due to anthracnose infection

A number of NGOs in Zimbabwe are involved in seed multiplication and distribution programs targeted at smallholder farmers. Their initial efforts focused on free seed distribution. For example, World Vision, Christian Care, CARE International, and the Lutheran World Federation have distributed free seed packs to farmers as part of drought relief programs. However, several problems were encountered:

- "Misuse" of seed—some farmers washed off the seed-dressing chemicals and consumed the seed, some sold the seed to neighbors in exchange for food
- Farmers developed a dependency syndrome, expecting new, free seed each year
- The costs of free seed distribution were high and unsustainable
- These efforts focused on distribution but did nothing to encourage seed multiplication
- In some cases standard seed or treated grain, rather than high-quality seed, was distributed.

In the light of other NGOs' experiences, Environment and Development Activities (ENDA)-Zimbabwe launched a seed exchange program through an NGO network known as the Zimbabwe Seeds Action Network. ENDA multiplied seed of local landraces, which was then distributed through the network to farmers' groups. At the end of the season, seed plus "interest" (in the form of seed) was returned to ENDA for further distribution to other NGOs.

The Seed Company of Zimbabwe (Seed Co)[1] learnt about the success of this seed exchange program. In the 1992/93 season Seed Co approached ENDA and offered to contract us to further subcontract smallholder farmers to produce certified seed of improved varieties of various crops. The scheme involved five crops traditionally grown by smallholders—sorghum, pearl millet, open-pollinated maize, short-season groundnut, and cowpea.

Certified seed production

Beginning in the 1992/93 season, farmers from ENDA's project areas started producing certified seed, initially of sorghum and pearl millet. The following season they diversified,

1. Seed Co, earlier known as the Zimbabwe Seed Cooperative (Seed Coop), was originally a cooperative of large-scale seed producers of mainly hybrid maize seed. It is now a private firm and the country's largest seed producer.

Table 2. Expected seed production in the 1996/97 season.

Crop	Variety	Allocated foundation seed (t)	Area sown (ha)	Expected yield (t ha^{-1})	Expected production (t)
Sorghum	SV 2	5.9	591	1.2	710
Pearl millet	PMV 2	0.4	73	1.0	73
Finger millet	FMV 1	0.19	38	0.8	30
Cowpea	IT 18	3.8	189	1.5	284
Groundnut	Falcon	20.5	205	2.5	511

producing medium-duration groundnut (varieties Falcon, Bebiano Branco, and Plover), cowpea, and open-pollinated maize in addition to sorghum and millets. Production figures for the past four seasons are shown in Table 1, while expected 1996/97 production is shown in Table 2.

Production problems. The project areas lie mainly in semi-arid areas, and consequently drought is a major problem. Of the four seasons that the project has operated, rainfall was adequate and well distributed in only only one season (1995/96). Other problems encountered are: aphids on cowpea, poor soil fertility, labor shortages that delay weeding and harvesting, and diseases, e.g., smut on pearl millet and anthracnose on cowpea.

The initial approach

From the outset, farmers were closely involved in decisions on project implementation. The field assistants, who were responsible for implementing the project on the ground, were hired from among the local community and selected with the assistance of farmers. Selection of seed growers, distribution of foundation seed, and monitoring of crop performance (with assistance from the local extension worker) were all done by the local community. Initially Seed Co provided free foundation seed to ENDA, hoping to recover the cost from the sale of certified seed produced by the project. However, several problems surfaced.

- Misuse of seed—some seed was consumed and some sold
- Isolation distances—some farmers who were not part of the scheme deliberately planted the same crop on fields adjacent to the seed plots, using different varieties or inferior seed
- The seed plots were often far apart, creating difficulties in monitoring and seed inspection
- It was difficult to fully recover the cost of foundation seed since some seed crops failed completely.

The modified approach

From the lessons learnt during the first year of operation, a modified approach was used in subsequent years. The earlier approach depended on the efficiency of the field assistant, with the assumption that the community would cooperate with him. While cooperation was expected from the community as a whole, responsibilities and tasks were not specifically identified. In the modified approach, day-to-day implementation was done through seed committees, with committee members acting as links between farmers and ENDA staff. Committee members' specific responsibilities were discussed and agreed to by ENDA and the

local community. Using the participatory approach, a seed committee was elected by villagers in each project area. These committees were responsible for selection of farmers, seed distribution, and crop monitoring. They also acted as judges during field days, identifying the best seed crop in the area and forwarding the names of these farmers to ENDA for entry in the competition for best small-scale seed producer of the year.

Project implementation

Farmers were selected as seed producers depending on their willingness to participate fully in project activities, as indicated by their attendance at training sessions and meetings. This ensured that resource-poor farmers—the target group of the project—could participate if they were sufficiently interested, and would receive support to enable them to produce seed. Training of committee members and farmers is a vital component of the project, and accounts for 60-70% of ENDA staff's time and 70% of the project budget. Farmers were provided training on agronomy of seed crops, pest control, quality control, and business management through demonstration plots, training sessions, field tours, farmer exchange programs, and field days. This training is conducted annually, by technical officers from ENDA. Committee members were trained on project implementation, seed production, and management.

In the early years of the project, more than two-thirds of the participants were women, but most of them were registered under their husband's name. In 1995/96 only 40% were women. This decrease is probably due to large-scale retrenchment in towns (as a result of the government's economic restructuring program) which has led to a sudden increase in male population in the rural areas. Since they are heads of households they then register in their own names. The tendency so far has been that women farmers choose to multiply cowpea and groundnut seed while male farmers prefer grain crops.

The Seeds Action Project now operates in 10 areas: Zvishavane District - Murowa ward communal area, Chipinge District - Checheche ward, Plumtree District - Emakhandheni ward, Mutoko District - Nyamustahuni and Kawere wards, Chivhu-Mboe and Gandami small-scale commercial farming areas, Gweru-Vungu small-scale commercial farming area, Mutare-Mukuni communal area and Rowa small-scale commercial farming area, Nyanga-Nyarubvurwe resettlement and Plumtree-Emakhadeni communal area[2].

Quality control

Seed Co, being a commercial company that follows International Seed Testing Association (ISTA) regulations, has specified minimum quality standards for seed produced by the project. The project has been largely successful in training farmers to appreciate the difference in management requirements between a grain crop and a seed crop. To date only three batches of seed have been rejected by Seed Co. Pearl millet seed from Mukuni was rejected in 1994/95 because the crop was infested by smut *(Ustilgo* spp). Finger millet seed from Nyanga was rejected for two seasons due to poor germination (53% in 1994/95, 58% in 1995/96), which was caused by late-season drought.

Field inspections are carried out by the Department of Research and Specialist

2. Areas are classified based on structure of ownership. Communal areas—land is communally owned but allocated to individual households for farming. Small-scale commercial—land owned by individual farmers. Resettlement area—large-scale commercial farms converted to communal areas. Size of landholdings (arable area per fanner) in the project was about 2.5 ha in communal areas, >50 ha in small-scale commercial farming areas, about 5 ha in resettlement areas.

Services' Seed Inspection Services. ENDA provides transport to inspection staff. In each area, 10% of fields are inspected. After harvest, 10% of the seed produced is sampled for laboratory tests before certification.

Subsidies by ENDA to farmers

In the first two seasons, 1992/93 and 1993/94, ENDA gave the farmers free foundation seed. In 1994/95 the cost of foundation seed was "recovered" by deducting weight equal to the weight of foundation seed supplied. Some farmers achieved high gross margins, but about 5% of the groundnut producers made a loss. From the 1995/96 season onward, ENDA recovered the cost of foundation seed in cash, by deducting the value of the foundation seed from the money payable to the farmer for the certified seed delivered.

ENDA delivers foundation seed to farmers without charging transport costs, but charges a nominal fee of Z$ 250 per ton (about US$ 24) to transport the certified seed to Seed Co depots. Farmers are given free packaging material. In the 1996/7 season Seed Co paid farmers the following prices per kilogram of certified seed: sorghum and millets Z$ 2, unshelled groundnut Z$ 4, and cowpea Z$ 4.40. This is about twice the market value of sorghum, millets, and cowpea, and about 50% more than the market value for unshelled groundnut.

ENDA pays for training, monitoring, and seed inspection. These activities are expensive and together consume more than 60% of the project budget. This project is funded by NOVIB, a Dutch organization.

Project sustainability

Sustainability is the major problem with most NGO-implemented projects. The project currently relies heavily on back-up support and technical services from ENDA, and there are concerns about whether the seed scheme can continue after ENDA pulls out. We are attempting to gradually build up to a point where the seed committees and farmers can manage the project on their own. The project proposal refers to the possibility of forming a small seed company at the end of the project, with shares owned by Seed Co, ENDA, and farmers. Such an arrangement would address the questions of quality control, technical advice, and marketing, and help ensure sustainability.

Lessons learnt

Training. It is essential that smallholder farmers be trained in seed technology and production, either by the extension services or through NGO agencies. Training schemes are expensive since they tend to involve large numbers of farmers. ENDA's experience suggests that given the limited resources of NGOs, it would be most effective to promote training through the government extension services.

Participatory methodology. Without a participatory approach the project would have collapsed. Misuse of seed, for example, is normally difficult to control, but in a participatory scheme farmers police each other and report to the seed committee or the NGO any side marketing or consumption.

Shortage of resources. Timeliness of field operations (sowing, weeding, pest control, harvest) is critical in a seed crop. Most resource-poor farmers lack the labor and other resources needed for timely operations, and require training on how to use available resources more efficiently, and to make them understand the importance of timeliness.

Shortage of land. Some competent farmers are unable to expand seed production because their landholdings are small.

Seed contamination. Fields of neighboring farmers in communal areas are often sown close to each other. As a result, a field close

to a seed crop may be sown (by another farmer) to a different variety of the same crop. This sometimes happens even when both farmers are involved in the project. ENDA encourages project participants to discuss their cropping plans with each other to avoid contamination.

Inadequate foundation seed. Each season, Seed Co and ENDA agree on the seed crop area required for each crop/variety. ENDA then decides how much seed to allocate to each project area, and farmers accordingly set aside the required amount of land. However, the foundation seed eventually delivered by Seed Co is only one-third of the agreed quota, causing inconvenience and losses to the farmers.

Late delivery of seed. Foundation seed is often delivered late, because Seed Co places a higher priority on delivering seed of more profitable crops to its large-scale commercial seed producers.

Late cleaning of seed. Cleaning of seed (Seed Go's responsibility) is often delayed. This leads to increased postharvest losses and also delays payment.

Conclusions

ENDA's experience shows that smallholder farmers can produce high quality seed of open-pollinated and self-pollinating crops, given the right technical advice and back-up. However, marketability remains a major problem. In most of these crops, seed is saved on-farm for up to five seasons. The domestic market is small. The export market (e.g., for relief seed) is uncertain and requires a high degree of organization. This aspect is critical to the sustainability of any small-scale seed project, and must be fully examined before such projects are launched.

ActionAid's Experience with Small-Scale Seed Production and Distribution in Malawi

A Msimuko[1]

Abstract

ActionAid Malawi, a British-based NGO, is involved in efforts to diversify crop production and improve seed availability in Malawi through two projects, one for cassava and sweet potato, and the Malawi Smallholder Seed Development Project. Under the cassava and sweet potato project, planting material of improved varieties is grown in nurseries and distributed to smallholder farmers for further community-level multiplication and distribution. There are 67 one-hectare community-managed nurseries and five central nurseries managed by ActionAid and the extension department. Eight additional primary nurseries are also being established. The Malawi Smallholder Seed Development Project is a community-based program that helps resource-poor farmers multiply seed on their own farms, with supervision and support from ActionAid and government agencies. The Project distributes seed and planting material on credit to community groups, provides training, and helps build community-level institutions to manage such projects. In 2 years of operation, 14 t of basic and certified seed of different varieties of eight crops (maize, soybean, groundnut, Phaseolus *beans, cowpea, sorghum, pigeonpea, pearl millet) have been distributed. Currently, there are 3122 beneficiaries, of whom 77% are women.*

Introduction

Since the early 1980s, Malawi has experienced annual dry spells and drought periods of varying severity in different parts of the country, which have threatened an already weak food security environment. The 1991/92 drought was the most severe since 1949. Rainfall during the season (country-wide average) was only 623 mm, half of normal. Harvests failed completely in over half the country, and large-scale relief efforts were launched. The following season (1992/93) was one of the best in recent history, with a total grain harvest of 2.1 million t—sufficient to meet the national requirement of 1.8 million t, with some surplus for reserve stocks or export. However, in 1993/94 the rains were late, erratic, and poorly distributed. The harvest was again seriously reduced, causing a massive food deficit, and substantial relief assistance was needed.

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Since the 1991/92 drought, some effort has been made to diversify food production away from the single-cropping pattern dominated by maize, and to include more drought-tolerant crops such as sorghum, cassava, and sweet potato. ActionAid Malawi, a British-based NGO, has been active in these efforts, both in its Rural Development Project areas and through its national projects. ActionAid supports a wide range of activities; this report will dwell on its seed multiplication and distribution programs in Malawi.

The cassava and sweet potato nurseries project

Demand for cassava and sweet potato planting materials is very high throughout Malawi. The cassava and sweet potato nurseries project was launched in Oct 1993 to facilitate crop diversification among smallholder farmers through the adoption and dissemination of improved varieties of these two crops. The strategy was to promote community multiplication and distribution of planting materials in all eight Agricultural Development Divisions (ADDs) of the country: Blantyre, Karonga, Kasungu, Lilongwe, Machinga, Mzuzu, Salima, and Shire Valley.

The project components included establishment of nurseries, training of extension staff on production techniques (isolation distances, roguing, rapid multiplication techniques), farmer training on multiplication and seed retention techniques, and sinking of shallow/tube wells for nursery irrigation during the dry season. The project was funded by ODA with a total of £ 69 500, managed by ActionAid in collaboration with the extension and research staff of the Ministry of Agriculture and Livestock Development.

Planting materials were supplied from nurseries managed by the Department of Agricultural Research and IITA/SARRNET (International Institute of Tropical Agriculture, Southern Africa Root Crops Research Network). By the end of the original 1-year project implementation period in Aug 1994, a total of 72 nurseries had been planted across the country. These consisted of 5 central nurseries managed by research staff and 67 nurseries (1 ha each, 0.6 ha cassava and 0.4 ha sweet potato) managed by community groups. The beneficiaries included 1616 households.

Primary and community-managed nurseries. The five primary or central nurseries, managed by researchers, ensure genetic purity of planting materials. The primary nurseries provide initial material to group nurseries, which then undertake further multiplication and distribution to individual farmers.

Additional primary nurseries. Increasing disease incidence and dilution of purity have been noted in the five primary nurseries and the 67 community nurseries. Therefore, ActionAid plans to establish eight additional primary nurseries (15 ha of cassava, 9 ha of sweet potato), one in each ADD. These nurseries will be established using carefully selected material from the existing primary nurseries, with help from government researchers, and managed in collaboration with the Root Crops Unit of the Department of Agricultural Research. ActionAid will provide funding. So far we have already developed 10 ha of cassava plots and 4 ha of sweet potato. Non-availability of seed material and delays in channeling funds to research stations (as a result of cumbersome procedures) have delayed the development of the new nurseries.

Once developed, these nurseries will provide disease-free planting materials to community nurseries in areas that are food-deficient but have permanent water supplies. These nurseries will be run by community groups of 10-30 members each. The groups will receive planting material on credit (details of credit given under the Smallholder

Seed Development Project, below) and repay the loan through sales of planting materials to their neighbors.

Training. The roots and tubers commodity training team from the Ministry of Agriculture and Livestock Development conducted 8 courses for 141 extension staff and 12 courses for 360 members of community nursery groups.

Tubewells. The provision of tubewells to irrigate the nurseries was delayed first by non-availability of equipment and then by drought, which drastically lowered the groundwater level. However, new and more powerful drilling equipment is being procured, which will be able to reach even the lowered water table. (In May 1995, the project was extended, without new funding, to enable ActionAid to complete these activities.) This will allow the establishment of additional permanent nurseries.

Crop diversification. ActionAid Malawi is currently collaborating with the Bean Improvement Project of the Department of Agricultural Research at Chitedze in central Malawi. The objective is to disseminate five new released bean varieties. These varieties have been supplied to the community groups for them to grow (in the 1996/97 season), evaluate, and adopt the most preferred ones.

Malawi Smallholder Seed Development Project

The Malawi Smallholder Seed Development Project (MSSDP) is a community-based program to improve food security in smallholder farm households. The objectives of the project are to:

- Improve and sustain seed availability of improved varieties of appropriate crops
- Establish community groups to manage seed production and distribution within the communities
- Train community groups, extension and project staff in seed production, quality control, group dynamics, and participatory methodologies.

The project was conceived in the 1991/92 drought season when ActionAid Malawi, in collaboration with the Ministry of Agriculture, distributed free seed to drought-affected communities. Non-availability of seed was a major constraint to resource-poor farmers in many communities. Private seed companies in Malawi (e.g., National Seed Company of Malawi, Lever Brothers, Pannar Seed) are not interested in multiplying seed of improved open-pollinated varieties, which farmers recycle for several years. Availability of certified seed is restricted mainly to hybrids, which are expensive. The MSSDP was therefore designed to help resource-poor farmers themselves multiply improved self- and open-pollinated varieties of a range of crops (maize, groundnut, soybean, *Phaseolus* beans, pigeonpea, cowpea, sorghum, pearl millet, plus others as required). The government Seed Services Unit will monitor and provide advice on quality control.

Project implementation

MSSDP is implemented by ActionAid Malawi in collaboration with the Ministry of Agriculture. The project began in Dec 1995 and will phase out in 2000, after which the Ministry of Agriculture will incorporate the activities of the project into its seed multiplication program. The project is being implemented in Mzuzu, Kasungu, Machinga, and Blantyre ADDs. It is funded by the Overseas Development Administration (ODA) under the British government with a total sum of £ 1.3 million.

Supply of certified seed on credit

The project operates through community groups, which are formed as follows. First, extension staff identify areas with food deficits. Communities in these areas are

asked to categorize themselves under three categories—poor, relatively better off, and rich. Groups of 10-30 members are then formed from among the first two categories. The emphasis is on selecting farmers who may have limited resources but are able and willing to work as a group.

ActionAid obtains basic seed from research institutions and contracts church farms, universities, or individual farmers to multiply the basic seed into certified seed, which is inspected and certified by the government Seed Services Unit. The certified seed is distributed to the community groups. Each group receives certified seed and planting materials of at least two crops (one variety of each crop), which are planted on 2 ha of land provided by the group. The group chooses which crop/varieties it will receive, and seed and planting material are provided on credit. The group multiplies this certified seed to seed of acceptable quality, termed here as "approved" seed, which is distributed to members of the group. Surplus seed is sold to neighbors for cash, and this cash is used to repay the credit plus 20% interest within one season.

Seed is provided on credit only for the first season. Subsequently, each group is expected to be financially self-sustaining. Surplus cash is deposited into the group's bank account to form a revolving fund which the group can use to buy seed and other inputs in the second and subsequent seasons. (A group bank account is a prerequisite for a group to receive seed on credit.) If a group is unable to produce or sell seed due to conditions beyond its control (e.g., drought), credit seed is provided the following season. However, the group must repay—in cash—both seasons' seed credit during subsequent good seasons.

Seed supply and production in 1995/96

Seed production. In Dec 1995, 2243 kg of basic and certified seed of various crops and varieties were supplied on credit to 47 community groups in the four ADDs. Because of shortage of certified seed, each group received only one variety of one crop. This was multiplied to produce 9.6 t of seed (Table 1). Credit repayment was poor—only 15% of the total group loans had been repaid as of Dec 1996. Failure to repay may have been caused by unclear credit rules, which were finalized only after the credit had been disbursed. Only 13 of the 47 groups repaid their loans in full; these groups were supplied with additional certified seed of varieties of their choice in the 1996/97 season. The remaining groups were not issued certified seed. Instead, they have replanted the seed they earlier received so that they can sell the seed for cash to repay their loans.

Quality control. Because these groups do not produce certified seed, very stringent quality requirements would be counter-productive. However, group members were provided training on isolation distances for various crops and roguing of off-types and diseased plants. They were also trained on grading, packing, and storage techniques. Regular inspections were conducted by ActionAid and government extension staff. Seed inspectors conducted random checks (because the number of fields was too large, not all could be inspected).

Seed crop management. Management of the seed crops by the community groups was not of the required standard. This was partly due to lack of supervision by project staff—staff were recruited and posted only in Mar 1996 (the project began in Dec 1995).

Seed supply and production in 1996/97

Seed production. In Nov 1996, 11 712 kg of basic and certified seed was distributed to 140 community groups, with an average of 20 members per group. Of the 140 groups, 71 are purely women's groups, one is an all-male group, and the other groups contain

Table 1. Basic and certified seed distributed (kg) to community groups in different ADDs, 1995/96 season.

Crop and variety	MZADD[1]	KADD	MADD	BLADD	Total seed supplied (kg)	Estimated area (ha)	Total estimated production (kg)
Groundnut							
CG 7, in-shell	90 (1 gp)	90 (2 gps)	90 (1 gp)	60 (1 gp)	330 (5 gps)	1.8	1331
Beans							
Kalima, Nasaka	380 (3 gps)	360 (4 gps)	180 (7 gps)	180 (2 gps)	1100 (16 gps)	12.0	3678
Soybean							
Santarosa, Duocrop	180 (3 gps)	360 (4 gps)	10 (1 gp)	90 (2 gps)	640 (10 gps)	7.0	2009
Pigeonpea							
ICP 9145	-	-	8 (1 gp)	37 (6 gps)	45 (7 gps)	5.6	1002.6
Cowpea							
UCR 418	10	-	6.5	15 (1 gp)	31.5 (1 gp)	1.6	135
Sorghum							
SPV 351, SPV 475	4	8 (2 gps)	8 (1 gp)	8	28 (3 gps)	7.0	1237
Pearl millet							
Okashana 1, SDMV 89005	-	-	8 (1 gp)	8 (1 gp)	16 (2 gps)	4.0	52
Composite maize							
CCC, CCD	-	37.5		15 (1 gp)	52.5 (1 gp)	2.0	110
Total	**664 kg (7 gps)**	**855.5 kg (11 gps)**	**310.5 kg (13 gps)**	**413 kg (14 gps)**	**2243 kg (45 gps)**	**41.0 ha**	**9554.6 kg**

1. Mzuzu, Karonga, Machinga, and Blantyre Agricultural Development Divisions (ADDs). Figures in parentheses show number of community groups

Table 2. Basic and certified seed distributed (kg) to community groups in different ADDs, 1996/97 season.

Crop and variety	MZADD[1]	KADD	MADD	BLADD	Total seed supplied (kg)	Estimated area (ha)	Total estimated production (kg)
Groundnut							
CG 7 (in-shell)	1710 (19 gps)	1890 (21 gps)	1770 (21 gps)	2430 (31 gps)	7800 (92 gps)	52	62 400
Beans							
Nasaka	220	610	-	-	830		
Kalima	320	430	180	50	980		
Mkhalira	50	120	20	-	190		
Kambidzi	20	160	-	-	180		
Total	610 (17 gps)	1320 (20 gps)	200 (6 gps)	50 (1 gp)	2180 (44 gps)	24	12 000
Soybean							
Santarosa	-	70	140	410	620		
Duocrop	110	100	340	250	800		
Ocepara	-	-	40	60	100		
Total	110 (2 gps)	170 (4 gps)	520 (18 gps)	720 (29 gps)	1520 (53 gps)	17	13 600
Pigeonpea							
ICP 9145	-	-	-	6	6		
ICPL 86012	-	-	4	-	4		
Total	-	-	4 (1 gp)	6 (2 gps)	10 (3 gps)	1.25	500
Cowpea							
UCR 418	-	40 (1 gp)	-	-	40 (1 gp)	2	800
Sorghum							
SPV 351, SPV 475	-	-	-	2 (1 gp)	2 (1 gp)	0.5	300
Composite maize							
CCC	-	20	-	-	20	0.8	
CCD	-	100	30	10	140	5.6	
Total	-	120 (6 gps)	30 (3 gps)	10 (1 gp)	160 (10 gps)	6.4	9600
Total	**2430 kg (19 gps)**	**3540 kg (27 gps)**	**2524 kg (27 gps)**	**3218 kg (35 gps)**	**11 712 kg (108 gps)**	**103 ha**	**99 200 kg**

1. Mzuzu, Karonga, Machinga, and Blantyre Agricultural Development Divisions (ADDs). Figures in parentheses show number of community groups

Table 3. Reserve and carry-over seed stock, 1997.

Crop	Varieties	Seed type	Quantity (kg)
Groundnut	CG 7	Certified Basic and certified Basic	49 (shelled) 6318 (in-shell) 500 (estimated in-shell)
Beans	Kalima, Nasaka, Mkhalira, Kambidzi, Nyauzembe	Basic and certified	5166
Soybean	Santarosa, Duocrop, Ocepara 4	Basic and certified	560
Pigeonpea	ICP 9145, ICPL 87105, ICPL 86012	Basic	75
Cowpea	UCR 418,UCR 405	Basic	370
Sorghum	SPV 475, SPV 351	Basic	832
Pearl millet	Okashana 1, SDMV 89005	Basic and certified	1041
Composite maize	CCC, CCD	Basic	941.5

both men and women. In all there are 3122 members, of whom 77% are women. Each group was supplied with two crops (one variety of each crop, crops and varieties of their choice, Table 2). Table 3 shows seed reserves and carry-over stocks in 1997.

Of the 140 groups, 108 received seed of two crops for multiplication in the 1996/97 season. Thirty-two groups continue to multiply seed they produced in the 1995/96 season. These groups did not receive additional certified seed because they did not repay in full the seed credit they received in 1995/96.

Seed sales/utilization. A group's first priority is to repay its loans, by selling seed at prices slightly higher than commercial grain prices. Each group also retains enough seed to plant about 0.5 ha. In general, about 20% of the seed produced by a group is shared among group members for individual use, 20% retained for group multiplication, and 60% sold to non-members.

Crop preferences. Farmers were offered a choice of eight crops—composite maize varieties, sorghum, pearl millet, soybean, groundnut, *Phaseolus* beans, cowpea, and pigeonpea. Groundnut was the most popular, chosen by 85% of the groups; 49% chose soybean, 40% *Phaseolus* beans, 9% composite maize, and 3% of the groups chose pigeonpea. None of the groups chose pearl millet or sorghum. Most groups selected non-staple food crops. It therefore appears that selection of which crop to multiply was based on market value rather than on food security concerns.

Seed crop management. Crop management has been satisfactory because project staff have been posted in project areas in all the four ADDs to monitor seed production. In addition, project staff, extension staff, and the community groups have been trained in seed production techniques.

Sustainability of the project

MSSDP is planning to link community seed groups with commercial certified seed producers under the European Union (EU) Programme. The community groups will use EU funds to purchase certified seed from the commercial producers, multiply it, and distribute it in their communities. This linkage, once developed, will help ensure the sustainability of the project.

Mvumi Rural Training Centre's Experience with Small-Scale Seed Production and Distribution in Tanzania

R A Makali'

Abstract

Mvumi Rural Training Centre (MRTC) is located in Mvumi division in the semi-arid Dodoma region of Tanzania. Sorghum and pearl millet are the main food crops in the area, but seed shortages are common. MRTC launched a small-scale seed production project in the 1993194 season, distributing certified seed of improved sorghum and pearl millet varieties to farmers within and outside the division, providing seed at moderate prices and generally on credit. The scheme has benefited over 600 farmers in the past 3 seasons. The Centre's experience shows that NGOs can he sustainable alternative sources of seed supply, provided due attention is paid to the key factors influencing the success of such projects—funding, institutional interactions, transport facilities, pricing (including an element of subsidy), quality, an effective seed distribution system, and the creation of farmer awareness.

Introduction

Mvumi Rural Training Centre (MRTC) is located in Dodoma rural district, a semi-arid area in central Tanzania. It is funded by the Interchurch Coordination Committee for Development Projects (a Dutch NGO) via the Diocese of Central Tanganyika. MRTC's objective is to make Mvumi division self-sufficient in food production. To this end, the Centre produces and distributes seed of new sorghum and pearl millet varieties that are drought resistant, early maturing, and high yielding. MRTC started operations in 1990, when the government banned livestock grazing in Mvumi division in order to control degradation. The Centre works in cooperation with the village extension workers of the Ministry of Agriculture and other government extension personnel in the division.

Seed production

In the 1991/92 season, MRTC started to work on ways to improve the cropping system in Mvumi division. One option was to promote the use of improved sorghum and millet varieties that are more drought-tolerant than the local landraces, mature earlier, and give higher yields. Under the guidance of MRTC and government extension staff, farmers established alley-cropping trials of two

1. Mvumi Rural Training Centre, PO Box 38, Mvumi, Dodoma, Tanzania

Makali, R.A. 1997. Mvumi Rural Training Centre's experience with small-scale seed production and distribution in Tanzania. Pages 116-118 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

improved varieties, Tegemeo (sorghum) and Serere 17 (pearl millet), at the MRTC station. The trials were conducted during the 1991/92 and 1992/93 seasons. Seed harvested from these trials was distributed to farmers for sowing in the 1992/93 and 1993/94 seasons.

In subsequent seasons, MRTC continued to distribute limited quantities of seed. This seed was obtained from different sources—produced on the MRTC farm, and from on-farm trials conducted by the Ilonga Research Station. These on-farm trials, which were conducted in 1993/94 at Mvumi and elsewhere in Tanzania, involved four improved varieties, two sorghum and two pearl millet. Three of the four varieties were subsequently released—sorghum variety SDS 2293-6 was released as Pato, and two pearl millet varieties TSPM 91001 and TSPM 91018 were released as Shibe and Okoa respectively.

Introduction and popularization of improved varieties is a key objective of MRTC. The release of these varieties encouraged us to continue and expand seed production of Pato and Okoa, both of which received very positive farmer feedback about yield, palatability, and earliness. Foundation seed is obtained from the Ilonga Research Station, multiplied on the MRTC farm, and sold at moderate prices of US$ 0.33 kg^{-1} to local farmers. The seed is provided as a loan, to be repaid after harvest. Farmers have the option of repaying either in cash or in kind (in the latter case, they repay the quantity of seed originally loaned, plus 25% extra). This repaid seed is used neither for multiplication nor for crop production, but is sold for use as food.

During the past three seasons (1993/94 to 1995/96), nearly 3 t each of Pato and Okoa have been produced (Table 1). Yields are relatively low as a result of several factors—poor germination and crop establishment due to inadequate and/or uneven rainfall (the seed crop is dry-planted), drought, birds, and occasionally due to labor shortages that delay field operations.

Quality control. Wherever possible, sorghum and pearl millet seed fields are isolated from other fields by a distance of 200 m in all directions. Where isolation is not possible farmers around the seed plots are given the same seed at reduced prices to sow in their fields. Off-type and diseased plants in the seed plots are rogued out before maturity. After harvest, the seed crop is dried in clean drying sheds. Care is taken to ensure that the threshing floor is clean and dry (first cleaned, then plastered with fresh cow dung and allowed to dry). The seed is then carefully winnowed, dressed with actellic super dust, and stored in a well ventilated store protected from rats and other pests.

Marketing. MRTC charges farmers a fixed price for seed. The seed is cheaper than certified seed (only half the price) but costlier (four times as expensive) than grain. If production is low the approach is to limit the number of purchasers or the quantity given to each farmer, rather than increasing prices.

Table 1. Sorghum and pearl millet seed production at the MRTC farm, 1993/94 to 1995/96.

Season	Variety	Area (ha)	Seed production (t)
1993/94	Pato	0.3	0.5
	Okoa	0.3	0.4
1994/95	Pato	0.6	0.9
	Okoa	0.8	0.9
1995/96	Pato	1.2	1.5
	Okoa	1.4	1.5

Prices are set depending largely on what most farmers can afford to pay. After the price is set, seed is handed over to the MRTC Village Committee in each target village in Mvumi division. The committee in turn appoints one of its members to sell the seed to farmers. In addition, farmers can also buy seed directly (at the same price) at the Centre.

Subsidized pricing. From our experience the cost of seed production increases every season. For example, the cost of labor for clearing land (not including plowing and other preparation activities) was US$ 13 ha^{-1} in 1995/96, and rose to US$ 17 ha^{-1} in 1996/97. If these and other costs are passed on to the small-scale farmer, he cannot afford to buy seed. Therefore in most cases NGOs must provide seed at subsidized prices. Gradually, as farmers are provided training and exposure to seed production methods, they will be able to sustain local seed production schemes even without donor funding.

NGOs as a sustainable, alternative source of seed

After 3 years of experience in small-scale seed production, the Centre has been able to meet the entire seed demand for improved sorghum and pearl millet varieties in Mvumi division (admittedly, demand is not very high). In all, over 600 farmers have benefited—140 in 1994/95, 219 in 1995/96, and 275 in 1996/97. Some seed has been sold outside the division and even outside the Dodoma region.

Local farmers are now showing interest in producing seed themselves, and MRTC is helping to first stimulate such interest and then provide back-up support to implement and sustain small-scale seed projects. MRTC first conducts seminars for interested farmers. In the next stage, MRTC Village Committees in different villages help organize farmers and liaise between the newly formed farmers' groups and government extension staff, who provide technical advice. Simultaneously, MRTC produces and distributes inexpensive, high-quality seed of improved varieties, providing seed on credit to farmers unable to pay cash. The Centre also looks for markets where farmers can sell surplus produce. These schemes can be replicated elsewhere by NGOs and farmers' groups, with some modifications to account for differences in location, climate, and farmers' crop/variety preferences.

The success and sustainability of these efforts—and of efforts by other NGOs—depend on several key factors.

- Funding—availability of funds (working/operational capital) for efficient farm operation and seed distribution
- Efficient institutional interaction—NGOs must cooperate closely with government and other institutions operating in the same area. These institutions can help the NGO in several ways, for example advertising the seed and providing extension advice to farmers. All extension advice on how to grow Pato and Okoa in Mvumi is provided by government extension staff
- Transport facilities—to transport harvested seed from the fields to the drying sheds, transport foundation seed and other inputs from distant places, and distribute seed to farmers
- Seed distribution network—effective and timely seed distribution is a good way to advertise the seed, extend the market, and build farmer confidence in the NGO
- Seed price—fair prices will encourage farmers to buy the seed and thus help the NGO to expand production
- Seed quality—attention to technical details during seed production will ensure quality and therefore greater demand for seed
- Creation of awareness—the NGO can organize field days and demonstrations to create interest and awareness. Unless farmers are convinced of the benefits from the new varieties, seed production will serve no purpose.

CARE International in Zambia—Experiences with Community-Based Seed Supply Systems

G A Mitti[1]

Abstract

This paper describes a seed multiplication and distribution project run by CARE International in Zambia s Southern Province. Seed and planting materials are distributed (on loan, to be repaid after the harvest) to farmers' groups, for multiplication for their own use and for exchange or sale to others in the community. In two seasons of operation, the project has distributed approximately 50 t of seed and 3 t of cassava cuttings, and now involves JO 000 households. A community organizational structure developed jointly by CARE and local communities helps ensure proper implementation and repayment of seed loans, and facilitates training and extension. CARE conducts training on group management, book-keeping, crop management, and seed handling and storage.

The project has substantially improved seed availability and food security, demonstrating that NGO-facilitated seed schemes can be successful provided they are based on a careful assessment of needs of the target community. Involving groups rather than individual farmers makes it easier to build local capacity through training and demonstrations; and group pressure helps ensure repayment of loans. In addition, farmers' groups can develop into effective community organizations.

Introduction

Zambia, like most countries in Southern Africa, has experienced recurrent droughts during the past 5-6 years. Food security in many regions has been severely affected. To avert starvation, the Zamrbian government, through a network of NGOs, implemented massive food relief operations in 1992, 1994, and 1995. Each season, an attempt was also made to distribute seed to enable farmers to recover from drought. This paper describes how CARE International, through the Livingstone Food Security Project, is helping improve seed availability in two districts in a drought-prone part of Southern Province. It also examines issues of concern regarding NGO involvement in seed supply.

1. CARE International Zambia, PO Box 36238, Lusaka, Zambia

Mitti, G.A. 1997. CARE International in Zambia—experiences with community-based seed supply systems. Pages 119-128 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

The Livingstone Food Security Project

CARE has been engaged in drought relief activities in Zambia's Southern Province since the 1991/92 drought. At first, activities were restricted to delivering relief food and supervising food-for-work schemes. However, after the 1993/94 drought, CARE expanded its activities to help address the underlying causes of food insecurity and vulnerability to drought. CARE works with community partners on a series of activities collectively referred to as the Livingstone Food Security Project (LFSP). The Project has three major components: agriculture, water and natural resource conservation, and small enterprise development. It is based in Livingstone town but operates in Livingstone district and the southern and western parts of the adjacent district of Kalomo to the north. The total rural population involved is over 120 000.

Participatory rural appraisal (PRA) studies conducted during the 1-year pilot phase of the project (beginning Nov 1994) showed a marked lack of seed of improved varieties. Most farmers could not afford such seed; many had lost even the seed of local landraces due to drought. Farmers indicated that seed supply and water were the areas where they needed assistance most.

The specific objectives of LFSP were formulated through an extensive participatory planning process with each local community. They are to:

- Build the capacity of community institutions to enable planning, management, and maintenance of a range of activities crucial to drought mitigation and household food security
- Develop sustainable farming systems, particularly in terms of crop mix and varieties, soil fertility, soil conservation, and tillage practices
- Improve water harvesting and utilization practices
- Raise incomes, develop market linkages, and widen income-earning opportunities, particularly during the "hunger period".

So far, activities have focused on the first three objectives. Under objective 2, seed activities and accompanying training have been the main focus. The seed-related activities here are described in greater detail in various LFSP documents (see reference list) and by Mitti and Kalonge (in press).

Seed production and distribution

The highest priority among most communities during PRAs was to obtain drought-tolerant, short-duration varieties of different crops, including some crops (legumes, cassava) that many smallholder households had not grown previously. However, seed was unavailable as a result of drought. It was therefore necessary to initiate a local seed bulking system. Following consultations with farmers, the Ministry of Agriculture, and seed companies to confirm the suitability and availability of crops and varieties, CARE held a series of meetings with farmers to explain the nature and attributes of available crops and varieties. In most instances only limited quantities of seed were available, and farmers were unfamiliar with some of the varieties. Some farmers were also skeptical about new varieties for some crops. Consequently, only a few farmers participated during the first season (1994/95).

During the pilot season (1994/95) only interested individual farmers were provided with seed, which was obtained from seed companies (sorghum) or research institutes (cowpea). Several conditions were agreed to before seed was distributed. Farmers would repay the same quantity of seed after harvest; recipients would not receive seed the following season; and farmers would sell or give away a part of their seed harvest to others. The program involved 330 households, each of which received 3 kg of sorghum (variety Kuyuma) and 2 kg of cowpea

(variety Lutembwe). Despite another drought that season, the loan scheme was very successful: the varieties performed well (those who planted local varieties experienced crop failure) and repayment rate was over 70%. Participating households were able to harvest an extra 6 months' supply of sorghum compared with neighbors in the same wealth category.

News about the performance of the new crops/varieties spread, leading to a rapid increase in demand the following season. In any case, after further crop failure, many by now had no seed while others had simply lost confidence in local varieties.

Formation and involvement of community-based organizations

In order to handle the increased demand (larger seed quantities and a much larger number of growers), a new and more efficient approach was required. The community needed to be involved more closely, but lacked an effective community organization through which participation could be channeled. The project sought to develop such a community organization. It facilitated the formation of seed groups (solidarity groups) in each participating village, based on the Grameen Bank Model[1]. Each group was to comprise four to seven households, who felt strongly that they could work together. The seed groups in each village were federated to form a Village Management Committee (VMC). In all, 180 VMCs were established representing 1208 seed groups and 6800 participating farmers. In the 1996/97 season, the number of groups rose to about 1500, involving some 10 000 households (Table 1).

Pre-scheme conditions

The following conditions were agreed with the participating communities beforehand:

- Seed would be supplied through mutual solidarity groups, not individuals
- Seed was for bulking, not consumption (i.e., this was not relief food)
- The seed was a loan, to be repaid after harvest based on agreed rates
- Seed bulked would be shared with those not participating that season
- A household would not receive seed of the same variety the following season.

Roles of the community groups, VMCs, and CARE

Roles and responsibilities for CARE (LFSP) and for the community were clearly defined and agreed. The community agreed that it was each village's responsibility to form seed groups. Each group would agree on which crop/variety they would prefer. Members in each group would pay back on behalf of a defaulting member, and failure to repay would hinder any future entitlements to the group. The VMCs would be responsible for distributing seed to groups and later collecting seed repaid by groups. VMCs would be accountable to CARE and to the seed groups for any seed collected. They would monitor the performance of groups and their crops, and also promote and facilitate the formation of new groups.

CARE would deliver to VMCs the type and amount of seed requested by each group, and monitor the performance of VMCs and of crops grown by each group. It would conduct training (e.g., group management, book-keeping, crop management, seed handling and storage) for VMCs, and provide information on types of seed and quantities available.

Repayment terms were also agreed to before seed was distributed. Each farmer received enough seed to sow about one-fourth of a hectare (e.g., 5 kg maize, 3 kg chickpea). The quantity to be repaid was calculated as:

1. CARE has successfully used the Grameen Bank Model over the past 4 years to provide credit to support small enterprise development among traders and small manufacturers in Lusaka.

Table 1. Number of community-based organizations and participating farmers in each target area, 1996/97 season.

Area	No. of groups	No. of VMCs	No. of local facilitators	No. of Area Committees	No. of beneficiaries
Livingstone					
Makunka	158	30	4	1	948
Sihumbwa	84	16	1	1	504
Sinde	75	16	2	2	450
Musokotwane	58	10	2	2	348
Siakasipa	72	6	2	1	432
Milangu	39	5	1	1	234
Sekute	121	22	3	2	726
Mandia	97	13	2	1	582
Mandandi	88	13	1	1	528
Siamasimbi	37	8	2	1	222
Chabalanda[1]	12	2	-	1	72
Katapazhi	106	17	4	1	636
Libala	20	7	-	1	120
Siandazya	44	8	3	1	264
Mukuni	241	24	2	2	1446
Total	1252	197	29	19	7512
Kalomo West					
Bbilili	110	14	-	1	660
Shindu	36	4	-	1	216
7A	-[2]	2	-		204
Dundumwezi	-[2]	4	-		496
Total	146	24	-	2	1576
Nyawa (Kalomo)			-	1	
Mweemba	59	10	-	-	35
Muzumbwe	24	5	-	-	144
Busanga	14	2	-	-	84
Total	97	17	-	1	263
Grand total	**1495**	**238**	**29**	**22**	**9351**

1. Newly formed VMC in Phase I Project area

2. No seed groups in this village, project implemented directly through VMC. No formal PRA conducted

enough seed for each group member to plant a similar area, plus enough seed (given to CARE) to allow one farmer from a non-participating village to plant that area.

After each meeting, the farmers formed groups, and each group elected a representative to serve on the VMC. The VMCs later elected office bearers, e.g., chairperson, secretary, and storekeeper.

Where a government extension officer was available, a partnership was worked out with the project to enhance synergy and avoid duplication. (CARE later convened a workshop to formalize the partnership between CARE and the Department of Agriculture.) Where extension staff were not available (e.g., due to lack of housing), extension services were provided by a community facilitator nominated by the local community and trained by CARE and the extension department.

CARE also held discussions with other NGOs and agencies working on seed to define geographical areas in which each would operate. Wherever possible, the extension department and development agencies are using the VMC structure to implement other development programs.

Distribution of crops/varieties

For the 1995/96 season, LFSP distributed approximately 25 t of seed—121 of sorghum, 5 t of maize, 1.4 t of cowpea, 1.5 t of pearl millet, 5.6 t of groundnut—plus 3 t of cassava cuttings (Table 2). As far as possible, each group was given the crops and varieties they asked for.

For the 1996/97 season, a further 25 t was distributed to new growers (Table 3). In addition, many more farmers were able to obtain seed of their choice from the groups or VMCs. Previous beneficiaries received seed only for crops they had not received the previous season.

To ensure a reliable local supply of fresh seed, most communities agreed to appoint a reliable seed grower for crops or varieties of their choice. These seed growers will initially be assisted by CARE and to some extent by the community. They will first sell the seed to their communities, and later sell to farmers from other communities depending on demand. In future it is hoped that more farmers will become interested in growing seed crops as a business, e.g., participating in schemes to produce "quality-declared" seed

Table 2. Crops and seed quantities distributed in 1995/96.

Crop	Variety	Quantity (kg)
Sorghum	Kuyuma	3962
	Sima	8346
Maize	Pool 16	820
	MMV 602/GV 12	1980
	MMV 400	2380
Cowpea	Lutembwe	1432
Pearl millet	Kaufela	1530
	Lubasi	91
Cassava cuttings		3171
Groundnut	Chipego	120
	Natal Common	5570

or contracting for private seed firms. To ensure that demand remains high, the Project will facilitate the flow of market information on both grain and seed, e.g., about people or organizations interested in a crop, and quantities of grain available in the project area. The VMCs will also be encouraged to form farmers' associations of one form or another to facilitate crop marketing and improve their access to credit.

Impact on seed supply and food security

Rapid spread of crops/varieties. Following a successful second season (1995/96), Kuyuma sorghum and Lutembwe cowpea have become extremely popular in the area, and their seed has spread widely. Although it is too early for a formal evaluation, there are clear indications that the scheme has facilitated farmer-to-farmer seed diffusion in the project area. Group members are paying back their loans and willingly sharing and exchanging seed with other farmers. The new seed has even been found with farmers outside the participating villages. Part of the success is because the crops and varieties have done well under low-rainfall conditions, and farmers are convinced of their drought tolerance.

Increased seed supply and access. By involving a large number of growers, seed has been made locally available to many people in a short period of time (over 10 000 households in two seasons). This has been done at a much lower cost than would have been incurred if the project had purchased and distributed fresh seed each season.

Food availability and diversity. The impact on food availability has been tremendous. A brief informal survey indicated that many

Table 3. Sources and quantities of seed distributed in the 1996/97 season.

Crop	Variety	Repaid seed (kg)	Purchased (kg)	Total (kg)	No. of beneficiaries
Maize	MMV 400	3725	-	3725	373
Maize	Pool 16	425	5000	5425	543
Sorghum	Kuyuma	4410	500	4910	1228
Pearl millet	Lubasi	-	500	500	125
Pearl millet	Kaufela	790	-	790	395
Groundnut	Natal Common	18	5000	5018	502
Groundnut	Chipego	176	-	176	88
Cowpea	Lutembwe	710	1000	1710	855
Cowpea	Bubebe	-	500	500	250
Green gram	Siasa	204	-	204	204
Pigeonpea	ICPL 90024	-	15	15	
Sunflower		540	-	540	1080
Cotton		-	1000	1000	23
Cedrella tree seedlings		-	100	100	schools, clinics, VMCs
Cassava cuttings		-	0.5 ha material[1]	0.5 ha	-[2]
Sunhemp		-	30[1]	30	
Velvet beans		-	39[1]	39	

1. Obtained from Department of Agricultural Research for bulking and testing for suitability in the region
2. Being produced by the project, to be distributed next season

participating farmers anticipate their harvest will last them 7-8 months. This is a significant improvement from a situation of nearly no food at harvest in 1993/94, to enough food for 5 months in the 1994/95 season, and now enough food for 7-8 months. Many households now have a variety of food crops; for example, many have at least two cereal staples among maize, sorghum, and pearl millet. Many households had not grown a legume crop in recent years; their consumption of cowpea (also groundnut) has increased dramatically.

Loan repayment and collection. Except for one or two villages where a politician claimed falsely during an election campaign that he had asked CARE to cancel the loan, all VMCs were able to repay their seed loans. Group pressure (and mutual solidarity) encouraged high repayment rates. At the same time the structure of the scheme institutionalized community participation and ensured that the community met their obligation to repay.

Accountability was also high because of strict record keeping by VMCs and groups. It was possible for CARE staff to trace seed movement from the VMCs to the individual grower and vice versa. This was also possible because VMCs and group leaders were accountable to the community. Leaders found to be wanting are replaced by the community without any hesitation.

Formation of new groups and VMCs. Some VMCs have—entirely on their own—helped form new VMCs in neighboring villages, even initiating training for the new VMCs and giving them a seed loan from their own stocks. The project is supplementing this effort to help the new VMCs. Thus, instead of CARE recruiting new growers, this is being done by experienced farmers, with CARE providing training, and sometimes fresh seed as well.

Farmer-to-farmer extension. Most VMCs organized field days for members to leam more about "good" and "bad" agronomic practices. Some young and better farmers were appointed by fellow farmers to be trained as community facilitators, who would then play the role of extension agents, particularly for new crops. This farmer-to-farmer extension was particularly useful because some areas are not serviced by government extension staff. These efforts helped to promote the use of improved seed and sound management practices, and to expand local supervisory capacity.

Return of pride. Many households were willing to host field days and to invite CARE staff to visit their fields to see a successful crop, demonstrating a complete change in attitude. In the past such success would be kept secret, especially to outsiders, to ensure that relief food continued to flow. The farmers are regaining confidence in their ability to produce their own food rather than depend on relief food. This pride is very important to the farmers, yet is often overlooked in impact assessments. This transformation in attitude from dependency to self reliance is very important for the sustainability of the scheme.

Lessons learnt

The lessons learnt from this experience are relevant to concerns about small-scale seed supply systems, and specifically the involvement of NGOs in seed supply systems. CARE's experience provides examples of some important roles an NGO can play to facilitate seed supply in a sustainable way.

Needs assessment. The adoption rate of many improved varieties remains low because the varieties do not meet farmers' requirements. It is therefore very important that researchers and seed producers identify what crops and varieties farmers really want. NGOs can help provide such information by conducting appraisal studies in their areas of

operation. CARE conducted extensive PRA studies at the beginning of the project, and this has led to rapid adoption of most of the crops and varieties introduced.

Community mobilization and capacity building. Working with individual farmers may not be the best way to produce and market seed quickly and effectively. Working through farmer groups has many advantages. It facilitates assessment of demand and selling of the seed (e.g., through demonstrations). It makes it easy to provide training to build local capacity. Above all, if seed is provided on credit, particularly to resource-poor farmers with little or no education, group pressure may be the only effective form of collateral. NGOs can play a significant role in mobilizing farmers into community-based organizations (CBOs) to facilitate seed production and marketing. Such community organizations also create a channel for training and capacity building, and can form the basis for future small-scale seed producers.

Market development. Farmers should be able to sell some of their surplus to raise money for school fees, medicine, etc. It is important that they be assisted to identify a market for their surplus crops. Farmers are likely to drop some of the crops currently being promoted if they cannot sell their surpluses. Conversely, marketability will encourage farmers to adopt a crop or a new variety. (For certain crops farmers only need to be linked to an existing scheme operated by a commercial company, such as Lornho's cotton scheme or BIMS schemes for various grain crops.) CARE has already started efforts to provide market information to farmers in the project area. Market possibilities can be enhanced by improving local processing and storage capacity. National and international research institutes may not have the capacity for grassroots level involvement in such activities; NGOs are more likely to be effective.

Participatory research and extension. Some of the seed used by CARE came from breeders. For instance, during the first year CARE tested three cowpea varieties; one released, two at advanced stages of on-farm testing. Farmers preferred the former—those who had the other two traded them off for consumption in exchange for seed of the released variety. The breeder was accordingly informed about these preferences. In general, CBOs provide a well-defined channel through which participatory breeding and on-farm research can be conducted. The same can be said about participatory extension, which is often overlooked when participatory approaches are discussed. CARE is working with the Ministry of Agriculture to achieve both—technology testing with researchers and community-based extension with the Extension Department.

Sustainability. It is important to put in place a mechanism to ensure that seed supply activities continue beyond the life of a project. CARE is trying to address this issue through capacity building at community level, e.g., development of a strong CBO structure. Examples are available elsewhere in Zambia, where after a project has ended, the CBO structure facilitated the formation of producer and marketing associations that have grown into small but self-sustaining seed entities. However, CBOs should be community (demand) driven for an agreed common purpose. Loose associations of farmers (often driven by credit suppliers and politicians) should be avoided.

Subsidies. Subsidies cannot be completely eliminated because target farmers are usually the resource poor, and are often located in remote areas. However, subsidies should be well targeted in terms of participants or beneficiaries, and activities. For instance it is not sustainable for NGOs to directly multiply seed, or to provide free seed every yeah Instead, NGOs should source the seed from seed producers or

breeders and provide training to growers. Some cost should be passed on to the farmers, but gradually. CARE hopes that farmers will have to pay for extra or fresh seed in areas where seed was originally given at somewhat subsidized rates. So far the VMCs have paid back substantial quantities of seed (Table 3), representing a major saving in our seed purchases for the 1996/97 season.

Quality control. Quality control has been a major concern in our scheme, especially for open-pollinated maize (the sorghum varieties used in the scheme are highly self-pollinated and thus less susceptible to contamination). The threat of contamination has not been serious so far for three reasons—many farmers had no other seed, most of the crops (e.g., legumes) are self-pollinated, and recycling is not a major factor because most of the seed has been introduced recently. However, during the past two seasons farmers were given training to help them maintain minimum quality standards. Many have very carefully selected seed materials from their crops for use in the following season. Isolation distance is not critical because most of the crops are largely self-pollinated. In any case, seed is picked from the center of the field; and for open-pollinated maize, recycling is discouraged unless the field in question was well isolated from other maize varieties.

For the present, the farmers' own standards have applied, with no external checks. For the future, steps are being put in place to reinforce quality control as seed generations advance, and even more important, as farmers begin growing special seed crops. The "specialist" community seed growers strictly maintain isolation distances. Injections of fresh seed will also help check seedborne diseases. During the 1997/98 season, CARE will organize training for seed growers, with assistance from seed specialists from the Ministry of Agriculture. However, we realize that certified seed production would be too expensive for the community and will remain an option only for farmers contracted by external buyers.

Conclusions

The community participatory seed scheme, though still in its infancy, clearly shows promise in improving seed security. It has been possible to introduce new varieties in a very short period of time. Through mass bulking, the scheme has made it possible to improve local availability of seed in terms of both quantity and diversity. The key to this success is the use of solidarity groups where members have mutual obligations towards each other. This participatory approach also ensures that the community remains committed to the success of the scheme. Besides the tangible successes, the scheme has helped transform people's attitude from dependence to self reliance, a prerequisite for sustainable development.

Acknowledgments

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The Seeds of Survival/Ethiopia Program

T Bevene[1]

Abstract

Local varieties of indigenous food grains were in danger of disappearing from many parts of Ethiopia, largely as a result of drought. The Seeds of Survival/Ethiopia Program works with farmers to conserve genetic diversity in stress-prone areas, promote the cultivation of indigenous varieties, and support farmer-based seed multiplication and improvement of such varieties. To conserve diversity, formal, laboratory-based, ex-situ conservation was combined with a more informal, in-situ, community-based approach in which small-scale farmers grew landraces on their own fields, with technical support from the Program and local extension agents. Another key aspect is farmer-participatory evaluation, selection, and enhancement of landrace materials. The project has also conducted 11 training workshops for NGO and government research and extension staff. These workshops have led to the initiation of similar efforts in Bangladesh, Indonesia, Lesotho, Mali, and Nepal.

Background

Periodic droughts have caused large-scale destruction in Ethiopia. For example the 1984 drought—the second major drought in a decade—caused widespread famine. Many farmers were forced to use seed stocks for food. Local varieties of indigenous food grains, the basis of food security in many regions, were in danger of disappearing from many parts of Ethiopia.

As seed of traditional landraces disappeared, farmers began using high-yielding varieties (HYVs) distributed through relief schemes or through breeding programs. And with the growing use of new varieties, already limited seed stocks of traditional varieties were further threatened. The HYVs were less adapted to local conditions and more genetically uniform than landraces. In general they were more susceptible than landraces to drought, pests, and diseases, putting farm families at greater risk. In addition they required expensive inputs (fertilizer, herbicides, pesticides). Farmers could not afford such inputs, and in many cases have gone into debt to pay for them.

The Seeds of Survival/Ethiopia (SoS/E) Program was launched in 1989 as a result of concern that loss of crop genetic resources would seriously affect the food and livelihood security of small-scale farmers. A consortium of Canadian NGOs, led by the Unitarian Service Committee of Canada, provided funding support through Partnership Africa Canada for Phases I and II of the program

1. Seeds of Survival/Ethiopia, PO Box 5760, Addis Ababa, Ethiopia

Beyene, T. 1997. The Seeds of Survival/Ethiopia Program. Pages 129-132 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

(1989 to 1996). Phase III, currently being implemented, is funded by the Canadian International Development Agency (CIDA).

The program was launched in partnership with the then Plant Genetic Resources Centre/ Ethiopia, now known as the Ethiopian Biodiversity Institute. There were two objectives:

- To work with farmers to conserve genetic diversity in stress-prone areas
- To promote the cultivation of indigenous varieties in order to ensure food and livelihood security for small-scale farmers.

Subsequently, activities have expanded to include support for farmer-based seed multiplication and improvement of traditional varieties.

Evolution and development

The SoS/E program has completed two successful phases and begun implementing its third phase. The primary focus of activities was different in each phase; however, the three phases integrate into an overall strategy to exploit local diversity (instead of using inappropriate HYVs) to improve crop productivity and food security. The three phases were as follows.

- Phase I, 1989-93: Rescue and conservation
- Phase II, 1993-96: Selection, evaluation, and enhancement
- Phase III, 1996-2001: Production and utilization.

Phase I: Rescue and conservation of plant genetic resources

Activities were coordinated by the Plant Genetic Resource Centre/Ethiopia, within the general framework of the national genetic resources program. Formal, laboratory-based, ex-situ conservation was combined with a more informal, in-situ, community-based approach in which small-scale farmers grew landraces on their own fields, with technical support from SoS/E scientists and local extension agents. The ex-situ component was conducted at the national genebank, where seeds were classified, characterized, and stored. These seeds were also provided to researchers for further observations, enhancement, and multiplication, and eventually for distribution to farmers.

Conservation efforts focused on wheat and sorghum. For wheat, the program targeted durum landraces in regions where they were once widely grown but had largely been replaced by new varieties. Composite (elite) populations of landraces were developed, which offered high yields—not merely for subsistence farming—while maintaining genetic diversity. Seed stocks of landraces were obtained from farmers and planted on farmers' fields at a large number of locations, to permit the expression of the full range of plant characteristics. The crop was grown using traditional management practices, and stored using traditional storage methods.

Phase II: Farmer-participatory evaluation, selection, and enhancement

Evaluation and selection of landrace materials are conducted simultaneously. These activities are carried out on farmers' plots, jointly by farmers, SoS/E scientists, and extension staff. For example, elite wheat landraces were selected at the Debre Zeit Agricultural Research Centre, and then multiplied and evaluated on small-scale farms.

Farmers and SoS staff identify the desirable characteristics in each variety, and establish criteria on the basis of which varieties are evaluated and selected. These criteria include resistance to drought, leaf rust, waterlogging, weeds, and pests; maturity duration; yield and yield stability; utility value; and storability. Selection is a continuous process, and farmers have been selecting while at the same time maintaining diversity.

Phase III: Production and utilization of indigenous varieties

The early phases of SoS/E focused on genetic diversity, but the primary goal has always been, and will continue to be, food security. Approximately 40 million Ethiopians, or nearly 80% of the population, are subsistence farmers, operating in harsh environments with unpredictable rainfall and variable soil quality. The program has made major strides in restoring the diversity of indigenous food grains in the target areas, and in increasing diversity at farm level. Nevertheless, to ensure food security and long-term maintenance of diversity, farmers must value indigenous food crops sufficiently highly that they will grow them without outside support.

Surveys of participating farmers have indicated that they have a strong preference for landraces, because they minimize the risk of crop failure, have better resistance to diseases and pests, are adapted to adverse growing conditions, and have multiple end uses. They can be grown with minimal inputs, freeing farmers from their dependence on external aid. However, distribution of indigenous varieties through local markets and farmer-to-farmer exchange is yet to be ensured. In addition, yields and value need to be further improved to encourage wide cultivation of these varieties. SoS/E continues to work with local farmers to identify, select, evaluate, and multiply elite landrace materials and composites to enhance yields and value.

As yields of (and demand for) the elite materials increase, SoS/E involvement will decrease. Market forces will take over, ensuring the continuing availability of farmer-preferred materials on a sustainable basis. The emphasis of current activities is therefore to improve yield and stability of landrace materials to the point where farmers can go beyond subsistence agriculture, selling a portion of their crop and storing some as a precaution against a poor future harvest.

Program components

The broad objective of the program is to maintain diversity while increasing productivity. Activities include multiplication and distribution of landrace varieties, promotion of landrace cultivation, enhancement of landrace materials, and improvement of traditional farming practices. The latter aspect is addressed through informal means (word of mouth, visits by SoS/E and extension staff) and formal farmer exchange programs and training courses. Farmers work closely with project staff on each component of the program.

Multiplication of elite seed by farmers. The objective of the multiplication exercise is to improve seed availability and thus encourage the use of landrace varieties. SoS/E obtains small quantities of seed of selected, elite, landrace varieties. This seed is distributed to farmers for multiplication, after which SoS/E buys back a portion of the crop for distribution to other farmers. Seed is multiplied by farmers and SoS/E field staff, in consultation with the Scientific Advisor.

Thus, farmers who wish to grow landraces can obtain seed from SoS/E, buy seed from the market, or obtain it from other farmers through purchase or exchange. SoS/E field staff provide advice on crop management practices, and on seed selection, cleaning, and storage for use the following season. The Senior Plant Breeder also works with farmers to record yields and evaluate the performance of the landrace varieties.

Enhancement. Enhancement of landrace varieties is a key project component. These efforts differ from standard breeding methods in that they focus on maintaining diversity and the integrity of landraces, and use low-input management even on seed plots. The objectives are to improve landrace performance by developing elite materials, adding desirable characteristics in response to specific

preferences or constraints, thus improving the market competitiveness of landrace-based materials.

Farmers are closely involved in this process. They identify specific problems and determine what plant or grain characteristics are lacking in the existing material. Detailed plans for enhancement work are developed jointly by farmers, project staff, and researchers from national research institutions, and implemented by all the partners working in collaboration. Enhanced materials thus developed are then multiplied on farmers' fields with SoS/E support.

Replicating SOS/E's efforts

To date, SoS/E has conducted eight international and three national training workshops. The international training workshops were attended by NGO staff and employees of the ministries of agriculture from several countries in Africa, Asia, and South America. The workshops, which typically lasted 2 weeks, included topics on biodiversity and sustainable agricultural development; the roles of farmers, women, and NGOs in conserving plant genetic resources; field visits to multiplication sites, etc. The most recent international workshop, held in Bamako, Mali, was attended by participants from francophone West Africa. The national training workshops have attracted considerable attention from NGOs based in Ethiopia, as well as government research and extension staff from different parts of the country.

As a consequence of the international workshops, genetic resource conservation programs have been initiated in Bangladesh, Indonesia, Lesotho, Mali, and Nepal. Each of these countries has also begun to disseminate information on biodiversity and the conservation of indigenous seed, through training workshops and networks in their own regions. Thus, SoS/E efforts have served as a model for similar programs elsewhere.

Three elements are crucial to the success of such programs—equal partnership with farmers in all project activities (planning, implementation, expansion), the degree to which the program can complement national efforts to improve food and livelihood security, and the effectiveness with which the project can combine farmers' indigenous knowledge with modern techniques to create a new knowledge base.

Session VI
The Role of Cooperatives and Farmers' Groups

Seed Multiplication and Distribution Through a Farmers' Cooperative in Namibia

W R Lechner[1]

Abstract

Pearl millet is a staple food crop in Namibia. A breeding program was launched in 1991, and small-scale seed production initiated the following year. All certified pearl millet seed in Namibia is now produced by a smallholder farmers' cooperative in northern Namibia, with technical support and quality monitoring by the government. Over the past three seasons, the cooperative has produced 323 tons of seed of Okashana 1. The cooperative obtains foundation seed from the government of Namibia and distributes it to members for multiplication into certified seed. The cooperative purchases this seed from members at N$ 2 kg^{-1}, cleans it, and sells it at N$ 3 kg^{-1}. Distribution to farmers is currently done by the government extension service, but the cooperative is negotiating with private firms to take over marketing. The success of this project has shown that if a farmer-preferred variety is available and technical support is provided, farmers organizations can economically and sustainably produce and market seed, even without subsidies.

Introduction

Namibia has a land area of 824 000 km^2, a population of approximately 1.5 million, and population growth rate of 3.5% per year. It is one of driest countries in sub-Saharan Africa. Rainfall is very erratic and varies from 650 mm annually in the Caprivi region in the northeast to zero in the Namib desert in the west. Namibia is the only SADC country where pearl millet (known as *mahangu)* is a staple food crop and also a part of the culture. Most pearl millet is grown in the northern part of the country, where about 60% of the population lives. The country's total pearl millet area, according to the FAO Early Warning System, is 340 000 ha. In view of the importance of pearl millet, the government launched a breeding program in 1991, the first season after independence.

The severe drought in 1991/92 highlighted the need for a strong program to ensure the availability of seed throughout the country. The government had three options—to produce seed itself, give the responsibility to farmers' organizations while maintaining government control, or leave seed production to one or more private companies. Previous experience has shown that seed production by the government cannot be sustained in the

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Lechner, W.R. 1997. Seed multiplication and distribution through a farmers' cooperative in Namibia. Pages 135-138 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

long run because of lack of staff. Private-sector production may not be viable, as Namibian seed requirements are too small to attract international seed companies, and a domestic private seed sector does not yet exist. The only option is for the government to support and encourage seed production by farmers' organizations.

This paper will attempt to answer four questions:

- Can farmers' organizations economically and effectively multiply and distribute seed?
- What are the key factors influencing the success and sustainability of these efforts?
- Must seed supply through farmers' groups be subsidized?
- How is quality control maintained?

Economics and sustainability

Immediately after the 1991/92 drought, the government launched a project under which small-scale farmers produced seed of Okashana 1, an open-pollinated pearl millet variety that had been released in 1990. Funding was provided by FAO (US$ 28 000) and the European Union (N$ 150 000, or approximately US$ 30 000). The Namibian government contributed research and extension staff and the facilities at the Mahanene research station. The FAO funds were used to purchase equipment, including a walk-in germination chamber, containers, sand sterilizer, seed blower assembly, and storage tanks. The N$ 150 000 from the European Union was kept in a revolving fund, which was used to expedite payment to seed growers/Rather than having to wait until the seed they produced was sold the following season, they were paid soon after they delivered seed to Mahenene (typically within 1 week after delivery, after quality control tests).

The project began with a 1-year pilot phase (1992/93), during which 21 t of seed were produced. In Sep 1993, a meeting was arranged between farmers and representatives of the government Department of Research and Extension. The objectives and the planned method of functioning of the project were explained, and interested farmers were asked to register. About 50 farmers registered as participants in the pilot phase. The final selection of seed growers was made after evaluating their knowledge of agronomy and visiting their fields to ensure that isolation distances and soil fertility were adequate.

An FAO document made the following comment on the pilot phase of the project—"This project demonstrated in practical and concrete terms that organized seed production by local farmers is possible in Namibia. The various actions taken by the project provide the basis for the development of the seed program in the country. Good quality seed at reasonable prices will make a clear impact on agricultural production and productivity and consequently on national food security."

The pilot phase was followed by a 3-year bridging phase (1993/94 to 1995/96), for which the European Union provided an additional N$ 400 000. This phase was also successful, and culminated in the formation of the Northern Namibia Farmer Seed Growers Cooperative. During these years, the project was managed by the government Department of Research and Extension. Seed was produced by farmers, and government staff provided technical support and supervised management and accounting. Efforts to establish and register the cooperative began in 1995. The Cooperative Bill was gazetted on 20 Dec 1996 and the cooperative officially began operations on 1 Jan 1997—the same farmers continued to produce seed, but now under a formal association.

The cooperative consists of 112 farmer-members, and has recently hired a full-time manager rather than continuing to rely on government staff for management support. The profits generated during the 3 years of operation were plowed back into the revolving fund, which has grown from the

initial N$ 150 000 to currently N$ 500 000. This has enabled the project to continue making prompt payments to seed growers, and to sustain rapid growth.

During the four seasons of operation, the cooperative has produced and sold 344 tons of Okashana 1 (Table 1). The cooperative is Namibia's sole producer of certified pearl millet seed. Seed is purchased from growers at N$ 2 kg^{-1}, cleaned, packed in 2 kg bags, and sold to other farmers for N$ 3 kg^{-1}.

The cooperative did not sell seed directly, but handed it over to the government extension services who sold it to farmers and paid the cooperative N$ 3 kg^{-1} for all seed sold. Thus, *all* marketing and distribution costs were borne by the extension service. However, this arrangement has now changed. Namibian government policy is to privatize seed production and distribution starting May 1997; the public sector will concentrate on variety development and providing technical advice. The extension service will no longer provide support (staff, vehicles, storage facilities, etc) for seed distribution. The cooperative is therefore negotiating with private firms to handle distribution. As a result, sale price to farmers is likely to rise from N$ 3 to N$ 5 kg^{-1} .

Table 1. Seed production (tons) of Okashana 1 in Namibia, 1992/93 to 1995/96.

	Pilot phase	Bridging phase		
	1992/93	93/94	94/95	95/96
Govt research service	37	38	46	17
Seed cooperative	21	35	74	214
Total	**58**	**73**	**120**	**231**

Key factors influencing the success of seed projects

There are four key factors that determine the success of small-scale seed projects:

- Availability of an attractive variety
- Confidence in the business
- Government support
- A policy of seed sales rather than free distribution.

The most important factor is the availability of a variety that farmers find attractive—which we had in Namibia in the form of Okashana 1. This variety was selected by farmers in Mar 1987, long before everybody was talking about farmer participation in breeding. It is now grown on approximately 86 000 ha, about 25% of the country's pearl millet area. Two new varieties, SDMV 93032 and SDMV 92040, are scheduled for release in 1997/98. The Department of Research and Extension is now multiplying these two varieties in order to ensure that adequate seed is available at the time of release. After release, the seed cooperative will take over multiplication.

Once farmers are convinced about the superiority of a new variety and sufficient certified seed is available, the next stage is winning the confidence of potential seed growers. These could include farmers' groups, individual subsistence farmers, and commercial farmers who may be interested in seed multiplication.

Another key factor, particularly in small grains, is government support. In many countries in the region, governments provide very limited funding and support for small-grains research. Fortunately this problem is not serious in Namibia, because 70% of the country's politicians are from the northern region and have known *mahangu* from their childhood. This helps to ensure that the crop gets adequate government attention.

Price subsidies and free distribution

Must seed supply through farmers' groups be subsidized? Perhaps others at this workshop feel differently, but my opinion is that at least in Namibia, subsidies are *not* required. The

extreme form of subsidy—free seed distribution by the government or by other organizations—can severely hinder the development of a strong seed sector. There is currently no free seed distribution in Namibia.

Quality control

Quality control is the government's responsibility. Field inspection is done by extension staff, for which some staff are provided special training. Seed testing is done by a small, separate government* unit. One important point is that additional resources are needed for training, especially for extension staff.

At present, the Namibian government obtains breeder seed from ICRISAT and multiplies it into foundation seed for distribution to the cooperative. In the long run, it is essential that the national program takes over breeder seed production. Foundation seed could be produced by the government or contracted out under government control. This should be done under irrigation during the off-season, in order to prevent contamination.

Seed marketing

Seed is now distributed mainly through the extension service, particularly to smallholder farmers, but this service will be privatized. It is clear that the private sector is keen to enter seed production and distribution as soon as the government moves out. But the private sector is unlikely to invest if it has to compete with subsidized government seed. Once the private sector takes over, seed prices will rise—maybe from N$ 3 to N$ 5 per kg—but farmers are willing to pay if the variety is right, the quality guaranteed, and the seed available on time. The problem in Namibia appears to be insufficient production rather than poor demand. Private producers are thus likely to find a profitable market even for open-pollinated pearl millet.

Conclusions

In the light of past experience and particularly the performance of ongoing seed projects, I think that farmer group involvement is not just possible but essential, particularly for open-pollinated small grains and to some extent also for legumes such as cowpea, bambara nut, and others.

The Role of Seed Growers' Associations in Seed Production and Marketing in Africa

V K Ocran[1]

Abstract

Many farmer cooperatives and associations in Africa produce and distribute seed of traditional and improved varieties within rural communities. Some have developed into powerful cooperatives capable of determining seed prices of improved varieties and also acting as pressure groups in drawing attention to their needs. However, the majority of farmers[1] groups require active government support to operate, e.g., germplasm, foundation seed, technical advice, and seed regulatory services from various public institutions. Considerable attention must be paid to educating seed growers and farmers' groups in seed production and quality control, enhancing their ability to distribute and market seed of improved varieties, and facilitating their access to farm credit. If this support is provided, farmers' groups can play a key role in seed industry development, and in enhancing food security at both local and national levels.

Introduction

The role of farmers' groups, associations, and cooperatives in seed production and marketing in Africa must be viewed against the background of a strong traditional (informal) seed system. This system supplies (through sale, barter, or gifts) farmer-saved seed of locally adapted, locally improved, and existing released varieties, and forms the backbone of the seed supply system in most developing countries. The success of farmers' groups in developing and sustaining a commercial seed sector depends on how governments draw on the experiences of the traditional system to support these associations in producing and distributing seed of improved varieties even to the most remote areas.

Seed growers' associations and cooperatives

Farmer cooperatives and associations have been formed in most countries in Africa. These groups manage small-scale projects to produce and distribute seed within rural communities. Some have developed into large-scale seed enterprises as in Zimbabwe; others are emerging as small-scale enterprises as in Ghana (Bockari-Kugbei 1994). In Zambia, the Seed Producers' Association

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produces seed on contract for the Zambia Seed Company (Zamseed). The Association negotiates with Zamseed for the area to be cultivated and the price to be paid. Farmer groups market most of the seed, acquiring it from provincial centers and distributing it at the local level. In Zimbabwe, the Seed Company of Zimbabwe Limited, which is owned by large-scale commercial farmers, is the largest seed producer and distributor in the country. Seed Co deals mainly in hybrid maize which its members produce and sell to farmers at moderate cost. In Kenya, the Grain Growers Cooperative Union is the main marketing channel for improved seed produced by the Kenya Seed Company. The Union also sells fertilizer, pesticides, tools, and machinery. It operates branches throughout the country, supported by stockists. In Lesotho the Coop Lesotho purchases seed from the Seed Multiplication Unit, imports vegetable seed, and sells them to farmers. In Swaziland, the Central Cooperative Union (CCU) purchases seed produced by the Seed Multiplication Project, and sells directly to farmers or to societies for further distribution at farm level.

The role of women in seed production and retailing

Women participate extensively in crop production in developing countries. They constitute an estimated 46% of the total labor force in Africa, and their most important role is in food production (Fong and Perett 1991). However, their involvement in seed production is rather low as has been observed in Ghana and the Gambia. The situation is different for seed retailing. In the Gambia, for example, women seed dealers are reported to be more receptive to advice and demonstrate greater responsibility in the management of their businesses, especially in terms of loan repayment (Bockari-Kugbei 1994). Similarly, in Ghana some of the successful seed dealers and commission agents are women. Women have been successful in seed retailing possibly because of their previous experience in selling foodstuffs (Ocran 1995).

Seed pricing

In most African countries, seed prices are determined by the government. Seed is almost invariably subsidized. Private seed companies have not been successful because their profits are limited by subsidized prices, low purchasing power of farmers, and high operational costs. In a few countries where the seed sector has been privatized, prices are determined by seed growers, farmers' groups, or cooperatives. In Kenya, Zimbabwe, Swaziland, and Ghana seed associations determine seed prices and operate efficient distribution networks that have helped introduce improved varieties to farmers. Competitive markets have developed in some of these countries, where market forces help to control seed prices. Seed pricing depends on various factors—production costs, marketing and managerial overheads, and farmers' ability to pay for good seed of improved varieties. Despite the constraints, opportunities do exist for profit and market growth (Ocran 1996).

Setting Ghana's seed industry in motion

Ghana has a total land area of approximately 24 million ha, of which 13.6 million ha is agricultural land. Agriculture contributes about 52% to the gross domestic product. The country's seed sector has undergone a series of transformations. These date as far back as 1958, when the Hybrid Seed Multiplication Unit was established as part of the Ministry of Agriculture. The Unit evolved through the Seed Multiplication Unit in 1961, contract growers system in 1969, the Ghana Seed Company in 1979,

and eventually to the current state of privatization.

The government closed down the Ghana Seed Company in 1989 to encourage private sector participation. The new policy in effect directed that the production and sale of certified seed should be a private sector commercial activity. Simultaneously, the government provided active support to the emerging private sector by developing and strengthening public sector institutions in various areas—research, foundation seed production, seed quality control and certification. The Ministry of Food and Agriculture launched intensive educational and promotional programs through the news media and the extension services to register potential seed growers and dealers. The private sector responded well, and now consists of small and medium-sized enterprises that produce and market seed.

Public sector institutions supporting seed industry development

New institutions were established and existing ones strengthened to perform specific functions to help development and growth of the seed sector. The **National Seed Committee** is the highest body in the seed industry. It addresses policy issues relating to both the public and private sectors. The **National Seed Service** provides leadership and technical support for seed production, seed sales, and the development of enterprises. It also coordinates the activities of all agencies involved in the seed sector, and advertises the location of seed growers/dealers in the country once a year. The **Ghana Seed Inspection Division** is responsible for registration of seed growers and seed enterprises, seed testing and certification, and training of seed producers in seed production and quality control.

Breeder seed is produced by public plant breeders. Research institutions currently provide breeder seed of maize, rice, cowpea, sorghum, soybean, and groundnut. The **Grains and Legumes Development Board** produces foundation seed from breeder seed supplied by plant breeders. **Extension Services** staff promote the use of good quality seed and assist farmers in its use.

The private seed sector in Ghana

Farmers' groups and associations constitute the private sector. They have organized themselves into three associations (total membership about 350) based on the country's ecological zones. Each association has a separate elected executive body, and members meet to discuss matters relating to seed sector development. There are many formal and informal farmers' groups, which are being encouraged to affiliate themselves with the growers' associations and become recognized seed producers. A major element of the strategy is to collaborate with NGOs that have previous experience in community development and proven ability to deal with grassroots issues. It is important that the groups are organized in such a way that they can sustain activities in the absence of external support. Sasakawa Global 2000 supports the seed growers' associations in seed production and in the development of effective distribution systems (Ocran 1996).

Factors limiting seed marketing in Africa

Seed replacement rate. With hybrids, farmers obtain fresh seed every season, so the replacement rate is always close to 100%. However, most farmers grow open-pollinated varieties, using farm-saved seed and purchasing fresh seed only every 4 years or more. In such a situation the replacement rate is about 20% (Venkatesan 1994). The replacement rate is low because farmers lack purchasing power, and are frequently unaware

of the benefits they could obtain by regularly planting fresh seed. This results in poor demand and insufficient profits for seed enterprises.

Credit facilities. Formal banking institutions offer credit in various forms to farmers' groups and seed enterprises for seed production. However, the procedures are cumbersome and often delayed. In addition, high interest rates and bank charges and requirements that loan applicants must meet, discourage applicants from taking credit.

Risks and uncertainties. These are caused by weather conditions, particularly rainfall, which is unreliable with respect to the onset, duration, distribution, and amount. As a result most farmers do not purchase seed until the onset of the rains.

Access to improved varieties. Farmers in many remote areas and on marginal lands do not have access to good seed of improved varieties. Their needs have been so neglected in the past that they are ignorant of the potential benefits of new technology.

The role of farmers' organizations in a changing seed sector

Local level seed activities. Public plant breeding should seriously address the needs of resource-poor farmers. Breeders will need to involve farmers more closely in variety development, and farmers' organizations must facilitate closer interaction between individual farmers/farmers' groups and researchers. Farmers' organizations must also more vigorously exploit opportunities for promoting local level seed production.

Farmers' groups should take advantage of support from NGOs to improve their performance. Local seed production groups will need to strengthen their links with research institutes, extension agencies, and seed regulatory authorities to obtain new germplasm, foundation seed, and technical advice. Farmers' groups can act as a vehicle for providing resource-poor farmers with improved seed of modern varieties at affordable prices. However, to do this they require government support; farmers' organizations can play a key role in attracting this support.

Production of good quality seed. Given adequate training, farmers' groups can produce good quality seed. This is evidenced by the fact that in many countries, contract seed growers produce most of the hybrid seed for private and public sector seed companies, and even sell such seed to neighboring farmers. For example, in Ghana it is envisaged that growers' associations will generate higher incomes when they start producing seed of hybrid maize varieties that will soon be released. The associations will also then be in a better position to attract investment by multinational subsidiaries or enter into joint ventures with local firms. Farmers' organizations should identify and exploit such opportunities for collaboration with public and private firms.

Extension initiatives. One of the best investments that extension programs can make is to increase their emphasis on seed sector development and promoting the use of good seed of improved varieties. In particular, they must assist in the development of local, small-scale seed producers/sellers. Extension programs could stimulate interest in the use of good seed of improved varieties through various innovative means—for example, yield contests for farmers, and the involvement of youth and school children in crop projects. Companies and seed associations should press for greater efforts by extension. However, in most cases the initiative must come from farmers' organizations, which can identify specific areas where extension efforts will yield maximum benefits, thus providing models for similar efforts in other areas.

Enterprise development. Market penetration should be increased by expanding the number of retail outlets. Seed enterprises should be encouraged to have several seed sellers

linked to them. Sellers must be trained to know their product, and should be given incentives to sell (for example, contests, bonuses, and prizes in addition to commissions). Seed sellers are an important part of any market intelligence program, and are valuable sources of information for forecasting market needs and identifying areas of potential expansion. The development of healthy seed enterprises will also provide seed growers with a guaranteed market—seed enterprises will contract seed production to growers, buy the seeds, and sell them. Again, farmers' organizations can catalyze these efforts, acting as an interface between seed sellers (existing and potential) and farmers.

Input supply network. Farmers' groups in some countries (e.g., Kenya, Nigeria, Zambia, Ghana, Zimbabwe) have developed input supply networks that deal not only in seed but also in other farm inputs and consumer goods. This system enables them to work throughout the year, and can raise incomes significantly. Government support will enable farmers' groups in more countries to adopt this system.

Credit facility. Government institutions should ensure the timely availability of credit to seed growers and dealers. Simultaneously, management and fiscal discipline (assessing loan requirements and seeking adequate collateral or guarantees) should be strengthened to minimize loan defaults. Better credit facilities should always be linked to educating farmers on the need to manage that money efficiently—poor financial management can quickly destroy farmers' groups. Farmers' organizations can lobby government authorities to provide training and credit, and also use their organizational reach to ensure better financial management and credit repayment.

Public awareness. Sales promotion activities must be intensified. Information dissemination systems must be strengthened to inform farmers on sources and prices of seed of improved varieties. Continuous advertising in the national media just before and during the planting season, particularly in local languages, will ensure that farmers are aware of where and how to buy seed. However, in some communities (and especially for low-value crops), information dissemination may be inadequate or the information may be available only to one section of the community. Farmers' organizations could consider setting up their own informal "information networks" to ensure that information is effectively disseminated, particularly to smallholder farmers in communities with poor access to normal communication networks.

Influencing agricultural development. Most farmers' groups are usually small, financially weak, and do not wield enough influence to ensure that their views receive attention. However, there are a few cases (e.g., the Grain Growers Cooperative Union in Kenya, Seed Co in Zimbabwe) in which they mature into independent, powerful cooperatives capable of drawing attention to their needs. By intensive lobbying and by acting as pressure groups, it is possible for organized farmers' groups to effect a change in policies so that agricultural development becomes more relevant to their needs (Carney 1996).

Conclusions

The role of farmers' groups and cooperatives in seed production and marketing is widely recognized. Governments must review their priorities on seed sector development and provide greater support to farmers' groups to enable them to play their potential role in agricultural development.

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Session VII
Seed Supply through Drought Relief and Resettlement Programs

World Vision's Experience with Seed Supply During Emergency and Resettlement Programs in Mozambique and Angola: Implications for the Future

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Abstract

World Vision has provided large-scale assistance for resettlement and rehabilitation programs in Mozambique and Angola. Initially, externally sourced seed and planting material was distributed. Concurrently, a variety screening program was launched to ensure that the most appropriate improved varieties were distributed. On-station and on-farm trials in both countries identified locally adapted varieties of a range of grain crops, tubers, and vegetables. Varieties are screened, demonstrated, and multiplied at field stations operated by World Vision in close collaboration with the Ministry of Agriculture, on national research institute farms, by private seed companies, and by farmers' groups. Technical staff, contact farmers, and growers' associations comprise an informal extension network with training provided through courses and field days. Farm families are involved in every stage of evaluation and selection, ensuring that selected varieties address consumer preferences (e.g., taste) and consistently increase yields under low-input farming. This approach leads to relatively high adoption rates and improved seed production and distribution.

Collaboration among different organizations is another key element—international research centers provide candidate varieties, commercial seed companies provide large-scale seed multiplication and packaging services, farmers screen varieties and provide feedback on acceptability. World Vision facilitates this process and ensures that new technology reaches small-scale farmers even in the most remote areas. Mechanisms are suggested to ensure the sustainability of this process of technology transfer and adoption.

Introduction

Extended periods of disruption (war, drought, economic and social displacement) combine to weaken or destroy coping mechanisms for achieving and maintaining food security. In response to such situations in Mozambique and Angola, World Vision and other international NGOs have provided large-scale food aid, support for crop production, and health care assistance to help resettle returning, displaced, and impoverished groups of people.

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Chapman, J., White, J., and Nankam, C. 1997. World Vision's experience with seed supply during emergency and resettlement programs in Mozambique and Angola: implications for the future. Pages 147-156 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

Mozambique, statistically one of the poorest countries in the world, is currently politically stable and on the road to economic recovery. Angola is on the brink of peace, but could relapse into war if the Government of National Unity does not take hold. As a result of extended civil war, both countries face problems of discontinuity in agricultural research and development, and loss of information on cropping systems and varieties suitable for smallholder farming. The effect of civil strife can be compounded by natural disasters (drought, cyclones, floods, pest attacks). Seed and planting materials are therefore in short supply or unavailable.

This paper summarizes World Vision's experiences in supplying seed over a period of 10 years in Mozambique, and a shorter period in Angola. These activities cover a transition from major destabilization of farming systems due to war and severe drought, to large-scale resettlement and long-term crop improvement programs.

Statement of problems

When World Vision initiated its emergency interventions, it was apparent that while the provision of food aid to starving populations was an appropriate short-term response, in the longer term it could become a non-sustainable and dependency-creating activity. Food aid and emergency health activities had to be integrated with the provision of basic agricultural inputs to hasten the restoration of food security. Supplying seed and tools is critical to the re-establishment of food supply systems. Getting farmers, and even non-farmers, back into food production is part of an integrated response to emergency situations, refugee resettlement, and post-war reconciliation in rural areas. Seed distribution is the first step to greater self reliance in food production in the short term, and plays an important role in restoring hope and contributing towards social and economic reintegration.

World Vision encountered various problems at the beginning of the agricultural recovery process:

- Stocks of seed and planting material were lost or in short supply. This required an emergency injection of planting materials from external sources
- Resettling families lacked the means to purchase agricultural inputs. Seed and tool "paks" were therefore distributed free of charge, along with food rations to tide people over until the harvest
- Lack of information on adapted varieties led to large-scale imports of mostly inappropriate varieties that were later replaced by low-yielding local varieties. Several seasons were required to identify suitable varieties and multiply seed, slowing the pace of agricultural recovery.

These problems highlighted the need to conduct field trials with farmer participation to evaluate varietal performances under farmers' conditions across a range of environments.

Stage 1—Emergency distribution of seed and hand tools

A series of field stations covering a range of agroecological conditions were therefore established in Mozambique to serve as focal points for evaluation trials, seed multiplication, demonstrations, and extension training. Research and extension technicians and leader farmers were brought in for training from areas that were relatively stable despite the ongoing civil war. The training used a practical approach with an emphasis on field demonstrations and a high degree of involvement by participants. In this way field trials also served as demonstration plots and in many instances as multiplication plots as well. Although the scope for extension support was limited by the emergency situation, it was clearly important to involve

community leaders, officials, and contact farmers in seed distribution and in local multiplication of perennial crops such as sweet potato. Thus a fledgling informal extension network was created.

In parallel to these initiatives, as part of its emergency relief efforts. World Vision began importing seed of traditional crops for free distribution to war- and drought-displaced farmers in northern and central Mozambique. The composition of seed packs varied according to local conditions, but the predominant cereals were maize and rice. Regional seed suppliers bid for contracts, with ability to supply large quantities and price as the primary selection criteria.

Widespread participatory variety testing led to a continuous improvement in our knowledge of adaptation of different varieties, and to better selection of varieties for distribution. For example, increasing quantities of a maize variety, Kalahari Early Pearl (KEP), were imported from Zimbabwe and distributed during five crop seasons, 1986/87 to 1990/91. Although KEP gave reasonable yields over a range of lowland and midland conditions it was very susceptible to postharvest attack by pests and diseases, and not sufficiently early-maturing. World Vision agronomists and breeders sought to identify varieties better adapted to local conditions; and in 1990, began to select and multiply such varieties.

Figure 1 shows the distribution of KEP seed and the switch to lour adapted varieties of maize over 11 seasons in Mozambique. Evaluation over a range of locations and seasons has shown the short-duration maize variety Matuba to be particularly well adapted to lowland conditions, with characteristics acceptable to farmers. It is also relatively tolerant of late-season moisture stress. The other three varieties have higher yield potentials

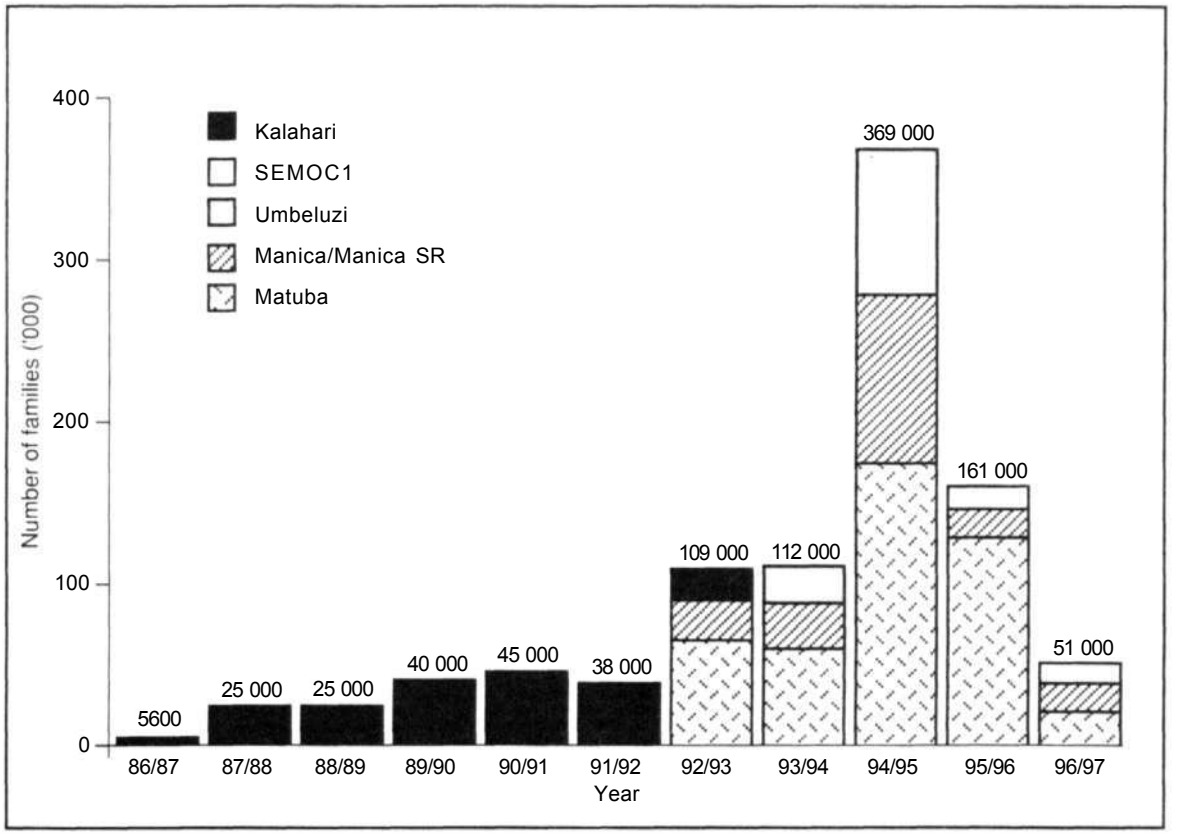

Figure 1. Distribution of maize varieties in Mozambique, 1986/87 to 1996/97.

Table 1. Seed distribution in Mozambique, 1990/91 to 1996/97.

Season	Quantity distributed (t)	Material generally adapted to local conditions (as a proportion of quantity distributed)
1990/91	1315	0%
1991/92	1004	0%
1992/93	1627	81%
1993/94	3911	100%
1994/95	8947	100%
1995/96	2970	100%
1996/97	456	100%

and are more suited to farmers' needs in the upland regions of Mozambique. Table 1 shows the progressive increase in the proportion of locally adapted varieties distributed by World Vision.

Stage 2—Participatory variety selection

To improve the quality and availability of seed, promising varieties had to be identified from germplasm stocks maintained by international centers, national seed programs, private seed companies in the region, and from farmers' existing seed stocks where available. These efforts are described in the three following sections:

- Identification and initial testing
- On-farm evaluation and community-based multiplication
- Variety characteristics

Identification and initial testing

Based on a knowledge of agroclimatic conditions and farmers' preferences in the target areas, World Vision screened the most promising germplasm lines, on-station and then on-farm. In collaboration with the Ministries of Agriculture, we have established a number of field stations on rented land in Mozambique and Angola. (In Mozambique, we have also helped rehabilitate a number of government field stations, e.g., Sussundenga and Murrua.) These stations are used for initial variety screening for a range of crops—cereals (maize, rice, sorghum, pearl millet), legumes (groundnut, pigeonpea, cowpea, *Phaseolus* bean), oilseeds (sunflower, sesame), tubers and root crops (cassava, sweet potato), vegetables (onion, tomato, green pepper, Portuguese kale), and tree crops (cashew). Varieties are evaluated for agronomic and consumer preference characteristics in replicated trials (four replicates) at approximately ten sites that represent the range of agroecological conditions in central and northern Mozambique (see Sperling et al. 1995 for some results of maize testing). Irrigation facilities are available for off-season testing and multiplication, and two cycles of evaluation are possible in one year.

On-farm evaluation and community-based multiplication

After initial testing, one or two of the most promising varieties undergo multiplication and are rapidly progressed into thousands of on-farm trials (1-2 replicates) for exposure to a wider range of conditions and regional farmers' preferences. Both technician-managed and farmer-implemented trials are conducted. They are organized in collaboration with INIA and the Department of Agriculture

at the provincial and district levels, through the "Farm Family First" extension network (see Sitch et al. 1997 for some results from maize on-farm trials). Decentralized sites for the local multi-plication of perennial crops (sweet potato and cassava) are established at strategic locations for further community-based dissemination. This process has made it possible to disseminate farmer-selected varieties (FSVs) to remote areas of rural Mozambique over a period of 2-3 years.

Similar results are anticipated in Angola through the Angola Seeds of Freedom Program (ASFP). ASFP is a partnership involving the Ministry of Agriculture, five international agricultural research centers (IARCs), and eight NGOs. During the first cropping season (1996/97), ASFP established 1030 farmer trials of maize, sorghum, pearl millet, and beans in 13 of the country's 18 provinces. Foundation seed of adapted and acceptable varieties of maize, cassava, sweet potato, and groundnut is being multiplied for distribution to contract seed producers. The IARCs produce and maintain stocks of breeder seed. World Vision produces foundation seed, which is then multiplied by individual farmers, farmers' groups, and (for large-scale production) seed companies.

Improved farming practices such as timely sowing and weeding, optimum plant spacing, and natural methods of pest control are demonstrated and discussed during farmer field days at substations located throughout the project area, helping to maximize benefits from the use of FSVs.

Variety characteristics

Improved yield alone is not a sufficient criterion to recommend a particular variety for seed multiplication and distribution. Instead, all varieties are examined for various characteristics, and farmers select the varieties that best meet their food preferences and requirements. Typical criteria include:

- Early maturity—short-duration varieties reduce the "hunger period" between harvests. They are generally more tolerant of terminal drought and can offer greater flexibility in sowing date. Short-duration maize varieties are of particular interest because they can be harvested and sold during the period when prices are usually at their highest
- Pest and disease resistance—since chemical control is not a viable option in disaster situations, crops must have reasonable levels of genetic resistance as part of a strategy for integrated pest control
- Drought tolerance—new varieties must give reasonable yields even under drought stress
- Adaptation to low fertility—soils in Mozambique and Angola are often low in natural fertility, and chemical fertilizers are generally unavailable
- Taste/cooking quality—flavor and texture are important criteria, and can be even more important than yield when families have sufficient access to food.

Stage 3—Multiplication and dissemination

Variety identification, testing, and selection result in a continuous stream of FSVs ready for wider multiplication and distribution. Extension staff receive regular training to help them identify and successfully work with farmers' groups, and develop activities appropriate to community needs. Participating farmers receive technical on-the-job training through a series of field days designed to identify problems and demonstrate improved techniques for seed saving. Multiplication is done through a combination of three mechanisms.

Contracting with private seed companies. WVI has entered into contracts with several regional and national private seed companies to multiply and package FSV seed for

distribution. In Feb each year, WVI issues a carefully specified competitive tender for the supply of seed. Bids are evaluated in Apr, seed delivered during Aug-Oct, and distributed from Oct to Dec. Firms that WVI has worked with successfully in the past are National Tested Seeds and Seed Co in Zimbabwe and SEMOC in Mozambique.

World Vision production. Another alternative is for WVI to produce the seed itself. SEMOC initially produced seed for the Mozambique Agricultural Recovery Program, but is now in the process of downsizing and refocusing its activities on the emerging commercial farming sector. As part of this process, SEMOC is willing to rent part of its production facilities to WVI. This will enable seed production for our Mozambique program and also possibly for Angola, servicing the temporary needs in both countries until alternative seed supply mechanisms are developed.

Community-based seed multiplication. World Vision also works with individual contact farmers and with farmers' groups. This decentralized approach will be particularly important for future seed production of open-pollinated maize varieties. Three community-based schemes have been initiated to multiply FSV seed through farmers' groups that WV Angola has formed in Dondo, Ndalatando, and Malange. Group members receive training in seed production techniques, seed selection, quality control, and group organization. The sustainability of these groups depends upon a continuous supply of foundation seed from the national research programs, appropriate government policies (seed certification), and the emergence of seed markets. In Angola, the National Seed Service issues a list of varieties for each agroecological zone, and NGOs operating in that zone are authorized to distribute seed of those varieties. Large-scale farmers in Gurue district, Zambezia, have multiplied Matuba maize under contract; WVI supplies basic seed and credit for inputs.

Distribution

Tools and FSV seed are packaged by World Vision or private seed suppliers for distribution to a large number of farmers in seed and tool "Ag-Paks" and "Veg-Paks". During the 1994/95 season, Ag-Paks and Veg-Paks containing over 6 million individual seed packets were distributed in Mozambique to 316 000 farming families. From 1994 to 1996 in Angola, Ag-Paks were distributed to 91 000 farmers and Veg-Paks to 33 445 farmers. Tables 2 and 3 show seed distribution in Mozambique over a period of seven seasons.

Results

Improved FSVs gave appreciably higher yields than the commonly used local varieties in Mozambique (Fig. 2). This was tested in replicated trials during the 1992/93 season

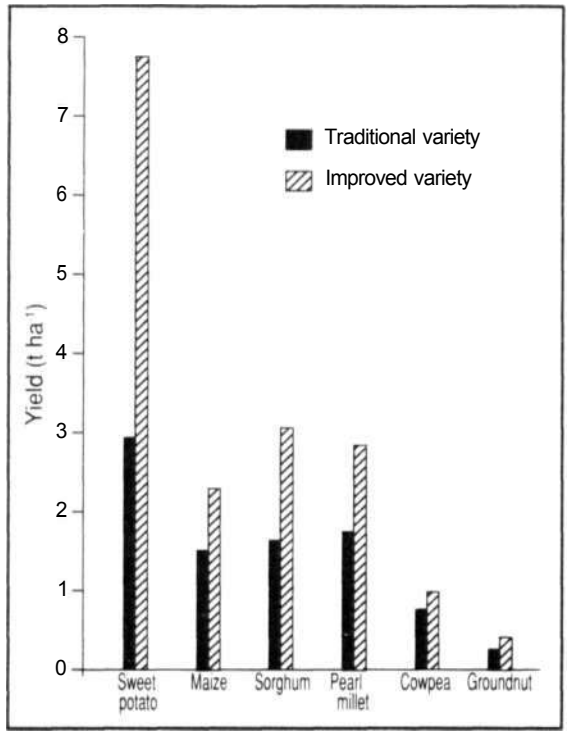

Figure 2. Yield advantage from improved varieties in replicated on-farm trials in Mozambique, 1992/93. Sweet potato TIS 2532, maize Matuba, sorghum Chokwe, pearl millet SDMV 89005, cowpea Namuesse, groundnut Natal Common.

Table 2. Large-scale seed distribution by World Vision to smallholder farmers in central and northern Mozambique over 7 seasons.

Program phase	Season	Milestones in participatory variety evaluation	No. of families[1]	Germplasm suitability	Origin of seed distributed
War displacement	1990/91	Comprehensive screening of improved and local varieties at field stations	45 000	Low	Zimbabwe
	1991/92	Extensive multilocational replicated field trials	38 000	Low	Zimbabwe
Drought response	1992/93	Widespread on-farm trials, local multiplication and contract seed production	128 000	Moderate	Zimbabwe, Malawi, Mozambique
Resettlement	1993/94	Monitoring germplasm diffusion and utilization, providing input to decisions on commercial seed production	262 000	Moderate to high	Zimbabwe/Mozambique
	1994/95	Technical weighting of criteria used to evaluate quotations to supply FSVs[2]	316 000	High	Mozambique/Zimbabwe
	1995/96	Subsidized seed sale, crop diversification	126 000	High	Mozambique
Development	1996/97	Community-based variety demonstration and seed multiplication	70 000	High	Mozambique

1. Beneficiaries of cereal and legume seed (to the nearest thousand)

2. Farmer-selected varieties

Table 3. Seed distribution in Mozambique, 1992/93 to 1996/97.

Crop	Quantities distributed (t) in different years				
	1992/93	1993/94	1994/95	1995/96	1996/97
Maize	813	1216	4680	1569	226
Rice	153	854	1720	18	127
Millet	65	860	430	364	1
Sorghum	269	316	584	355	6
Bean	0	46	230	37	25
Cowpea	130	236	520	260	31
Groundnut	160	278	580	241	29
Pigeonpea	37	55	123	53	5
Sunflower	0	50	80	69	7
Total	**1627**	**3911**	**8947**	**2970**	**456**

under farmers' conditions (no fertilizer or crop protection chemicals). Variety evaluation has enabled the Agricultural Recovery Program in Mozambique to identify a number of improved varieties with wide adaptability and high yield potential, often outyielding local varieties by 50-200%, offering better pest and disease resistance, and meeting farmers' preferences in terms of maturity duration and palatability. Among the varieties of interest are: Matuba, Manica, Keran and SEMOC 1 (maize), Chokwe sorghum, SDMV 89005 and SDMV 91018 pearl millet, Bebiano Branco groundnut, Namuesse and Brahman cowpea, TIS 2534 and 15 Dias sweet potato, and Mucudo Meuvia and Mulaleia cassava.

Recent WVI surveys indicate that between 58% and 84% of farmers save seed of FSVs and new crops distributed through the extension network (Sitch 1996).

Lessons learned—positive aspects

Emergency situations offer opportunities. Farmers short of seed are receptive to receiving, sowing, and adopting new varieties on a large scale. In contrast, they are far less likely to adopt new technology when they have adequate quantities of planting material. Therefore, emergency seed distribution, if properly implemented, is an opportunity to introduce improved varieties over a wide area, with a major impact on production. Conversely, the distribution of grain as seed causes quality control problems and lowers productivity. This cheap and quick option is actually quite expensive when the value of missed yield benefits through replanting over a number of years is taken into account.

Farmers' preferences. Adoption can be maximized by selecting varieties with characteristics that match farmers' preferences. Taste, color, grain hardness, resistance to storage pests, and ease of processing are important criteria, and can result in the rejection even of a high-yielding variety. A participatory approach to variety selection, in which farmers rather than agronomists decide on the relative importance of each characteristic, helps ensure high adoption and high replanting rates.

Combating drought through early maturity. The introduction of short-duration crops and varieties is an effective strategy for disaster mitigation. Examples include pigeonpea and short-duration pearl millet and sorghum varieties that perform relatively well despite late-season moisture stress.

Cost effectiveness. The introduction of FSVs is a highly cost-effective intervention, increasing productivity and reducing the period for which food aid is needed. It is inherently sustainable and re-establishes family productivity, food security, and livelihoods.

Partnerships. A key feature of the successes in Mozambique and Angola has been the partnership among different organizations, each playing the role to which it is best suited. IARCs and national agricultural research systems (NARS) provide candidate varieties, farmers help screen these varieties and provide feedback on suitability and acceptability, seed companies provide seed and packaging services, and NGOs help implement and facilitate the entire process.

Issues and constraints

In the initial stages of an emergency intervention, information about what varieties are suitable for local conditions is limited or non-existent; and appropriate varieties are often unavailable in adequate quantities. It is essential to identify appropriate crops and varieties for a range of agroclimatic and socio-economic conditions so that initial and subsequent distributions are as effective as possible.

Another constraint is that opportunities for distributing seed of improved varieties are limited. Emergency seed distribution is temporary. Once emergency donor funding ceases, farmers revert to saving and exchanging seed of open- and self-pollinated crops in the traditional manner. Commercial seed channels do not exist, and farmers find it difficult to obtain seed of an improved variety even when they are aware of its potential. Gradually, World Vision will try to develop links between farmers interested in buying seed of commercially available varieties and provide incentives to seed suppliers. This, however, does not solve the short-term problem of non-availability of seed.

It is not clear who should "take over' responsibility for technology development and transfer as NGO activities diminish or shift toward areas of greater need or potential impact. Due to funding and other constraints, public sector research and extension organizations have not been shown to be capable of implementing effective programs.

Implications for future seed supply strategies—emergency situations

Participatory varietal evaluation involving NGOs, NARS, and IARCs should be initiated as soon as it becomes evident that a large-scale emergency situation is likely to develop. An NGO involved in these efforts must have proven logistical and implementation capability in the target areas. In order to meet the demand for seed during post-war resettlement, several steps are necessary.

- IARCs provide improved germplasm in response to feedback on farmers' needs
- NARS/NGOs push IARC and locally available germplasm rapidly through on-station and on-farm trials with a high degree of farmer participation
- NARS/NGOs accelerate the process by identifying and exploiting environments for off-season evaluation
- NARS expedites the registration and approval of FSVs
- National or regional seed companies undertake multiplication, treatment, and packaging
- Donors provide timely and adequate funding, allowing NGOs to plan seed procurement in advance.

The experiences in Mozambique and Angola constitute a model for similar programs in other African countries where restoration of food security is a priority. Maintaining a development perspective (to the extent the situation allows) while operating in an emergency context hastens the transition, maximizes benefits to the target populations,

and reduces the time and cost of food assistance efforts.

Implications for the future—non-emergency situations

Within the non-emergency context and in the aftermath of a period of extended civil strife, there are two major conclusions.

Longer term strategy. A national or regional strategy must be developed to ensure adequate supplies of appropriate seed against the background of periodic natural disasters such as drought. Integrated Disaster Mitigation Projects (IDMPs), if adequately funded, would help ensure the ongoing dissemination of varieties that perform well under drought conditions, give higher yields, and resist storage pests. IDMPs would also help to develop and maintain strategic seed stocks that could be rapidly multiplied when needed.

Open-pollinated varieties. Open-pollinated varieties are unattractive to large-scale commercial companies due to limited sales volume, low bearable market price, and lack of breeders' rights. It is therefore necessary to develop channels through which seed of improved open-pollinated varieties can be produced and distributed. This in turn will need strong linkages between IARCs (who would provide backstopping) and NARS. In particular, NARS need to strengthen supply channels for new seed stock and ensure that foundation seed is available to small-scale, decentralized seed producers. Large-scale multiplication of FSVs could be done by private seed producers and commercial distributors. Government policies should facilitate the development of community-based and local private sector seed production, including small-scale enterprises developed with NGO assistance. An essential feature of this initiative will be impact assessment, by tracking a sample of farmers receiving seed, conducting follow-up surveys, and monitoring rates of adoption and renewal of seed stocks.

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Emergency Seed Supply in Afghanistan

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Abstract

Following the signing of the Geneva Accord in 1988, various aid agencies launched agricultural rehabilitation programs in Afghanistan. The FAO Programme for the Rehabilitation of Afghanistan Agriculture sought to expand and sustain the use of improved seed through various activities—on-farm trials, selection, production, outside procurement, networking, distribution, and popularization of certified seed. Fertilizer was also distributed to maximize the benefits offered by the improved seed, and some assistance was provided to restore traditional irrigation systems. The Programme also formulated guidelines for procurement and distribution of seed, covering various areas including bidding procedures, quality standards, prices, and terms of payment.

A number of constraints had to be overcome—identification of suitable varieties, risk of exotic diseases and pests, delays in seed delivery due to poor security and transport, unscrupulous implementing partners, lack of trained staff, and difficulties in advance procurement due to lack of long-term commitments from donors. Despite these constraints, over 90% of the inputs did reach the farmers. By 1995, the Programme had distributed more than 24 500 t of winter crop seeds and 4335 t of summer crop seeds, mainly through NGOs and private voluntary organizations.

Introduction

Afghan agriculture—the most important sector of the economy—has been ravaged by the 18-year long civil war. Irrigation systems, rural roads, and bridges have been destroyed or damaged, fields and grazing lands sown with land mines, houses and animal shelters demolished, domestic animals including draft oxen slaughtered. Nearly a million hectares of cultivated land have been abandoned. Public delivery mechanisms have broken down, severely hampering the flow of essential inputs, and resulting in stagnation and decline in production and yield.

Following the signing of the Geneva Accord in 1988 various aid agencies including FAO (the Food and Agriculture Organization of the United Nations) launched emergency programs for agriculture in Afghanistan. It was clear at the outset that significant improvements in crop production were required to feed the increasing population of the country and to reduce the necessity for food aid. Seed was one of the essential tools to achieve this goal, and was

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therefore a major priority in all agricultural rehabilitation programs. The policy had two main components—to support returnees and restore food production through a package of inputs.

To encourage displaced populations and refugees to return to formerly productive agricultural areas, two requirements were paramount:

- To help rehabilitate neglected and abandoned irrigation systems, because agriculture in these regions is particularly dependent on irrigation
- To ensure that, as far as possible, returnees and resident farmers had access to good quality seed of high-yielding, disease-resistant varieties of crops suitable for local conditions.

To get the best results from the seed supplied, it was also necessary to provide appropriate quantities of fertilizer.

The FAO Programme

One apparent consequence of the breakdown of the agricultural system has been a degeneration in the genetic potential of principal field crops due to the lack of timely replacement with new seed. The initial aim of the FAO Programme for the Rehabilitation of Afghanistan Agriculture has therefore been to get as much good seed of suitable varieties to as many farmers in the region as possible, and depending on availability of resources, to help restore traditional irrigation systems. Distribution of seed and fertilizer was restricted by many factors, particularly in the first years of the program and still to some extent, 5 years later.

The FAO Programme sought to expand and sustain the use of improved seed through various activities—on-farm trials, selection, production, outside procurement, networking, distribution, and popularization of certified seed in various parts of the country. Three agencies were involved—primarily FAO, but also UNHCR (operating through FAO), the Swedish Committee for Afghanistan (SCA), and USAID (through a contracting agency, Development Alternatives Inc, DAI). UNDP/ Office of Project Support also supported the program through its extension and training activities for NGOs. FAO played a leading role in the seed component, in addition to being involved in other key areas.

The program was operated from Pakistan and provided seed and fertilizer to farmers in 17 border provinces of the East, East-Center and South. These activities were backstopped internationally through an informal network for early-generation seed. This network, developed by the program, comprised organizations from the public and private sectors, including CGIAR institutes. Activities were concentrated in eleven provinces—Kunar, Nangarhar, Laghman, Paktia, Paktika, Ghazni, Wardak, Logar, Zabul, Kandahar, and Nimroz. Inputs were distributed mainly through 55 selected NGOs and private voluntary organizations.

Distribution of inputs

By 4995, more than 24 500 t of winter crops seeds and 4335 t of summer crop seeds had been distributed (Table 1). In addition, fertilizer (Table 2) and root stock, cuttings, and saplings of commercially important trees (Table 3) were also distributed. Besides FAO and UNHCR (their distribution programs use FAO guidelines), SCA and DAI also distributed improved seed and other essential agricultural inputs.

SCA was involved in three major areas, education, health, and agriculture. Activities in agriculture included food production, crop protection, animal development, and the Agricultural Survey of Afghanistan. The agency had been involved in seed multiplication in Afghanistan since the mid 1980s, and had conducted seed trials involving spring and winter wheat, rice,

Table 1. Seed distribution (tons) under the FAO Programme, 1989/90 to 1994/95.

Winter crops

Season	Wheat	Barley	Peas	Vegetables	Berseem
1989/90	6470	.	.	0.228	-
1990/91	4371	-	-	0.975	-
1991/92	3259	8.0	-	0.635	-
1992/93	3805	-	-	0.475	-
1993/94	3417	9.7	-	2.000	1.70
1994/95	3143	8.6	0.5	0.700	1.85
Total	**24 465**	**26.3**	**0.5**	**5.013**	**3.55**

Summer crops

Season	Rice	Maize	Greengram	Groundnut	Sugarcane	Sesame
1989/90	-	224	-	-	-	-
1990/91	25.0	280	-	-	-	-
1991/92	36.2	243	35	-	-	-
1992/93	38.0	284	47	2	800	-
1993/94	50.5	304	88	-	800	0.5
1994/95	51.5	169	55	3	800	-
Total	**201.2**	**1504**	**225**	**5**	**2400**	**0.5**

Table 2. Distribution of diammonium phosphate (DAP) and urea fertilizer, 1989/90 to 1994/95.

Season	DAP (t)	Urea (t)
1989/90	-	5500
1990/91	-	-
1991/92	1853	1500
1992/93	3229	-
1993/94	2000	2000
1994/95	2050	3550
Total	**9132**	**12 550**

maize, and food legumes in eight provinces[1]. It always maintained a working relationship with FAO and the Cereal Crop Research Institute of Pakistan, sharing technologies for application in Afghanistan.

DAI carried out a seed multiplication and distribution program in the provinces of Helmand, Kandahar, Paktia, Ghazni, Logar, Wardak, Nangarhar, Bamyan, Parwan, Baghlan, and Takhar. The seed was sold to farmers

1. This component was transferred to FAO in 1996 and is now part of the Integrated Crop and Food Production Programme in Afghanistan (AFG/94/002).

Table 3. Distribution of saplings, apple root stock, and poplar cuttings, 1989/90 to 1994/95.

Season	Saplings'	Apple root stock	Poplar *(Populus nigra)* cuttings
1989/90	-	-	-
1990/91	207 770	16510	120 000
1991/92	414 650	10000	-
1992/93	359 650	6000	10000
1993/94	309 600	11000	40 000
1994/95	52 800	-	50 000
Total	**1344 470**	**43 510**	**220 000**

1. Saplings of apple, pear, apricot, peach, plums, cherry, almond, and persimmon trees

through existing market mechanisms. However, USAID closed down its Afghanistan operations in 1994.

The United Nation's strategic objectives were to continue providing substantial assistance to Afghanistan, to provide a platform from which key programs could be jointly funded by donors. As the situation in the country improved, the focus changed from emergency assistance to rehabilitation from 1995 onward. The major components of crop production—seed, fertilizer, crop protection, extension, and irrigation—were combined in the Integrated Crop and Food Programme (AFG/94/002) launched in Apr 1995.

Legal issues

Because the administrative machinery has collapsed, Afghanistan has no regulations or legal policy governing seed quality. To ensure that farmers obtained good quality seed, the FAO program formulated guidelines for procurement and distribution of seed (guidelines not listed here due to lack of space, but are available from the author). These cover various areas:

- Guidelines for soliciting bids
- Technical specifications—minimum standards specified for quality declared seed were followed
- Terms of payment
- Prices—maximum justifiable prices were defined for export quality seed.

Constraints

Emergency seed supplies are made in response to a food crisis. In such a situation speed of response is critical, and blanket distribution of commercial/certified seed is the only practical solution. This carries various risks—introduction of exotic pests and diseases, poor performance of the selected varieties, and of course looting of seed stocks. The major constraints faced during the FAO emergency seed supply were as follows.

Identification of suitable varieties. This proved to be a very difficult task. Although varieties were selected from neighboring countries on the basis of agroecological overlap, some varieties performed poorly. To ensure some degree of performance, a number of wheat varieties were field tested in Afghanistan for large-scale introduction. These varieties were of international (mainly CIMMYT) origin, selected and developed by the Pakistan national program.

Risk of exotic diseases and pests. During the later stages of the program, the varieties distributed were mostly those released and cultivated in India, Iran, Pakistan, and Turkey.

They were already being grown in Afghanistan to some extent, either as a result of previous seed distribution programs or through introduction by farmers in border areas. Thus, the risk of introducing exotic pests and diseases was minimized. Even so, some scientists were apprehensive that wheat varieties introduced from India and Pakistan might create a bridge between Turkey and Pakistan for the spread of new races of rust. Similarly, there was a risk of introducing Karnal bunt *(Neovossia indica)* and carrot grass *(Phalaris minor)* along with the wheat seed from neighboring countries.

To avoid over-reliance on a narrow genetic base (a potentially serious problem with some wheat varieties), the Programme has from the beginning included a number of alternative varieties. Every individual project includes at least small quantities of different varieties. This also helps to maintain genetic diversity. Other disease-resistant and potentially high-yielding varieties have been field tested through NGOs, who employ competent Afghan agronomists. As a result, variety selection has been possible with the minimum of risk.

Ad hoc planning. In most cases, donors committed funds for only one or two seasons. Consequently, advance planning and procurement was not possible. In such cases, procurement and distribution was restricted by non-availability of stocks of suitable varieties.

Timely supply of seed. Seed and fertilizer were stocked in staging areas near the Afghan border well in advance of sowing time. However, seed delivery to target areas within the country was difficult and risky due to poor security and poor transport; donkeys were sometimes used to deliver to remote areas. Despite these constraints, over 90% of the inputs did reach the farmers.

Security risks. FAO had been unusually lucky in this respect. No lives were lost due to shooting or mines. However, project staff (an international staff member along with national staff) were once taken hostage for several days. Such risks were always present.

Unscrupulous implementing partners. Another problem during the early years of the program was the scarcity of reliable partners who could undertake even simple seed/fertilizer distribution, let alone anything more complicated. During the first two seasons the program was dependent on the assistance and cooperation of less than 20 organizations countrywide, mainly international NGOs who had established project bases inside Afghanistan and had the necessary resources (funds and technical competence). From 1991 onwards, however, the number of national Afghan NGOs increased—there were 90 NGOs in 1995.

Funding shortages. Seed and fertilizer were to be distributed as a package, because fertilizer was essential if the seed was to be used effectively. Funds were sufficient for seed, but not for fertilizer—the project obtained funds sufficient to supply only 25% of fertilizer requirements.

Lack of trained staff. Most of the educated, trained staff had left the country, and it was difficult to find trained persons in Afghanistan to assist in seed production and distribution. This also severely hampered efforts to train farmers to grow new varieties and to select and save good quality seed for use in the next season.

Future plans

Lack of sustainability of seed projects is a common and serious problem. This aspect was given considerable attention at the planning stage of the Programme. Seed was not distributed free, but sold at 10% above cost, thus obtaining a surplus after recovering production, distribution, and overhead costs. This surplus has grown steadily during the years, and now amounts to over US$ 1 million. The funds will be used to purchase seed processing equipment and build storage facilities for use by the emerging government seed enterprises.

Accelerated Multiplication and Distribution of Cassava and Sweet Potato Planting Material in Malawi

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Abstract

Cassava and sweet potato are important crops in Malawi, but shortages of planting material were becoming more acute as a result of recurrent drought. In late 1992, a program of accelerated multiplication and distribution of cassava and sweet potato planting materials was launched as a drought-recovery measure. The program involved farmers, government agencies, NGOs, and donor agencies, with backstopping from IITA/SARRNET. Ministry of Agriculture estimates show that between 1991/92 and 1995/96, area and production of both crops increased significantly as a result of this program. Other studies confirmed these results—between 1994 and 1995 alone, cassava area and production increased by 31%, while sweet potato area increased by 63% and production by 92%. These increases have improved food security, nutrition, and incomes in farm communities and ensured government support for the promotion of cassava and sweet potato as drought-tolerant, food-security crops. The project has also forged synergistic and durable partnerships among farmers, NGOs, church groups, village groups, and research and extension administrators, creating a base on which to build similar activities in future.

Introduction

Maize is the main staple food in Malawi. In 1993/94, the area sown to maize was slightly over 1 million ha, while cassava was grown on about 72 000 ha and sweet potato on 37 000 ha (MOALD/FEWS 1994). Although less cassava is grown and consumed than maize, current trends indicate that the gap between these two crops is narrowing rapidly. The importance of cassava and sweet potato as food security crops is becoming more and more apparent with changes in the physical and socioeconomic environments: persistent drought and increase in the prices of farm inputs caused largely by the devaluation of the Malawi kwacha. The latter has resulted in escalating prices of fertilizer, which is an essential input in maize production (IITA/SARRNET 1995b).

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Cassava in Malawi was traditionally grown in the lakeshore areas, but is now rapidly expanding into new areas. Sweet potato occupies a smaller area, but is more widespread. The Malawi government started to multiply and distribute cassava and sweet potato planting materials on a very small scale before 1992. In response to the catastrophic drought in 1991/92, the government greatly expanded these efforts with financial assistance from USAID channeled through IITA/ESARRN and later through IITA/SARRNET (International Institute for Tropical Agriculture, Southern Africa Root Crops Research Network).

Malawi has more experience than other countries in Southern Africa in the multiplication and distribution of cassava and sweet potato planting materials as a drought recovery and diversification measure. Considerable experience has been gained since the 1992/93 season in nursery establishment and management, distribution of planting materials, establishing linkages and partnerships, and training. The objective of this paper is to summarize these experiences and draw lessons that can be applied to similar projects elsewhere.

Methodology

The information used in this paper came from three main sources.

a) The program on accelerated multiplication and distribution of cassava and sweet potato planting materials was evaluated in Oct 1994 to identify general strengths and weaknesses and assess the linkages between the program and research, extension, NGOs, policy makers, and farmers, Evaluators visited fields in the northern, central, and southern regions to document area sown, varieties grown, and management practices used. Sixteen out of 21 primary and secondary multiplication sites were visited. This was followed by semi-structured interviews with a variety of collaborating partners: Ministry of Agriculture and Livestock Development (MOALD) staff, donors, UN agencies, NGOs, and churches. Different questionnaires were used for each group, reflecting their different roles in the program. In addition, 25 farmers (men and women) were selected randomly and interviewed.
b) In Apr 1995, MOALD and IITA/SARRNET organized a 2-day workshop to consider the recommendations made in the 1994 evaluation and assess the impact of the project. Program Managers from all eight Agricultural Development Divisions (ADDs) presented detailed reports on area expansion and current status of the two crops, particularly in drought-prone areas (IITA/SARRNET 1995b)
c) An adoption and impact assessment was undertaken between Sep and Nov 1995. Unstructured questionnaires were administered to NGOs, development agencies, research and extension administrators, research technicians, and extension agents. In addition, structured questionnaires were administered to 15 farmers' groups, 60 households that participated in the program, and 30 non-participating households.

Results

Several million meters of cassava stakes and sweet potato vines were distributed through the program, and have made a very positive impact.

Expansion in area and production. Cassava and sweet potato areas have grown significantly in the past three seasons (Table 1). Year-on-year percentage increases have been particularly impressive for the two most recent seasons. Preliminary estimates for 1996/97 show a continued increase. Cassava production was 20% higher than in 1995/96, while sweet potato production was 19% higher (MOALD/FEWS 1992-97). Between

1992/93 and 1994/95, cassava was multiplied at 10 primary and 5 secondary sites while sweet potato was multiplied at 8 primary and 6 secondary sites. In the 1994/95 season these sites covered 91 ha of cassava and 34 ha of sweet potato. It was estimated that if all materials produced at these sites were distributed, they would be sufficient to plant 2000 ha of cassava and 3500 ha of sweet potato, benefiting about 10 000 and 350 000 families respectively. These figures are based on multiplication ratios of 1:20 for cassava and 1:100 for sweet potato, and an average of 0.2 ha of cassava and 0.01 ha of sweet potato per family. By 1994/95, 2200 ha of cassava and 4500 ha of sweet potato were planted.

Capacity building. Training at all levels was an important component of the program. The program strengthened research, extension, NGO, and farmer capacity in multiplying and distributing improved planting materials. Some 281 research, extension, and NGO staff have been trained to date. In addition, 15 farmers' groups (over 350 farmers) received training on nursery establishment and management. The program provided these farmers with facilities to produce healthy planting materials. Posters and pamphlets were used to publicize awareness about these crops. As result, both crops are now expanding into non-traditional areas as cash crops.

Higher incomes, better nutrition. Program beneficiaries reported income increases of 25% from the sale of cassava roots, sweet potato tubers, cassava leaves, and planting materials. They used this extra income to buy fertilizer for maize, medicines, pay school fees, and purchase other items to improve the quality of life. Family nutrition improved as a result of increased intake of cassava and sweet potato (both are high-energy foods, and the leaves in particular are a good source of vitamin A, iron, and calcium). Fourteen out of 15 villages interviewed reported widespread consumption of cassava and sweet potato leaves. Reduced length of the hunger period (severe food shortage which occurs when households run out of food stocks and do not have sufficient cash to buy food on the market) was widely noted in villages where improved planting materials had been distributed. Growers estimated that the hunger period decreased from 5 months to 3 months, and was even eliminated in some areas as a result of the program.

Program implementation, roles, and responsibilities

Multiplication of cassava and sweet potato planting materials is organized at three levels. Primary multiplication nurseries are located

Table 1. Area and production of cassava and sweet potato in Malawi, 1990/91 to 1995/96.

	Cassava		Sweet potato	
Season	Area (ha)	Production (t)	Area (ha)	Production (t)
1990/91	71 619	167 818	na	na
1991/92	63 965	128 827	19 886	43 074
1992/93	75 050	216 005	na	na
1993/94	72 149	250 066	37 151	165 322
1994/95	94 731	328 424	60 701	317714
1995/96	116 523	534 549	68 804	596 469

na = information not available
Source: MOALD/FEWS 1994-96

on agricultural research stations, established and managed by research station staff. Financial support is provided by USAID through IITA/SARRNET. Secondary multiplication nurseries are established mainly in areas under the jurisdiction of the Agricultural Development Divisions (ADDs). Extension staff are responsible for monitoring and supervision; research staff provide advice and technical support, particularly on disease and pest monitoring.

Secondary sites can also be established in a farmer's field. In such cases the farmer enters into a "contract" specifying his/her responsibilities and receives financial and technical support. NGOs and church groups are involved in the establish-ment and management of secondary sites under similar "contract" conditions.

Tertiary multiplication nurseries are established and managed mainly by farmers' clubs—particularly women's groups—and individual farmers. Although no direct financial support is provided, such groups receive material support (e.g., watering cans, hoes, and other tools) from the Department of Agricultural Research and Extension or NGOs. Farmers' clubs, particularly women's groups, have proved to be a reliable and rapid method of disseminating planting materials (Saka and Minde 1994). NGOs have played a crucial role at the secondary and tertiary levels in multiplication/distribution and training of farmers on crop management practices.

The strength of this system lies in the synergistic benefits that come when a wide range of partners is involved. Eight research stations, 8 ADDs, 12 NGOs, several church groups, IITA/SARRNET, donor groups, and an estimated 200 000 farmers were involved. Each collaborator performs a specific role within the overall group effort. Each collaborator is fully integrated into the effort and has tried to recognize and respect the comparative advantage of other partners. For example, NGOs and churches generally have better grassroots contacts with farmers than other organizations. The partners and their roles are briefly described below.

The program is implemented by SADC/IITA/SARRNET and managed by USAID Malawi. The national research and extension services has primary responsibility for undertaking the agreed tasks in collaboration with the other partners. It coordinates program activities, provides land and irrigation water for nurseries, manages primary sites, trains field staff and farmers, and monitors and supervises all multiplication sites. Development agencies (e.g., FAO and UNICEF) play a role in mobilization, provide financial support at tertiary level, and assist in the distribution of planting materials to farmers. NGOs and churches provide land, financial support, labor for multiplication at secondary sites, monitor and backstop secondary and tertiary sites, and distribute planting materials to secondary sites and farmers. They also mobilize farmers at grassroots level. Bunda College of Agriculture (University of Malawi) and Natural Resource College provide land, irrigation water, and technical staff to supervise the multiplication sites on their campuses. Farmers' groups manage tertiary sites, multiply materials on their land, and distribute materials to other farmers. USAID provides financial support.

Constraints

Although the program has been extremely successful, two areas in particular need further attention.

Livestock damage. Livestock damage to cassava and sweet potato crops is a threat to the success of the program. For example, in some of the sites surveyed in 1994/95, over half the cassava fields were damaged. Village authorities and individual farmers are trying to apply sanctions to reduce the problem, but livestock owners, although few in number, are wealthy and have strong ties with the local chiefs. A multifaceted approach including

community education, community sanctions, fines, and fencing of gardens needs to be introduced. Fencing is a practical solution because cassava fields are generally small enough (average 0.4 ha) to be fenced. Many farmers are constructing elaborate fences around their fields to keep out livestock.

Training. Training of frontline extension staff, agricultural research technicians, NGO field workers, and farmers needs to be expanded. For example, many of the field assistants interviewed during the surveys said they had insufficient knowledge of pests and diseases, and would like to receive training. An earlier country-wide study (IITA/SARRNET 1995a,b) showed that farmers lacked knowledge about East African common mosaic disease (an important cassava disease), and rarely selected mosaic-free plants for cuttings. Record keeping also needs improvement. Better records will allow the program to follow up on trainees' activities in later years.

Lessons learned from the Malawi experience

The lessons learned from the Malawi multiplication and distribution program can easily be applied to similar programs in the region. Some of the key issues are outlined below.

Collaboration and policy support. The Malawi program has benefited from a participatory approach involving a wide range of partners, and organizational flexibility to help overcome traditional institutional barriers. Most important, it benefited from government policy support for the promotion of cassava and sweet potato.

Location of multiplication sites. The optimum spatial distribution of multiplication sites depends on the size of the country, roads and transport facilities, and the availability of scientists and technicians for monitoring. In Malawi, multiplication sites were established throughout the country. This helped to reduce distribution costs, ensure rapid distribution (large quantities of planting materials must be distributed within a short period of time), and made it easier for farmers to visit demonstration sites. The disadvantage of decentralized production is that too few scientists and technicians may be available to adequately supervise production at a large number of scattered sites. Sites must be inspected almost fortnightly for rogueing; some technicians are inadequately trained and need help from experienced scientists on pest and disease identification.

Preservation of planting materials. For such programs to succeed, farmers must have the ability to preserve or otherwise obtain planting materials each season. In Malawi, cassava is normally harvested at the beginning of the rains, and the next crop planted immediately; planting material is therefore easily available. The problem arises when cassava is harvested in the dry season and planting material must be preserved for several months, until planting time. There is a similar problem with sweet potato, which is usually harvested in May-June and planted only in Dec-Jan. In such cases, small quantities of the crop must be grown with "irrigation" (e.g., using waste water from the kitchen) in order to have planting material for the main season. However, this practice is rarely followed, and instead farmers request planting materials each season. This is clearly not sustainable. The only sustainable method is for the farmers to have their own nurseries to provide "seed" stock for the following season. However, there should be a periodic replenishment of stock to prevent build-up of pests and diseases.

Commercialization of the program. For a program to be sustainable, materials from all multiplication sites, whether primary, secondary, or tertiary, will need to be sold albeit at a nominal cost. Past experience has shown that giving away planting materials

creates an attitude that the materials will be available free next year at the same site. Programs therefore need to develop the capacity to manage sales.

Training. This is a vital component, and in most cases should receive a large share of the program budget. Farmers as well as research and field technicians need to be trained. Research and extension administrators also need to be sensitized to appreciate the importance of pest and disease management for root crops.

Expected adoption rate. Multiplication of cassava and sweet potato planting materials is fairly simple once farmers have been trained; the major input required is family labor. Adoption rates will depend on the physical and socioeconomic environment. In areas with low and unreliable rainfall, cassava and sweet potato will be preferred to food crops with high moisture and input requirements (e.g., maize).

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Session VIII
Farmer-to-Farmer Seed Supply

Farmer-to-Farmer Seed Movements in Zimbabwe: Issues Arising

D D Rohrbach[1]

Abstract

This paper reviews the structure and performance of village seed markets in southern Zimbabwe.

There is limited private sector interest in multiplying and selling seed of open-pollinated varieties of such crops as sorghum and pearl millet. The village market represents an important alternative seed supply channel. Seed distribution under drought relief programs offers new seed stocks; local markets can maintain and further distribute this stock.

In the case of sorghum and pearl millet, small-scale farmers will generally select seed from their previous harvest. Seed shortages are resolved through seed trade between farm households. Most of these transactions are free of charge. This limits the feasibility of investment in localized seed multiplication and sale. Suggestions that seed distribution under drought relief programs have wiped out local varieties are incorrect. Despite multiple years of drought and over 4 years of free seed distribution, most households continue to plant an array of traditional varieties. Several recommendations are offered for improving the village seed market.

Introduction

In recent years, seed for open-pollinated sorghum and pearl millet varieties in Southern Africa has been produced and distributed almost entirely through government and donor-sponsored drought relief programs. Private seed companies have expressed limited interest in these crops, except to supply the drought relief efforts. The lack of commercial interest in sorghum and pearl millet seed trade has prompted interest in exploring alternative seed supply channels. One alternative is the village seed market. Farmers already produce much of their own seed stocks and exchange seed among themselves. Village seed markets could also be employed to distribute new varieties.

Several NGOs in Southern Africa have developed projects to encourage seed production on-farm and to stimulate farmer-to-farmer seed exchange (see papers from CARE Zambia and ActionAid Malawi earlier

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in this volume). The probability of success of such projects can be improved if they build on existing patterns of seed exchange in the village market rather than creating new institutions. This paper reviews the structure and performance of such village seed markets in southern Zimbabwe. The analysis indicates that most sorghum and pearl millet seed is traded as gifts. When cash sales take place, seed prices are often equal to those for grain. As a result, the returns to investments by seed traders in improving the quality and range of their product are limited. However, technical support can facilitate improvements in seed management across the wider rural community. Such initiatives can facilitate the spread of new varieties and the maintenance of a wider range of local germplasm.

Data sources

Data were drawn from a survey of 220 households distributed across 11 smallholder farming areas in southern Zimbabwe. These areas were chosen at random from a listing of more than 30 communal areas in which at least 20% of land was sown to sorghum and pearl millet. Two villages were sampled within each communal area (22 villages in total) and 10 farmers were interviewed in each village. This survey was carried out in June 1996, approximately 1-2 months after the 1995/96 harvest. The previous cropping season offered a favorable harvest in areas prone to frequent drought.

One major source of bias affected the survey results. The Government of Zimbabwe distributed free maize, sorghum, and pearl millet seed to small-scale farmers at the beginning of each of the previous four cropping seasons under its drought relief programs. Most of the maize distributed was hybrid seed. Much of the sorghum and pearl millet was of mixed varieties purchased as grain, processed, and distributed as seed. In the year previous to the survey, a large shipment of grain, converted to seed, was obtained from neighboring Botswana. Only smaller quantities of certified seed of several recently released sorghum and pearl millet varieties were distributed, particularly in 1992. Roughly one-half of the households in the sample had previously received sorghum or pearl millet seed through the drought relief programs.

Local seed supply and household seed stocks

Despite substantial government investments in the distribution of sorghum and pearl millet seed under drought relief programs, small-scale farmers draw the largest share of their planting seed from their own stocks. Even following the extremely severe 1991/92 drought—commonly described as the worst in the past 100 years—the majority of farmers in southern Zimbabwe still had sorghum or pearl millet seed for planting the following season (Friis-Hansen and Rohrbach 1995). Recent SADC/ICRISAT surveys in Zimbabwe and Botswana suggest that it is rare for a village to run out of seed. Under severe drought conditions, a small proportion of farmers may lose their seed stocks. However, this loss can generally be offset by larger seed stocks held by better-than-average farmers.

The main sources of sorghum and pearl millet seed for farmers in southern Zimbabwe are outlined in Table 1. In 1995, the Government of Zimbabwe distributed 1775 t of sorghum seed and 100 t of pearl millet seed. These quantities were sufficient to plant almost 100% of the smallholder sorghum area and about 10% of the pearl millet area. Despite this, only 56% of the households growing sorghum planted the drought relief seed. Since the pearl millet seed was distributed largely in the southern parts of the country, almost one-quarter of smallholder households planted the drought relief

Table 1. Proportion of households obtaining seed from alternative market sources, southern Zimbabwe, 1995/% [and expected seed source in 1996/97].

Source of seed	% of farmers obtaining sorghum seed from each source		% of fanners obtaining pearl millet seed from each source	
Local store	2.8	[3.4]	0	[2.3]
Distant town	4.0	[2.3]	1.5	[1.5]
NGO	4.0	[0]	3.8	[0]
Neighbor	6.8	[1.7]	10.0	[1.5]
Friend/relative	25.7	[2.3]	20.0	[1.5]
Drought relief	56.3	[11.4]	23.8	[2.3]
Own stock	43.8	[91.4]	65.4	[97.5]

Source: SADC/ICRISAT Seed and Fertility Management Survey, 1996

allotment. The survey indicated that just under one-half of all farmers drew sorghum seed from their own stocks. This proportion would undoubtedly have been higher without the free seed shipments. Two-thirds of pearl millet producers drew seed from their own stocks.

Concerns about a growing dependence on drought relief shipments are not justified in these data. Only a small minority of sorghum and pearl millet growers expected to receive seed from drought relief programs in the coming 1996/97 cropping season[1]. More than 90% planned to draw seed from their own stocks.

The main alternative source of seed in local communities is neighboring friends and relatives. If drought relief seed is not available, farmers can readily turn to neighbors for small quantities of seed. Following the 1994/95 drought, roughly 30% of the farm sample obtained seed stocks through this channel. This includes relatives who may be living in other parts of the country. However, dependence on this source of supply drops sharply when rains are favorable and households expect to cover their own needs, e.g., after the 1996 harvest.

Sorghum and pearl millet seed are only rarely available through local retail shops, and seed purchase in more distant towns is expensive. These channels are under-developed because most commercial companies do not perceive a profitable market for open-pollinated varieties of sorghum and pearl millet. Rural retailers are reluctant to stock this seed because they similarly perceive a lack of demand. Past deliveries of free seed through national drought relief programs have likely further discouraged the development of this market.

Yet hybrid maize seed is widely available in village shops. Small-scale farmers recognize the need to purchase hybrid seed each year and most will readily do this. These same farmers also realize they can replant open-pollinated varieties of sorghum and pearl millet obtained from their previous harvest. Seed purchases are perceived to be unnecessary.

Transactions on the village seed market

Village market transactions are dominated by free gifts. Almost 80% of the sorghum and pearl millet transactions were free of charge

1. Nonetheless, over 1500 t of sorghum and 100 t of pearl millet seed were again distributed free.

Table 2. Distribution of seed trade transactions, 1995/96 planting season.

	% of seed market transactions in the form of		
	Cash sales	Barter	Gifts
White sorghum	2.8	11.1	34.7
Red sorghum	0	0	9.7
Pearl millet	0	6.9	34.7
All crops	2.8	18.0	79.1

Source: SADC/ICRISAT Seed and Fertility Management Survey, 1996

Table 3. Diversity of sorghum and pearl millet varieties grown in southern Zimbabwe, 1995/96.

	Average no. of varieties grown per smallholder farming area	No. of varieties grown per farmer
Sorghum	6.4 varieties	71 % of farmers grow one variety 17% grow 2 varieties, 12% grow 3 varieties
Pearl millet	3.8 varieties	73% of farmers grow one variety 25% grow 2 varieties, 2% grow 3 varieties

Source: SADC/ICRISAT Seed and Fertility Management Survey, 1996

(Table 2). It was difficult to determine the extent of reciprocal obligations inherent in these transactions. However, farmers have consistently indicated that such obligations do not exist. Rather, seed should be provided to neighbors in need as a community responsibility. This responsibility is reinforced by family ties, as most of these transactions are between relatives.

The proclivity to provide sorghum and pearl millet seed freely is probably encouraged by the small quantities involved. Seed-to-grain multiplication ratios are high and seeding rates are low. Most transactions involve less than 2 kg. In contrast, village seed transactions for a more valuable crop with lower multiplication ratios, like groundnut, are generally in the form of cash or barter transactions.

The one-fifth of transactions in the form of barter commonly involve the trade of one seed variety for another (although some barter transactions involved the trade of grain for seed). Such transactions are encouraged by the diversity of varieties within a local community (Table 3). The survey identified approximately 30 different varieties of sorghum and 20 different varieties of pearl millet being grown[2]. Within any given community (communal area), farmers distinguished an average of six varieties of sorghum and four varieties of pearl millet. Approximately 30% of the farmers in any given community grow more than one variety.

The relatively small proportion of farmers growing more than one variety was surprising given the common view that farmers desire

2. This reflects farmers' perceptions of varietal differences. A botanist would undoubtedly identify a substantially larger number of genetically unique cultivars.

more genetic diversity. Several NGOs in Zimbabwe are promoting inter-regional seed movements and the broader exchange of landrace varieties on the assumption that individual farmers seek to grow many varieties for both multiple end uses and as a means to offset production risks. These perceptions are reinforced by anecdotal evidence of "lost" varieties or of farmers searching for varieties that had been grown in previous years.

While it seems likely that individual farmers lose seed from time to time, ICRISAT's reconnaissance surveys and related impact studies following the severe 1991/92 drought suggest it is rare for a community to run out of seed. Farmers do not commonly complain that they have lost needed varieties of sorghum or pearl millet. Further research is merited on the value local communities place on varietal diversity. However, initial enquiries indicate that the interests of a few farmers in "lost" varieties cannot be generalized. The survey evidence suggests that a few farmers will grow a range of germplasm, but most farmers are satisfied with growing one variety.

Farmers who grow multiple varieties are more likely to act as community seed sources. Roughly 20% of households within any given farm community provide seed into the local market (Table 4). Most of these farmers are involved in only one or two transactions, most commonly to relatives and close neighbors. However, a few seem to act as seed stockists for their communities. These farmers are willing to grow and provide several different varieties and are viewed by local communities as sources of seed if other more localized sources fail.

Such farmers may offer the basis for developing seed trading systems in local communities. Yet the fact that most transactions are made free of charge suggests there are no returns to individual investments in maintaining community seed stocks. If seed is sold, a premium can be charged for the added costs of maintaining multiple varieties and storing seed stocks. But without cash transactions, seed production and stockholding decisions remain a subsistence calculation.

This view of the market is reinforced by limited evidence of the willingness of smallholders to purchase sorghum or pearl millet seed on the commercial market (Table 5). Survey respondents were asked the hypothetical question whether they would be willing to purchase sorghum and pearl millet seed from local retail outlets in the same way they almost universally purchase hybrid maize seed. The interpretation of this question is almost inevitably biased by the fact that sorghum and pearl millet seed have not been available through local retail shops in the past. Further, many farmers had received free sorghum or pearl millet seed through drought relief programs during the previous 4 years. The combination of possible biases notwithstanding, at least 90% of the respondents claimed they would *never* purchase sorghum or pearl millet seed from a local shop.

Table 4. Proportion of households trading seed as gifts, barter, and sale, southern Zimbabwe, 1995/96.

Source of seed	% of households growing sorghum	% of households growing pearl millet
Providing seed as gifts	14.2	19.2
Offering seed on barter	4.5	3.1
Selling seed	1.1	0

Source: SADC/ICRISAT Seed and Fertility Management Survey, 1996

Table 5. How often will farmers growing SV 2 sorghum or PMV 2 pearl millet be willing to purchase this seed at a local retail shop?

Frequency of expected purchase	% of farmers growing SV 2	% of fanners growing PMV 2
Never	89.5	97.2
Only after drought	5.0	0.9
Every other year	1.4	0.5
Every year	3.2	0.5
Other	0.9	0.9

Source: SADC/ICRISAT Seed and Fertility Management Survey, 1996

The lack of interest in commercial seed sales cannot be attributed to a lack of demand for varieties being produced by the seed companies. In several years of previous surveys, small-scale farmers have consistently voiced interest in the new varieties of sorghum and pearl millet being produced by these companies. Lack of access to seed is cited as the principal constraint limiting wider adoption of the sorghum variety SV 2 and the pearl millet variety PMV 2.

At least one seed company argues (S B McCarter, personal communication 1997) that such responses would change if seed was in fact available in local shops. This company suggests that farmers would be willing to pay for higher quality, pure seed of the newly released varieties. But local retailers refuse to stock this seed because of their perception of a lack of demand. As long as retailers refuse to stock the seed, the level of demand for high-quality commercial seed will remain untested.

Improving rural seed trade

The combination of widespread dependence on own seed stocks, availability of free seed when stocks run short, and the apparent lack of retail trade demand suggest limited scope for investment to develop rural seed markets for sorghum and pearl millet. At best, there may be a small premium market for traders offering particular varieties to meet local demand. This may include new varieties that are not yet widely available in rural communities. It may also include specialized varieties with particular end uses which have been "lost" after several drought years. The survey results suggest, however, that even these markets merit only limited investments.

The most valuable contribution to the development of rural seed trade may come from helping a wide cross-section of small-scale farmers become better at seed selection and storage for their own use. By improving the seed stocks of individual households, the stocks of each village community can be improved. Rather than promoting seed trade per se, such a strategy would improve the opportunity to trade when demand arises. Importantly, household investments would be primarily geared toward improving each farmer's cwn productivity. Such investments would not depend on the consistency of seed demand or the magnitude of the seed price premium.

One opportunity for improving household (and village) seed stocks is to improve the timing and criteria of seed selection. Farmers responding to the survey generally select their seed after harvest and before the grain is threshed (Table 6). Most households make selections on the basis of head size, seed size,

and color. While there is a degree of correlation between these characteristics and the plant type and variety, this relationship could be better tracked with seed selection in the field just before harvest. This would allow a farmer to select seed on the basis of the growth characteristics of the plant and not simply the characteristics inferred from the appearance of the grain panicle.

High payoffs may also be gained from development assistance to improve seed storage practices. The survey responses indicate 40% of respondents apply no seed treatment (Table 7). This strategy may be reasonable for landrace varieties with hard grain. However, one common complaint about the newer varieties is that they do not store as well. Varieties such as SV 2 and PMV 2 have softer grains than most landraces and greater care may be required for maintaining seed—particularly for periods longer than the few months between the harvest and the immediate planting season.

A range of seed treatments are used including ash, smoke, and manure. Ten percent of the respondents use chemical insecticide. The relative efficacy of these options merits further investigation.

Similarly, there is scope for evaluating the relative performance of alternative seed storage sites. One-third to one-half of all households simply store their seed in the granary (Table 8). This includes many of those households that do not treat their seed. Such a strategy may increase the likelihood of insect infestation. Storage in the kitchen is linked with the use of smoke to keep insects out of the hanging panicles. Storage in the

Table 6. Proportion of respondents selecting sorghum and pearl millet seed at different times of the harvest, 1996.

	% of farmers selecting white sorghum	% of farmers selecting pearl millet
In the field	24.8	22.8
After harvest and before threshing	74.4	77.2
After threshing	0.8	0

Source: SADC/ICRISAT Seed and Fertility Management Survey, 1996

Table 7. Proportion of households applying various treatments to sorghum and pearl millet seed, 1996.

	% of farmers growing white sorghum	% of farmers growing pearl millet
Untreated	38.0	44.7
Ash	31.0	24.4
Insecticide	10.5	13.8
Smoked in the kitchen	12.2	12.2
Goat manure	5.3	2.4
Other	3.0	2.4

Source: SADC/ICRISAT Seed and Fertility Management Survey, 1996

Table 8. Proportion of households storing sorghum and pearl millet seed in alternative locations, 1996.

	% of farmers growing white sorghum	% of farmers growing pearl millet
Separate bag in the granary	33.9	52.8
In the kitchen	39.2	25.2
In the house/bedroom	19.3	13.8
Other[1]	7.6	8.2

1. Includes storage in a tin, in a jar, etc
Source: SADC/ICRISAT Seed and Fertility Management Survey, 1996

home or bedroom is commonly in a small bag left in a corner. Again, further research can evaluate the magnitude of losses associated with each practice. Farmers may also benefit from advice on options for maintaining seed stocks over a longer period.

Targeting assistance to the rural seed market

In sum, commercial sorghum and pearl millet seed trade in the smallholder farming areas of southern Zimbabwe is virtually nonexistent. While at least one company believes this market is still worth testing, most agree that the retail market is not particularly profitable (see Kelly and Rusike, this volume). Informal village seed markets offer an alternative channel for seed supply for most farmers, and have provided consistency of supply well before the recent history of drought relief programs.

Significant levels of private investment in seed production and trade for sorghum and pearl millet are unlikely unless this trade becomes more fully monetized. Free seed will not justify investments in improving seed quality or maintaining seed stocks. Such investments can only be justified as a strategy pursued by individual households to do a better job of maintaining their own seed supplies. Research and extension efforts can target improvements in seed selection practices, seed treatment, and seed storage. Currently, no such assistance is even attempted.

The development of rural seed trade may best be fashioned around the dissemination of new varieties. Farmers are always looking for better-performing varieties. Insofar as new sorghum and pearl millet varieties, or higher quality seed of existing varieties, offer significant productivity gains compared with the seed available in local communities, at least a small market niche should exist. This is evident in the consistency of the rural market for hybrid maize seed.

Finally, the regularity of droughts in southern Zimbabwe argues for the improvement of community capacities to maintain longer-term seed stocks of a wide range of varieties. One strategy is to encourage those few farmers currently choosing to produce multiple varieties to invest in keeping larger seed stocks in multi-year storage. However, the justification for maintaining community seed stocks may depend on the development of a market for such seed. Investment in local information systems connecting seed buyers (including NGOs and government organizations) and seed sellers may facilitate such investment.

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Farmer-to-Farmer Diffusion of Cowpea Seed in Northern Nigeria

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Abstract

The International Institute of Tropical Agriculture (IITA) has developed a number of improved cowpea varieties in collaboration with national programs. Of these, eight varieties have been released for general cultivation in Nigeria. However, due to various constraints, these varieties are not being multiplied and distributed in sufficient quantities. IITA's Kano Station is therefore working closely with farmers to study their traditional seed systems and develop strategies to improve seed production and distribution of improved varieties. This paper describes the traditional cowpea seed distribution system in northern Nigeria; analyzes three IITA interventions (involving intercropped, sole, and irrigated cowpea) that have catalyzed the rapid spread of improved varieties; and proposes strategies and an action plan to promote and strengthen farmer-to-farmer diffusion of cowpea seed.

Introduction

Few countries in Africa have all the components needed for modern agriculture—improved seed, adequate amounts of fertilizer and chemicals, good farm management practices, and sufficient infrastructure for storage and marketing of farm produce. Most countries in sub-Saharan Africa have neither a well organized plant breeding program nor a fully functional seed industry (Venkatesan 1994, Tripp 1995, Cromwell 1996). The few countries that do have such programs concentrate mainly on major food crops like maize. Collaborative research between international agricultural research centers (IARCs) and various national programs in Africa has led to the development and release of a range of improved varieties of many important crops. However, due to various constraints, these varieties are not being multiplied and distributed* in sufficient quantities. Consequently, most farmers continue to grow traditional varieties in their traditional manner. This contributes to stagnation in agricultural productivity and a decline in per capita food availability.

Food production can be substantially increased simply by ensuring seed availability of available improved varieties. Several countries in Africa are in the process of developing and strengthening the formal seed sector (Venkatesan 1994, Cromwell 1996).

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Simultaneously, it would also be useful to study and strengthen the traditional channel of farmer-to-farmer seed distribution, so that this channel can also be used to distribute seed of improved varieties. This is particularly important for self-pollinated crops, for which seed companies are reluctant to produce seed (Grisley 1993, Sperling 1996). This would involve studying the existing seed systems, analyzing constraints, and developing a suitable strategy to strengthen the system. The International Institute of Tropical Agriculture (IITA) has developed several improved cowpea varieties for both sole and inter-cropping systems, and is working closely with farmers to enhance seed production and distribution of these varieties. This paper discusses the existing system of farmer-to-farmer cowpea seed distribution in northern Nigeria and suggests ways to improve it.

Traditional cowpea cultivation and seed system in northern Nigeria

Most cowpea in Nigeria is intercropped with sorghum, millet, and groundnut in various spatial and temporal arrangements that have evolved over centuries of experience to ensure maximum use of rainfall and available resources for food and fodder production (Ntare 1990, Singh 1993). The predominant crop mixtures are millet-cowpea, sorghum-cowpea, millet-sorghum-cowpea, millet-cowpea-groundnut, and sorghum-cowpea-groundnut. Cowpea is normally sown in alternate rows with the cereals, and occupies 30-50% of the field. The plant population is low, ranging from 2000 to 6000 hills ha^{-1}. Farmers often grow grain and fodder type cowpea varieties in alternate gaps between cereal rows in the same field. Due to shading by cereals and susceptibility to diseases and insects, mean grain yields of cowpea are low, ranging from 0 to 150 kg ha^{-1} (Singh 1993).

Depending upon the farmer's economic condition and pressure for cash and home use, most of the cowpea produced is either sold or consumed. Little or no seed is retained for sowing the next season. This is particularly true for farmers who have small landholdings and produce limited quantities of cowpea. Also, since the seed requirement for cowpea for intercropping is relatively low, most of the seed that small farmers purchase from the market is damaged by bruchids. Even those farmers who save seed use traditional storage methods that do not completely prevent bruchid damage. Damaged and poor quality seed results in poor germination, which causes low yields.

A survey of 105 farmers from 15 villages in the northern part of Kano state, where traditional cowpea intercropping is still practiced, indicated that 58% of farmers save cowpea seed for the next season's sowing, 38% purchase seed, and 4% obtain seed as a gift from others. Of the 58% farmers who save seed, 36% have enough only for their own use, while 22% have small surpluses (often less than 10 kg) for sale to others.

Genetic purity of farmer-saved seed

Samples of cowpea seeds were obtained from 59 farmers' fields covering 11 villages representing the Sudan Savanna and Sahel in Kano and Jigawa states. The samples were studied for genetic diversity in terms of seed color, hilum color, seed size, photosensitivity, and maturity duration. The results are summarized in Table 1. Of the 59 samples studied, only 4 were genetically pure, 18 were 75-99% pure, 19 were 50-74% pure, and 18 were less than 50% pure. The genetic mixtures were with respect to seed color, hilum color, and seed size as well as photosensitivity and maturity duration.

Even though there was considerable genetic diversity, the predominant type was white, medium-sized seed with a grey hilum, which probably represents "Dan Ila", a popular photosensitive grain type variety. The next largest group had white, medium-sized seeds

Table 1. Genetic purity and diversity in local cowpea varieties in northern Nigeria.

Seed color	Hilum color	Genetic purity (%)	No. of samples	Percentage (out of 59 samples)	100-seed mass (g)	Photosensitivity and maturity duration	Other seed mixtures
White	gray	100	1	1.7	12	PSE	nil
White	gray	100	1	1.7	15	PSE	nil
Speckled	gray	100	1	1.7	13	PSE	nil
White	brown	100	1	1.7	14	PSE	nil
White	gray	75-99	10	17	10-15	PSE+PSM+ PSL	wbl+wbr+ sp+wg
Speckled	gray	75-99	4	6.7	14-16.5	PSE	wg+br
Brown	self color	75-99	4	6.7	13-17	PSE	wbr+sp
White	gray	50-74	12	20	11-19	PSE+PSM+ PSL	wbl+wbr+ sp+wg
White	brown	50-74	5	8	15-27	PSE+PSM+ PSL	wbl+wbr+ sp+wg
Speckled	gray	50-74	1	1.7	13-16	PSE	wbr+wg
Brown	self color	50-74	1	1.7	12-22	PSE	wbl+wbr+ sp+wg
Mixed samples		<50	18	31	9-29	PSE+PSM+ PSL+NPS	wbl+wbr+ sp+wg+br

PSE = Photosensitive early, PSM = photosensitive medium, PSL = photosensitive late, NPS = non photosensitive
wbl = white-black-hilum, wg = white-gray, wbr = white-brown-hilum, sp = speckled, br = brown

with a large brown hilum representing "Aloka local", another photosensitive grain type variety widely grown on both sides of the Nigeria-Niger border. The large white seeds with small brown or nearly black eye are mostly photosensitive and late-maturing, representing local varieties Kanannado, IAR 1696, and others. Both the speckled and brown-seeded varieties are originally from Niger and grown along the Nigeria-Niger border. The brown-seeded variety is TN 5-78, known as Jan Wake (red bean) in Hausa. The mixed samples contained some non-photosensitive types, which are either mixtures from varieties grown in the Lake Chad region or outcrosses with improved varieties from IITA and the Institute for Agricultural Research (IAR). A few small smooth seeds were also observed. These could have originated from outcrosses with wild cowpeas, which are widespread in the region.

Thus, there are four major varieties—Dan Ila, Jan Wake, Aloka, and Kanannado—with several intermediates between them resulting from outcrossing, mechanical mixtures, and selections over the years. All these varieties were of the spreading type and photosensitive, but represented three maturity groups—early (80-90 days), medium (90-100 days), and late (100-130 days). The late types are grown mainly for fodder; most have large seeds (100-seed mass 18-27 g). These observations indicate that farmers are able to maintain seed of popular local varieties with reasonable genetic purity. This may be due to obvious differences in plant type, maturity duration, seed size, seed color, and hilum color.

Improved cowpea cultivation and seed systems in northern Nigeria

During the last few years, strip cropping with 1-2 rows of cereals to 4-6 rows of cowpea as well as sole-cropped cowpea are becoming popular with some farmers who have the means to purchase insecticides and periodically obtain improved seed from research stations, the National Seed Service (NSS), or seed companies. Irrigated cowpea is also gaining popularity in some areas. However, the number of such farmers is rather low because of non-availability of seed and insecticides within a reasonable distance and in reasonable quantities. (Sole cowpea is very profitable and therefore cost of inputs is not a major constraint.)

Limited amounts of improved cowpea seed are multiplied by NSS, research institutes, and a few seed companies (Olorunnipa 1984, A. Joshua 1997, personal communication). Total annual production may be less than 60 t, sufficient to plant about 2000 ha of sole cowpea. Cowpea cultivation can be increased several-fold if seed of improved varieties can be multiplied and distributed through dealers located throughout the cowpea-growing regions, particularly in cotton-growing areas, where insecticides are readily available. Some farmers do retain seed for sowing and also sell small quantities to their neighbors, but the quality of this seed is poor and distribution is limited.

Strategies to improve seed supply at farm level

Possible strategies to improve the informal seed sector through farmer-to-farmer diffusion are discussed below. The discussion is based on results from three types of interventions that IITA has made in collaboration with IAR and Kano Agricultural and Rural Development Authority (KNARDA) to popularize cowpea in Kano state.

Farmer-participatory evaluation of improved cowpea varieties

This program was initiated in 1993 in Gezawa and Minjibir local government areas of Kano, where 99% of the farmers grow cowpea as an intercrop with millet or sorghum. Seed of improved grain and fodder varieties was distributed. Each farmer received about 400 g of seed—200 g each of one grain type and one fodder type. Different farmers received different grain varieties, but all received the same fodder variety. The scheme involved 10 improved grain type varieties and 70-100 farmers each year, of whom about 40% were "regular" participants, receiving seed each year. We ensured that the "regulars" received seed of a different variety each year.

The farmers were asked to grow these varieties using the same methods and in the same field they used for their own varieties in traditional intercropping systems, and compare the performance of the two. A follow-up survey has indicated that the new varieties are spreading steadily, and farmer feedback has been very positive. Since 200 g cowpea seed will produce only 5-10 kg when intercropped, most smallholder farmers either sell it for cash soon after harvest or consume it—they do not save seed even if the new variety performs better than the local ones.

However, 30-50% of farmers did save seed of the best varieties and planted larger areas the following year. They also gave away and/or sold some seed. A few of these farmers are knowledgeable about cowpea production and storage, and also try to maintain genetic purity of varieties by removing off-type seeds after harvesting and threshing. (The varieties distributed by IITA can easily be distinguished because of their differential plant type, maturity duration, seed color, hilum color, and seed size.) If these farmers are periodically supplied with seed of new varieties, they can become key sources of seed for their communities.

Sale crop on-farm demonstration by KNARDA

In 1982, KNARDA initiated demonstrations of sole crop cowpea on farmers' fields. Seed of two improved varieties, TVx 3236 and ITA-60, was obtained from 1ITA. Seed, fertilizer, and insecticides were provided to farmers on credit, and recovered in kind. The repaid seed was then distributed to other farmers. The project started with about 130 farmers in 1982 and rose to 5000 farmers in 1983 and over 9000 farmers in 1984 (Harkness et al. 1985). Due to a change in policy in 1985 regarding the supply of inputs, this project could not continue. However, several farmers continued growing improved cowpea on their own and some of them have now developed into well known seed growers. In a recent survey we identified 49 farmers who sell between 100 kg and 500 kg of improved cowpea seed each planting season to hundreds of farmers in their vicinity.

Introduction of improved cowpea for a special niche in the dry season

Northern Nigeria has the potential for large-scale cowpea production during the dry season (Nov to May) using the existing irrigation facilities and residual moisture in wetlands and river beds. Farmers currently grow wheat and vegetables, but the wheat sowing is often delayed by late harvesting of the rainy-season crop, and vegetable prices fluctuate depending on the season. Farmers were looking for a more dependable and profitable alternative, and cowpea appeared to be the solution. It can be sown as late as 15 Jan to 7 Feb and matures in April to mid May, well before the onset of the rains. However, thrips, aphids, and nematodes are major pests and all the local varieties are susceptible. IITA has developed varieties combining resistance to these pests and tested these varieties in the dry season beginning Jan 1991. Results of the trials from 1991 to 1993 indicated that if sown between 15 Jan and 7 Feb, improved cowpea varieties (IT84S-2246-4, IT89KD-288, IT89KD-374, IT90K-76) can yield up to 1.9 t ha^{-1} of grain and 4-6 t ha^{-1} of fodder with little or no use of insecticides. The crop is harvested from the end of Apr to mid May, when grain and fodder prices are at their peak. Therefore, cultivation of improved cowpea varieties in the dry season can be very profitable.

While the IITA trials were still going on, an irrigation official (who is also a farmer) from Bunkure village in Kano took 200 g seed of IT89KD-288 cowpea in Apr 1993 for observation. He arranged to multiply the seed in the 1993 rainy season, and together with six relatives and friends, planted these seeds in Jan 1994. The results were so encouraging that 47 farmers planted this variety in Jan 1995, over 230 farmers in Jan 1996, and over 1000 farmers in Jan 1997. IT89KD-288 is resistant to aphids, thrips, bruchid, and nematodes, and has large white seeds similar to those of the local varieties. Its fodder production is also good. In 1995, we estimated yields (20 farmers) ranging from 0.8 to 1.9 t ha^{-1} of grain and 1.1 to 2.9 t ha^{-1} of fodder, which was sold to cattle herders for in situ grazing.

IT89KD-288 has spread mostly from farmer to farmer. At least three farmers had about 2 t of seed each in Dec 1996 for sale to farmers in Jan 1997. Several farmers also came to IITA's Kano Station between 1995 and 1997 to obtain small quantities of fresh seed of this variety. Total seed production in May 1997 is expected to be more than 200 t, from the initial 200 g distributed in 1993—all through farmer-to-farmer diffusion. This variety is now spreading to other parts of Kano where irrigation facilities are available.

Essential elements for the success of farmer-to-farmer seed diffusion

The three examples described above indicate that several factors influence the success and

effectiveness of farmer-to-farmer seed diffusion. Some of the essential elements are briefly described below.

Genetic superiority. The new varieties should be noticeably superior to local varieties in yield or other attributes like disease resistance, insect resistance, faster growth, better adaptation to special niches, better quality, etc. These differences should be visible even under low-input management. When change of variety alone makes a perceptible difference to the farmer, the seed itself becomes the main driving force for diffusion.

Breeding behavior. Maintenance and diffusion of varieties is easier in self-pollinated crops than in cross-pollinated ones. High multiplication ratios and low seed requirement per unit area will also facilitate rapid diffusion of a new variety among farmers.

Distinguishing characteristics. The new varieties should be easily distinguished from local varieties, both in the field and in storage. A distinct morphological character—e.g., leaf type, flower color, pod color, seed color, hilum color, or seed size—enables farmers to maintain the genetic purity of a new variety particularly if they are impressed by its performance.

Ease of cultivation. The new varieties should not require any extra purchased inputs or major change in cultivation practices compared to the local varieties. However, we have recommended that new cowpea varieties be sown at higher densities than local varieties; farmers have experimented with this practice, obtained significant yield increases, and accepted the change.

Technical backstopping and training. Research and extension staff should monitor the diffusion of new varieties and provide guidance to farmers. Establishing demonstration plots will allow farmers to observe new varieties and acquaint themselves with specific management requirements (plant density, sowing date, etc). Farmers also need advice on how to maintain genetic purity and viability in farm-saved seed.

Periodic infusion of fresh breeder seed. In order to ensure a reasonable level of genetic purity over time, fresh breeder or foundation seed should be periodically provided to selected seed growers who are the key seed sources within a community. The frequency of such infusions will depend on the availability of breeder or foundation seed and the popularity of the new variety. Such efforts are particularly important for varieties that are widely popular.

Awareness campaign. Information about the benefits of growing new varieties and on availability of seed with farmers in different local government areas should be widely disseminated. This could be done through the media (radio and television) and through other communication channels (women's groups, religious groups, traditional leaders, etc).

The formal seed industry. We see little competition or conflict between the formal and informal seed sectors. Farmer-to-farmer diffusion will become *more* effective as a strong formal seed industry develops, because of the added emphasis on seed multiplication and distribution. A combination of strong formal and informal sectors will result in faster diffusion of improved varieties because every farmer who purchases seed of a new variety becomes a potential source of seed to many other farmers.

Strategy to strengthen farmer-to-farmer diffusion of cowpea seed in northern Nigeria

A 2-year action plan has been developed to facilitate the rapid diffusion of improved cowpea and soybean varieties in northern Nigeria. Various organizations worked together

to develop this plan—IITA, the IITA/GTZ/ Crops Research Institute (Ghana) Project on promotion of seed production and marketing in West Africa, Sasakawa Global 2000, IAR, and KNARDA. The general strategy is to multiply sufficient quantities of breeder seed and give it to selected farmers. The farmers will be selected for their farming skills and familiarity with soybean/cowpea, and further trained on seed multiplication and maintenance of genetic purity. In addition, demonstration plots of these varieties will be established, where farmers will be brought for group discussions and training. The movement of seed from the selected seed-growing farmers to other farmers will be monitored. Six activities are involved.

1 Identify one farmer in each of three villages in three states to sow demonstration plots of improved cowpea and soybean varieties. These demonstration plots (9 soybean, 9 cowpea) will be sown in Kano, Jigawa, and Katsina states for cowpea, and Kano, Jigawa, and Kuduna for soybean. Suggested varieties are TGX 1448-2E, TGX 894-313D, and TGX 1485-1D for soybean; IT89KD-374, IT90K-277-2, and IT86D-719 for cowpea.
2 Another three farmers in each of these villages will individually produce seed of one of the three varieties of cowpea and/ or soybean on 0.25 ha, making a total of 27 farmers growing cowpea seed and 27 farmers growing soybean seed.
3 IITA and IAR will produce about 200 kg of breeder seed of each of the 3 varieties of cowpea (IITA) and soybean (IAR). This seed will be used to sow the 1998 demonstration plots and seed production fields. Farmers will have to pay for the seed they receive, and the money will be used to establish a revolving fund to sustain the annual production of breeder seed.
4 Prepare and distribute brochures, videos, slide presentations, etc on seed production methods.
5 Organize training for extension staff and field days for farmers, and monitor all demonstration and seed production plots.
6 Study farmers' reactions to the new varieties and monitor the spread of these varieties.

Future prospects and recommendations

Even if a formal commercial seed sector does develop, many self-pollinated crops such as cowpea and soybean will remain a much lower priority than hybrid maize. Farmer-to-farmer seed distribution will thus continue to play an important role in promoting improved cowpea and soybean varieties. Therefore, research institutions, NGOs, and extension agencies in Africa should make concerted efforts to strengthen both informal and formal seed sectors. Together, the two sectors can ensure rapid adoption of new varieties, increase productivity, and ensure household food security.

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Farmer-to-Farmer Seed Supply: Case Study of Pigeonpea Seed Distribution in Kenya

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Abstract

In the semi-arid Makueni district in Kenya, smallholder farmers traditionally intercrop their staple cereal with long-duration pigeonpea. Short-duration pigeonpea varieties developed by ICRISAT and the Kenya Agricultural Research Institute can give high yields and escape drought, but require non-traditional management practices (e.g., sole-cropping, spraying against insect pests). Field day demonstrations generated considerable interest in these short-duration varieties, particularly among groups of women farmers. A woman farmer who had successfully grown the new varieties, and was a member of a women's group herself started to multiply and sell seed. She distributed some seed free, as a promotional effort, and provided free agronomic advice to all customers. Adoption of short-duration pigeonpea in the region has been encouraging. Demand for seed is increasing, as a result of these promotional efforts and efforts by ICRISAT to introduce and popularize improved pigeonpea processing and utilization techniques.

Introduction

This paper describes how smallholder fanners in the semi-arid district of Makueni, Kenya, have developed a system for the multiplication and distribution of improved pigeonpea seed. Pigeonpea is a traditional crop in the district, grown both for food and as a cash crop. The tender green peas are favored for food while the whole dried grain is both consumed and sold. In recent years, commercial processors have been exporting both whole pigeonpea and processed *dhal* from Kenya. The country is now the world's second largest producer of this crop (after India, which produces 90% of the world's pigeonpea).

The introduction of short-duration pigeonpea

The local varieties are classified as long-duration, and the growing period spans both the short rains (Oct-Dec) and the long rains (Mar-Jun). The major constraint to crop production in Makueni is rainfall. The long

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rains are unreliable and in dry years, long-duration pigeonpea fails to yield any grain. ICRISAT has developed short- and medium-duration pigeonpea varieties that mature in 120-180 days. The short-duration varieties, in particular, differ significantly from traditional Kenyan varieties. Apart from their different phenology, they are short in stature and must be monocropped, rather than intercropped with a tall cereal. They are also more susceptible to insect attack than long-duration pigeonpea.

In Oct 1994, a field day was conducted at the Kiboko Research Station, where farmers from Makueni district were shown short-duration pigeonpea being grown under high management. There is a strong demand for early-maturing crops in the semi-arid areas of Kenya, and many of the visiting farmers requested seed they could test on their own farms. Although short-duration pigeonpea varieties can produce high yields in dry areas, non-traditional management practices (e.g., spraying, monocropping) are needed. It was therefore essential that farmers be provided with a technology package as well as seed if they were to succeed with this crop.

Kenya has an extension service, but staff and resources are limited. However, the district has a well developed network of women's groups (e.g., 30 groups in Kathonzweni Division alone, with 15-25 members per group), which are well organized, with legal recognition from the Ministry of Social Services and support from the extension service. It was therefore decided to promote short-duration varieties through these groups. Following the field day, seed was provided directly to women's groups that were interested in experimenting with the crop. ICRISAT, the Kenya Agricultural Research Institute (KARI), and the extension service provided agronomic advice.

Promotional efforts and seed sales

On-farm trials were conducted on fields belonging to members of women's groups, using seed supplied by ICRISAT and KARI. These farmers obtained high yields from the new varieties, and began to plant larger areas with the seed they produced. In addition, other farmers who visited the trials expressed interest in growing short-duration pigeonpea, and sought to buy seed from farmers who had participated in the trials.

The first author of this paper was among those who participated in the trials. She received seed from ICRISAT, and sowed it during the long rains in Mar 1994. The harvest was sufficient to provide a surplus for sale. However, rather than selling the seed at a premium price and making a quick profit, she provided 500 g of free seed to each of 75 women farmers from three women's groups for sowing in the short rains, Oct 1994. She also provided the groups with extension advice through a combination of methods—inviting members to see the crop on her own farm, visits to the farms of group members, and group meetings.

In addition to the free distribution, she sold 400 kg of seed to non-group members at US$ 0.90 kg^{-1} i.e., double the price of grain. She provided free extension advice on cropping methods and pest control to all farmers (group members and non-members) and also offered to buy back a portion of the crop at the end of the season. This entrepreneur made efforts to ensure that recipients of seed grew the crop successfully—over 30 farms were visited at least once and the majority were visited twice, at sowing and flowering.

These promotional efforts, together with strong additional support and promotional efforts from ICRISAT, ensured that demand for seed increased steadily. In 1994, she distributed 37.5 kg free, and sold over 400 kg of seed, sufficient to plant 10 ha of short-duration pigeonpea in pure stand. In 1995, no free seed was distributed; 600 kg was sold. In 1996, 25 kg was given free to 50 members from two women's groups and 900 kg sold to non-group members. Thus, in a period of 3 years, a single farmer has been able to

distribute 62.5 kg of free seed and sell an additional 1900 kg. To date all the seed requirements have been met from the improved varieties grown on her own farm, but when farmers have come from far away requesting seed, they have been referred to other farmers who grew the crop with advice from her and were known to have surplus seed for sale.

Marketing of pigeonpea grain

There is considerable demand for pigeonpea from processors and exporters in Kenya, and this entrepreneur has made contact with several potential buyers. Because of her regular interactions with pigeonpea growers in the area, she can easily mobilize them to set up collection points through the women's groups. This will be done in future both for green peas and dried grain. In Kibwezi division of Makueni district, traders have purchased green peas for export from farmers who grow the improved short-duration varieties.

Promotional efforts by ICRISAT

Although there is a ready market for whole grain, it is important to widen the utilization base (local consumption patterns favor green peas over whole dried pigeonpea) and add value to the crop so that farmers get a better return on their investment. ICRISAT carried out a survey of pigeonpea processing and utilization in the region in 1993, and introduced a range of technologies to improve on existing practices. The most important of these is the use of a simple grinding stone *(chakki)* to remove the seed coat and split the cotyledons. The resulting product *(dhal)* is more palatable and requires only half the cooking time when compared with whole dried grain.

In 1996, among other promotional efforts, ICRISAT trained 10 women, including this entrepreneur, in this technolpgy. An NGO, World Vision International, contracted the entrepreneur to train another 320 women. This training has created a further demand for seed—this entrepreneur has received orders from 50 farmers for the 1997 season. In Feb 1998, ICRISAT will conduct training courses on seed production (communities are already in the process of identifying farmers who will be trained). This training will improve the ability of pigeonpea seed growers in each community to obtain high yields and produce grain that is true to type.

Conclusions

This paper described how an enterprising woman farmer was able to develop a business through the provision of seed and agronomic advice. Short-duration pigeonpea was a "new" crop and required new management methods. Even so, the superiority over traditional long-duration varieties in this environment—early-maturing varieties escape drought, and provide food during the period when food supplies are lowest—was sufficient incentive for adoption.

Adoption was stimulated by two factors. First, the ready availability of seed and good extension advice delivered in an understandable way by someone with credibility in the community. Second, strong support from ICRISAT, KARI, and World Vision through promotional efforts, training, and technical advice (to this entrepreneur as well as other farmers) on crop management.

Seed multiplication does not pose any special problems. In an area where short-duration varieties have only just been introduced, there is virtually no possibility of cross-pollination and so the seed will be true to type. Pigeonpea, and other legumes, are highly susceptible to storage pests but the use of chemicals to control these is familiar to farmers and highly effective. The main threat to the long-term viability of local or community-based seed businesses is that seed

of a new variety can be sold at a premium only for one or two seasons; after that, farmers will recycle seed saved from their own harvests, unless local stocks are wiped out (e.g., by drought).

Seed multiplication was only one of several small-scale business opportunities created by the introduction of short-duration pigeonpea. Other opportunities (as a result of processing and utilization training) include grinding whole grain into *dhal,* and the manufacture of grinding equipment (stone *chakkis).* Already local artisans have produced a dozen prototype stone *chakkis* for which they are seeking a market.

The empowerment of individuals and communities with knowledge can bring about rapid change when that knowledge leads to a significant economic benefit. In this case investments in knowledge (in the form of agronomic advice to farmers) resulted in profits from seed sales. Further empowerment of farmers with appropriate knowledge can strengthen this system further.

Session IX
Concept Papers

Between States and Markets—Innovations for Small-Scale Seed Provision

R B Tripp[1]

Abstract

The recent shift away from reliance on public seed enterprises has directed interest towards small-scale seed projects. However, there is little guidance available regarding the organization or potential scope of small-scale seed provision. This paper reviews experience to date and provides guidelines for analyzing the potential of various seed provision options. The nature of seed demand varies tremendously, and this has a strong bearing on the choice of seed provision strategy. It also must be recognized that seed provision is a complex process involving a series of specialized tasks. Most small-scale seed activities will require the interaction of several different organizations from the public, commercial, and voluntary sectors. Attention should be focused on the organization, source of funding, and incentives for each stage of the process. Of equal importance, successful small-scale seed provision will depend on the development of effective interactions among the various organizations involved in the process.

Introduction

The most prominent feature of current agricultural development policy is the shift in emphasis from the state to the market. Until recently the state has played the leading role in most developing countries, supporting agricultural research and extension, providing such inputs as seed and fertilizer, and often managing the marketing of agricultural produce. There is now widespread agreement that the balance must be shifted away from the state and towards the market. The prevailing mood among policy makers and donors is that, despite inevitable problems, "imperfect markets are better than imperfect states" (Colclough 1991:7).

This shift is particularly relevant to national seed systems. Formal seed provision in most developing countries has been dominated by the state, but recently private commercial seed production and plant breeding have begun to make their mark. Most seed policy analysts expect this trend to accelerate, and predict a predominant role for the private sector (Pray and Ramaswami 1991, Jaffee and Srivastava 1994). Evidence of this trend is already available (Rusike 1995, Pray et al. 1991).

This paper is not concerned with the nature of state or commercial seed systems, but rather explores the transition between the two. It addresses the following questions: What can the state do to foster the emergence

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of effective commercial seed enterprises? What are the remaining state responsibilities in national seed systems? And what is the role of other agencies, such as NGOs and farmer organizations, in developing equitable seed provision that fills "the institutional gap between flawed markets and failing governments" (Wiggins and Cromwell 1995:420)?

The paper is divided into three parts. The first part is concerned with definitions. It begins with a brief look at the nature of seed demand, and draws implications for the organization of seed provision. This is followed by an outline of the stages of seed provision and a sketch of the various actors that might contribute to each stage. The second part of the paper presents an analysis of alternative ways of organizing seed provision. It focuses on competencies and incentives; it also emphasizes the importance of the transaction costs that characterize collaboration among different types of organizations. The final section presents some conclusions on institutional responsibilities.

Some Definitions

Many discussions of seed sector reform suffer from imprecise terminology. Concepts such as "seed demand" and "seed production" are discussed as if they were homogeneous, undifferentiated entities, while in fact they are much more complex. Similarly, the organizations that play major roles in the seed sector are usually described in broad-brush terms (e.g., "the private sector" or "NGOs") that mask considerable diversity.

Seed demand

Any analysis of seed provision alternatives should logically begin with an understanding of seed demand. Although seed provision should be tailored to specific needs, many seed projects are designed and implemented with only a vague notion of the nature of seed demand.

Seed is certainly the primary agricultural input, and as the embodiment of the farmer's future harvest it provides considerable symbolic value for many development projects as well. It is important to remember, however, that the majority of the world's seed is managed by farmers themselves, in household stores or through indigenous provision in local communities and markets. Precise figures are not available, but most estimates for developing countries indicate that about 90% of seed is provided through informal mechanisms (Almekinders et al. 1994). It is sometimes overlooked that even in industrialized countries the figures from are not much different for crops where hybrid technology is not widely used. More than half of the wheat, barley, and oats sown in the USA is farm-saved seed (Jaffee and Srivastava 1994). Half of all seed in France and Germany, and 30% in the UK, is farm-saved (Ghijsen 1996).

There are certainly many opportunities for expanding the proportion of formal seed provision in developing (and industrialized) countries, but it is important to bear in mind that seed demand is not universally high, and that formal seed provision will often compete against well-developed informal alternatives.

Farmers seek seed in the formal sector for specific reasons, which fall into four categories:

- Seed demand due to poverty
- Seed loss caused by disaster
- Seed management problems at farm level
- Interest in acquiring a new variety.

These categories may sometimes overlap, and the classification is not comprehensive, but it should serve our purpose. Each of these types of demand has distinct characteristics, and distinct implications for seed provision.

Seed demand due to poverty. Much of the seed demand in developing countries is a consequence of poverty. Farming conditions are so tenuous for many households that the harvest does not provide adequate seed. Debt

or other household requirements may force the farmer to sell produce that would have otherwise been retained for seed; household food shortages close to sowing time may cause saved seed to be consumed. In many areas, this type of poverty-related demand is chronic and widespread. Currently this demand is met largely by various informal seed provision mechanisms including loans, bartering, purchase, and sharecropping. It is not likely to be addressed to any significant extent by commercial (or state) enterprises. Its ultimate resolution depends on better access to resources and on improvements in farming conditions and technology, but meanwhile the households that suffer this type of seed demand must be an important focus for seed policy.

Seed loss caused by disaster. Seed demand can be expected to increase in times of emergency (civil war, drought, floods). Seed demand during emergencies is usually more widespread than that associated with chronic poverty, but usually a more temporary phenomenon. Considerable caution is required in addressing emergency seed demand, however. A recent review has shown that even in severe emergencies local seed systems are surprisingly resilient, and that individual households or local markets may be able to supply a significant proportion of the required seed (ODI 1996). The same study shows that in many cases emergency programs have provided seed of inappropriate type or quality. It concludes that emergency seed provision should be based on the use of local resources and seed, or on collaboration with well-established and knowledgeable commercial or public seed enterprises.

Seed management problems at farm level. Difficulties in seed management can cause farmers to acquire seed off-farm. Seed may be difficult to store (e.g., soybean in tropical conditions) or the environment may be unsuitable for the production of a seed crop (e.g., seed potato in virus-affected zones). The crop may be harvested before seed develops (e.g., forage crops) or farmers may sell their entire harvest of a commercial crop and not wish to invest in seed storage. In certain cases seed conditioning problems (e.g., separating weed from crop seed) may also motivate seed purchase.

The most important example in this category of seed demand is the use of hybrids, which (theoretically) require the farmer to acquire fresh seed each season. Maintaining varieties of cross-pollinated crops (e.g., pearl millet or maize) may also be difficult at times, requiring the farmer to purchase fresh seed periodically. This category is admittedly a diverse mixture of cases, but the common thread among them is a relatively stable agricultural situation in which a predictable seed demand can be met by formal seed sources.

Interest in acquiring a different variety. The fourth type of seed demand is related to the availability of different varieties. Farmers acquire a new variety by acquiring seed of that variety. However, once a variety is acquired, the farmer may be capable of maintaining it indefinitely, without further recourse to the formal seed market. Demand for new varieties presents one of the most difficult challenges for seed provision. The demand for seed of a new variety depends on the performance of the variety (it will not be accepted simply because it is "new" or "improved"), and on the proportion of a farmer's crop that is likely to be planted with this specific variety.

In addition, once a new variety is being grown by a number of farmers, other farmers may prefer to acquire seed from their neighbors rather than from formal sources. Varieties (both local and modern) often spread from farmer to farmer, without the intervention of formal seed provision. A considerable proportion of the diffusion of Green Revolution varieties of wheat and rice in Asia has taken place not through formal seed provision but by farmer-to-farmer seed movement (e.g., Heisey

1990). Even though demand for a new variety may be high, justifications for a formal, commercial seed enterprise to meet this demand may be lacking.

Table 1 summarizes the different classes of seed demand, and their implications for seed provision. Such a summary is admittedly crude, but it is sufficient to show how seed provision systems depend on demand. Most demand related to seed management (including the use of hybrids) can be met by commercial provision, either by conventional seed companies or innovative small-scale schemes. Emergency seed provision is obviously a continuing responsibility for governments and voluntary agencies. Meeting seed demand related to poverty—where farmers are often unable to exert effective demand in the market—or demand related to variety (which may be transient) is more problematic. Most instances in both these categories will require collaboration between public and private (commercial or voluntary) sectors.

Seed Provision

One of the unfortunate features of many discussions on alternative seed supply strategies is an undifferentiated view of seed provision. This contributes to a tendency to focus on only certain aspects of the seed provision process. But as Jaffee and Srivastava (1994) point out, decisions about the division between public and private responsibilities in seed provision must look at the individual steps in the process. There are a number of ways of partitioning seed provision, but the following divisions will be used in this discussion.

Plant breeding and variety selection. Seed provision begins with variety development. Seed may be of a modern variety or a local variety, but it is important to identify the organization(s) responsible for plant breeding or variety selection.

Source seed production. Several stages are usually required to move from the small amount of seed produced by the breeder to quantities sufficient to be used for seed multiplication. There are several nomenclatures in use to describe these stages; the OECD scheme identifies breeder, pre-basic, and basic seed as stages preliminary to the production of certified seed. Even where local varieties are the focus of formal seed provision, decisions must be made about how source seed is to be maintained and produced.

Seed multiplication. Most discussions of seed provision focus on seed multiplication. Although this is obviously a key stage in the process, it is only one aspect of seed provision.

Quality control. This is not really a discrete stage, but includes activities that are carried out during several other stages. It is important enough, however, that it should receive separate treatment. Activities may include some type of official certification (including field visits) and seed testing after harvest, as well as quality control procedures used by seed producers and merchants.

Table 1. Seed demand.

Source of demand	Nature of demand		Response
	Effective	Continuous	
Poverty	No	Yes	?
Emergency	No	No	Govt or voluntary programs
Seed management/hybrids	Yes	Yes	Commercial seed provision
New variety	Yes	No	?

Seed conditioning and storage. After seed is harvested it must be dried, graded, and cleaned. In many crops, seed must be stored for a considerable time before sale or distribution, and adequate storage facilities must be available.

Seed marketing and distribution. Appropriate mechanisms must exist for delivering seed to farmers. This may require a complex marketing or distribution network.

Farmers. The final "stage" in seed provision is farmers' utilization of the seed. This is an appropriate place to recall that seed must respond to farmers' specific demands, whether for a particular variety or for a specific type and quality of seed.

The actors

Innovations in small-scale seed provision include alternatives to public sector seed programs and conventional commercial seed operations, but participants may be drawn from both state and market sectors. In addition, sectors commonly described as "NGOs" and "the community" are frequently mentioned. These sectors are briefly examined below.

The State. It is difficult to define the precise character and limitations of public sector involvement. Although there is general agreement that government's role in seed production and distribution should give way to more private participation, there are still a number of activities, including agricultural research and seed regulation, for which the state will retain some responsibility. The division between public and private is also blurred by the increasingly commercial character of some state seed enterprises, which may have partial private ownership, or may contract some operations to private agencies (Hubbard 1995). In addition, public research and extension are being encouraged to develop their own sources of funding. Many public breeding programs attempt to earn royalties on their varieties, and there are various schemes for privatizing agricultural extension (Schwartz 1994). Finally, state agencies are often recipients of donor funding and international technical assistance which significantly influences the character of public seed activities. In short, "the state" is a much more diffuse entity than is generally acknowledged.

The Market. The nature of the private sector is similarly ambiguous. Commercial activity may refer to multinational corporations, private seed companies operating at the national level, small family seed production or marketing enterprises, or even an individual farmer who occasionally sells some seed in the local market. Cooperatives are best included in the commercial category as well, although they include everything from some of the world's largest seed producers to nascent local groups dependent on donor funds.

NGOs. There has been a rapid growth of NGO participation in seed activities. Farrington and Bebbington (1993) propose criteria for a classification of NGOs that include location (North-based or South-based), scale (community level or supra-community), ownership (non-membership or membership), and orientation (profit-driven or value-driven). The range of organizations that may be considered NGOs is remarkable. As Brett (1993) remarks, a number of large North-based NGOs are similar to parastatals. Some NGOs are particularly dependent on donor funds, and it may be difficult to distinguish their activities from those of consulting firms or university consortia that are contracted by donors to manage agricultural development projects. At the opposite end of the scale are the many grassroots organizations that Uphoff (1995) argues should be considered a separate "membership sector". There are few examples to date of unassisted grassroots organization activities in formal seed provision, however.

The Community. The "community", like the "market", is an abstraction, but this does not prevent frequent references to "community seed projects". Discussions of (formal or informal) community seed provision must pay close attention to representation and coverage. Community seed provision is not necessarily socially equitable nor the expression of a "moral economy"; seed provision may form part of patron-client relations (Louette and Smale 1996), and knowledge about new varieties may move in restricted pathways (Green 1987). Similarly, it is not unusual for community seed projects to benefit only a small proportion of farmers. Therefore the description of a seed project as "community-level" only defines its scale, not its adequacy or equity.

Analysis

The components of small-scale seed provision

Any analysis of the various options for seed provision must account for difficulties in categorizing the potential participants, the complex nature of seed provision, and the multiple sources of seed demand. At a minimum, we must recognize that innovative seed provision will almost always require coordination among different types of organizations. Various seed policy analyses (Douglas 1980, Kelly 1989, Jaffee and Srivastava 1994) have stressed the importance of collaboration between the public and private sectors, but we must be much more specific in assigning particular responsibilities for performance and communication.

An analysis of each component of seed provision should include three aspects (see also Thirtle and Echeverria 1994).

- Organization and ownership of the resources needed
- Source of funds (government, donor/voluntary, commercial)
- Incentives for performance (government service, voluntary service, commercial incentive).

The viability of any seed provision option depends on the efficiency and incentives of each individual component.

The following discussion examines a number of small-scale seed projects. It examines each of the components of seed provision, and focuses on the organization and support for various alternatives.

Plant breeding and variety selection. Despite the growth of private seed companies, public sector plant breeding remains important for many crops in industrialized countries (Knudson 1990). Developing countries will also depend on public plant breeding, especially for open-pollinated crops. Public varieties will be particularly important for small-scale seed projects, but the priorities of resource-poor farmers must be addressed by public plant breeders more effectively than they now are. Seed projects are frequently based on overly optimistic assumptions about the demand for the modern varieties that are currently available.

Farmer participation in variety testing and selection can be linked to seed provision (Eyzaguirre and Iwanaga 1996). In Colombia, farmers' groups that were formed to collaborate with research and extension in participatory technology development identified new crop varieties that performed well. Several of these groups received training and assistance for small-scale seed production and were able to sell seed of these varieties in local shops and markets (Ashby et al. 1995). Groups of farmers who participate in variety testing with the Adaptive Research Planning Team in Zambia are given assistance in multiplying seed of preferred new varieties that can be used by group members and sold locally (Lof and Nchemba 1994).

Small-scale seed provision can also focus on local varieties. The MASIPAG project in the Philippines combines university resear-

chers and farmers in the selection, improvement, and distribution of local rice varieties (Salazar 1992). Such projects require considerable external input from NGOs or public researchers in order to manage the selection and distribution process.

Source seed. Source seed production requires particular care and supervision. The state will continue to play an important role in producing source seed of modern varieties for small-scale seed projects. Source seed production may be the responsibility of a research institute, university, or other public organization. In Brazil, the national maize research center (CNPMS) provides inbreds of public hybrids to an association of small-scale commercial seed producers (Lopez-Pereira and Filippello 1995). Because public funds are limited, there must be a clear strategy for supporting source seed production in the future, and most small-scale seed projects will have to be prepared to pay the full cost of the source seed they use. As national seed systems develop, commercial seed companies will take increasing responsibility for source seed production of the public varieties they market.

Seed multiplication. Most commercial firms multiply seed through contract farmers. Although much public seed production was once done on state farms, the general consensus is that it more efficient to contract individual farmers (Abeygunawardena et al. 1990). Small-scale seed projects usually rely on individual farmers to multiply seed, although multiplication is occasionally done on community plots (Cromwell and Wiggins 1993).

There are instances where NGOs have been able to help farmers become contract seed growers. In northern Pakistan, farmers in high-altitude areas are particularly well situated for seed potato production. An NGO was able to organize and train local farmers to produce seed potato for commercial companies that market the seed in the south of the country. The Federal Seed Certification Department established an office in the area to manage quality control (Alain and Saleemi 1996).

The organization of contract seed multiplication may present several dilemmas for NGOs. Farmers who are able to do commercial seed multiplication are likely to have more resources and skills than average, and hence there is a question of balancing the NGO's equity goals with the opportunity to develop a local enterprise. There is also a debate about the effects of contract farming. Some studies report significant advantages for farmers who are able to produce seed, particularly of high-value horticultural crops (Benziger 1996). Other analysts are concerned about the risks of contract farming, especially when subsistence food production is replaced by dependence on unstable commercial markets (Little and Watts 1994).

Whether seed multiplication is done on commercial contract or is part of a small-scale scheme, the participating farmers usually require considerable training and advice (Lepiz et al. 1994, Benziger 1996).

Seed quality control. Most small-scale seed projects require technical advice rather than official policing by state quality control agencies. In some projects, NGO or extension staff have been deputed to provide advice and supervision (Joshi 1995). In several seed projects in the Gambia, the government Seed Technology Unit (STU) shared field inspection duties with NGO staff, and seed samples were sent to STU for testing (Cromwell and Wiggins 1993). In Ghana, the Seed Inspection Unit provides training, advice, and inspection for small-scale producers (Bockari-Kugbei 1994).

Seed quality control agencies in Bolivia are organized by region, and each agency has considerable autonomy (Garay et al. 1988). The agencies offer technical advice and

training to seed project staff and farmers. All formal seed production in Bolivia is subject to official certification, but small-scale operations are allowed considerable flexibility. In one case, a cooperative pays for the certification of bean seed that it sells outside the community, but is able to sell uncertified seed locally (at a lower price), based on the cooperative's reputation (Rosales 1995).

Whether official agencies offer technical advice or more comprehensive inspection for small-scale seed projects, the funding of these activities must be considered. In many cases, national seed quality control services charge only a fraction of their actual costs, but this cannot continue. More efficient means of quality control, by official agencies and seed producers themselves, will have to be developed.

Seed conditioning and storage. Formal seed production usually requires training for farmers as well as access to specialized equipment and facilities. One important decision for any seed operation is the degree to which seed conditioning facilities will be centralized or dispersed. Equipment is available to match various scales of operation, but the costs, maintenance, and replacement of such equipment must be factored into project budgets. In some cases, small-scale projects may be able to rent state-owned processing facilities, as happened in Ghana when private producers replaced the parastatal Ghana Seed Company (Bockari-Kugbei 1994).

Storage is an equally important concern, and errors in the siting or capacity of storage facilities can add considerably to the final cost of seed (Cromwell et al. 1992). In a "producer-seller" project in Nepal, where farmers were trained in seed production techniques and were then expected to manage seed sales within their communities, one of the key inputs was metal storage bins provided to participating farmers (Bal and Rajbhandary 1987).

Marketing and distribution. Mechanisms for marketing seed produced by small-scale projects are often overlooked. In some cases it is assumed that seed of a new variety made available to a few farmers will automatically find its way to many others in the community, but this is overly optimistic (Sperling and Loevinsohn 1993). The assumption that farmers who produce extra seed will easily find a market within their communities is similarly unfounded, and has been the cause of more than one seed project failure.

KOSEVEG, a successful seed production project in Nepal, found that it needed to establish a separate organization to deal with marketing (Joshi 1995). One of the principal factors in the success of the Lahaul Potato Society, a cooperative producing seed potato in Himachal Pradesh, India, has been its aggressive marketing strategy (Baumann and Singh 1996). Training for merchants who will begin selling seed is also advisable.

In Rwanda, local merchants have been successful in selling small packets of seed of new bean varieties (Sperling et al. 1996). Market sellers are often sources of information and seed of new varieties in Ghana (Bortei-Doku Aryeetey 1995). Grisley (1993) is surely correct that well-planned distribution of small quantities of seed of new varieties is more cost-effective than launching a full-scale seed production project, but precise strategies to achieve widespread and equitable access have yet to be determined.

Transaction costs in seed provision

The organization, funding, and incentives for the various stages of seed provision are not the only concerns for the development of small-scale seed projects. Equal attention must be given to transaction costs—the costs of acquiring information, establishing contracts, and developing trust—between the individuals and organizations responsible for different stages of seed provision. Transaction costs

can be divided into three categories: "search and information costs, bargaining and decision costs, and enforcement costs" (Dahlman 1979:148). The total costs of production for a commodity such as seed are the sum of transformation costs and transaction costs (North 1990).

Transaction costs are important in the interaction between farmer and seed provider (Wiggins and Cromwell 1995:414). Farmers need information about the type of seed that is available, access to a location where they can obtain seed, and assurances about seed quality. Although these factors may be difficult to include in a budget, they are nevertheless real costs to the farmer. They add to the actual cost of seed and, if they are too high, discourage demand for seed.

Transaction costs are also relevant to the interactions *among* the components of the seed provision system. Producers of source seed require information on varietal demand from seed multipliers; clear contracts are required between seed producers and seed merchants; and seed producers need some guarantee of the quality of the source seed they acquire. With the exception of the work done by Rusike (1995), little has been done on transaction costs in seed provision, although lack of attention to transaction costs is a major reason for the failure of many small-scale seed schemes.

Transaction costs are particularly relevant while planning changes or "innovations" in the seed system. One theory holds that the growth of firms is determined in large measure by the nature of transaction costs; the establishment of a firm serves to lower the transaction costs that characterize contracting among individual enterprises (Williamson 1979). Large commercial seed companies can be seen as firms that incorporate most of the components of seed provision within their boundaries. At the opposite end of the scale, traditional local-level seed provision, where farmers take responsibility for everything from variety maintenance to seed utilization, is also an integrated process with low transaction costs. On the other hand, most of the small-scale seed provision options considered in this paper involve interactions—and transaction costs—among many different organizations.

The choice between integration (within a single firm) and contracting (between enterprises) is not simply a question of scale, but also a matter of costs and opportunities for specialization. The cost of developing and maintaining specialist skills may be higher than the transaction costs of contracting for those skills, as recent trends in the disaggregation of firms illustrate (Miles and Snow 1996). Specialists may be contracted when particular skills are required that a firm does not wish to develop. For example, a large seed company may use an outside laboratory for certain types of quality control, or obtain foundation seed from a specialist producer.

Communication between farmers and breeders. Demand for seed of new varieties depends crucially upon the suitability of those varieties for farmers' conditions. Much work remains to be done in modifying public plant breeding programs in order to increase communication with farmers and decentralize variety testing (Ashby and Sperling 1995). In addition, better communication is needed between seed merchants and breeders regarding farmers' demands. There are costs involved in making these adjustments, but they will yield significant benefits in improving the flow of seed of acceptable new varieties.

Communication between seed growers and source seed providers. Most small-scale seed operations depend on a public agency for source seed. In many seed projects, NGO staff establish relationships and make the contacts necessary for acquiring the source seed each season. If projects are to become independent, it is crucial that these responsibilities be transferred to members of the

farmers' group or cooperative. Gathering information about what type of source seed is available, transmitting demands for source seed of particular varieties, and establishing a relationship of trust between seed grower and source seed provider all represent significant, and unavoidable, transaction costs.

Contracts with seed growers. Even the largest commercial seed company must bear the transaction costs of contracting with seed-growing farmers. There are risks on both sides of these contracts. Seed growers may be tempted to sell their harvest to another buyer, if the timing or sale price is more attractive than the original contract. On the other hand, seed producers may be disappointed by the company's refusal to buy all their output, by excessive quality discounting, or by late payment. Both growers and enterprises must invest considerable resources in developing and maintaining a productive contractual relationship.

Communication between seed growers and quality control agencies. Quality control agencies may interact with small-scale seed projects in order to provide technical advice or because of the requirements of national seed regulations. Growers need to be in constant contact with certification officials to ensure that they are able to reach the production plots for the requisite inspections. The relationship between producers and the quality control agency may be difficult. Mandatory seed certification presents many opportunities for rent seeking, which adds to the cost of seed (Tripp and van der Burg in press). On the other hand, compromises by the quality control agency jeopardize the reputation of all formal seed production.

Communication between seed growers and merchants. Most formal seed sales in developing countries are handled by government agencies, farmers' cooperatives, or large dealerships. Small-scale seed provision will increasingly need to tap into local-level marketing channels. When seed producers begin dealing with merchants who will sell their seed, mutually acceptable arrangements must be established (e.g., to what extent unsold stocks may be returned, or how the merchant will promote the product). The development of effective relations between seed producers and merchants requires considerable investment. Joshi (1995) describes problems of mistrust and lack of communication that characterize relations between small-scale seed growers and seed merchants in Nepal, and points to ways of improving coordination between the two groups.

Communication between seed suppliers and farmers. Seed producers and merchants must pay significant costs to establish their reputations with farmer clients (Cromwell 1996). Investments in brand names and advertising will be necessary. A relationship of trust needs to be established in which farmers can rely on seed providers for information about new products, and where farmers feel that their concerns and complaints are respected. The development of trust requires time and investment. Developing such relationships between farmers who rarely buy formal sector seed and merchants who have little experience in marketing seed is particularly challenging. Merchants could also establish links with extension agents, who can help arrange demonstrations and field days.

All these examples of interaction between different components of the seed provision process are characterized by significant transaction costs. Agencies involved in developing small-scale seed provision alternatives must pay particular attention to lowering these transaction costs if their projects are to achieve viability. In many cases, external agencies such as NGOs bear many of these costs, without accounting for them in an analysis of project viability.

Table 2 shows several examples of small-scale seed projects. Each example is

characterized by key interactions between components. The level of the associated transaction costs helps determine the viability of the project. Table 3 describes the organization, funding, and incentives for the cases cited in Table 2. These examples illustrate the wide range of organizations that contribute to the management and support of various components. Most of these projects are still in progress, and few can yet be judged as successes or failures. But it should be obvious that a clear assignment of responsibilities, and an understanding of participants' expectations, will be necessary for sustainable seed provision.

Conclusions

Formal seed supply in developing countries is in the midst of a transition from dependence on public seed systems toward greater private sector involvement. But the speed and degree of completeness of this transition will depend on the type of crop and the nature of seed demand. A significant proportion of seed demand will not be addressed by large commercial seed operations, but alternative pathways are not yet defined.

Small-scale seed provision is certainly a possibility (even in industrialized countries, a large number of seed businesses are small, often family-owned operations) but even small-scale seed enterprises require considerable investment and expertise.

Different organizations, both public and private, must collaborate in the seed provision process. This requires that competencies and incentives are well defined for each stage, and that adequate channels of communication exist among the various stages in the process.

It is clear that there are certain areas of seed provision where the state will continue to have important responsibilities (plant breeding, source seed production) and others where its mandate will significantly decline (seed production) or disappear (marketing). There are also areas (quality control) where careful decisions will have to be made about state participation.

There is also much that seed policy can do to foster the development of small-scale seed operations. Seed laws should encourage innovation and should not impose unreasonable restrictions on the release of new varieties or the sale of seed. Quality control agencies should support and encourage small-scale seed initiatives. Seed policy can also promote the availability of adequate training opportunities for seed project personnel. Import barriers for germplasm and seed conditioning equipment should be removed. Public extension agencies can play an important role in helping to organize the testing and demonstration of varieties offered by private seed enterprises. The state also can foster the development of seed producer cooperatives and associations.

External agencies also can contribute to small-scale seed production. The major players to date have been non-membership NGOs and donors that sponsor seed projects. But these organizations must spell out the nature of their involvement in a seed project. If they hope to establish a sustainable seed provision option, then a plan for operational and financial independence should be described. On the other hand, if the activity is motivated by welfare considerations, and external funds are used to support seed provision that could not be sustained by local resources, this justification should be articulated.

Finally, it is appropriate to close with the reminder that the success of any small-scale seed operation depends on the skill and efficiency with which operations are performed, and on the capacity of the participating organizations, public and private, to establish effective working relationships with each other.

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Table 2. Examples of small-scale seed provision.

Case	Type	Example	Important transaction costs[1]
1	Variety distribution	Small packets of seed of new bean varieties, selected through farmer participatory research, were prepared by the research agency and sold in markets in Rwanda.	F-B, G-M
2	Variety multiplication	In Ecuador, an NGO helped farmers multiply seed potato. The NGO acquired the source seed from government research.	F-B, G-S, S-F
3	Seed multiplication	Several NGOs in the Gambia helped organize farmers to multiply seed which the NGOs then distributed.	G-S, G-Q, S-F
4	"Producer-seller"	A donor project in Nepal provided source seed, inputs, and storage facilities to farmer seed multipliers who were expected to sell their output.	G-S, G-Q, S-F
5	Contract growers	An NGO organized farmers in northern Pakistan to produce seed potato for sale to commercial seed companies.	G-S, C-G, G-Q
6	Cooperative	APROSFYM, a producer cooperative in Bolivia, gets source seed from the local university and produces certified bean seed for members and for sale.	F-B, G-S, G-Q, S-F
7	Seed multiplication and commercialization	KOSEVEG, a donor project in Nepal, organizes farmers to multiply seed which is purchased by seed traders and cooperatives.	G-S, G-Q, G-M
8	Incipient commercial enterprise	SEFO, a seed company in Bolivia organized by a donor and a university, contracts farmers to grow seed of local and improved forage varieties and sells these to farmers and NGOs.	C-G, S-F

1. Transaction costs: costs of communication between farmers and breeders (F-B), between seed growers and source seed producers (G-S), seed growers and quality control (G-Q), seed growers and merchants (G-M), seed suppliers and farmers (S-F); and costs of contracting seed growers (C-G)

Case sources:

1 Sperling et al. 1996
2,3 Cromwell and Wiggins 1993
4 Bal and Rajbhandary 1987
5 Alam and Saleemi 1996
6 Rosales 1995
7 Joshi 1995
8 Ferguson and Sauma 1993

Table 3. Organization, funding, and incentives[1] for components of small-scale seed provision.

Case[2]		Breeding/ selection	Source seed	Seed multiplication	Quality control	Conditioning and storage	Marketing and distribution
1	Organization	State	State	State	State	State	State/Private
	Funding	Public/Donor	Public	Public/Comm	Public	Public	Public/Comm
	Incentive	Govt	Govt	Govt	Govt	Govt	Govt/Profit
2	Organization	State	State	Farmers	Farmers/NGO	Farmers/NGO	NGO/Farmers
	Funding	Public	Public/Donor	Comm/Donor	Comm/Donor	Comm/Donor	Donor/Comm
	Incentive	Govt	Govt	Vol	Vol	Vol	Vol/Profit
3	Organization	State	State	Farmers/NGO	NGO/State	NGO/Farmers	NGO
	Funding	Public	Public/Donor	Donor	Donor	Donor	Donor
	Incentive	Govt	Govt	Profit/Vol	Vol	Vol	Vol
4	Organization	State	State	Farmers	State	Farmers/State	Farmers
	Funding	Public	Public/Donor	Comm/Donor	Public	Govt/Donor	Comm
	Incentive	Govt	Govt	Profit	Govt	Profit	Profit
5	Organization	State	State	Farmers/NGO	State	Private	Private
	Funding	Public	Comm	Comm/Donor	Public	Comm	Comm
	Incentive	Govt	Profit	Profit/Vol	Govt	Profit	Profit
6	Organization	State	State	Farmers	State	Farmers/State	Private
	Funding	Public	Comm	Comm	Public/Comm	Comm	Comm
	Incentive	Govt	Profit	Profit	Govt	Profit	Profit
7	Organization	State/Farmer	State	Farmers/NGO	State/NGO	Farmers/NGO	Private
	Funding	Public	Public/Donor	Comm	Public/Donor	Comm/Donor	Comm
	Incentive	Govt	Govt	Profit/Vol	Govt/Vol	Profit/Vol	Profit
8	Organization	Farmer/State	Private/State	Farmers/NGO	Farmers/NGO	Private	Private
	Funding	Comm	Comm	Comm	Comm/Donor	Comm	Comm/Donor
	Incentive	Vol/Profit	Profit	Profit	Profit/Vol	Profit	Profit/Vol

1. **Organization.** State = a state agency, NGO = staff of a voluntary agency, Private = a private organization or business, Farmers = a group of farmers or individual farmer
Funding. Public = public funds, Donor = external donor or NGO funds, Comm = commercial transaction (or compensated farmer activity)
Incentive. Govt = government service, Vol = voluntary or community service, Profit = commercial incentive

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Public Policy, Public Investment, and Private Investment in Seed Supply—Experiences in Turkey and India

C E Pray[1]

Abstract

Many African countries have sought to encourage private sector participation in the seed industry by liberalizing input markets and privatizing government parastatals. However, in many cases the private sector has been unable to respond fully to these initiatives, either because policies have not actually been reformed or because the private sector is not yet sufficiently developed. This paper draws on recent experiences with seed policy reform in India and Turkey to identify the key policy and institutional reforms that encouraged growth in the private seed sector.

The reforms in Turkey and India allowed seed prices to rise, permitted new firms to enter the seed industry, and reduced restrictions on imports of varieties and seed. Large-scale private firms entered the most profitable sectors (hybrid seed), while less profitable sectors were left to small seed companies, farmers, and the public-sector. In some cases, as in Punjab, the combination of small seed companies and farmers was more efficient than the public sector in rapidly spreading new varieties. The liberalization process in Southern and Eastern Africa, with a few exceptions, has not advanced very far. A number of policy restrictions militate against private sector development. We conclude that private companies in Southern and Eastern Africa will supply seed of hybrid crops if governments lift seed price controls; allow grain prices to rise to near world market levels; eliminate government monopolies on varietal research, seed production, and marketing; and develop clear and stable policies. Government parastatals need not be privatized, but their subsidies should be reduced to allow the private sector to compete. Public research must continue to develop, import, and test new varieties of open-pollinated crops, where substantial private investment is unlikely. In addition, governments must continue to multiply early-generation seed, to ensure that enough seed is available for small seed companies, farmers, and other seed producers to multiply.

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Introduction

Many African countries have recently responded to past government failures in the provision of agricultural inputs by liberalizing trade in agricultural input markets and privatizing government parastatals. Some supporters of privatization have suggested that if the government would just step aside, the private sector would take over all the important services now provided by the government—research, variety testing, seed supply, etc. In many African countries, however, private firms have not replaced the public sector in providing agricultural inputs (Rusike 1995). Is this because policies have not actually been reformed or is it because the private sector is incapable of providing these services? One key question is whether further policy changes will encourage the private sector to increase its role in providing seed of open-pollinated varieties in Africa. A second important question is: what is the role of government investment if the private sector does play a larger role?

This paper does not attempt to answer these questions directly. Instead, it draws on recent experiences with seed policy reform in India and Turkey to identify the key policy and institutional reforms that encouraged growth in the private seed sector. It identifies activities and crops where private investment is unlikely and public investment is still needed. The paper then identifies policy areas that could constrain the development of the private seed industry in Southern and Eastern Africa.

Demand, Prices, and Policy Factors

Farmers' decisions on seed purchase can be broken down into three component decisions—how much area to plant under that crop, which Variety to plant, and how much seed of that variety to buy to meet their target area.

The variety decision is based on the economically important genetic characteristics of the variety, such as yield, yield variability, disease/pest resistance, grain quality, and cost. Superiority of a new variety will depend on these qualities, and the speed at which these qualities are lost as the variety become genetically mixed or resistance breaks down. Farmers will not buy new varieties unless they give a marginal return of at least 100% ($1 in additional seed cost must give $2 in increased profits) and some private firms feel that the increase must be at least 300% (Lopez-Pereira and Filippello 1994:16). Once the farmer chooses a variety, he must determine how much of his farm to allocate to production of that crop. If the farmer is interested in maximizing profits, the land allocation is optimum when, at the margin, profits are equal for all different crop activities.

After deciding on the variety and the area of the crop, farmers will decide how much seed of the variety to buy. This decision depends on how fast farmers can multiply the seed themselves and how many years they should retain farm-saved seed before they purchase fresh seed again. Most farmers buy new seed of hybrids each year because yields may decline by up to 30% if seed is re-used. Many farmers in developing countries buy a small amount of seed of varieties of open-pollinated crops which they multiply for several seasons until they have enough to plant the desired amount of land.

Private companies will not enter a new industry or expand unless they believe that there will be sufficient demand (and therefore sufficient profits) and their share of the market will be sufficiently large. Thus, a firm must offer seed that is considerably superior to seed that farmers produce and store themselves. At the early stages of seed industry development, when farmers do not have much confidence in commercial seed firms, the superiority must be particularly great.

This implies that firms must sell either high-yielding varieties or hybrids.

Firms are responsive to changes in seed prices. In the early stages of the industry, supply may be somewhat inelastic because it takes time to effectively set up and coordinate the different functions and because the seed industry is quite risky. Therefore increased demand will increase prices, but it is precisely these higher prices that attract investment and accelerate the growth of the seed industry.

Government policies will also affect the speed at with the private sector expands. If governments hold down prices through price controls, if they reduce the size of the market by supplying seed through government agencies, if they drive up the firms' costs through taxes or regulations, fewer firms will enter the industry and some will drop out. If the rules of the game—property rights, legal system, taxes, and regulations—are not clear, fewer firms will enter the industry.

Foreign companies will supply seed and transfer technology if they expect to make profits in that country and can repatriate some of the profits. They need a return on investment that will be larger than alternative investments in other countries. If foreign firms transfer technology and conduct local research, they must be assured that the costs of transfer will not exceed the income they make from transferring that technology. To make profits from research or technology imports, three requirements must be met:

- The time required to develop or adapt a new, farmer-acceptable variety must be relatively short (1-5 years)
- The firm must be able to charge a sufficiently high price for products that embody the new technology (appropriability)
- The market must be large enough to justify the investments in research and adapting the technology.

Seed Industry Growth in India and Turkey

Situation before the reforms—Turkey

The demand for commercial seed in Turkey was created by imports and local development of improved varieties, particularly wheat varieties in the late 1960s. In collaboration with CIMMYT, US, Soviet, and European scientists, Turkish government institutes introduced varieties of semidwarf spring wheat, improved winter wheat, sunflower, and cotton in the 1960s and 1970s. Government scientists also worked on maize hybrids and open-pollinated varieties from the 1950s, but none of the government maize varieties or hybrids had much success. Successful research and technology transfer in semidwarf wheat created demand among farmers for large amounts of commercial seed for the first time in Turkish history.

The Turkish government responded to this demand by importing high-yielding wheat varieties for a few years in the late 1960s and establishing a seed component of the government's agricultural input supply agency, now called TIGAM (General Directorate of Agricultural Enterprises). TIGAM held a monopoly on the production of seed of early generations of new varieties. Distribution of seed to farmers was in the hands of government-sponsored cooperatives.

The national seed law, passed in 1963, gave the Ministry of Agriculture control over seed production, domestic trade, imports, and exports. Seed prices were fixed by the government based on costs of production. No imports were allowed except through the government seed agency. All new varieties had to be tested and approved by the Ministry of Agriculture. Only public research institutes and universities could enter varieties into the tests, which gave the public sector a monopoly

on variety development All commercial seed had to be quality-certified by the government before it could be sold.

Situation before the reforms—India

In India the modern varieties produced by the Green Revolution stimulated the growth of the seed industry. Research institutes of the Indian central and state governments produced a steady stream of wheat, rice, cotton, coarse grain, and sugarcane varieties after Independence. Green Revolution wheat, rice, maize, millet, and sorghum varieties along with hybrid cotton were all developed in the 1960s by government research agencies—often working in collaboration with scientists from the USA, UK, and international agencies such as FAO, Rockefeller Foundation, CIMMYT, and IRRI. Before the 1960s the demand for early-generation seed of new varieties was filled by government research and extension services. These agencies were inadequate to meet the huge increase in demand created by the Green Revolution.

In response to the increase in demand the Indian government established a National Seeds Corporation (NSC) that was supposed to assist state governments and private companies to expand seed production. However, NSC soon concentrated most of its resources on expanding its own seed production and distribution system. Early-generation seed of improved varieties was produced at research institutes and universities. NSC contracted private growers to produce commercial seed, and marketed the seed through government cooperatives. State governments also established state seed corporations (SSCs) modeled after NSC. The government and Ford Foundation imported seed of some high-yielding wheat and rice varieties for a few years starting in 1966. But as the capacity of NSC, SSCs, and local private companies expanded, the government banned import of commercial seed (except vegetable seed) and restricted exports. Two pieces of legislation in 1969 and 1973 restricted seed industry participation to relatively small, Indian-owned firms. Firms with assets over Rs 1 billion (then worth approximately US$ 80 million), or with over 40% foreign equity, were not allowed to invest in the seed industry.

Unlike in Turkey, local private companies were allowed to introduce their own varieties, and government certification of quality was never mandatory in India. The National Seeds Act was passed in 1966 and implemented in 1968, establishing a voluntary variety testing and certification system. Government variety testing and seed quality certification was established throughout India, but it was mandatory only for government varieties and government seed production. Uncertified seed can be sold as "truthfully labeled"—the name of the variety, germination rate, and purity of the seed must be mentioned on the label. If the seed fails to meet that standard the firm can be prosecuted by the government or by farmers.

In the 1960s NSC did provide some technical assistance to local entrepreneurs and farmers who wanted to enter the seed business. NSC also used these companies as contract seed producers, giving them an assured market in the early stages of production. The individuals who were assisted by NSC became the pioneers of the seed industry and now run the largest private seed companies in India. The government controlled seed prices by fixing the price of seed supplied by NSC and SSCs, and seed prices for government varieties. These prices were often below the true costs of production, processing, and distribution. Consequently, NSC and many SSCs suffered large deficits.

Seed sector reforms in Turkey and India

Seed industry reforms started in 1982 in Turkey and in 1986 in India. In both coun-

Table 1. Seed industry structure and regulation before and after reforms in India and Turkey.

	Turkey pre-reform	Turkey after reform	India pre-reform	India after reform
R&D	Govt monopoly	Govt and private, incl MNCs	Mainly govt, some private	Govt on OPVs and hybrids, private on hybrids
Seed production	Govt monopoly on improved varieties	Govt and private, incl MNCs	NSC, SSCs	NSC, SSCs, and private incl MNCs
Seed marketing	Govt, coops monopoly on improved varieties	Govt, coops, and private, incl MNCs	Private companies; no big firms or MNCs	NSC, SSCs, and private incl MNCs
Variety registration	Mandatory testing	Mandatory testing	Voluntary testing	Voluntary testing
Seed regulations	Mandatory certification	Mandatory certification	Voluntary certification	Voluntary certification
Price regulations	Govt sets prices of improved varieties	No price controls	Govt control on public varieties	No price controls
Seed imports and exports	Only govt	Private with govt permission	Only govt or with govt permission	Vegetables unrestricted. New varieties of oilseeds and coarse grains for 2 years. No imports of wheat, rice, or cotton seed

MNCs = multinational corporations, NSC = National Seed Corporation, SSCs = State Seed Corporations

tries the reforms allowed new companies into the seed industry and opened parts of the industry to international trade. The Turkish government made a commitment in 1980 to liberalize the entire economy; liberalization of the seed industry followed a few years later. In India the seed industry was liberalized somewhat earlier than the rest of the economy. The government did not make a commitment to general liberalization until 1991, while seed reforms had begun in 1986. Table 1 summarizes the structure and regulation of the Indian and Turkish seed industries before and after reforms.

Reforms in Turkey

In Turkey, seed industry reforms started in 1982. The government monopoly on commercial seed supply was gradually dismantled. Maize was the first crop affected by these changes. First, the government tested many private (foreign) varieties and imported and distributed seed of these varieties through 1984. Although firms were officially allowed to set prices from Dec 1993, maize seed prices were controlled by government—first at a seed:grain price ratio of 3:1 through 1984, and 10:1 for the next 2 years when the government still controlled maize seed imports. In the late 1980s the government stopped interfering in markets; in 1993 the ratio reached 24:1 for some of the most popular hybrids (TEBD 1994).

Starting in 1985 the government allowed companies to establish their own distribution network, sell seed, and set their own prices. Imported varieties still had to pass through

the government variety testing system but the time required to test a variety dropped from about 5 years to 1 year. Local production of commercial seed was encouraged by government subsidies and by linking seed import licences to the company's seed exports.

Recently subsidies have been withdrawn for local production, and imported varieties are allowed in with a minimal amount of local testing. However, imports of commercial seed are still subject to restrictions through the licensing system.

Public investments in the seed industry have declined. Government plant breeding research is currently (1995) being starved by lack of funds. The government seed corporation, after growing during the 1980s thanks to a World Bank project, is now getting less money from the government. Thus, it is under pressure to be profitable and could perhaps be privatized.

Reforms in India

The government started to look more favorably on private sector development in the early 1980s. Private companies were allowed to set their own seed prices for varieties developed in their own breeding programs. However, they were not allowed to raise prices on public varieties. Private companies developed their own hybrids of pearl millet, maize, sorghum, and cotton, and several companies made very large profits (particularly on hybrid cotton) under the liberalized pricing system. This was especially obvious to people within these companies. Many of them split off to establish their own seed companies.

In the late 1980s, the government reduced barriers to entry of foreign firms and large Indian companies, and liberalized regulations on imports and introduction of new agricultural technology. In 1986, the seed industry was opened to foreign-owned firms and large Indian conglomerates. In 1988 a new law allowed firms to import commercial vegetable seed with no trade restrictions (except a small tariff) and to import commercial seed of foreign varieties of coarse grains and oilseeds for 2 years, after which seed firms had to produce the seed inside India. Restrictions on imports of varieties and germplasm for research purposes were greatly reduced. In 1991 the whole economy began a massive process of liberalization, which has reduced regulations on technology transfer and on the role of foreign firms.

The government continues to invest heavily in research and seed distribution. The Indian research system continued to increase in size in real terms until 1994, when it leveled off. Investment in government seed production has also grown, although from the mid 1980s through the 1990s the central government and some of the state governments have been pressing NSC and the SSCs to at least cover their production costs if not make a profit. In some states (e.g., Punjab) there has been a substantial reduction in the government subsidy and thus a reduction in size of the SSC.

Summary of reforms

The reforms did not privatize the government seed corporation in either country. In the 1980s government seed production grew in both countries, thanks in part to loans from the World Bank. However, in the 1990s both governments are cutting back on their subsidies to government seed companies, placing them under increasing pressure to be efficient. In some parts of India (e.g., Punjab) the provincial government has decided that large SSCs are no longer essential. The Punjab SSC plays only a small role in foundation seed production and in the production and distribution of commercial seed.

In India and Turkey the reforms left in place restrictions on seed trade. In India "canalized items"—seed of groundnut,

cotton, sunflower, soybean, safflower, and rapeseed—can be imported only through agencies designated by the central government. Restricted items—seed of castor, cotton, fodder crops, jute, onions, and others—can be exported only with government permission. Import of rice and wheat seed is still not allowed. In addition, samples of imported varieties and inbred lines have to be deposited with the Indian government's National Board for Plant Genetic Resources. In Turkey seed importers must obtain government licenses that are allocated to firms that agree to produce locally for export. Cotton seed sale is still restricted to cooperatives that are controlled by the government.

In summary, the reforms consisted of three main changes. First, seed prices were allowed to rise. Second, new firms were allowed to enter the seed industry—in Turkey the government monopoly was broken; in India foreign firms and large Indian companies were allowed to conduct research and supply seed. Third, restrictions on imports of varieties and germplasm were greatly reduced and bans on import of commercial seed were lifted in both countries, although major restrictions on commercial imports remain in both countries.

In addition, several important preconditions were in place which allowed private seed companies to prosper. First, the success of Green Revolution varieties of wheat, rice, and coarse grains led to demand for large quantities of seed of improved varieties of major field crops. Second, both governments made major investments to develop human and physical capital for agricultural research and the seed industry. Third, complementary inputs such as fertilizer, irrigation, and pesticides were available.

Impact of Reforms

The impact of reforms fits in well with expectations based on economic theory. Private competition grew rapidly in profitable sectors of the seed industry but not in other sectors. Private firms provided farmers with new technology—in Turkey, technology developed in other countries; in India, technology developed by Indian research programs using foreign and local germplasm. This section looks at the patterns of private sector activity and what caused them.

Private seed supply

In Turkey, private companies moved rapidly to supply seed of hybrid maize, soybean, and vegetables. Table 2 shows that by 1985 the private sector had already taken over most hybrid maize and vegetable seed production and was producing over 40% of the soybean. By 1990 it was producing 80% of the seed potatoes and soybean seed, two-thirds of the sunflower seed, and a small share of the wheat seed. TIGAM, the government seed company, still dominates wheat and barley seed, while government cooperatives provide almost all the cotton seed.

In India, as in Turkey, reforms appear to have been particularly important in increasing the supply of hybrid seed, but they also probably increased seed sales of open-pollinated varieties. Commercial seed sales by the public and private sectors grew rapidly from 250 000 t in 1980/81 to 484 000 t in 1984/85 and 764 700 t in 1992/93 (Agrawal 1997). Industry sources indicate that the share of the private sector has remained at approximately 50% from 1984/85 to the present.

Accurate estimates of current production by the public and private sectors are not readily available, but Table 3 gives an idea of the sources of seed used by farmers in India. In 1987 less than 10% of seed came from the commercial sector. The rest was produced by farmers themselves or by very small seed companies. Within the commercial sector, production was split equally between private firms and the government. This is still the

Table 2. Commercial seed production (tons) by registered seed companies in Turkey, 1980-93.

Crop	Sector	1980	1985	1990	1993
Wheat	Private	0	<1000	7 000	10 000
	Public	49 000	188 000	124 000	103 000
Barley	Private	0	0	0	300
	Public	13000	35 000	16000	10 000
Hybrid sunflower	Private	0	80	2600	3 500
	Public	0	10	30	40
OPV sunflower	Public	2 500	4 800	1000	200
Hybrid maize	Private	900	1 800	4 500	7 200
	Public		300	200	200
Sugarbeel	Private	na	3400	na	3 300
	Public	na	0	na	3 300
Cotton	Private	0	0	500	300
	Public	35 000	27 000	30 000	31 000
Potatoes	Private	200	800	4 200	2 200
	Public		6 300	900	200
Chickpea	Private	0	0	0	90
	Public	0	200	200	70
Soybean	Private	0	800	3 200	3 600
	Public	0	1 100	600	200
Vegetables	Private	191	300	600	700
	Public		30	30	30

na = data not available

Source: Turkish Seed Industry Association

case today, according to officials of the Seed Association of India. The private sector tends to specialize in hybrid seed of sorghum, maize, pearl millet, cotton, and sunflower, while wheat and rice varieties make up the bulk of public sector sales. However, even for rice the private sector supplies most of the seed. Public hybrids and public varieties are also sold by private firms. Large firms want to be able to provide their customers a full line of varieties and so they supply public varieties if they do not have their own hybrids. Many small firms and farmers also produce and distribute public varieties.

Research and technology transfer

Many of the varieties supplied by the private sector embodied new technology that was either imported or developed by private companies. In Turkey there was an influx of new varieties from abroad (Table 2). Maize, sunflower, potato, and vegetable varieties were particularly important Companies found that their varieties which were developed for the USA or Europe did so well in Turkey that there was no need to establish local breeding programs. All that was needed were locations where they could test these

Table 3. Seed requirements and commercial supply of major field crops in India, 1987.

Crop	Total seed sown ('000 t)	Commercial seed		Public supply ('000 t)
		Quantity ('000 t)	Value (Rs million)[1]	
Wheat	2088	158	650	105
Paddy rice	1025	132	550	52
Sorghum	992	25	400	19
Maize	150	13	150	4
Pearl millet	110	15	150	6
Pulses	677	23	250	14
Groundnut	635	38	300	14
Other oilseeds	176	16	200	9
Total	**5853**	**420**	**2650**	**223**

1. Exchange rate in 1987 approximately US$ 1 = Rs 28

Sources: Pray 1990, World Bank 1987 (public sector seed)

Table 4. Hybrid seed production (tons) by the private and public sectors in India, 1993/94 to 1995/96.

Crop	Source	1993/94	94/95	95/96 (expected)
Sorghum x sudangrass	Public	0	0	0
	Private	8400	7200	16 000
	Share of Private	100%	100%	100%
Sunflower	Public	600	900	700
	Private	4500	4800	4900
	Share of Private	89%	84%	87%
Pearl millet	Public	5600	6500	4600
	Private	9400	11 300	11 200
	Share of Private	63%	64%	71%
Sorghum	Public	11000	9200	17 600
	Private	4600	3900	11 200
	Share of Private	30%	30%	39%
Cotton	Public	3000	5900	7700
	Private	600	1600	2500
	Share of Private	16%	21%	25%
Maize	Public	14000	15000	15 000
	Private	17 000	25 000	27 500
	Share of Private	55%	63%	65%

Source: Seed Association of India

varieties. Only one firm, Pioneer, established a research program in Turkey to develop new sunflower hybrids resistant to *orobunki,* an important parasitic weed.

In India the reforms stimulated local research. The number of companies conducting research rose from 20 in 1985 to 41 in 1995 (Agrawal 1997) and real investment in research *tripled* between 1986 and 1995 (Pray 1997). Subsidiaries or joint ventures with multinational companies—which had been excluded before the reforms—accounted for 36% of all private seed industry research in 1995. Another reason was that local firms and multinationals started research programs on rice and mustard which now account for 16% of total research (Pray 1997). This built upon previous research successes—practical ways of producing hybrid rice seed, developed by public research, and methods of producing hybrid mustard, developed by both public and private researchers.

The results of private research are apparent from the increase in area under proprietary hybrids. Figure 1 shows that proprietary maize hybrid sales increased rapidly in the 1990s. Multinational firms developed proprietary hybrids combining local germplasm with germplasm developed by the firm outside India or from CIMMYT (Singh et al. 1995). The Seed Association of India recently estimated the share of private hybrids based on information from both public and private corporations. Their estimates (Table 4) indicate that private hybrids make up the largest share of the market in fodder (sorghum x sudangrass), sunflower, pearl millet, and maize. Private hybrids also have an important and growing share of the market in cotton and sorghum.

Technology was transferred through different paths in the two countries. In Turkey it was primarily through imported hybrids and there were large imports of seed in the early stages of liberalization. In India most hybrids were developed by private companies using imported inbred lines or germplasm—

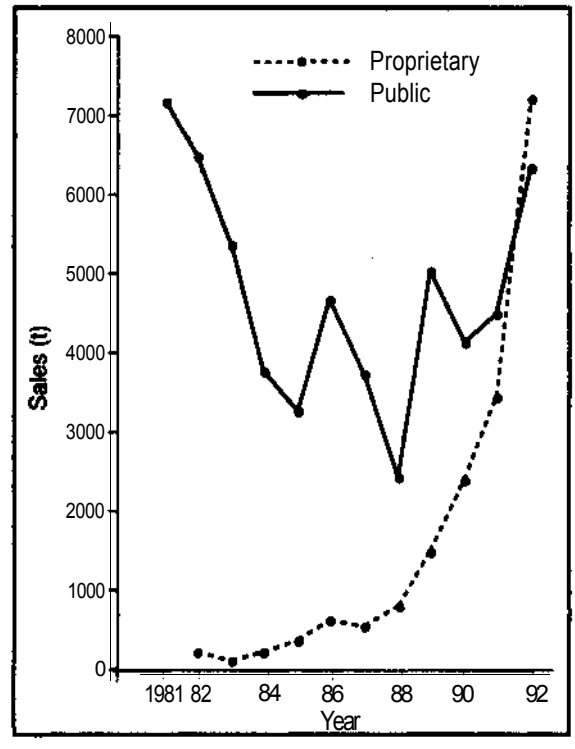

Figure 1. Sales of hybrid maize seed in India, 1981-92

imports of commercial seed were not important. Thus, it appears that openness to technology rather than actual technology imports is the crucial factor.

Impact on farmers

Maize yields have increased in both countries as improved varieties became available. Figures 2 and 3 show that yields were stagnant in India and growing slowly in Turkey befpre the reforms. In Turkey average maize yields nearly doubled after the reforms in the early 1980s. In India public maize hybrids were already in use before the reforms, but yields increased in the late 1980s and early 1990s, partly due to the increase in private research and the adoption of private hybrids. In Turkey the impact on sunflower was equally important, although harder to document. All the popular sunflower varieties had lost their resistance to

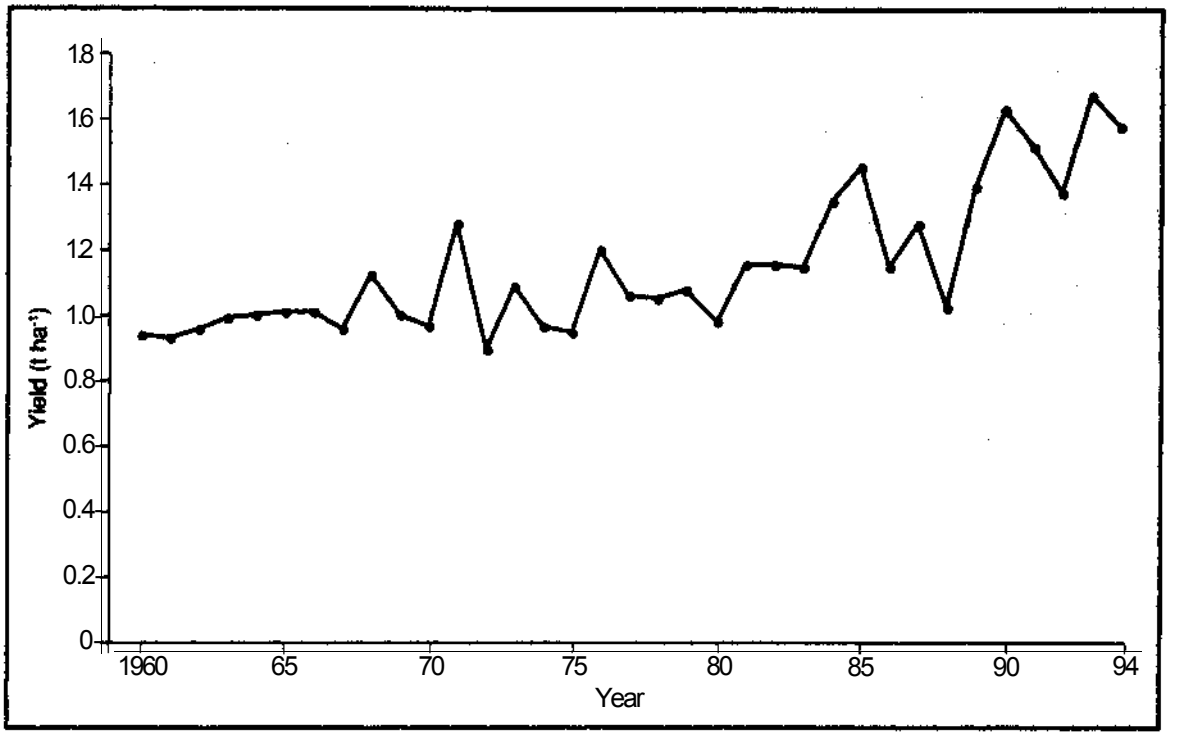

Figure 2. Maize yields in India, 1960-94.

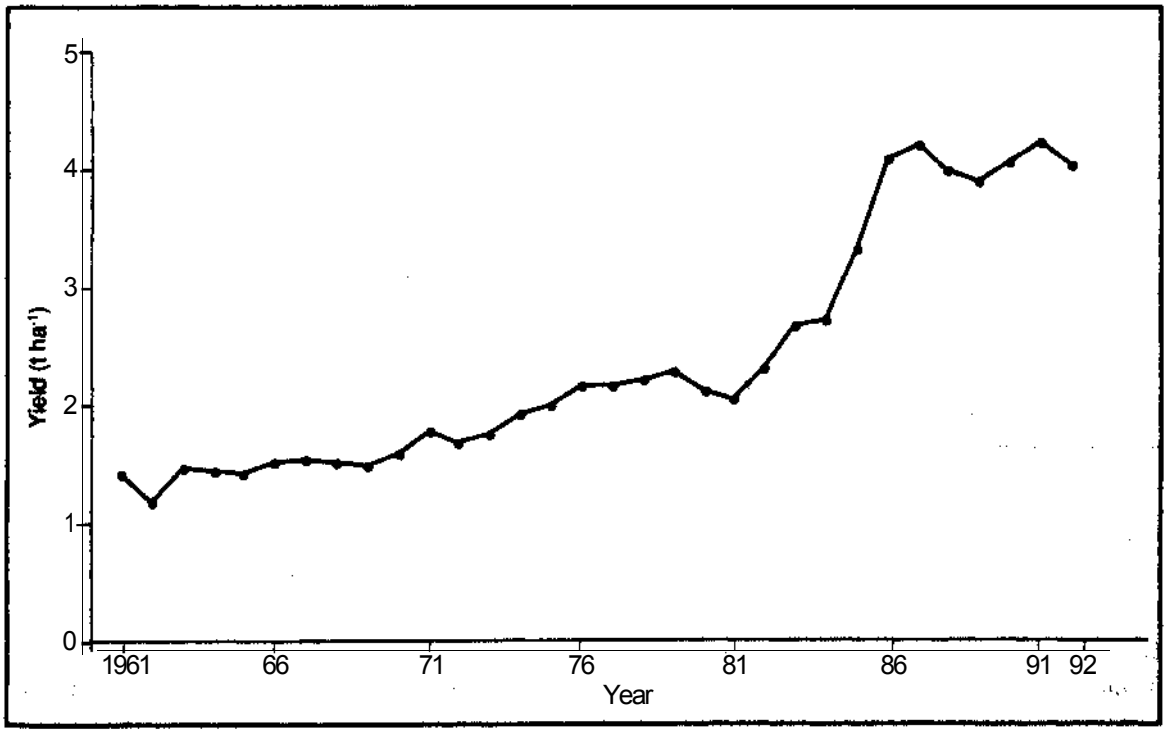

Figure 3. Maize yields in Turkey, 1961-92.

orobunki, a parasitic weed, and yields and acreage would have been expected to decline. With the new hybrids, both yields and acreage increased (Gisselquist and Pray 1997).

Impact on seed industry structure

In both countries, opponents of trade liberalization and privatization feared that the local seed industry and local research would be overwhelmed by imports. In Turkey, imports were much higher in crops with less liberalization and privatization. During the 5-year period 1989-93, annual average-seed imports by government agencies and cooperatives were—wheat 9326 t, barley 1001 t, and potatoes 5150 t. Imports were much lower for crops where the seed trade was liberalized—on average 159 t of maize and 151 t of sunflower (TEBD 1994). This outcome is not entirely due to the market. Government policies encouraged local seed production by restricting imports and subsidizing local seed production.

Another concern was that the local seed industry would be dominated by foreign-owned firms. In Turkey foreign firms did capture an important share of the crops that were liberalized, but local firms have also increased their production and the government continues to control wheat and barley. One indication is the share of planned seed production (Table 5). Subsidiaries of six foreign firms produced about half the hybrid maize and sunflower. Most of the remainder, and 98% of the soybean seed, was produced by six Turkish firms that have joint ventures with foreign firms.

Unofficial estimates from the firms we interviewed suggest that the market share of the largest firm is about 30% in maize and 25-30% in sunflower. There does appear to be free entry into these segments of the industry because the largest firm selling maize seed reports that their market share is being eroded by small firms that are undercutting prices.

In India foreign imports and multinational firms had less impact on the structure of seed sales. Commercial seed imports are still primarily for vegetables. The market share of foreign firms has undoubtedly increased since 1987. Cargill, Ciba-Geigy, Unilever, and Zeneca entered the market since then and as noted above, they are doing more than a third of the research, which should enable them to increase their share in the near future. However, the market leaders in terms of sales are still Indian companies led by Maharashtra Hybrids. Unfortunately, no precise data is available on market share held by foreign companies. However, a recent study of maize found that "Fears that the industry would soon be dominated by a small number of transnational companies thus far have proved to be unfounded (Singh et al. 1995:13)".

Table 5. Seed production plans (production in tons, percentage share in parentheses) by type of firm, Turkey, 1994.

Type of firm	Maize	Sunflower	Soybean	Wheat
Subsidiaries of foreign firms	6200(50%)	1500 (48%)	0	2500(1%)
Joint ventures	5500(45%)	1500(49%)	3100(98%)	0
Other private firms	400(3%)	0	0	6800 (2%)
Govt firms	310(2%)	110(3%)	70(2%)	275 000(97%)
Total	**12400**	**3100**	**3200**	**284 000**

Source: Calculated from MARA 1994

Limits of reform: non-impact on small markets and open-pollinated crops

Seed supply. When the policy reforms took place in the 1980s private companies, particularly multinationals but also local firms, moved in fairly rapidly to supply hybrid seed—maize and sunflower in Turkey, cotton, maize, sorghum, pearl millet, and sunflower in India. Large private companies have moved much more slowly to supply seed of open-pollinated crops such as wheat and rice and into areas with less than ideal growing conditions such as the maize areas along the Black Sea coast in Turkey.

This does not mean that farmers who grow wheat and rice in India or wheat and barley in Turkey cannot get good seed. Parastatal seed companies continue to supply seed for these crops and more importantly, to small local companies and farmers. Table 3 shows that farmers provide most of the seed of open-pollinated crops in India and parastatals also have a major role, particularly in wheat. Yields of these crops continue to rise, suggesting that the combination of government supply and farmer supply has been effective.

Impact on research

Policy reform did not lead to a major increase in research in Turkey. Private companies conducted varietal trials primarily to identify the best US and European varieties of hybrid maize and sunflower. The market did not require research because maize hybrids from the US corn belt and Europe grow very well in irrigated and high-rainfall regions of Turkey. The market for maize seed on the Black Sea coast was too small to justify a research program.

Reform did induce private companies to invest in research in India. Almost all this research was on hybrids. The crops listed in Table 6 are all hybrids, and the "others" category is almost entirely hybrid vegetables. Private firms have started breeding rice and rapeseed and mustard in India recently, because of breakthroughs in the production of hybrids in these crops. India is a much larger market for hybrids than Turkey, and agroclimatic conditions are considerably different from those in the main markets of multinational companies.

Table 6. Private sector plant breeding research in India, 1987 and 1995.

	No. of firms with R&D		Research expenditure (million 1995 Rs)		Share of research expenditure (%)	
	1987	1995	1987	1995	1987	1995
Sorghum	10	27	7	21	17	14
Pearl millet	12	30	8	20	19	13
Maize	6	24	4	23	11	15
Sunflower	10	26	7	21	18	14
Cotton	9	27	4	27	11	17
Mustard	1	9	1	10	2	6
Rice	0	15	0	16	0	10
Others	9	20	9	16	22	10
Total			**40**	**154**		

Role of government for open-pollinated crops[1]

Government seed companies continue to operate in both India and Turkey. However, the experience in Punjab suggests that large government seed companies are no longer needed, and that farmers and the private sector can be the primary distributors so long as the government continues to develop new varieties, provides foundation seed, and does not interfere greatly with seed markets.

In Punjab new varieties of wheat spread through a combination of university production of breeder seed and production of "commercial" seed by farmers and small seed businesses. A new variety is first tested for 3 years on Punjab Agricultural University (PAU) experimental stations, and then in six nonreplicated trials on farmers' fields in each district. Three trials are managed by PAU extension agents and three by Department of Agriculture extension agents. At the same time PAU starts multiplying seed of the new variety.

If a variety performs very well in the trials, farmers immediately start multiplying the produce from the trials. The variety is submitted to the State Variety Release Committee for approval for cultivation within Punjab. PAU provides breeder seed to the Punjab State Seeds Corporation (PSSC) but also keeps at least 25% of the breeder seed for direct sale to farmers. It is sold in packets of 1-2 kg at farmers' fairs which are held twice a year at four places around the state.

Farmers and small seed companies multiply superior varieties very rapidly. The most efficient farmers plant 12-25 kg ha^{-1} of seed and produce 4 t, a multiplication ratio of 1:320 compared to a ratio of 1:40 at PAU and even less by the PSSC. A few companies have winter nurseries so that they can produce two crops a year. Companies then sell the new variety at a premium. Farmers who produce new varieties keep some for themselves, give some to their friends and relatives, and sell some. Officials from small seed firms in Ludhiana said that they had to multiply the crop quickly because they could charge a price premium only during the first two seasons after a new variety is available to farmers. After that, farmers produce enough for their own needs; and as demand declines, the market price falls to a level where seed companies can just cover their production costs.

PSSC plays only a small role in the spread of wheat varieties because it does not start selling certified seed until after farmers have multiplied the variety for several years. PSSC's slowness also makes it difficult for it to find markets for its seed and to realize a profit.

Public Policy And Investment Issues for Africa

Policy and investment constraints in Africa?

Are public policies or lack of public investment constraints to seed supply for open-pollinated crops in Africa? Two recent studies of institutional structure of African seed industries suggests they could be, and thus need to be studied further. Seed laws in most African countries require that varieties be tested and registered, and all commercial seed be certified. These regulations make it difficult to move varieties from one country to another (Gisselquist 1997). This contrasts with India, where registration and certification are voluntary; and Turkey, which has reduced variety testing to 1 year at several company-run sites.

Countries in Southern and Eastern Africa are starting the same liberalization process that Turkey and India are involved in. How-

1. Information on Punjab taken from Ministry of Agriculture (1989).

ever, with a few exceptions (e.g., South Africa), liberalization has not advanced very far. Table 7 summarizes seed policies in five countries in Southern and Eastern Africa. In all these countries except Zimbabwe, seed supply of improved varieties and hybrids of the major field crops is a parastatal monopoly or near monopoly. In Zimbabwe, a cooperative with close ties to the government had 92% of the hybrid maize market in 1993 (Rusike 1995:123). Most of the major multinationals including Cargill, Pioneer, Unilever, Zeneca, and others are active in the region, but have very small market shares. Prices were controlled in all five countries until recently; Tanzania lifted price controls in 1990, Zambia and Zimbabwe in 1993. Only Zimbabwe and Kenya have plant breeders' rights (PBR) in effect, but the other three countries have passed PBR legislation or are currently discussing such legislation. Tanzania and Zambia began major reforms in the 1990s—special laws guaranteeing the right of private firms (domestic and foreign) to participate in the seed industry, and tax breaks to attract foreign companies (Rusike 1995).

Private sector investments in research in Africa may not be as potentially profitable as in India and Turkey. The only readily available data is for maize, which overstates

Table 7. Policies and institutions that affect the seed industry in five countries in Southern and Eastern Africa.

	Kenya	Malawi	Tanzania	Zambia	Zimbabwe
Seed law enacted	1972	None		1967	1952, 1965
Variety registration	Mandatory			Mandatory	Mandatory
Seed certification	Mandatory			Mandatory	Mandatory
R&D	Govt R&D	Govt R&D	Govt R&D	Govt R&D	Govt R&D monopoly until Pioneer enters 1985
Seed production and marketing	Parastatal monopoly	Parastatal and Cargill until 1989. Unilever enters 1991	Parastatal monopoly until 1990. Cargill enters 1991, Pioneer and Pannar 1993	Monopoly prod by ZamSeeds, distribution through coops until Pioneer 1991, Cargill, Pannar 1992, Carnia 1993. ZamSeeds now produces 96% of maize seed	Seed Co monopoly on sales until 1980s. Seed Co now produces 92% of maize seed
Seed price policy	Govt controls prices	Govt sets most prices	Prices decontrolled 1990	Hybrid maize prices decontrolled 1993	Prices decontrolled 1993
Plant Breeders' Rights	Not implemented	None	None	None	1973

the role the private sector would play in other crops. Substantial public investments (and some private investments) in breeding have been made in Africa. However, the investments are much smaller (relative to production) than in Asia and Latin America (Table 8).

Lessons from Turkey and India

First, if African governments lift seed price controls; allow grain prices to rise to near world market levels; eliminate government monopolies on varietal research, seed production, and marketing; and develop clear and stable policies, private companies will supply seed of hybrid crops. The market for hybrid maize is large enough to attract foreign and local companies to sell seed and to conduct regional research. Government parastatals need not be privatized, but their subsidies for the production of commercial seed should be reduced to allow the private sector to compete. When this happened in India and Turkey, the private sector rapidly took over the hybrid seed market from parastatals.

Second, private companies could deliver new hybrid seed technology as they did in Turkey if barriers to importing germplasm, inbred lines, and commercial seed are reduced. Zimbabwe and South Africa have long been exporters of maize varieties and seed to other countries in the region. Thus, many countries could benefit from imports of technology if new varieties are not slowed by quarantine systems that act only as trade barriers, mandatory variety testing that takes years, and limits on commercial imports of seed.

Third, public research must continue to develop, import, and test new varieties of open-pollinated crops. Even with the passage of PBR legislation private companies are not likely to invest much money in breeding or importing and testing open-pollinated crops. This legislation is difficult to enforce in developing countries.

Fourth, appropriability—and therefore private research—can be strengthened for crops that are presently open-pollinated by developing inexpensive methods for producing hybrids. In India the development of hybrid tropical rice and hybrid mustard has stimulated many private companies to start working on rice and mustard, crops they had previously ignored.

Fifth, if scientists are successful in identifying or developing new varieties, the government must invest some money in multiplying early-generation seed. There must be enough seed available so that small seed companies, farmers, and other seed producers can obtain small amounts of seed to multiply.

Sixth, the government can provide the private seed industry with technical assistance and foundation seed of public varieties, following the Indian pattern. The Indian government, with technical assistance from the Rockefeller Foundation and USAID,

Table 8. Public and private sector maize scientists in less developed countries.

	Sub-Saharan Africa	Asia (excluding China)	Latin America
No. of public maize breeders	86	175	180
No. of other researchers	188	240	85
No. of private researchers	38	169	108
Breeders per million ton maize production	5.4	12.9	10.3

Source: Byerlee et al. 1994

provided business and technical training and foundation seed to private entrepreneurs who wanted to enter the seed business. In the mid 1960s the government began training farmers on seed production; these training programs were continued by state seed corporations when they were established in the 1970s. This process developed a large pool of technically skilled farmers, who could be contracted by private or public companies.

Seventh, the goal of a regulatory system in a market economy should be to encourage private companies to introduce new varieties and high quality seed and to ensure that the industry is competitive. This requires a fundamental change in attitude—regulators in many countries see private companies as the enemy to be controlled and restricted. Both Turkey and India went through changes of this sort in parts of their bureaucracy. Variety testing and seed certification are still mandatory in Turkey, but are now conducted in such a manner as to ensure that the procedures are no longer a barrier to variety imports and seed production and distribution. In India the 1988 New Seed Policy explicitly acknowledged the importance of the private sector and reduced restrictions on importing varieties for testing or use in breeding. Equally important, government officials started to work with the industry, not against it.

A checklist of issues for policy reform

If African policy makers wish to encourage a larger role for private seed companies, the experience of Turkey, India, and other countries suggests they need to look at the issues listed below. This could be used as a checklist of issues which any policy reform program would have to address.

Barriers to reform

- What barriers to the entry of private industry are still in place? Trade barriers to varieties and commercial seed? Barriers to private investment? to foreign investment? Are seed prices controlled?
- Which interest groups are trying to preserve these barriers? How can they be brought into the reform process?
- If a seed parastatal is to be privatized, how can a country ensure that it is not turned into a private monopoly?
- Do parastatals still receive major subsidies? Are these subsidies for the provision of seed to promote equity or some other goal of society, or are they simply to give the parastatal a cost advantage over private competitors?
- Do plant quarantine, variety registration, and seed certification really reduce the risk of disease and pests and help farmers choose the best varieties and seeds? Or do they only act as barriers to entry into the industry? What would be the costs and benefits of eliminating these regulations or making them voluntary?

The provision of public and club goods

- What is the potential social benefit from public financing of research on open-pollinated crops? Who could be taxed or organized to pay for research with high pay-offs but low appropriability?
- What are the potential social benefits from government provision of foundation seed of new varieties of open-pollinated crops?
- Can seed companies or farmers be organized to provide foundation seed or conduct research? Could the government help organize such groups? Would a government subsidy be needed?

Conclusions

The experience of Turkey and India suggests that if African countries remove policy and regulatory barriers, private firms will enter the seed industry provided markets are big enough and there is some appropriability, as in the case of hybrid seed. In addition, farmers and small companies can provide

seed of self-pollinated crops if the government provides new varieties and basic seed and allows prices to fluctuate with supply and demand. Thus, there still are important roles for government research—providing new varieties of self-pollinated crops but also supporting private research in hybrids by developing disease-resistant lines, developing new ways of producing hybrids, and running (voluntary) tests of private hybrids and varieties.

The Indian and Turkish cases suggest that two other policy changes—complete privatization of public seed supply corporations and plant breeders' rights legislation—are less important for the initial development of the private sector in Africa. Private firms can compete so long as public firms do not have large subsidies that prevent unfair competition. The absence of breeders' rights legislation did not stop private firms from developing in India; and several African countries already have breeders' rights legislation in place.

Finally, the paper provides a checklist of issues that reformers should look at when proposing seed policy reform or seed industry projects. These will hopefully assist African policy makers to develop more efficient markets in the future.

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Regulatory Constraints to Seed Multiplication and Distribution Through Alternative Seed Systems

D Gisselquist[1]

Abstract

In many developing countries, seed regulations hinder the development and functioning of a competitive private seed sector and thus limit the flow of new varieties to farmers. This paper analyzes policy constraints, and suggests specific reforms for governments, international agricultural research centers (IARCs), NGOs, and governments. Governments can make four key policy changes to stimulate private sector involvement—lower barriers to seed company entry, make variety registration optional or automatic, enforce truth-in-labeling and make other seed quality assurances available hut optional, and establish standard procedures to give seed companies access to material developed through public research. IARCs could improve farmer access to IARC lines by challenging government claims to monopoly distribution of these lines, strengthening legal mechanisms to ensure that these lines remain public goods, and marketing IARC lines and germplasm at cost to all comers, rather than distributing them free.

NGO seed projects could promote the establishment of small seed companies, thus ensuring sustainability when projects end. Donors could link aid for agricultural research to regulatory reforms to give the private sector greater freedom to introduce new varieties. Donors could also modify seed relief programs to promote sustainable private seed systems by distributing seed vouchers rather than seed.

Introduction

Farmers in many developing countries, and especially in smaller African countries, have limited access to the flow of new varieties developed by public and private research organizations around the world. In many countries, inappropriate and over-protective seed regulations are part of the problem, impeding market entry for new companies and varieties. The recommendations made in this paper challenge governments, donors, NGOs, and international agricultural research centers (IARCs) to change regulations and policies to more effectively foster the emergence of small seed companies and competitive seed markets in developing countries.

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Alternative seed systems

In this paper, the terms "alternative seed systems" and "small seed enterprises" (SSEs) refer to all small and medium private seed producers and traders (including farmers who sell seed to neighbors), NGOs, and small seed companies. This definition excludes parastatals, multinationals, and other large seed companies. Most SSEs are in the private sector. Some SSEs, such as farmers, are informal in that they do not interact with government organizations that regulate commerce or seeds. On the other hand, small seed companies, by definition, work within the framework of formal commercial markets and seed regulations.

Why include small seed companies in the definition of alternative seed systems? Compared to developed countries, many developing countries have a conspicuous lack of small and medium seed companies. The emergence of such companies is crucial to the development of a competitive seed industry supplying seeds for all crops to all farmers. One path or vision for seed system development is for informal producers—private farmers who sell seed to neighbors or produce seed in collaboration with NGO programs—to join the formal sector, i.e., to become small seed companies. The character of seed industry regulations can make this transformation easier or more difficult.

What can SSEs do?

Wherever regulations allow, SSEs can be expected to:

- Identify new varieties that farmers value, by screening potential varieties from various sources including foreign and in-country public and private research
- Sell seed of new varieties to farmers.

Identify new varieties

For all formal and informal seed enterprises in the private sector, SSEs as well as large companies, the ability to identify new seed technology that farmers want and are willing to pay for is crucial. In developed countries, the market life for new varieties is seldom more than 5-7 years, as breeders continuously deliver newer and better varieties; market life may be longer in developing countries with weaker flows of new varieties. In any case, successful SSEs and companies are those that are good at identifying what farmers want. Companies do this through tests and demonstrations. SSEs may rely on a few local farmers testing new varieties and talking to neighbors. Larger seed companies (and larger NGOs) may organize hundreds or thousands of test and demonstration plots every year.

From where do SSEs access their varieties? Without paying anyone royalties or licensing fees, SSEs can select varieties that are in the public domain, including traditional varieties and varieties from in-country and foreign public breeding (national agricultural research systems or NARS, IARCs, universities, parastatals, etc). SSEs may also arrange contracts with large foreign research-based companies to introduce their varieties; for example, a small seed company in Zambia could contract with one or more foreign seed companies to test and introduce varieties for vegetables or field crops.

Deliver seed of new varieties

Most SSEs have lower overhead costs than parastatals and large research-based private companies. Low overheads give SSEs an edge in secondary crops, relatively low-value non-hybrid seed for pulses, maize open-pollinated varieties (OPVs), self-pollinated grains (wheat), tubers, etc. For these crops, potential seed sales and profits from new varieties may be too small to attract large research-based companies.

Will farmers buy seed for beans, cereals, and other non-hybrid crops without subsidies? This depends heavily on the supply of new

varieties and on seed production costs. For non-hybrid seed, faster farm-level turnover of varieties increases seed sales and profits. A continuous flow of new varieties can create stable markets for non-hybrid seed. In addition, lower production costs allow lower seed prices, which can encourage farmers to replace seed more often, increasing seed sales and profits.

Delivering seed of public varieties to farmers. Many seed experts dealing with developing countries identify SSEs as an important (potential) link between public sector breeders and farmers, with SSEs taking varieties from public research and multiplying seed for farmers. This paper endorses that vision, with an additional feature: part of the task of delivering seed of new varieties to farmers is to winnow and select from among all new public varieties those that are of interest to farmers.

Many experts ask or expect that SSEs will accept experts' decisions about which varieties to introduce. With this approach, experts in NARS, IARCs, national seed committees, etc, recommend a relatively short list of tested varieties or even identify specific varieties. At the same time, governments and NGOs may provide some subsidies to seed producers. For example, they may give credits or inputs to farmers who grow seed, or buy seed from growers for resale to other farmers at prices that do not fully cover costs. These arrangements have some basic problems. If SSEs are to be sustainable, then they must offer seeds that farmers want. However, years of experience in many countries provide solid evidence that experts often recommend varieties that farmers do *not* want. An SSE that decided what to produce based on public sector or NGO recommendations alone would probably lose money.

For anyone producing seed, poor foresight about what varieties farmers want leads to low prices and unsold stock. With governments and NGOs involved, poor judgement can be off-set by subsidies. Subsidies can cut seed prices to a level at which farmers will buy, and cover the cost of unsold seed. Such solutions allow organizations to continue to waste attention and resources on inferior varieties. One good reason to get away from seed subsidies is to allow expert-endorsed varieties to fail, so that attention can shift to varieties that farmers value.

Arguably, SSEs must make their own decisions about what to produce if they are to produce what farmers want. With multiple SSE entrepreneurs making decisions about what farmers want, the market rewards those that make the best decisions. This process leads to steady improvement in SSE variety selection and seed supply over time. A vision with SSEs making decisions about what varieties to introduce shifts all public sector and NGO breeders and experts from directing to supporting roles. In this vision, scientists in NARS, universities, IARCs, and NGOs breed and offer their best lines and varieties. Then, based on SSE tests and on-farm demonstrations, entrepreneurs in SSEs pick and choose what they think is worth multiplying.

Enlarging the pool of varieties for SSE selection. Allowing SSEs to choose from among new varieties from both foreign and in-country research improves choice and flow of new varieties to farmers. However, enlarging the range of varieties from which to choose entails designing seed regulations to allow SSEs access to a wide range of lines from in-country and foreign breeding, and to give SSEs the authority to introduce (i.e., sell seed of) new varieties that NARS and government seed committees have not yet tested and approved.

SSEs in Peru and Turkey

Emergence of formal SSEs in Peru. In the late 1980s, Peru decentralized implementation of government seed regulations. State-level public-private committees were created

and made responsible for promoting new private seed companies and certifying seed (however, certification was voluntary). These committees controlled seed processing facilities, making them available to small seed companies that did not have their own equipment. With these arrangements, the number of seed companies in Peru increased from 11 in 1988 to 44 in 1991 and 178 in 1995. Significantly, these arrangements allowed seed-producing farmers to register as small seed companies: in 1995, from a total of 178 seed companies, 98 produced less than 10 ha of seed each, while only 21 produced over 60 ha of seed.

SSEs introduce new varieties in Turkey. In the early 1980s, the government of Turkey lowered barriers to entry for new seed companies and also to private introduction of new varieties. With these reforms, the number of companies increased from only a few vegetable seed companies in the early 1980s to about 80 companies in the early 1990s producing and trading seed for all crops; many of these new companies had formal associations with one or more seed multinationals. New companies, and in particular new channels to the international seed industry, led to a large increase in the number of varieties available for all crops, from grains to fruits and vegetables.

While Turkey has some very large multinational and national seed companies, introduction of new varieties is not limited to the giants. Medium-scale companies test and introduce new varieties, including varieties from foreign public breeding (e.g., IARCs and foreign universities) and from foreign private breeding (through licensing or other arrangements with foreign companies). In 1990, companies selling seed for as little as 4000 ha managed testing programs to identify new varieties of six field crops for introduction into Turkey (Table 1). Many of the varieties coming out of these testing programs would be grown on much less than 4000 ha, since companies offer multiple varieties.

The experience in Turkey suggests that even relatively small companies can contribute to technology transfer, testing and selectively introducing appropriate varieties from foreign public and private breeding. In other countries, the scale of seed sales required to support a testing program may be even smaller than in Turkey, since Turkish seed regulations force companies to pay some unnecessary costs for variety registration and seed certification (both of which remain compulsory rather than voluntary for major crops).

Designing Government Regulations to Facilitate SSE Activities

In many developing countries, seed regulations inhibit SSEs from contributing to agricultural development through selection of new varieties and sale of quality seed. This section recommends that governments should: (a) lower entry barriers for small seed companies, (b) lower entry barriers for new varieties, (c) reduce the costs that SSEs must pay to meet seed quality requirements, (d) give SSEs access to NARS and IARC germplasm.

Preliminary comments on regulatory reform

Reforms for small companies. Many discussions on regulatory reforms confuse the issue by focusing on whether or not to allow multinationals to enter and operate companies in a given country. Whether or not to allow a handful of multinationals is no longer the issue. Overall trends away from socialism ensure that parastatals will shrink and multinationals will enter seed markets. However, the entry of a few large companies does not mean that seed regulations will assure a competitive private seed industry.

Table 1. Private breeding and testing programs in Turkey, 1994.

Crop	Area sown, 1990	Private breeding programs	Private testing programs	Comments
Wheat	2.5 million ha spring wheat, 7 million ha winter wheat	1 company reports sending materials for foreign breeding	Approx 5 firms, each producing seed for 4000-8000 ha	Most varieties developed through govt testing and introduction of foreign public lines. After reforms, private companies test and introduce foreign varieties
Soybean	70 000 ha	?	Approx 4 firms, each producing seed for 6-20 000 ha	Dominated by private testing and introduction of foreign varieties
Maize	52 000 ha	?	>10 firms, the largest supplies seed for approx 160 000 ha	Dominated by private testing and introduction of foreign private hybrids
Sunflower	720 000 ha	At least 1 in-country program, breeding for other countries as well	>10 firms, the largest supplies seed for approx 200 000 ha	Dominated by private testing and introduction of foreign private hybrids
Cotton	640 000 ha			Dominated by govt testing and introduction of foreign varieties
Sugarbeet	400 000 ha	1, maybe 2 programs. Private foreign breeding with selection for Turkey	Approx 3; one firm supplies seed for about 360 000 ha, others share 40 000 ha	Private research dominates

Incomplete regulatory reform may simply lead to oligopoly. By selling high-value products for major crops (such as hybrid maize), large private companies can generate sufficient profits to operate in difficult regulatory environments.

This paper calls for regulatory reforms to allow a full range of small to large private companies selling seed for a full range of major and minor crops. Large private seed companies have sometimes supported restrictive regulations that block entry and competition for other companies. But there is at least one good reason for large companies to support reforms that lower barriers to entry for new large and small seed companies: the resulting broad-based private seed industry can be a powerful force against bureaucratic interference, allowing both large and small companies to operate in a secure commercial environment.

Reforms through ministries or parliaments. A number of government controls on private investment and international trade were removed during the reforms process. Before these reforms, governments (particularly ministries of agriculture) in many developing countries controlled the seed industry through general controls on private investment, access to foreign exchange for imports, permission to export, etc. When governments relax overall controls on private investment and trade, some controls on private seed industries still remain, in the form of regulations on phytosanitary import controls, seed quality, and other aspects of seed production and trade. These regulations are sometimes, but not always, based on seed laws that grant specific authority to ministries of agriculture.

The regulatory reforms discussed in this paper are generally within the authority of ministries of agriculture under existing legislation; which often includes seed laws. In some cases, reforms might entail a change in existing laws, which would require parliamentary action.

Four recommendations for government regulatory reform

This paper argues for four specific reforms to stimulate private-sector involvement.

- Lower barriers to seed company entry
- Make variety registration optional or automatic
- Enforce truth-in-labeling and make other seed quality assurances available but optional
- Establish standard procedures to give seed companies access to public sector varieties, lines, and germplasm.

Recommendation 1: Lower barriers to seed company entry

Seed laws commonly give ministries of agriculture the authority to approve companies to sell, produce, or import seed. Ministries may issue regulations setting objective criteria for registration of seed companies. They may also reserve authority to exercise discretion, approving or denying registration whether or not a company meets whatever objective criteria have been set.

Who is able to produce seed? Seed producers do not need to own equipment (they can hire seed processing services from anyone who owns equipment) or land (they can contract farmers to grow seed). The proper concern of government is that farmers are able to buy truthfully-labeled seed in competitive markets (with some minimum quality standards, such as absence of noxious weed seeds). There is no objective way to determine a priori whether a proposed new company will be able to produce seed that meets market demand and is truthfully labeled. Therefore, governments can be encouraged to make registration of new seed companies a pro forma exercise, with modest, objective criteria and little or no room for registering officers to exercise discretion in deciding whether or not to register any

prospective company. At the same time, ministries can boost capabilities and efforts to monitor retail seed sales to ensure truth-in-labeling.

Governments also regulate who can import, wholesale, and retail seeds. These regulations can limit competition among importers and also inhibit the development of wholesale-retail networks to deliver the full range of seed to small farmers through competitive and accessible private markets.

Ministry authority to register seed companies can be an important barrier to entry and competition. In Turkey, for example, only companies that produce seed are allowed to import seed. This restriction forces companies that produce vegetables for export (often producing the specific variety that foreign buyers demand) to import seeds through a seed company, which takes a cut, increasing seed costs.

In Zimbabwe, for another example, the Seeds Act gives the Minister of Agriculture authority to register seed sellers and seed laboratories. From 1992/93, ENDA, an NGO, has organized communal farmers to grow certified seed for millet, sorghum, groundnut, and cowpea. Seed is collected and delivered to the Seed Company of Zimbabwe (formerly Seed Coop) for processing and packaging, after which it is often exported. Except for groundnut and cowpea, this seed does not come back into the market. These arrangements take improved seed out of communities and away from Zimbabwean farmers. It is unfortunate that the government (at least through early 1996) had not registered small seed companies among communal farmers that ENDA was supporting. Communal seed growers could work with small local entrepreneurs to establish new companies, package and sell seed, and build local markets over time. If seed quality is a concern, ENDA or some other organization could provide technical support to communal farmer-based companies for seed processing and quality testing.

Advocates for strict government limits on who can produce and trade seed argue that seed is a sensitive commodity, that quality is important, and that these restrictions will ensure quality. These arguments are weak at several points. Limiting entry reduces competition, which tends to reduce market pressures for quality. Also, seed is no more sensitive than many other goods and services for which most governments allow competitive private markets to operate. For example, governments allow thousands of small shops to repair brakes on trucks and buses and thousands of small stalls to prepare and serve food, even though bad brakes and bad food could kill much faster than bad seed. For vehicle repair and restaurant services, governments trust regulations (e.g., restaurant inspections and licenses) and competitive markets to enforce quality, allowing thousands of small-to-large firms to compete.

Recommendation 2: Make variety registration optional or automatic

Throughout the world, countries generally follow one of three practices with respect to variety registration: optional variety registration, multi-country lists of allowed varieties, or single-country lists of allowed varieties.

Optional variety registration. One common regulatory pattern (possibly the most common) is that governments offer registration as an option, but allow companies to sell seed of unregistered varieties. This pattern is followed in India, the USA, and many other countries. In these countries, companies that want to sell seed of a new variety can sell it as truthfully labeled seed, without having to get any government agency to test, approve, or even recognize the variety.

Multi-country lists of allowed varieties. In contrast to the previous system, countries in the European Union (EU) require variety registration before seed is allowed for sale, but these countries automatically accept

(register) varieties that have been registered in any other EU country. Companies that want to sell seed of a new variety in one or more EU countries must get at least one EU government to test and approve the variety. Seed samples are tested for 2 years to determine whether or not they constitute a new variety (tests for DUS = distinctive, uniform, stable) and whether or not the new variety has value to farmers (tests for VCU = value in cultivation and use). Once one EU government has registered the variety, it goes into an EU Common Catalogue, and seed of the variety can be sold throughout the EU without any further testing.

Single-country lists of allowed varieties. In a third pattern, governments require variety registration as in the EU. However, unlike the EU, varieties registered in another country are not automatically accepted—they must be tested in the country where registration is sought. Among developed countries, Canada, Australia, and some others follow this pattern (at least for some crops). Among developing countries, the pattern is common in Africa and can be found in Asia and Latin America. In some cases, lists of allowed varieties are limited to major crops (e.g., hybrid maize and coffee in Malawi; rice, wheat, potatoes, sugarcane, and jute in Bangladesh), with no controls on varieties of vegetables or other minor crops. In some countries, lists of allowed varieties may be extended to essentially all commercial seed. For countries and crops with single-country lists of allowed varieties, a company that wants to sell seed of a new variety has no choice but to invest the time and expense to register the variety in each country where seed is to be sold.

In countries where variety registration is required before seed sale is allowed, the time and expense involved in variety registration inhibit private companies from testing and introducing new varieties. Companies balance market size and expected revenues against costs—for countries and crops with small markets and modest expected revenues, costs and time for compulsory testing and variety registration can stop all private introduction of new varieties. Compulsory registration is a more forbidding obstacle in smaller countries, and for lower value seeds and minor crops.

Options for reform. As already discussed, costs associated with compulsory variety registration are particularly troublesome for minor crops and low-value seed, which are particularly important for SSEs. In order to reduce the costs that SSEs must pay to register and introduce new varieties, procedures must be liberalized to make registration either optional or automatic.

Make variety registration optional. Opponents of this reform often raise concerns about possible damage from new varieties of major crops. If these objections cannot be overcome, reforms introducing voluntary variety registration can begin with all other crops. In Bangladesh, for example, the government in 1990 made variety registration optional for all but five crops.

Make variety registration automatic. There are several ways to do this. For example, variety registration could be a pro forma exercise (as in Zimbabwe). Or a government could announce that variety registration is automatic for varieties registered in a few other specified countries (for example, Romania allows automatic registration for all varieties in EU Common Catalogues).

Often, seed laws give ministers of agriculture the authority to limit seed sales to approved varieties, but the laws do not require that ministers do so, nor do they elaborate how ministers are to decide what varieties to allow. In most cases, reforms away from compulsory variety registration can be introduced by ministers of agriculture with authority from existing seed laws and without amending those laws.

Reform away from compulsory registration is particularly important in many African

countries, where small markets and uncertain commercial environments already discourage private investment in seed. Under such circumstances, anything short of near-automatic registration can be expected to severely discourage private sector contributions to research and technology transfer, even for major crops and high-value seed.

If registration is optional, will companies introduce varieties without testing? Normally, the number and range of tests and demonstrations that seed companies carry out for their own purposes—to determine performance and market demand—far exceed the limited and formal testing that governments require for variety registration. As already discussed, even when SSEs are forced to choose from a short list of varieties tested and approved by public sector scientists, any SSE that wants to stay in business will do its own tests and demonstrations on those varieties. Many varieties approved through public testing are not valued by farmers. Furthermore, even "good" varieties are not appropriate for all environments and seasons; no matter how much governments might try to regulate allowed varieties, companies and farmers have to exercise judgement about where to sell and when to plant. Voluntary registration allows companies to spend less time and money talking with registration agencies, leaving more time and money to find out what farmers want and to identify and introduce new varieties.

Biodiversity and landraces. Another objection to compulsory registration is that it forces companies to reduce genetic diversity in traded seeds. If companies cannot sell seed except for registered varieties, then it is illegal to sell seed of landraces (which are genetically diverse collections of seed). To meet DUS criteria so that a collection of seed can be registered as a variety, companies that want to sell seed of a landrace are forced to select specific sub-populations with limited genetic diversity. With optional variety registration, companies could continue to sell seed of landraces depending on market demand, and this would tend to maintain genetic diversity in commercial seed and on farmers'fields.

Recommendation 3: Enforce truth-in-labeling and make other seed quality assurances available but optional

Most governments enforce some regulations to assure farmers that the commercial seed which they buy meets a minimum set of standards. Some seed quality regulations are required for all seed, while other regulations are required only for certain classes of seed. For example, quality requirements would need to be stricter and more extensive for foundation seed than for certified seed.

Essentially all countries enforce truth-in-labeling for all commercial seed, specifying information that must be on the label and requiring that seed conform to that information.

At the next level of quality control, many countries set minimum standards for analytical quality (e.g., germination, presence of other seeds or non-seed material), which can be determined by laboratory tests. These minimum standards may be optional. Zimbabwe, for example, sets minimum quality standards for "standard grade" seed, but allows the sale of "substandard" seed that does not meet these standards but is accurately labeled. Some governments allow companies to do their own laboratory tests, while others, such as Malawi and Zimbabwe, demand that seed samples be tested in government or government-licensed laboratories before seed can be sold.

The next level of quality control is certification, which means that some extra-company authority visits seed crops in the field to ensure that seed is of the variety that is stated on the label In many countries, such

as the USA and India, certification is voluntary for all crops. In Zimbabwe, seed certification is voluntary for all but 11 crops. In Malawi, it is voluntary for all crops except hybrid maize and tobacco. In the EU, certification is required for most field crops. Governments may license or allow local governments or private organizations to manage certification schemes.

While private certification can be an attractive option, government regulations surrounding such systems can create serious problems for competitive markets. For example, if a government requires certification for one or more crops, and then gives exclusive variety registration or certification authority to a private group, the result may be official sanction for a private oligopoly. This is a danger with current efforts to privatize certification in Zimbabwe.

Options for reform. Whatever a government tries to do about seed quality, regulations are ineffective unless companies are willing to produce seed that meets those standards. Standards can be so high and quality assurance procedures so onerous that companies cannot meet them without seed costs exceeding what farmers are willing to pay. If commercial seed is not available, farmers plant relatively low quality farm-saved seed. Thus, unreasonable quality regulations can actually encourage farmers to use low-quality seed. The cost of complying with government quality regulations can be a particularly important consideration for SSEs and the relatively low-value seed in which they have a comparative advantage.

Requiring government quality assurances (certification, prior testing) entails company interaction with bureaucrats or other highly paid experts. The costs of these interactions can be more easily met by large companies that produce large quantities of high-value seed and maintain head offices in the capital than by small companies producing smalt quantities of relatively low-value seed (minor crops, non-hybrid seed) and with head offices in small towns or villages. For example, hybrid maize often sells for 20 or more times the price of grain, which leaves room to pay for costs associated with compulsory certification. In contrast, seed prices for wheat and other small grains may be less than double grain prices, leaving much less room for companies to pay the legitimate costs for compulsory certification, to say nothing of any extras that may be required to get government inspectors to visit scattered and remote fields.

With respect to seed quality, the best option in developing countries is to make certification optional for some or all crops. When certification and other quality tests are optional, companies and farmers are able to decide through markets whether or not they value government quality assurances enough to pay for them. Normally, when certification is optional, companies will forego government certification, but will set and meet their own quality standards that are at least as high as government standards. On the other hand, when governments require certification, there is no way for markets to indicate the relative value that farmers place on government or company quality assurances; also, certification agencies are able to demand bribes to pass even good seed.

Another option is to move away from compulsory prior testing of seed lots in government laboratories and towards own testing. The arguments in favor of allowing companies to do their own seed tests are similar to the arguments for voluntary certification.

Does the relatively weak legal framework for consumer protection in developing countries justify more aggressive upstream govern* ment controls on seed quality? Whatever upstream standards government may set for seed quality, regulations are ineffective unless government is able to enforce truth-in-labeling at the point of retail sale. If

companies are able to sell seed that is mislabelled or out of date, they can ignore or evade even the most stringent certification, quality, and testing standards. Thus, weakness of consumer protection at the retail level in a developing country is a poor argument to justify excessive government interference in seed production and processing.

Recommendation 4: Establish standard procedures to give seed companies access to public sector varieties, lines, and germplasm

In many developing countries, public sector research continues to provide a large share of the new varieties that go to farmers' fields. Without parastatals to multiply and distribute seed of these new varieties, public research agencies increasingly rely on private companies, and in particular SSEs, to multiply and deliver seed.

For these new systems to work efficiently, NARS and other public research organizations (e.g., universities) can set standard procedures to release (sell) results from their research to SSEs and other private companies. Without standard procedures, sales arrangements may be ad hoc and subject to high-level decision, which can hinder the flow of research results to SSEs and eventually to farmers.

Standard procedures may differ for different products. For example, governments may allow public research agencies to sell most germplasm, breeder seed, and foundation seed at cost without any licensing limitations. These arrangements would be suitable for crops and varieties intended for communal or small-scale farmers for which donors and government have deliberately subsidized research; for the most part, these are the crops in which SSEs dominate. On the other hand, for germplasm expected to have an international market (e.g., a gene for disease resistance or an inbred line for sunflower or another important crop) governments could ask research agencies to negotiate special contracts for each transaction, and to submit these contracts for high-level review by ministries of agriculture.

Suggestions for IARCs to Improve Distribution of Research Results to Farmers

Public lines coming from any NARS will normally have been developed by the NARS itself, NARS in other countries, or IARCs. In many countries, governments do not allow SSEs and companies to establish direct access to germplasm from IARCs and other foreign public institutions. Also, countries with compulsory variety registration do not allow SSEs or companies to market seed of foreign public lines (including IARC lines) unless governments have explicitly approved each variety. This section recommends steps for IARCs to improve SSE and farmer access to IARC lines.

The Consultative Group for International Agricultural Research (CGIAR) organizes financial support for IARCs and provides guidance on policies and research focus. CGIAR objectives and principles envision wide and free distribution of results from IARC research, so that farmers can adopt new technology and improve production and incomes. The 1995/96 CGIAR Annual Report (page 8) asserts that research supported by the CGIAR must "be aimed at producing ... international public goods."

From their plant breeding activities, IARCs distribute lines rather than varieties, but many of their lines are suitable for release as varieties with no further breeding. As allowed by the governments of countries in which they work, IARCs distribute lines and other research results to companies and NGOs as well as to public research organizations (NARS).

However, governments of many developing countries closely control the dissemination of

IARC lines, forcing IARCs in those countries to work exclusively with and through public sector NARS. These controls severely limit farmer access to IARC lines and to benefits from IARC research, which also cuts returns to donor investment in IARC research.

Another threat to the distribution of IARC lines within developing countries comes with the extension of Plant Variety Protection (PVP) legislation. PVP legislation offers some important benefits. However, there can be problems in the details: depending on the design of PVP laws and regulations as well as government policies, IARCs may have difficulty ensuring that lines remain public goods.

The following recommendations ask IARCs to improve and defend farmer access to IARC lines by: (a) challenging government claims to monopoly distribution of IARC lines, (b) reviewing and strengthening legal mechanisms to ensure that IARC lines remain public goods, (c) establishing formal commercial arrangements to market IARC lines and germplasm at cost to all comers.

Recommendation 1: Challenge governments to allow free access to all IARC lines and unrestricted sale of seed from all IARC lines

In many developing countries (those with compulsory variety registration) governments do not allow seed companies to introduce varieties from IARC lines without explicit approval by some government committee. In such countries, seed derived from most IARC lines is contraband; it is illegal for companies to import such seed or even to multiply and sell it in-country. These arrangements have delayed the introduction of useful varieties in many developing countries.

Many agricultural experts have stories to tell about problems faced in introducing IARC varieties (or varieties from IARC lines). In Turkey, for example, government scientists in the 1960s refused to permit the introduction of new CIMMYT varieties of spring wheat despite positive results from years of testing. In 1965, a private Turkish farmer received about 25 kg of seed of a CIMMYT variety from an agricultural expert at the United States Agency for International Development (USAID), who had smuggled it from Pakistan through the US diplomatic pouch (seed sale of these varieties; was illegal). The farmer's field, which was prominently located near a major road, yielded more than twice as much as neighboring fields. Seeing the field, more than 100 local farmers asked for permission to import CIMMYT seed. A senior official in the Ministry of Agriculture who saw the field facilitated approvals for import of this seed, and the government subsequently supported widespread introduction of CIMMYT wheat.

IARC breeding programs work mainly on low-value seed (e.g., non-hybrids for cereals, tubers) and secondary crops (pulses). Access to these lines is particularly important for SSEs, which have a comparative advantage in low-value seed and secondary crops. Government limits on the dissemination of IARCs lines through SSEs block the development of small and medium seed companies, force farmers to continue with relatively poor varieties, and cut returns to IARC research.

In many developing countries, IARCs have for years worked exclusively through NARS, delivering lines to one government agency and relying on that agency to select and distribute lines within the country. This approach—working through a monopoly—almost ensures expensive delays in the delivery of research results to farmers. Moreover, these monopoly agencies may never approve some valuable lines for distribution.

If IARCs are to fulfill their charge to improve technology at the farm level, then it is reasonable for them to aggressively and repeatedly protest regulatory obstacles that

prevent farmers and SSEs from accessing all available IARC lines. The options include: (a) challenging governments to do away with compulsory variety registration, at least for IARC crops; (b) challenging governments to automatically register varieties from IARC lines that have been registered in any other country in the region.

Recommendation 2: Review legal arrangements for ensuring that IARC lines can be kept in the public domain in developing countries that adopt PVP legislation

IARCs have established some policies and strategies to deal with the spread of PVP legislation. The guiding policy to date has been to continue to maintain public access (deny private ownership or exclusive private use) for lines brought into or coming out of IARC research programs.

The core strategy to implement this policy has been to "register" new IARC lines in the public domain in the USA by publishing descriptions of the lines (e.g., in *Crop Science).* This process for "registering" lines allows IARCs to challenge and block anyone else (e.g., a company) who might subsequently try to claim invention and ownership of an IARC line under PVP law. Within the USA, other public research organizations such as universities and the Agricultural Research Service (ARS) of the United States Department of Agriculture use the same strategy to place their new lines in the public domain. One incident has been reported in the USA where a company tried to register ownership of germplasm coming out of an IARC (CIMMYT). After out-of-court discussions, the company agreed not to register ownership.

However, "registration" in the public domain by describing new lines in a US journal does not ensure that lines remain in the public domain in other countries. Jim Elgin, an expert with the ARS, reports six incidents of companies complaining that foreign countries have registered private ownership of varieties that are in the public domain in the USA. In a typical incident, a US company tries to export seed of a public variety to Spain, meeting objections from another company that has registered private ownership of that variety in the EU. In these incidents, the company which wants to defend the public goods nature of the variety lodges a complaint with the US office that represents OECD Seed Schemes (which lists varieties registered in all cooperating countries). The US office raises the issue with the Spanish office for OECD Seed Schemes.

In six incidents to date, the US office for OECD Seed Schemes has been able to establish competitive entry in other countries for varieties that are in the public domain in the USA. However, this process only works with countries that take part in OECD Seed Schemes. Also, no case has gone to court. And finally, the process has only been used for lines out of US public research, not for any IARC lines.

It has not yet been established in many developing countries whether and how "registration" in the public domain can be legally established and defended. Also, incidents can be found in developing countries where companies have been able to claim exclusive use of IARC lines. In Zambia and Zimbabwe, for example, long-term government-company agreements to give results from government research to one or another private company could result in these companies gaining exclusive rights to a broad range of IARC lines. When countries such as Zambia and Zimbabwe move from socialist control of research and/or seed production to market systems, distribution of IARC lines should move into competitive markets, but this might not happen. If not, are IARCs and the CGIAR system ready to advise and protest?

Several incidents have been reported in Zimbabwe in recent years in which the government has blocked one Or more private

companies from selling seed of several maize QPVs distributed through CIMMYT as well as an ICRISAT pearl millet hybrid on the grounds that PVP rights had been assigned to another company, even though CGIAR policy is that IARC varieties remain in the public domain. These incidents raise some troubling questions for CIMMYT and ICRISAT and more generally for the CGIAR system. Are there any procedures established under Zimbabwe's PVP legislation for ICRISAT or another IARC to defend the public goods character of their lines? Are ICRISAT or the CGIAR prepared to defend public access to their lines in Zimbabwe or any other developing country? Are there, within IARCs and the CGIAR Secretariat, strategies, internal processes, staff responsibilities, or legal resources available to defend public access to IARC lines in developing countries?

Recommendation 3: Establish formal commercial arrangements to market IARC lines and germplasm at cost to all comers

According to current policies and practices, IARCs distribute breeder seed and other germplasm free to NARS and other organizations, which may include NGOs and private companies. Free distribution entails the exercise of discretion on the part of IARC managers to decide who will get how much seed.

Discretionary distribution of free seed does not take advantage of the potential for efficient multiplication and distribution of IARC lines through competitive seed markets. With a host of small companies, NGOs, and farmers' groups involved in seed multiplication and sale, how can IARC managers decide which ones are going to be effective in multiplying and distributing seed? If managers cannot decide, and if there are many companies, then free distribution does not work. If breeder or foundation seed is sold at cost—higher than the cost of commercial seed for sowing—it will be bought only by those who can effectively multiply it for sale. If seed were distributed free, it could be taken by people who are unable to realize its full value in seed production, but simply sow it for a commercial crop.

Formal markets for IARC breeder seed and germplasm may be supplied from seed produced by IARCs, by private companies with IARC supervision, or by some combination of these arrangements. For example, CIMMYT could contract with one or more private companies to produce and sell breeder seed for CIMMYT lines to all comers according to terms agreed with CIMMYT (prices, cut-off dates for advance orders, etc).

Suggestions for NGOs

Recommendation 1: Promote and support small formal seed companies

Many NGOs, particularly in Africa, are active in seed production and trade. They may support small and medium farmers as seed growers, provide technical assistance, and in some cases buy and then retail their seed. In working with seed growers, NGOs could promote the emergence of small formal seed enterprises. Depending on country and circumstances, this could involve:

- Setting up seed processing equipment and selling processing services to small companies
- Setting up (licensed) seed testing laboratories and selling testing services to small companies
- Offering legal and logistic assistance for seed-producing farmers and local entrepreneurs to register new seed companies
- Working with government officials and private seed associations in each country to propose and promote seed regulatory reforms that lower barriers to market entry for new companies and cut costs for

small companies to introduce new varieties and satisfy quality control rules.

Promoting the emergence of small formal seed companies is one way for NGOs to ensure the sustainability of their efforts to improve seed systems. If NGOs leave a crop or a region without establishing new seed companies, how will the benefits be sustained? Without new seed companies, how will farmers with new seed-growing skills continue to gain access to new varieties, and how will they expand their activities to involve and train more people?

Suggestions for Donors

Donors support many agricultural programs that could, with some redesigning, serve as channels to promote seed regulatory reforms and to strengthen competitive seed sectors. The following paragraphs discuss two areas where donors might consider revising ongoing programs.

Recommendation 1: Link aid for agricultural research to regulatory reforms allowing private technology transfer

Aid organizations have long supported public sector agricultural research in developing countries. For many years, these organizations have virtually ignored government regulations that block private sector technology transfer, forcing all technology to go through aid-supported government research organizations and associated regulatory agencies. The resulting systems which donors have built and supported for introducing new agricultural technology into developing countries are often far different—more centralized and controlled—than the corresponding systems in donor countries.

If the objective of aid for agricultural research is to improve the flow of new technology to fanners, then additional funding for agricultural research can reasonably be linked to requests for governments to relax controls in order to make it easier for the private sector to introduce new varieties and other new technology.

Recommendation 2: Revise programs for distributing emergency seed to promote sustainable commercial seed systems

In recent years, donors have paid for distribution of seed in many African countries after civil conflicts (e.g., in Rwanda) or drought (Zimbabwe, Malawi) and also in response to economic recession and poverty. Typically, donors pay for an NGO or government agency to buy and distribute seed. These arrangements have had some problems. In some cases, the varieties distributed have been inappropriate for the environment; reportedly some maize did not mature in Rwanda, and some sorghum did not flower in Malawi's Shire Valley. Another problem is that large-scale government purchases can disturb normal marketing channels, pulling large quantities of seed off the market during the peak marketing season while companies wait for governments to award tenders. In addition, free seed distribution to farmers reduces demand for seed from existing commercial marketing channels.

When disaster strikes or donors for some other reason wish to support distribution of seed into a country, distribution arrangements could be designed to support the expansion of sustainable commercial marketing systems as follows.

(a) Instead of paying for governments or NGOs to purchase and distribute seed, donors can pay for distribution of vouchers. Farmers can use these vouchers to buy seed from registered seed companies and dealers, which would include NGOs, SSEs, and all available companies from target and neighboring countries

(b) Donors can challenge governments to allow entry for new companies and varieties, either by removing variety controls altogether or by allowing entry for varieties from neighboring countries.

Distribution of vouchers that allow farmers to choose seed of varieties (or even crops) would reduce the risk that farmers would end up with inappropriate varieties. Distribution of vouchers would attract the attention of seed companies in neighboring countries, and deregulation would allow them to enter. Normally, any regional or other foreign company that wanted to build a sustainable business in the target country would look for local collaborators and would take steps to set up seed production in the target country. Market entry and new business alliances would help to build a sustainable and competitive private seed industry. For minor crops and low-value seeds, small and medium seed companies (along with NGOs) could be expected to sell a large share of the seed and to end up with a large share of vouchers for redemption.

With more companies, including regional companies, producing seed for a particular country, seed supply would be more secure against future disruptions from whatever source. Competing companies that have experience with the market could respond to local disruptions in seed supply by bringing in seed of known varieties from other countries in the region.

The Role of International Agencies in the Seed Sector

C H Rosell[1]

Abstract

International institutions (e.g., United Nations agencies, government aid agencies, international banks) have long supported seed sector development programs in developing countries. These agencies play important roles in several areas—policy guidance, management of plant genetic resources, research, seed project development and implementation, variety protection legislation, quality control, seed trade, technology and information exchange, financial support or credit for infrastructure development, and in establishing advisory, policy, and training networks.

However, despite the efforts of governments and international agencies, seed supply is inadequate in most developing countries, partly because needs and priorities are changing. Correspondingly, new strategies are required, which must build on past gains and exploit new technology, clearly identify priority needs (farmers' needs, food security), examine the relationship between food security and biodiversity issues (the genetic base for plant breeding and crop improvement), and thus develop effective and cost-efficient strategies focusing particularly on the most vulnerable areas. These strategies must be developed within the framework of international conventions and therefore better coordination among international agencies—and among different national agencies within a country—is critical. FAO has initiated discussions that are expected to lead to the development of a world expert consultation involving international agencies and national experts. The objective is to draw up a new global seed policy and a set of programs relevant to the needs of developing countries.

Introduction

It is widely recognized that improved varieties have the potential to dramatically increase crop production and quality, farm productivity, and incomes, and thereby enhance food security. In the face of rapid population growth, other options for increasing crop production are becoming more difficult. Productive land is becoming less available. The use of huge doses of fertilizers and farm chemicals is becoming economically prohibitive and less effective than before, and resulting in land degradation. Even with the use of improved varieties, yields may have reached a plateau in many areas and in several crops, implying that the present strategies are no longer

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Rosell, C.H. 1997. The role of international agencies in the seed sector. Pages 245-250 *in* Alternative strategies for smallholder seed supply: proceedings of an International Conference on Options for Strengthening National and Regional Seed Systems in Africa and West Asia, 10-14 Mar 1997, Harare, Zimbabwe (Rohrbach, D.D., Bishaw, Z., and van Gastel, A.J.G., eds.). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.

adequate. A new approach in enhancing food security is needed, This requires a "systems" approach in which seed of improved varieties plays its role alongside other interventions in policy, investments, and technology. International agencies have, for decades, been in the forefront of seed sector development in developing countries, and their continued support will be crucial in the new approach. International agencies can play important roles in areas directly linked to the development and improvement of seed production and supply:

- Management and use of plant genetic resources
- Agricultural research, variety development, and technology generation
- Seed project development, financing, and implementation of investments in the seed sector
- Facilitation of international seed trade
- Variety protection legislation
- Seed quality control
- Advisory, policy, and training networks.

FAO's seed-related activities

The Food and Agriculture Organization of the United Nations (FAO) has played a pioneering role in the development of the seed sector in member countries. In 1953, it initiated seed awareness programs and began distributing small quantities of seed of improved varieties for experimental purposes. From then on, with the support of donors and recipient countries, FAO's Seed and Plant Genetic Resources Service (AGPS) has successfully implemeated a number of major initiatives.

- Collected and disseminated information on seed and plant genetic resources for variety development
- Defined appropriate seed policies and programs aimed at developing and improving national supply systems for seed and planting material
- Strengthened national and regional programs for the production and supply of seed and planting material
- Provided regulatory mechanisms, standards, and improved technology on all aspects of production, quality control, distribution, and utilization.

FAO has produced a number of seed-related publications that have been widely distributed—World List of Seed Sources, Seed Reviews, World List of Seed Equipment, Information System on Seed and Plant Genetic Resources, and a World Information and Early Warning System for Plant Genetic Resources comprising several databases (developed in cooperation with IPGRI). Over 50 technical publications have been produced and distributed.

Early FAO efforts were conducted under the World Seed Campaign, which covered 79 countries and territories and encouraged the breeding, introduction, and seed production of improved varieties. In the 1970s, FAO created the Seed Improvement and Development Programme (SIDP) to expand seed programs worldwide. Under SIDP, FAO helped implement many projects in member countries, and formulate programs to improve national seed systems through donor assistance. Since its inception, SIDP has, directly or indirectly helped implement more than 700 seed-related projects with an accrued budget of over US$ 600 million. More than 40 seed projects currently operate in 30 countries, supported by over 50 national and international experts.

FAO has had several other notable achievements in recent years.

- Establishment of the Asia Pacific Seed Association, leading to rapid improvements in the seed sector in the region
- Establishment of the Caribbean Seed and Germplasm Resources Information Network (CSEGRIN), a computerized database system for CARICOM countries
- Development of the Quality Declared

Seed concept, appropriate for seed sector development in developing countries
- Emergency seed assistance in countries affected by natural disasters or civil strife (Afghanistan, Bosnia, Haiti)
- Assistance in national seed policy development and public-private sector partnerships in the seed industry in several countries in the Caribbean, Africa, Asia, Latin America, and the Near East.

Other international agencies

Apart from FAO, several other international agencies have been active in seed development. The Danish International Development Agency (DANIDA) and the governments of Austria, Belgium, France, Italy, Norway, Spain, Sweden, and Switzerland, and the Arab Gulf Fund have also provided notable assistance to the FAO Seed Field Programme. The UNDP has been a major funding agency for several FAO seed projects in Africa and Asia.

GTZ and USAID have funded and implemented a number of seed projects in Africa, Asia, and Latin America. Recent efforts by GTZ (acting in collaboration with ICARDA over the past 10 years and from 1996 in collaboration with IITA) to establish networks in the West Asia and North Africa region and in West Africa are new strategies that hold much potential.

Variety protection legislation. The International Union for the Protection of New Varieties of Plants (UPOV), the leader in variety protection legislation, plays an important role in the seed industry. UPOV was established in 1961 when the International Convention for the Protection of New Varieties of Plants was signed in Paris, and aims at protecting the rights of plant breeders.

Plant breeders' rights are becoming a crucial issue as countries gear up to incorporate private research in their efforts to develop the national seed sector. Recent discussions in Asia, Africa, and Latin America at national and regional levels indicate that UPOV input, especially by way of advice and guidance, will be very important as countries seek to strike a balance between plant breeders' rights and the need to ensure that legislation does not unduly constrain seed delivery or hinder food security.

Seed quality control. The International Seed Testing Association (ISTA) was established in 1924 to promote accurate and reliable testing methods for seed being traded both internationally and nationally. ISTA facilitates the efficient production, processing, distribution, and utilization of seed not only within member countries but also in international trade. With its membership comprising government-accredited seed testing stations and seed technologists, ISTA promotes uniformity in seed testing procedures through the International Rules for Seed Testing.

Facilitation of international seed trade. The International Seed Trade Federation (FIS), which was formed in 1924, is an association of national seed industry associations. It works on standardizing terms and conditions to facilitate seed trade transactions. FIS is largely made up of seed associations in the developed countries, though some developing countries with relatively strong private sectors and active seed associations (Argentina, India, Mexico, Morocco, Tunisia, Venezuela) have been members for many years. The aims of FIS are to liaise between international and national seed agencies, bring together seed industry participants through meetings, and create congenial conditions for international trade.

Investments in the seed sector

In several developing countries, local resource allocation for seed sector development has been minimal, because national budgets are insufficient and the private sector

is not willing to invest because of unattractive policies or lack of incentives. Since governments, by and large, recognize that seed sector development is their responsibility, they have sought assistance from donor countries and agencies. UNDP and Trust Funds resources (made available to FAO by governments of developed countries) have been important sources of funds to implement projects, alongside FAO's own internal funds that are used to support short, crucial, and often forerunner projects under the FAO Technical Cooperation Programme.

In recent years, international banks such as the World Bank, the Inter-American Development Bank, the African Development Bank, and the Asian Development Bank have provided large amounts of credit to help governments establish the necessary infrastructure for a seed industry. Such credits are useful tools to encourage private sector participation and reduce government responsibility as the sole investor in the seed sector. A healthy collaboration has emerged between banks and developmental agencies, ensuring that investments are properly channeled.

Seed networks

There are few networks devoted entirely to the seed industry. The most active has been the West Asia and North Africa (WANA) Seed Network which operates under the auspices of ICARDA, where the network secretariat is based. The network has initiated several activities to improve seed supply, with the emphasis on regional cooperation among member countries. These include the development of a uniform seed policy and regulatory framework to standardize seed production and quality control procedures, and thus integrate national seed systems and stimulate regional seed trade. The network stimulates information exchange through its publications and a newsletter, SEED INFO.

The recently formed Asia Pacific Seed Association fa also a network but with both public and private sector participation. Although established only recently, it has made a strong impact on seed trade in the region. Its bi-monthly magazine, Asian Seed and Planting Material, already enjoys a wide international readership. Its seed trade publications, conferences, seminars, and study tours have also contributed in enhancing seed trade in the region, and developing regional position papers on important issues. CSEGRIN—Caribbean Seed and Genetic Resources Information Network—is another seed network developed under the FAO aegis for 14 CARICOM countries. Among other initiatives, efforts are under way, with FAO assistance, to help SADC countries establish a SADC On-farm Seed Multiplication Network.

New challenges

In spite of the efforts of governments and international agencies, seed production and supply in most developing countries do not adequately meet national needs. While seeking solutions, it is important to recognize that although strategies must build on past gains, they must take into account the new realities of a changing world and the priority needs of developing countries striving to redirect their investments in agriculture in a more cost-effective manner to ensure food security.

Governments and international seed agencies face a big challenge—to recognize the present and future needs of the seed industry, develop effective strategies quickly, mobilize resources, and finally install the right policies and programs. Some of the new issues that need to be tackled include:

- National and global strategies to protect biodiversity and how they affect the genetic base for crop improvement; and the possibility of incorporating these strategies into seed security schemes in vulnerable areas
- Active use of recent research advances, (eg., use of apomixis, true potato seed,

artificial seed, and hybrid rice)
- Socioeconomic factors influencing farmers' crop/variety choices and their implications for food security
- Cooperation between the public and private sectors and its implications for sustainability, cost-effectiveness, and adequate seed supply for a broad range of crops
- Current trends in plant protection legislation and their implications for seed production
- Recognition of and support for on-farm seed production to extend the benefits of research programs to small-scale farmers
- The fate of seed projects under various successor arrangements, and the roles of both public and private sectors in ensuring sustainability.

Cooperation among international agencies

Seed production and supply requires a coordinated approach by the various actors involved. In particular, international agencies must cooperate closely, coordinating their activities to ensure efficiency in seed assistance. Seed strategies must recognize the importance of such linkages, and the need to develop and strengthen them. Furthermore, future seed policies and programs will need to be developed in the light of international conventions: the UPOV convention for plant variety protection, OECD schemes for variety certification, GATT and TRIPS agreements for protection of trade-related intellectual property rights, *sui generis* systems, the Convention on Biological Diversity and UNCED, Agenda 21, and ISTA guidelines on seed testing.

The FAO's Sustainable Seed Development Programme (SSDP) has initiated discussions that will lead to a world expert consultation involving international agencies and national experts. The objective of these consultations will be to develop a new global seed policy and a set of programs relevant to the needs of the seed sector in developing countries. International seed agencies are expected to participate actively, and where necessary, reshape their own operations to better address newly emerging needs. For example:

- IARCs need to redefine crop improvement strategies for minor crops, assist in the development of on-farm crop improvement strategies, support emerging private sector research programs, and accelerate the transfer of relevant, appropriate technologies to farmers
- Seed projects supported by donor agencies must be compatible with local systems to ensure sustainability, and should exploit complementarities with the national agricultural system to improve cost-effectiveness
- Regulatory and service agencies must recognize the needs of the seed sector in developing countries, and provide appropriate assistance, especially in seed legislation, quality control, and international trade, with a view to gradually achieving international norms
- International banks need to channel more resources to the seed industry. They must also make better use of the experience of other international organizations—in identifying areas of investment and subsequently in formulating, implementing, supervising, and evaluating seed projects
- Seed networks must be expanded to cover other areas and must consider four important issues—the needs of the informal sector, which supplies the major portion of seed in developing countries; strengthening seed security through national and subregional efforts; germplasm conservation; and training for small-scale seed growers.

The cumulative might of the many inter-

national agencies can go a long way towards addressing all the issues facing the seed sector. But whether this collective might can be used effectively will depend largely on the ability of these agencies to recognize the real needs of the sector, and their willingness to collaborate with each other and with governments, seed producers, and farmers.

Strategies for Seed Sector Development

Working Group Discussions

Background

Nearly half the workshop was devoted to intensive, small-group discussions on specific topics. Six Working Groups were constituted, one for each of six key aspects of seed sector development.

Each group identified four or five major constraints in a particular area, and suggested solutions or approaches to strengthen national and regional seed systems. Working group recommendations were presented, discussed, and ratified at a session attended by all the delegates.

Working Group 1: Seed Regulation and Policy

Lack of govt seed policy in many countries. Effective laws and a clear policy are basic prerequisites for seed sector development. These laws and policies ought to specify government objectives for seed production and distribution, define the roles of the private and public sectors, and identify specific measures to stimulate private sector involvement. Policies should be framed with inputs from all stakeholders. Policies would vary depending on the level of development of the seed sector in a particular country. The Working Group highlighted the following specific recommendations.

- Governments should establish national seed advisory councils with representation from farmers, Ministries of Agriculture, seed services agencies, the private sector, research institutes, and NGOs.
- International associations with experience on seed policy and regulation should be used to provide advice where needed (e.g., on issues relating to bioengineered material).
- In general, regulation is not recommended for crops for which seed is produced largely in the informal sector.

Poor or non-existent seed laws and regulations. Seed laws should facilitate the development of the seed sector and encourage innovation.

- Laws should be flexible, easily amended, and respond to the changing needs of farmers and industry as well as to new technological developments.
- There should be no subjective criteria, and only a minimum set of objective criteria guiding the regulation of seed production and distribution.

Lack of plant breeders' rights. The lack of plant breeders' rights (PBR) hinders the entry of foreign investment into the national seed market and the development of local seed entrepreneurs. PBR should also apply to the public sector; this would provide an incentive to public sector breeding programs. The group recommended that governments should:

- Recognize that PBR are appropriate only when the seed industry has reached a minimum level of sophistication. Legislation should be developed/enforced with this in mind.
- Move towards membership in UPOV.
- Enact PBR legislation in line with UPOV procedures.
- Improve enforcement by strengthening enforcement organizations or establishing new ones where needed.

Variety approval/registration procedures. Release and registration procedures for new varieties are often cumbersome, and sometimes biased or subjective. In many countries, it is difficult to introduce varieties from foreign sources. Several steps need to be taken to improve the flow of modern varieties to farmers.

- Simplify registration procedures and standardize registration requirements to reduce subjective criteria.
- Reduce the amount of information that breeders/firms are asked to supply for variety registration—variety name, description, and areas of adaptation should be sufficient.
- Ensure rapid registration; 2 years of data on field performance should be considered sufficient to apply for registration.

- Ensure private sector representation on release committees.
- Release committees meetings should be held regularly, with transparent procedures; the record of discussions and results at these meetings should be published.
- Introduce a regional listing, so that varieties registered in one country are automatically registered in other countries of the region.

Lack of incentives for the private sector. Governments must make strong efforts to attract private investment. Incentives to private firms must be increased, particularly since seed businesses have long gestation periods before profitability is achieved. Various specific incentives were recommended.

- Governments should provide state land on long lease to private seed producers.
- Commercial banks (especially state-owned banks) should provide credit at low interest and establish cash credit facilities for seed businesses.
- Governments should allow duty free import of farming and seed processing equipment.
- Private firms should be given a tax holiday for 5-10 years, depending on the structure and stage of development of a country's seed sector.
- The state should gradually disinvest from the seed sector, and transfer public seed entities to the private sector on long-term, installment payment plans.

Working Group 2: Roles of the Private and Public Sectors

Unfair competition between public and private sectors. Government subsidies provide public sector firms an unfair advantage over private firms. In order to encourage fair competition without disrupting the existing system:

- Subsidies should be gradually phased out, and public sector seed prices should be adjusted to reflect market realities and actual costs.
- Throughout this period of transition (and beyond), governments must ensure the continued production and availability of high-volume, low-cost seed (e.g., rice, wheat) that private firms may find unattractive.

Seed industry associations. The absence of professional seed industry associations was felt to be a significant constraint. The formation of such associations (which are found in most developed seed economies) will ensure that private sector concerns are adequately addressed while formulating seed policy. It will also improve coordination within the private sector, and between private firms and regulating agencies. The FAO and donor agencies provided support for the secretariat of the Asia Pacific Seed Association. This could be used as a model for Africa and West Asia.

- Donor support could be sought for the establishment of national or regional seed associations.

Better use of existing facilities. Existing facilities (e.g., processing plants, testing laboratories) should be used more efficiently.

- Where possible, private firms should be permitted to lease or buy public sector facilities.

Promotion of new varieties. Greater efforts are needed to stimulate demand for seed of modern varieties. Various promotional methods should be used.

- Demonstration plots, established with public sector facilities and staff where necessary.
- Exhibitions and fairs to generate awareness.
- Concessional advertising rates in government-owned media (press, radio, TV) to both private and public seed companies.

Poor linkages between private and public sectors. Closer linkages would eliminate duplication of effort and help public and private firms focus on their respective areas of comparative advantage.

- Hold regular meetings between private and public agencies to ensure the continuous exchange of information and ideas.

Working Group 3: The Roles of National and International Institutes

Research priorities. Research impacts are limited by the poor adoption of many available modern varieties and lack of adaptation in some varieties. These problems persist because of poor documentation of varietal adoption and impact. While research priorities are best set by national programs, the following general recommendations were made.

- Research should be consumer-focused and demand-driven. It should focus on both open-pollinated varieties and hybrids, with a different "mix" for different target areas.
- Empirical studies of farming systems and farmers' preferences should be conducted before developing a variety for a specific agroecology.
- Researchers should display a stronger sense of stewardship of varieties. Their involvement should continue after variety release, through seed production and dissemination, monitoring adoption, and obtaining farmer feedback on performance.
- While breeding for broad adaptation is necessary, it is essential to factor in local preferences (e.g., for plant height, crop mix, fodder/fencing usage), especially since these preferences can vary substantially in different regions. Participatory breeding is therefore strongly recommended.

Breeder seed production. This was felt to be a critical bottleneck in many countries. Production of breeder seed is the responsibility of national programs. However, international agricultural research institutes (IARCs) may need to play a catalytic role and provide initial material to some national programs.

- National programs should increase funding and priority to ensure that adequate breeder seed is produced for all released varieties.
- Breeder seed should be supplied to many organizations for multiplication, not restricted to one organization or public agency.

Intellectual Property Rights. IARCs have a clear policy of unrestricted access to any materials they develop. However, in some cases this policy has been violated due to poor enforcement or lack of information. Private firms have sometimes acquired sole rights to such materials, denying farmers' groups and NGOs the right to multiply and distribute seed.

- IARCs should monitor the use of the varieties they provide to national programs, and ensure these remain in the public domain.

Declining funding. Both IARCs and national research institutes are affected by declining budgets, and should seek new funding sources, particularly to support breeder seed production.

- Research institutes need to be more imaginative in their search for funding, and should look for alternative mechanisms to ensure sustainable funding for breeder seed production.

Linkages. IARCs should form wider associations, among themselves and with national research institutes, to ensure regular exchange of information and ideas.

- IARCs and national programs should pursue more consistent strategies for communication on seed issues.

Working Group 4: Roles for NGOs and Farmers' Groups

In a non-emergency or developmental situation, NGOs should focus, as a general rule, on capacity building and training rather than on direct intervention. NGOs should aim to strengthen local institutions, facilities, and administrative structures rather than developing new structures and channels. They should help develop farmers' groups and similar community organizations, strengthen local capacity in key areas, and gradually devolve responsibility to the local community. They should help farmers' groups—even if they operate in an "informal" way—to link into a more formal system (e.g., registered societies, credit financing).

In an emergency (relief) situation, NGO intervention has necessarily to be more direct, but the above guidelines should apply to the extent possible. Such principles apply to interventions relating to seed supply as well as to other NGO targets.

Six major constraints were identified to seed production by NGOs and farmers' groups.

Lack of farmer training. In many areas, farmers lack the necessary skills to maintain varietal purity and produce high-quality seed. NGOs must help disseminate information on new varieties and management practices, seed production methods (isolation distances, seed selection), and storage and processing methods

- NGOs should provide farmers involved with seed production with training in seed crop management, processing, and storage.

Lack of entrepreneurial skills. Even farmers who may be skilled at seed production generally lack skills in marketing, small-business management, and book-keeping and accounting. NGOs must provide appropriate training in these areas, where necessary in collaboration with specialized training institutions and other agencies.

- NGOs should facilitate local seed trade by providing training on business management and accounting.

Inadequate expertise among NGOs. Most NGOs lack skills in areas related to entrepreneurship and small-business management, and cannot strengthen communities in these areas. NGOs themselves would require training and backstopping, which could be provided by donor or government agencies.

- NGOs should diagnose their own weaknesses in supporting community-level seed production and maricet development, and seek training to strengthen these skills.

Poor community organization. NGOs and farmers' groups should strengthen community organizations. This will help local communities articulate their needs, and facilitate empowerment by making them aware of their rights and obligations. Training on group dynamics should be considered, wherever needed.

- NGO interventions should build on existing community organizations and thus strengthen local seed supply systems.

Lack of coordination between NGOs and public agencies. NGOs should develop close links with extension services and other public agencies operating within the area. This will help ensure that different agencies complement each other, comparative advantages are fully exploited, and duplication of effort and waste of resources are minimized.

- NGOs should work with national research and extension institutions involved with seed production and distribution. Links with the private sector may also be fruitful.

Lack of sustainability. Many farmers' groups and NGOs collapse when donors withdraw support. Long-term sustainability of small-scale, community-based seed projects could be ensured through better design of programs, emphasizing economically viable, socially acceptable interventions, and developing structures that will become self-sustaining and financially stable.

- NGO-supported community-level seed schemes should be designed to ensure sustainability after donor assistance is withdrawn.

Working Group 5: Emergency Seed Schemes

Timeliness and funding. Emergency schemes require complex logistics and large financial resources. Speedy mobilization of funds is essential. Even more important, emergency seed supply schemes need to improve their capacity to obtain and distribute seed. This can ideally be done through the establishment of seed security stocks in each country. National stocks could be linked to provide a regional buffer stock available for emergencies. Currently, funding constraints limit the feasibility of building up such stocks. However, a start could be made by planning in advance for the next emergency. This planning could encompass:

- Development of a strategy for rapid seed multiplication once emergency needs are recognized.
- Establishment of an information network (seed availability, variety catalog, list of producers, import/export regulations, quarantine regulations, etc) to be able to mobilize regional seed stocks from whatever sources might be available.

Coordination. Poor coordination between different agencies is due to several factors—poorly designed relief schemes, lack of information on seed channels, poor targeting (oversupply/shortages) due to difficulties in estimating the number of affected households, poor monitoring of seed movement and adoption, diversion of seed for food use, and poor coordination between implementing agencies and/or between donors, NGOs, and the government. Two recommendations were made to improve coordination.

- Establish a national emergency seed committee, with representatives from donors, government, and implementing partners.
- Establish a national committee of NGOs and implementing agencies in countries where multiple agencies are involved in relief work.

Seed quality. It is difficult to impose strict regulations since seed is generally imported under emergency situations, when availability is more critical than quality. This creates the danger of introducing exotic pests and diseases. This risk cannot be eliminated, but can be reduced if seed suppliers provide relief agencies with information—disease/pest susceptibility, grain quality, adaptation, phenology, seed rates, expected performance—for each variety they hold in stock. Relief agencies can then advise farmers accordingly.

- Establish and disseminate national lists of varietal characteristic for seed that might be distributed under emergency schemes.

Adaptation. Due to lack of time or unavailability of appropriate seed, relief agencies are often forced to distribute seed of non-adapted or completely inappropriate material, e.g., distributing hybrids because open-pollinated varieties are not available. It was recommended that:

- All seed relief operations should be planned with a clear "exit strategy" in mind.

- Regional information systems should be developed, e.g., a database on availability and characteristics of cultivars with specific adaptation.
- Efforts should be made to improve future seed security by building up stocks of cultivars with specific adaptation.

Sustainability. A number of facilities and mechanisms (e.g., storage facilities, monitoring methods, distribution channels) are developed during relief schemes. Often, however, no policy exists on steps to be taken after relief agencies withdraw. As a result, local communities are generally unable to use these facilities to strengthen their capacity to respond to future emergencies, or to ensure that these mechanisms continue to function in normal years. It was recommended that relief schemes:

- Use existing seed channels wherever possible, which will continue to function after the scheme ends.
- Help to ensure that established seed traders and "leading" farmers, who act as seed banks in normal years, survive the emergency.
- Establish a strategy for regular local seed production and marketing.

Working Group 6: Seed Information Systems

There is a widespread lack of information on seed needs, availability, regulations, and markets. The group discussed four areas where this lack of information was felt to be particularly serious.

Poor understanding of farmers' needs and practices. The flow of information between breeder and farmer is often poor, resulting in the development of non-adapted cultivars and consequently poor adoption. Various factors are involved. The farmers who participate in trials may not be representative of their communities (e.g., in terms of gender, landholding size, attitudes to risk). Lack of communication between men and women farmers, or between progressive farmers and the rest of the community, tends to limit adoption. Finally, lack of data on adoption limits breeders' ability to diagnose constraints and respond to farmers' preferences. Several recommendations were made.

- Involve farmers more closely and at earlier stages of technology development.
- Select fanners who represent various categories of end users, in order to obtain a selection more representative of the community.
- Study existing seed supply systems and work with these systems.
- Conduct surveys to determine seed needs and current practices.
- Use extension staff and ongoing adaptive research programs to collect location- and context-specific information on seed production and use.
- Identify seed "experts" at community level, who will interact with breeders to factor farmers' preferences into germplasm screening.
- Clearly identify farmers' needs and train extension officers (through field days and seed seminars) on how to help farmers address these needs.
- Provide extension materials that farmers and extension staff can easily use.
- Establish a system to monitor varietal performance and adoption; link this information into the technology development process.

Lack of information on available varieties. Information does not flow efficiently between breeders and extension staff, and between companies (especially those in the public sector) and farmers. Farmers often lack information about the availability, price, and characteristics of modern varieties that have been developed but not widely disseminated. Information flow will improve as private sector involvement grows, since private firms depend on effective marketing and quick response to farmers' needs in order to survive. However, since large-scale public sector involvement is likely to continue in the near future in many countries, the following recommendations were made.

- Create a database on seed availability (varieties, quantities, prices, locations), and disseminate this information to farmers through extension staff
- Use local radio stations and posters to inform farmers about market opportunities for both seed and grain.
- Increase awareness and stimulate demand for modern varieties in various ways—field days, demonstrations, posters, and advertisements in national media (especially in local languages).
- Produce inexpensive pamphlets for farmers on variety characteristics and management recommendations, to be distributed at sale points.

- Publish a comprehensive annual source book of the identity and characteristics of varieties available for sale. Summarize information from the source books into regular newsletters for extension staff. These can be produced by the Ministry of Agriculture and perhaps sponsored by seed companies.
- IARCs should support national efforts on information dissemination by helping to compile information, supporting information dissemination networks, and providing updates on new varieties.

Lack of information on seed regulations. Farmers are generally unaware or unclear about seed regulations and their implications for community-level seed trade. This information is restricted to regulatory bodies, the public seed sector, and large-scale private seed growers. Communication between policy makers and the seed sector (public and private) is poor. Several recommendations were made.

- The government should focus on developing and implementing regulations on truthful labeling, rather than on strict seed quality requirements, which are often irrelevant at smallholder level.
- Simplify quality control regulations into a small set of objective, unambiguously defined standards.
- Make information on seed regulations and quality standards easily available to seed growers and farmers. Train farmers about their consumer rights.
- Expand training programs for seed growers, farmers, and extension staff on standards, quality control, and seed crop management.

Lack of information for seed entrepreneurs. In order for small-scale seed entrepreneurs (growers and processors) to develop, information must be made available on market opportunities, market conditions, prices, etc. The following recommendations were made.

- Governments should not control the market (either as the major purchaser or through excessive regulation), but focus on facilitating its functioning.
- The Ministries of Agriculture should coordinate information flow between government agencies.
- Use existing farm survey programs to collect information on seed markets; use variety demonstrations to assess market demand; and thus create a database on seed requirements and prices for each area within a country.
- Produce a newsletter outlining varieties, prices, locations where seed is available, regulations, market conditions and opportunities.
- Periodically during the planting season, governments should publish data (variety, quantity, price) of seed stocks at various locations.
- Publish an annual listing of NGOs involved in seed distribution.

Other areas where information is lacking. Information flows are poor in many other areas; for example, between countries (on performance and availability of widely adapted varieties); between producers of different classes of seed (on demand and stocks of breeder, foundation, and certified seed). Lack of information on seed requirements and stocks can cause wide-spread—and unnecessary—problems, particularly during emergency situations. Restricted flow of information on training needs and opportunities leads to a shortage of skills (for example, most NGOs and farmers lack business skills) or to inappropriately chosen or poorly maintained equipment.

Regional Action Plans for Improving Seed Multiplication and Distribution

Background

On the final day of the meeting, participants formed three regional discussion groups to review the recommendations of the six Working Groups and identify priorities for regional action. Each regional group was asked to prioritize the problem areas outlined during the previous sessions, and develop practical plans to resolve the three or four most important seed supply problems in the region. These plans were to identify specific activities and suggest a schedule for completion of each activity; identify institutions that could take primary responsibility for each activity; and estimate funding requirements. The resulting plans were reviewed at the plenary session of the conference.

The regional action plans outlined below are incomplete. Further discussions are required in order to work out the modalities of implementation and seek formal agreements with regional institutions and funding agencies. Responsibility for the further development and implementation of these action plans was assigned as follows;

- Southern and Eastern Africa—the SADC Food Security Unit and SADC/ICRISAT
- Western and Central Africa—IITA/GTZ Promotion of Seed Production and Marketing Project
- WANA—ICARDA and the WANA Seed Network.

Action Plan for Southern and Eastern Africa

A number of NGOs, donor agencies, and others are active in seed sector development in the region. However, they have been unable to significantly improve seed availability. Private sector investment is limited to a few high-value crops. Government or parastatal monopolies and complex variety release and certification procedures contribute to the non-availability of seed of modern varieties of most food crops. Frequent droughts in large parts of the region, and disruption of agriculture due to civil strife in some areas, have put seed systems under great strain.

This Working Group identified four priority areas that must be addressed.

- Inappropriate seed laws and policies
- Lack of sustainability of informal seed systems
- Poor understanding of farmers' needs and priorities
- Poor coordination of emergency seed supplies.

The regional action plan is developed as a series of 10 objectives, focusing on these priority areas.

Objective 1 To encourage the formulation of seed policies with simple, transparent release and certification procedures, removal of restrictions on seed trade, greater incentives for the private sector, and enforcement of truth-in-labeling

Activity	*Responsibility*	*Schedule*	*Budget*
Establish private seed associations in each country	Joint private-public sector committee	5 years	National activities normally possible out of existing resources, but international activities may need some funding. In addition, public seed services could be permitted to recover costs through levies
Formulate appropriate policies and laws after extensive consultations among all interested parties. Policies should include the following elements—a regional variety list, non-restrictive phytosanitary and import/export regulations, voluntary or automatic registration for all or most crops, and enforcement of truth-in-labeling	Private sector, govt, and researchers	5 years	As above
Establish regional and/or African seed trade association	To be defined	5 years	As above
Regional harmonization of seed laws for easier movement of seed and varieties across borders	Regional/African seed trade association to discuss with govts	5 years	As above
Participatory breeding; researchers to support farmer review and choice of new lines	All organizations introducing new varieties	5 years	As above
Allow private sector to carry out seed certification and laboratory testing under close monitoring by govt bodies	Govts, seed companies, farmers	5 years	As above
Make extension workers familiar with national seed laws	Govts, seed companies	5 years	As above

Objective 2 To improve the availability of breeder and basic seed

Activity	*Responsibility*	*Schedule*	*Budget*
Monitor levels of stock and demand for breeder seed	NARS, seed association	Seasonal; on-going activity	Probably no new funding needed
Assign responsibility for production of breeder and basic seed	Currently with NARS, but should be gradually devolved to private sector	Seasonal; on-going activity	Probably no new funding needed

Objective 3 To reduce dependence on donor funding, create an enabling environment for seed sector development, and thus ensure the sustainability of seed projects

Activity	*Responsibility*	*Schedule*	*Budget*
Modify or create seed regulations to attract private sector investment	Govts, donors	On-going in several countries	Only minimal funding needed
NGOs to identify examples of successful cost-recovery strategies	NGOs	On-going in several countries	Only minimal funding needed
Govts to make appropriate use of selective/ dedicated taxes encouraging private investment in seed production and distribution	Govts	On-going in several countries	Only minimal funding needed

Objective 4 To improve targeting of subsidies by identifying the most appropriate targets for public support

Activity	*Responsibility*	*Schedule*	*Budget*
Ministry of Agriculture policy units to evaluate returns to targeted public investment in seed production and distribution	Govts	To be defined	To be defined
NGOs and NARS to target subsidy where cost recovery is most difficult	NGOs, NARS	To be defined	To be defined

Objective 5 To develop and implement an appropriate long-term strategy for regional seed sector development

Activity	*Responsibility*	*Schedule*	*Budget*
Review national and regional seed sector activities for consistency with long-term development objectives	SADC, NARS	1999	US$ 250 000 (total for all activities)
Establish a regional seed network	SADC, NARS	1999	
Implement performance-based budgeting wherever possible	SADC, NARS	1999	

Objective 6 To improve the design and implementation of seed projects by strengthening the organizational and technical capacity of implementing agencies

Activity	*Responsibility*	*Schedule*	*Budget*
Establish an information collection system, including the use of reconnaissance surveys and rapid rural appraisal methods	Ministry of Agriculture, NGOs, private sector	Ongoing	US$ 100 000 (total for all activities)
Training in seed production marketing	NARS, NGOs	Ongoing	
Encourage partnerships between NARS and NGOs, based on each institution's comparative advantages	NARS, NGOs	Ongoing	

Objective 7 To better understand farmer demand, and thus target seed programs more effectively

Activity	*Responsibility*	*Schedule*	*Budget*
Surveys to evaluate level and consistency of demand for seed	To be defined	To be defined	To be defined
Establish data collection methodology	To be defined	To be defined	To be defined

Objective 8 To improve seed marketing and distribution

Activity	*Responsibility*	*Schedule*	*Budget*
Encourage development of private and informal seed systems through reduced public sector involvement in seed production and distribution	Govts, private seed companies, seed associations	To be defined	Minimal
Review credit constraints to expanding investment in seed trade	Govts, universities, NGOs	To be defined	Minimal
Provide business training	Universities, NGOs	To be defined	Minimal
Develop farmers' capabilities as seed traders/companies	Universities, NGOs	To be defined	Minimal

Objective 9 To better understand and incorporate farmers' needs and priorities into research priorities

Activity	*Responsibility*	*Schedule*	*Budget*
Evaluate current levels of varietal adoption and seed trade	All stakeholders	To be defined	To be defined. Govts, donors to provide support
Involve farmers, traders, and consumers at an earlier stage in technology development	NARS, IARCs	To be defined	To be defined. Govts, donors to provide support
Set national and regional targets for seed supply and varietal adoption	NARS, SACCAR, ASARECA	To be defined	To be defined. Govts, donors to provide support
Conduct impact assessment studies of crop breeding and seed supply programs	NARS, SACCAR, ASARECA, IARCs	To be defined	To be defined. Govts, donors to provide support
Conduct participatory breeding	All stakeholders	To be defined	To be defined. Govts, donors to provide support
Identify seed experts at the village level	Extension, NGOs	To be defined	To be defined. Govts, donors to provide support
Encourage dialog between biological and social scientists	To be defined	To be defined	To be defined. Govts, donors to provide support

Objective 10 To improve the coordination of emergency seed distribution by developing a regional seed security strategy and strengthening national and regional networks

Activity	*Responsibility*	*Schedule*	*Budget*
Seed security task force (govt, IARCs, private sector, NGOs) to develop concept paper and funding proposal	SADC Food Security Unit and ASARECA to prepare draft document	6 months (by Sep 1997)	Total for both activities US$ 40 000 ($20 000 each for Southern and Eastern Africa)
Develop strategies for seed supply response with different time frames: short term, medium term, and long term (i.e., exit strategy)	SADC Food Security Unit and ASARECA to prepare draft document	6 months (by Sep 1997)	

Action Plan for Western and Central Africa

Despite the availability of a number of modern varieties and substantial investments by donors in seed production over the past 20 years, formal seed supply systems in Western and Central Africa have largely failed. Seed is produced and distributed by government departments and NGOs. However, government departments lack staff and expertise, while NGO programs are generally unsustainable, being dependent on continuous donor subsidies. Many governments lack a clear seed policy, and information on varieties is lacking.

The recently initiated IITA/GTZ Promotion of Seed Production and Marketing Project is expected to play a leading role in seed sector development in the region. However, strong support from national programs is essential, particularly because a basic reorientation of priorities may be necessary in some areas.

The Working Group identified four key areas where interventions are needed.

- Inappropriate seed policies and regulations
- Lack of information on available modern varieties (characteristics and seed cost/ availability)
- Inappropriate research priorities, and lack of emphasis on breeder seed production
- Lack of seed production skills at farm level.

The regional action plan thus contains four objectives.

Objective 1 To develop appropriate seed policies and regulations

Activity	*Responsibility*	*Schedule*	*Budget*
Set up a regional seed advisory committee	NARS, GTZ/IITA Seed Project	2 years	To be defined
Set up/strengthen national seed advisory policy committee in each country	Regional seed advisory committee, NARS	2 years	To be defined

Objective 2 To collect and disseminate information on variety characteristics, seed cost, and availability

Activity	*Responsibility*	*Schedule*	*Budget*
Initiate regional seed network for Western and Central Africa	NARS, GTZ/IITA Seed Project	2 years	To be defined
Publish a seed newsletter for Western and Central Africa	To be defined	2 years	To be defined
Initiate a regional variety catalog	NARS, regional seed advisory committee	2 years	To be defined
Organize a national seed supply workshop	NARS, GTZ/IITA Seed Project, NGOs	2 years	To be defined

Objective 3 To reorient research priorities with greater emphasis on breeder seed production

Activity	*Responsibility*	*Schedule*	*Budget*
Stimulate farmer participation in variety development and evaluation	NARS, IARCs	2-5 years	To be defined
Improve production of breeder seed at IARCs and NARS, with clear identification of responsibilities	NARS, IARCs	2-5 years	To be defined

Objective 4 To improve farmers' skills in seed production

Activity	*Responsibility*	*Schedule*	*Budget*
Promote farmer training on different aspects of seed production	Extension, NGOs	5-10 years; on-going	To be defined

Action Plan for West Asia and North Africa

The WANA region differs from the other two regional groupings in several key features. Agroecology and climate are different from those in many other parts of Africa; strong national research programs exist in most countries; few NGOs operate (except in Ethiopia and Sudan); emergency situations are rare (except Ethiopia, Afghanistan); and a regional seed network is already in operation. There is wide variation among countries in skills and expertise. For example, Turkey has a strong, growing private sector, while Afghanistan and Ethiopia have no private sector.

This Working Group identified four priorities for action.

- Seed policy
- Support for the informal seed sector
- Support for national seed associations
- Incentives for the private sector.

Specific activities were defined relating to each of these priorities. Implementation of these activities will generally require additional funding support. The existing regional seed network is expected to expand its role as a technical advisory body, and increase its involvement in developing and influencing regional seed policies. The network is also expected to expand its activities relating to the dissemination of seed information among member countries and institutions.

Objective 1 To develop clear national seed policies to encourage development of the formal and informal sectors

Activity	*Responsibility*	*Schedule*	*Budget*
Draft a model seed policy with help from international organizations	WANA Seed Network	Dec 1997	To be defined
Establish national seed councils with representation from all sectors	Govt ministries	To be defined	To be defined
Formulate/modify national seed policies	National seed councils	To be defined	To be defined

Objective 2 To provide greater support to the informal sector

Activity	*Responsibility*	*Schedule*	*Budget*
Form committee on informal seed sector	WANA Seed Network	July 1997	To be defined
Collect and analyze information about the informal seed sector	Committee, WANA Seed Network Secretariat	March 1998	To be defined
Develop proposal for support activities	Committee, WANA Seed Network Secretariat	March 1998	To be defined
Exchange information with other regions (Southern and Western Africa)	ICARDA Seed Unit	To be defined	To be defined

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Sumario

Estrategias alternatives para o fornecimento de sementes ao pequeno agricultor: actas duma conferencia international sobre opcoes para o reforco dos sistemas nacionais e regionais de sementes em Africa e Asia Ocidental. A falta de sementes e o maior constrangimento para o pequeno agricultor em muitas partes do mundo em desenvolvimento. Esta publicacao reporta uma conferencia de 5 dias, que procurou definir os problemas de oferta de sementes em Africa e Asia Ocidental; discutir os papeis correntes e potencias dos sectores publico e privado, ONGs, institutos internacionais de investigacao, cooperativas, e grupos de agricultores; e analisar o funcionamento de varios canais de fornecimento de semente, incluindo as trocas de agricultor para agricultor.

A conferencia foi organizada pelo ICRISAT, ICARDA, IITA e GTZ, e atendido por mais de 70 participantes de 18 paises (Algeria, Costa do Marfim, Egipto, Etiopia, Gana, Quenia, Malawi, Marrocos, Namibia, Paquistao, Serra Leoa, Sudao, Siria, Tanzania, Turquia, Yemen, Zambia, e Zimbabwe), 4 centros CGIAR, e um numero de doadores, ONGs, agendas nacionais e internacionais, e institutos de investiga9ao avancada.

O objectivo principal da conferencia foi desenvolver estrategias para reforcar tanto os canais de distribui9ao de sementes formais como os informais, particularmente para as culturas de seguranca alimentar onde o interesse do sector privado e limitado. Cerca de metade da conferencia foi devotada para a identificar e priorizar politicas e constrangimentos institucionais, e com base nestas discussoes, desenvolver pianos de accao para melhorar a disponibilidade de semente em cada uma das tres regioes—Africa Austral e Oriental, Africa Ocidental e Central, e Asia Ocidental e Africa do Norte. Estas actas contem os artigos apresentados na conferencia, e as recomendacoes e pianos de accao desenvolvidos atraves das discussoes.

خلاصة

يُعد عدم توفر البذور أكبر عائق بالنسبة للزراعة ذات الحيازات الصغيرة في أصقاع واسعة من بلدان العالم النامي. وتعرض هذه المطبوعة وقائع ورشة العمل التي استمرت خمسة أيام لتحديد مشكلات توريد البذور في كل من إفريقيا وغربي آسيا؛ وبحثت الدور الحالي والممكن للقطاعين العام والخاص؛ والمنظمات غير الحكومية ومؤسسات البحوث الدولية، والجمعيات التعاونية ومجموعات المزارعين؛ وتحليل عمل مختلف قنوات إمداد البذور بما فيها تبادل البذار بين المزارعين. وقد شارك في تنظيم ورشة العمل كل من إكريسات وإيكارادا وإيتا وGTZ وحضرها مايزيد على ٧٠ مشاركاً من ١٨ بلداً (الجزائر، ساحل العاج، مصر، إثيوبيا، غانا، كينيا، مالاوي، المغرب، ناميبيا، الباكستان، سيراليون، السودان، سورية، تانزانيا، تركيا، اليمن، زامبيا وزمبابوي)، بالإضافة إلى ٤ مراكز تابعة للمجموعة الاستشارية، وعدة جهات مانحة ومنظمات غير حكومية، ووكالات إقليمية ودولية ومعاهد بحوث متقدمة.

وتمثل الهدف الرئيسي في وضع استراتيجيات لتعزيز قنوات توزيع البذور الرسمية وغير الرسمية، وخاصة لمحاصيل الأمن الغذائي حيث تكون مصالح القطاع الخاص محدودة. وقد خصصت نصف ورشة العمل تقريباً لتحديد معوّقات السياسات والمعوّقات المؤسساتية وتحديد أولوياتها، وعلى أساس هذه المناقشات، تم وضع خطط عمل لتحسين إمكانية الحصول على البذور في كل منطقة من المناطق الثلاث – جنوبي وشرقي إفريقيا، غربي ووسط إفريقيا، وغربي آسيا وشمالي إفريقيا. وتضم هذه الوقائع الأوراق المقدمة في ورشة العمل، والتوصيات، وخطط العمل التي أسفرت عنها المناقشات.

About ICRISAT

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

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

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

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