

MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

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**Constraints and Strategies for the Development of the
Seed System in Mozambique**

by

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EXECUTIVE SUMMARY

Low biological productivity and low value of production are the primary constraints to a more effective contribution from agriculture to the goal reduction of absolute poverty in Mozambique. As a gateway to the world's growing stock of improved germplasm, the seed sector has the potential to make an enormous contribution to increased productivity and, through quality improvements, to the market value of crop production. But Mozambique's seed sector is still in its infancy and, with the exception of emergency seed provision, has so far had only a marginal impact on the well being of the rural population.

The purpose of this working paper is to help accelerate improvements in seed sector performance by providing a practical framework for reviewing seed sector development strategy in a market economy context. The paper is divided into three major sections. The first section defines what a seed system is and presents a generalized model of the stages of seed sector development over time, identifying the driving forces at each stage. The second part of the paper describes the current organization and performance of Mozambique's seed sector, concluding with the constraints identified at the first national seed workshop held in Maputo in June 1999. The sector is at present primarily driven by emergency seed supply, most of which is imported.

Key elements of a revised strategy to overcome the sector's constraints include 1) increased demand for and access to a broader range of seed technology for market and food security oriented crop production; 2) expansion of private sector seed production and distribution through both the formal and informal sectors; and 3) effective and balanced partnerships between public, private, NGO and donor organizations in strengthening different components of the seed system, supported by a flexible and facilitative regulatory environment.

The final section of the paper presents recent case studies of efforts to introduce improved varieties for three crops in Mozambique (maize, sunflower and sweet potato). Drawing on the lessons learned in the case studies, the paper identifies concrete interventions needed to expand demand and supply of improved seed for both commercial and food security-oriented production systems over the next decade, and outlines the role and contributions required from public, private, NGO and donor organizations.

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ACRONYMS

Acronym	Meaning or Description in ENGLISH	Meaning or Description in PORTUGUESE
AFRICARE	Non-governmental Organization	Organização Não-governamental
BR	Black Record	Variedade de Girassol “Black Record”
CARE	Non-governmental Organization	Organização Não-governamental
CIAT	International Center of Tropical Agriculture	Centro Internacional de Agricultura Tropical
CIMMYT	International Center for Maize and Wheat Improvement	Centro Internacional de Melhoramento de Milho e Trigo
CLUSA	Cooperative League of United States of America	Sociedade Cooperativa dos Estados Unidos da América
CNS	National Seed Committee	Comité Nacional de Sementes
DAP	Department of Policy Analysis	Departamento de Análise de Políticas
DE	Directorate of Economics	Direcção de Economia
DINA	National Directorate of Agriculture	Direcção Nacional de Agricultura
DNER/SG	National Directorate of Rural Extension/ Sassakawa Global	Direcção Nacional de Extensão Rural/ Sassakawa Global 2000
ENS	National Enterprise of Seed	Empresa Nacional de Sementes

Acronym	Meaning or Description in ENGLISH	Meaning or Description in PORTUGUESE
FAO	Food and Agriculture Organization of the United Nations	Organização das Nações Unidas para Agricultura e Alimentação
FFA	Agrarian Fund	Fundo de Fomento Agrário
FHI	Food for the Hungry International	Fundação Contra a Fome
GTZ	German Technical Assistance <i>Deutsche Gesellschaft für Zusammenarbeit</i>	Assistência Técnica Alemão
HKI	Helen Keller International	Helen Keller Internacional
IARC	International Agriculture Research Center	Centro Internacional de Investigação Agrária
ICRISAT	International Crop Research Institute for Semi-Arid Tropics	Instituto Internacional de Investigação para os Trópicos Semi-Áridos
IITA	International Institute of Tropical Agriculture	Instituto Internacional de Agricultura Tropical
INIA	National Institute for Agronomic Investigation	Instituto Nacional de Investigação Agronómica
LLFSP	Luapula Livelihood and Food Security Program	Programa de Segurança Alimentar e de Subsistência de Luapula
MADER	Ministry of Agriculture and Rural Development	Ministério da Agricultura e Desenvolvimento Rural
MRI	Seed Private Enterprise	Empresa Privada Operando na Área de Sementes
MSU	Michigan State University	Universidade Estatal de Michigan
NARS	National Agriculture Research Services	Serviços Nacionais de Investigação Agrária
ONG	Non-Government Organization	Organização Não-governamental
OPV	Open Pollinated Variety	Variedade de Polinização Aberta
PANNAR	New Private Seed Company in Mozambique that receives support from PANNAR-South Africa	Nova Companhia Privada de Sementes em Moçambique que recebe apoio da PANNAR-África de Sul

Acronym	Meaning or Description in ENGLISH	Meaning or Description in PORTUGUESE
PESU	Emergency Program of Seed and Tools	Programa de Emergência para Sementes e Utensílios
SADC	Southern African Development Community	Comunidade de Desenvolvimento da África Austral
SARRNET	Southern Africa Roots and Tubers Network	Rede Austral de Raízes e Tubérculos
SEEDCO	Seed Company based in Zimbabwe	Companhia de Sementes de Zimbabwe
SEMOC	Seed Company of Mozambique	Sementes de Moçambique
SNS	National Seed Service	Serviço Nacional de Sementes
TRIPS	Trade-Related Intellectual Property Rights (Agreement of the World Trade Organization)	Direitos de Propriedade Intelectual Relacionados ao Comércio (Acordo da Organização Internacional do Comércio Mundial)
UEM	Eduardo Mondlane University	Universidade Eduardo Mondlane
USAID	United States of America International Development	Agência Americana de Desenvolvimento Internacional
WTO	World Trade International Organization	Organização Internacional do Comércio Mundial

CONSTRAINTS AND STRATEGIES FOR THE DEVELOPMENT OF THE SEED SYSTEM IN MOZAMBIQUE

1. BACKGROUND

Because of Mozambique's rapidly expanding population (from 16.1 million in 1997 to an estimated 28 million in 2020), agricultural productivity must accelerate in order to improve rural incomes and satisfy the growing demand for food in both rural and urban areas. During the 1990s, Mozambican agricultural production grew rapidly. Then, the main source of growth was the expansion in area cultivated following the resettlement of displaced refugees. But uncultivated land for expansion is rapidly disappearing in accessible, high-potential areas of the country and peri-urban areas around the three major cities. In the future, agricultural intensification (i.e., raising yields on fixed supplies of arable land through the adoption of improved seed varieties, chemical and organic fertilizers, soil/water conservation technologies, pesticides, and animal traction) will be increasingly important as a strategy to increase food supplies and rural incomes without damaging the environment.

1.1. Research Questions, Methods, and Organization of the Paper

The adoption of improved seed, fertilizer and other technologies are critical prerequisites for increasing future agricultural productivity, but the majority of Mozambican smallholders are unaware of the advantages of using improved technologies and lack access to them.

This paper focuses on seed subsector development. Four key research questions are addressed:

- 1) what are the key factors affecting seed system development?
- 2) to what extent are improved seeds currently being used in Mozambique, and how is the supply of improved seeds currently organized?
- 3) what are the main constraints to increased availability and use of improved seeds by smallholders?
- 4) what actions might be taken by government, the private sector, non-governmental organizations and donors to facilitate more rapid development of the seed subsector?

The report draws on a larger study of constraints and strategies affecting the development of the agricultural inputs sector in Mozambique. The agricultural inputs study was undertaken by a working group composed of representatives from the following organizations, including the Economics Directorate (DE) of the Ministry of Agriculture and Rural Development, the National Directorate of Agriculture (DINA), the National Institute for Agronomic Research (INIA), the National Directorate for Rural Extension (DNER), the Agrarian Fund (FFA), the Ministry of

Plan and Finance (MPF), the Cotton Association of Mozambique (AAM), and representatives from private agrochemical firms.

Two working sessions were held, in which the group decided to (1) analyze current levels of agricultural input use and organization of the sector, and (2) carry out case studies examining intensification experiences in areas with low and high agro-ecological and commercial potential, in order to identify key constraints and strategies for agricultural input sector development. Three case studies were developed: improved maize intensification in Nampula Province, improved sunflower production and processing in Manica, Nampula and Zambézia Provinces, and dissemination and utilization of improved orange-fleshed sweet potato varieties in Mozambique and elsewhere in the region. The study was executed by staff members from the Department of Policy Analysis (DAP) with faculty from Michigan State University's Department of Agricultural Economics, in close consultation with technical experts from the working group.

The paper is structured as follows. We begin by generally defining the seed system and presenting a conceptual analysis of seed system development in Section 2. Section 3 discusses trends in improved seed use, seed system organization and constraints to increased seed use in Mozambique. In Section 4, we review key findings from the case studies and their implications for improved seed marketing and dissemination in Mozambique. Finally, we discuss potential policy and program actions that could be taken by the government, in partnership with the private sector, NGOs, donors and other international organizations, to facilitate seed sector development.

2. A CONCEPTUAL FRAMEWORK FOR SEED SYSTEM DEVELOPMENT¹

2.1. The Seed System

The “seed system” refers to the entire complex of organizations, individuals and institutions associated with the development, multiplication, processing, storage, distribution and marketing of seeds. The seed system includes the traditional (or informal) system in which individual farm households carry out all seed functions for land races, including seed development, multiplication, processing, and marketing, and the formal or commercial systems comprised of specialized organizations with distinct roles in supplying seeds of new varieties. Figure 1 illustrates how seeds of improved and landrace varieties flow from organizations and individuals in one stage of the “seed chain” to the next through channels depicted by arrows. Legal considerations such as variety release procedures, intellectual property rights, certification programs, seed standards, contract laws, and law enforcement are also an important component of the seed system. These institutions help determine the quantity, quality and cost of seeds passing through the seed system.

Seeds pass through the chain of activities to one of three outlets. They are either sold in the market, used in development programs, or retained by households for the next planting season (Figure 1). Seeds of landrace varieties and of new varieties that have entered the farmer-based informal system are generally retained by farm households for their own use or exchanged with other farm households. Seeds of new varieties entering the formal system of seed organizations are usually marketed, but some are also used in development programs, such as drought and disaster relief and the free distribution of seeds to promote new varieties.

The three supply outlets of the seed system – markets, non-market distribution and retained seeds – form the three sources of seed for farm households. The relative importance of each seed source will depend on the effective demand for seeds of new varieties compared to landrace varieties. Farmer retention is the most common source of landrace varieties for most grain crops. For new varieties, markets and farmer retention are both important depending on whether the demand for seeds is continuous or periodic. Non-market sources of seed are important in cases where demand for seed is affected by chronic poverty or by external conditions (such as drought, war, disasters) affecting a region.

Figure 1 provides a basic framework for understanding the seed system and how it is affected by the dynamics of seed supply and demand. It also provides a means for identifying gaps, opportunities and strategies for organizing an effective seed system. **A well-functioning seed system is defined as one that uses the appropriate combination of formal, informal, market and non-market channels to stimulate and efficiently meet farmers’ evolving demand for quality seeds.**

¹ The following section draws heavily on Maredia, Howard, Boughton et al.1999.

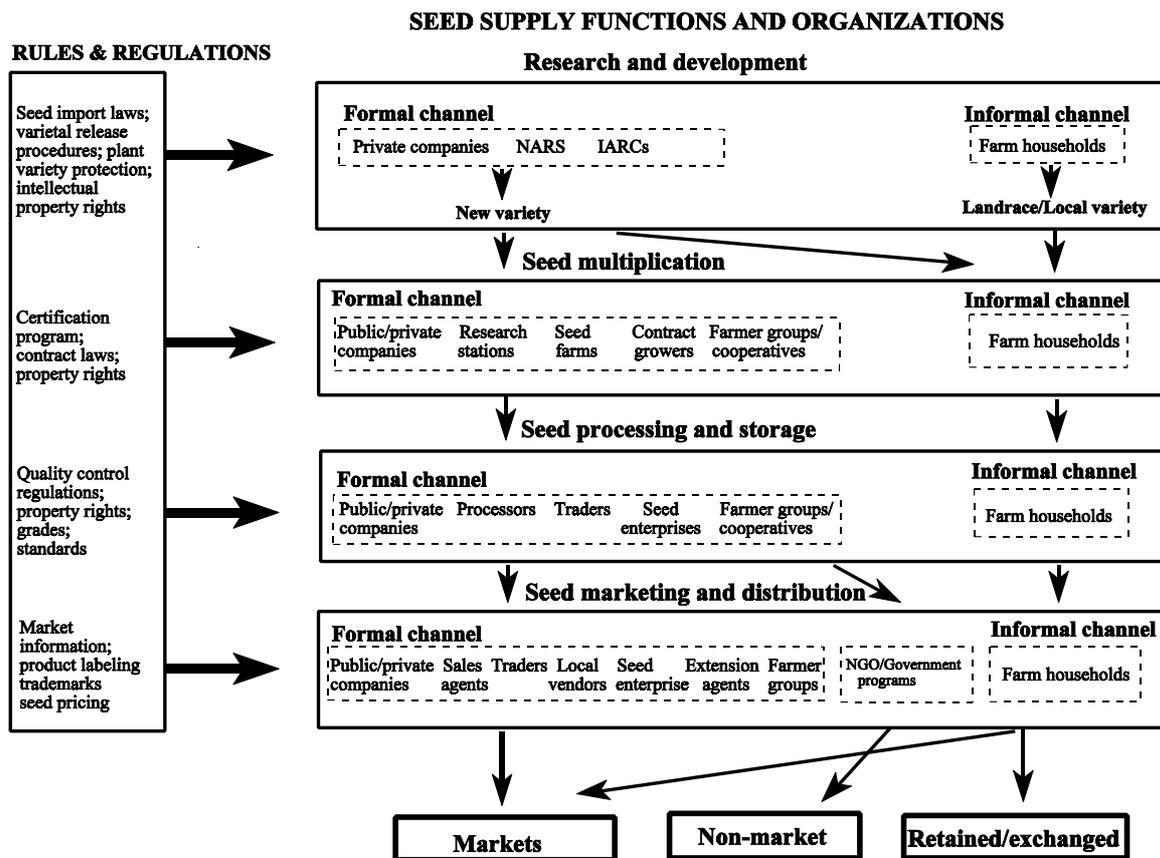


Figure 1. Seed System: An Organizational and Institutional Framework

2.2. Seed System Transformation

The seed system passes through several phases as it evolves from a traditional system, where all production and supply functions are carried out by the farm household, to a more complex system in which many different organizations (e.g., seed companies, seed growers, farmer-based seed enterprises, seed processors) and legal institutions (e.g., seed standards, regulations, certification programs) play specialized roles in the seed supply chain (Douglas 1980; Pray and Ramaswami 1991; Jaffe and Srivastava 1992; Rusike and Eicher 1997). The key features of each stage are summarized below.

- In stage 1, the informal seed system predominates; most farmers save their own seed or obtain seed from nearby farmers or villages, and the rate of new varietal development and adoption of new seeds is low.
- During stage 2, seeds of improved varieties developed by publicly-financed research begin to replace local varieties, use of complementary inputs (e.g., fertilizer) is limited but increasing, and an emerging private sector is involved in the multiplication and distribution of public varieties.

- During stage 3, the private sector begins to play an active role in research and development, particularly in developing hybrids and seeds for specialized cash crops. Seed distribution systems become more organizationally varied and decentralized, and many components of the mature seed system exist but the supply of seed from the formal sector still ranges from fair to poor.
- In stage 4, the seed system and the agricultural sector as a whole are well developed. Commercial seed production and marketing are common, effective seed laws and regulations are in place, linkages with actors outside the seed sector are well established, and the use of improved seed is widespread.

As the seed system evolves, advancements in plant breeding and seed processing methods make it possible to expand seed research, production, multiplication, processing and marketing functions beyond individual farmers and communities. The rules, regulations, and infrastructure coordinating the components of the seed system also evolve to allow organizations to specialize in different functions of the seed system. The public sector may specialize in basic research and research on subsistence crops, and in regulating the seed system, for example. The national and international private sectors increasingly focus on research, production and marketing of seed for hybrids, specialty crops, vegetable crops, and commercial food and fiber crops. Community-based organizations and NGOs try to fill the gap by concentrating on multiplication and distribution of seed for crops and farmers not targeted by the private sector.

The transformation process described above should not be interpreted as the simple linear progression of a national seed system from an informal to a formal system (Tripp 1995). Seed systems for different commodities follow distinct development paths as they move from one phase to the next. For example, the path for a hybrid maize seed system will be different from that for millet or cowpea, and those systems may never reach the technical, organizational and institutional complexity of a hybrid maize seed system in phase 4. The seed system for maize in the advanced phase (such as in the U.S.) may be composed only of formal seed channels, with the private sector meeting the market demand for hybrid seed each season. On the other hand, seed systems for beans, wheat, cowpeas, and groundnuts, even in a mature phase, may have all the components of the seed system depicted in Figure 1, with both formal and informal sectors playing important roles in meeting the demand for seed.

It is important to recognize the complexity and diversity of the seed sector in each phase, and the dynamic roles of a range of formal and informal seed organizations in promoting the transformation process (Tripp 1995, Louwaars 1994). Two points are particularly important: (1) the changing (but not necessarily declining) public sector role as private sector involvement increases in different stages of the seed chain; and (2) the declining relative importance of the informal seed sector as the seed system develops. Past donor and government strategies were based on a much narrower interpretation of the transformation process, focusing only on the development of large-scale public and private commercial seed enterprises and regulatory agencies that promoted the use of certified seeds and hybrids.

2.3. Seed Demand and Supply Dynamics

Seed system development can be viewed as a dynamic process of matching the supply to the changing demand for seeds. On the supply side, this involves strengthening and promoting the seed supply organizations depicted in Figure 1. It also involves designing institutions (e.g., seed regulations governing varietal development, release, and certification) appropriate to existing technical (e.g., type of crop, cropping system) and environmental (e.g., transportation, market infrastructure) conditions to promote the development of seed supply chains.

On the demand side, institutions and programs will influence farmer decisions regarding the use of saved versus commercial seed. Several factors affect this decision, including: (1) the farmer's ability to produce and save seed; (2) the type of crop (self-pollinated, open-pollinated, roots and tubers); (3) the yield or quality advantage of purchased seed; (4) the cost of seed (purchase price plus the cost of procuring seeds from distribution outlets); (5) the price and availability of complementary inputs; (6) the relative price of crops; (7) the farmer's forecast of weather conditions and output prices; and (8) the farmer's purchasing power (Pray and Ramaswami 1991).

These factors help determine the quantities demanded by farmers from market versus retained sources. The comparative advantage that different types of seed supply organizations will have in meeting these demands depends on three factors: the economic status of seed users; crop biology (e.g., breeding system, multiplication factor, seeding rate); and the market outlook for the commodity.

3. USE OF IMPROVED SEED AND ORGANIZATION OF THE SEED SYSTEM IN MOZAMBIQUE

3.1. Use of Improved Seed

Most of Mozambique's production systems – and almost all smallholder production systems – are characterized by very low levels of improved input use. The use of improved varieties of seed is extremely limited and discontinuous, varying by category of farmer, by crop, and by region. Only an estimated 5-10% of all seed used by Mozambican smallholders comes from improved varieties. The great majority of seed used by smallholders is grain saved from season to season (Libombo and Uaiene 1999).

3.2. Organization of the Seed System

In Mozambique, civil war and its aftermath have fundamentally affected the development of the seed system and the supply and demand for seed products. The principal effect of these disruptions was to give non-governmental organizations (NGOs) a disproportionate role in most stages of the formal seed system (research and development, multiplication, processing and storage, and marketing and distribution), as they struggled to fill the vacuum left by disintegrating public and private entities. Partly as a result, non-market distribution and retained seeds have remained the primary sources of seed for smallholders (Figure 1). Seed market development has been limited, as has private sector participation in different stages of the seed system.

Research and Development. The organizations involved in this stage of the seed system include the National Institute for Agronomic Research (INIA), the Faculty of Agronomy of the Eduardo Mondlane University (UEM), the Seed Company of Mozambique (SEMOC), and NGOs such as World Vision, CARE, GTZ, and Food for the Hungry. The NGOs, especially World Vision, signed memorandums of understanding with INIA to assist extensively in varietal testing and agronomic research during the relief and recovery period of the 1990s, testing varieties for potential inclusion in seed packs that were distributed to camps and newly resettled farmers following the end of the war. Direct involvement by NGOs in seed-related research and development diminished in the late 1990s, but continues in some regions and commodities. For example, CARE, Africare and World Vision are collaborating with UEM in the adaptive testing of oilseed germplasm imported from neighboring countries.

Multiplication, Processing and Distribution in the Formal Seed Sector. The key actors in these stages of the formal seed sector have been NGOs and SEMOC. Until very recently, SEMOC was the only commercial seed production and distribution entity operating in Mozambique. PANNAR, a new Mozambican seed enterprise, created in August 2000, that sells products from PANNAR-South Africa and intends in the coming year to produce seed of Mozambican origin within Mozambique. Tecap, a Mozambican firm, recently became an agent for MayFord, a

South African seed firm. SEMOC was created in 1989 as a semi-commercial seed company,² descended from the parastatal *Empresa Nacional de Sementes* (ENS), which had been operating since 1980. In 1982 the government also established a national seed service (SNS)³ within the National Directorate of Agriculture (DINA) with responsibility for seed testing and quality control. SEMOC produced seed for rice, maize, groundnut, bean, cowpea, soybean, sorghum, sunflower and some vegetables, while cotton seed production remained the responsibility of the state. Production took place initially on centralized seed farms and, beginning in the early 1990s, with contracted seed producers. Processing plants with standardized equipment are located in Maputo, Lionde (Gaza Province), Chimoio (Manica Province), and Namialo (Nampula Province).

SEMOC initially planned to concentrate on multiplication and distribution of varieties developed by INIA, but because INIA had limited capacity for generating new varieties, SEMOC began varietal testing and other research activities in collaboration with INIA and UEM. The company focused on variety screening of indigenous and introduced material, production of pre-basic and basic seed and utilization of open-pollinated varieties (OPV) instead of hybrids, given the low management level on seed farms and the limited capacity of Mozambican farmers to purchase hybrids each year (Tesfai 1991; Svalöf 1988, 1990; Strachan 1994).

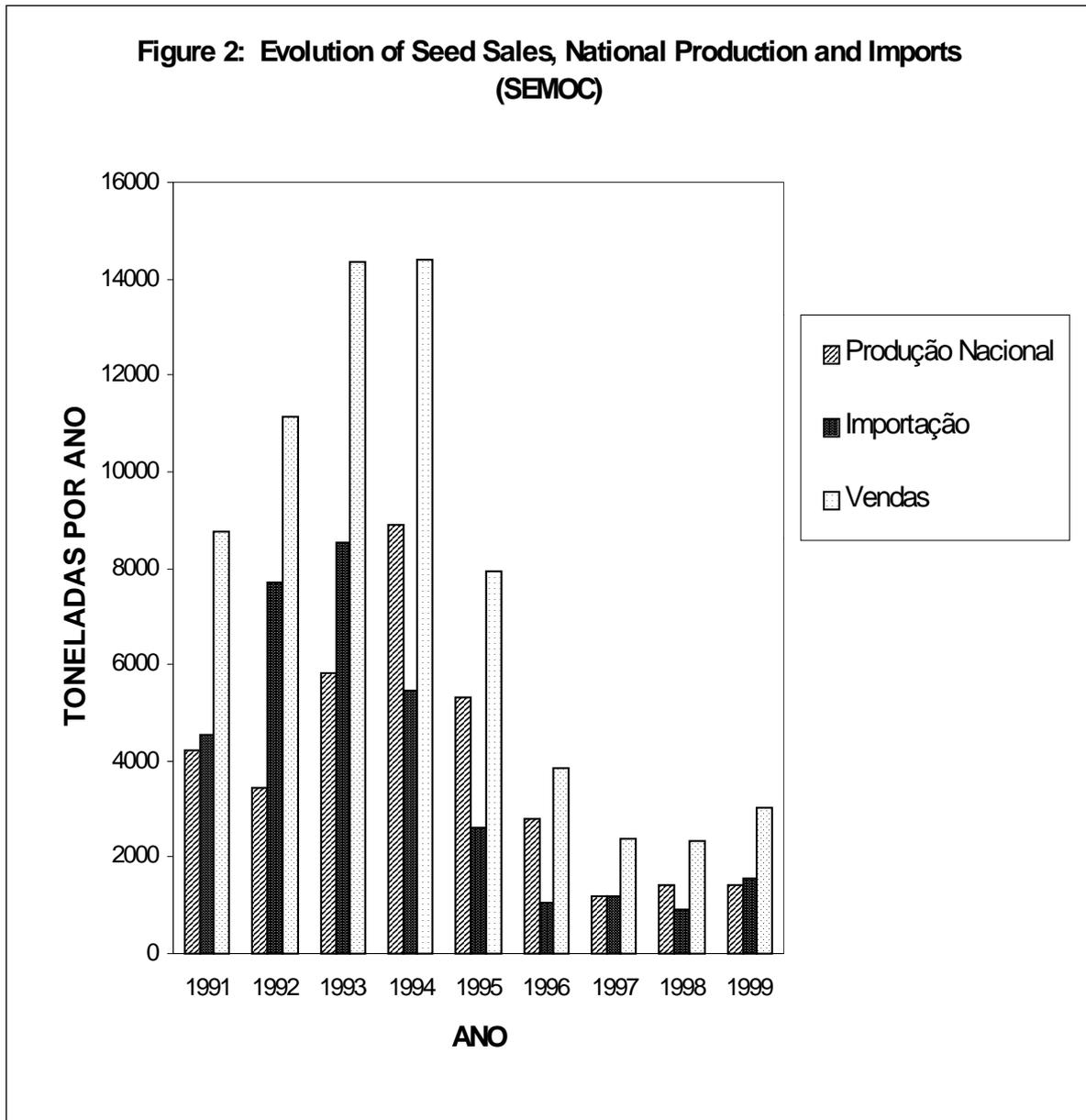
During the emergency recovery period, from the late 1980s until 1994, great quantities of food crop seeds were multiplied or directly imported by SEMOC or NGOs for distribution to smallholders through the Emergency Program for Seeds and Equipment (PESU). At its height, an estimated 1.2 million families received seeds and tools through the emergency programs annually. Sales for emergency programs represented over 90% of SEMOC's total business. SEMOC marketed the remainder of the seed commercially through various wholesalers such as Boror Commercial, which retailed the seed through their own networks. SEMOC also retailed and sold seed directly to agricultural projects as well as small amounts to customers through its shop in Maputo.

When the emergency programs began to wind down, demand for formal sector seed fell sharply. SEMOC sales fell from over 14,000 tons per year in the early 1990s to 3,000 tons in 1997 and 1998 (Figure 2). SEMOC's seed production fell to 1000 tons in 1995, far below the installed processing capacity of 18,000 tons/year (SEMOC 1995). Because the distribution of emergency seeds was carried out through the Provincial Directorates of Agriculture or directly by NGOs, the commercial infrastructure for the distribution of seeds was almost non-existent. And, while the emergency programs introduced farmers to improved seed varieties, persuading smallholders to purchase seed was difficult after many years of free distribution.

² The Ministry of Agriculture and Rural Development held 80% of shares, Svalöf AB (Sweden's largest seed company) 10% and Swedfund 10%.

³ As part of the on-going reorganization of the Ministry of Agriculture and Rural Development, since 1999 the National Seed Service should technically be considered the Seed Department, still within DINA. However, the term National Seed Service is still the most widely used designation, with will use SNS throughout this report. Physically, the laboratories and offices of SNS are housed within INIA buildings.

SEMOC is currently undergoing a major restructuring in an effort to improve its efficiency and response to market demands. In 1998 Seedco, a private Zimbabwean seed firm, acquired majority ownership of SEMOC and initiated a number of actions aimed at building smallholder demand and improving their access to improved seeds. In 1998 SEMOC began marketing seeds in 2-kilogram packages. By 1999, SEMOC's commercial network had expanded to include



Source: SEMOC

dedicated stores in 6 provinces and 330 affiliated retail shopkeepers throughout the country (personal communication, F. Dimande 1999). Significant problems remain, however. Programs

such as DNER/Sasakawa Global 2000 improved maize demonstrations, and CARE, World Vision and Africare oilseed programs have helped increase smallholder demand for improved maize and oilseeds. SEMOC has been unable to supply adequate quantities of improved maize seed to program participants in a timely manner, however, and farmers have complained of germination problems with both maize and sunflower seed (Howard, Massingue, Jeje, Tschirley, Boughton and Serrano 2000).

3.3. Rules and Regulations Affecting the Seed System

The legal instruments for regulating the various processes of the seed system – including variety improvement, variety listing, seed production, processing, storage, analysis, certification and marketing (import and export) – were created in the early 1990s. The most important of these laws include:

- Decree No. 41/94, which establishes the mechanisms for the development of a national seed industry, including guidelines for the production and marketing of different categories of seeds in Mozambique. The decree assigned MADER the responsibility for implementing this law, and creating and enforcing other complementary regulations affecting the seed sector. It also creates the National Seed Committee to advise the Minister of Agriculture on seed issues.
- Ministerial Diploma No. 95/91, which establishes rules and procedures for seed importation. This legislation seeks to insure that imported seeds are of good quality, discourage unnecessary seed imports, and coordinate and assist the different organizations involved in seed importation. Importing agents must be registered with the Ministry of Commerce and have previous authorization from DINA for each importation. Seed varieties imported must be recorded in the Official Variety List. Documentation must be shown to prove that the imported seeds are of high quality.

3.4. Constraints to Seed System Development

3.4.1. “Disconnection” Between the Formal and Informal Sectors

Significant resources were invested in the 1980s to replace the informal seed sector with a public sector-dominated formal system composed of SEMOC, INIA, UEM, and SNS. Twenty years later, the majority of smallholders continue to depend on the informal sector for seed supplies and have little or no access to improved varieties. SEMOC, now privatized, faces severe financial difficulties because of the limited demand for its seed products and problems in meeting production and quality requirements.

By contrast, the diversity of seed users in Mozambique (e.g., including estates and smallholders producing cotton and grains for the international market as well as subsistence farmers), in seed biological characteristics, and in the potential for commercialization implies the need for a diverse set of seed supply organizations. The seed supply system can be conceptualized as a continuum of seed organizations ranging from formal large-scale, multinational seed corporations to parastatal seed companies, NGO-supported seed networks, informal farmer seed exchanges and farmer-retained seed. Any one organization will not meet all seed demand, but together they can meet the needs of various users for different types of seeds. Public, private and non-governmental organizations have distinct comparative advantages in performing various activities within the seed chain and in supplying seeds of different types and commercial potential to various categories of seed users. The supply responses from different organizations to seed demand factors and characteristics are summarized in Table 1.

The commercial sector is interested in profits. Its focus will be those types of seed for which there is effective demand, a predictable market in terms of volume and frequency, and which are profitable, such as hybrids and other commodities requiring regular purchase of seed (Table 1). Public sector seed organizations usually have a mandate to serve a broad range of seed users, particularly those less able to buy seeds from commercial dealers. They may offer a wide range of seed types, including those that are relatively costly to produce (e.g., seeds with low multiplication rates such as groundnuts) and/or which have a relatively low value (e.g., self-pollinated crops such as beans, rice, etc.). They may also need to deliver emergency supplies to seed-insecure farmers in remote and marginal areas.

Farmer associations, NGO seed networks and individual producers supply seeds of cross- and self-pollinated crops to subsistence and seed-insecure farmers. However, the most important source of seed for subsistence smallholders is farmer-to-farmer seed exchange and farmer-retained seed.

Until now, Mozambican seed supply organizations have not been able to effectively meet farmer needs in the specific markets identified in Table 1. To promote seed system development, it will be important to recognize the strengths and define the roles of a range of formal and informal seed organizations within Mozambique's seed system, and use public and private resources creatively to help them develop.

3.4.2. Specific Technical and Institutional/Organizational Constraints

A comprehensive analysis of specific technical and institutional/organizational constraints to seed sector development was made during the National Seminar on Seeds held in Maputo in June

Table 1. Supply Responses to Types and Sources of Seed Demand

Demand	Characteristics of Demand		Supply Response
<u>Demand by Seed Use Type</u>	<u>Effective Demand</u>	<u>Frequency of purchase</u>	
Poverty alleviation	No	Seasonal/periodic	Non-market solutions, possibly markets (e.g., seed vouchers)
Emergency program	No	Periodic ^a	Non-market solutions (e.g., government, NGOs)
Renewal of variety	Yes	Periodic	Market (small-scale enterprises), non-market (free distribution of samples), farmer retention
Commercialization	Yes	Seasonal	Commercial large-scale enterprises

<u>Demand by Seed Technology Types</u>	<u>Volume</u>	<u>Frequency of purchase</u>	
Hybrids	High/ low ^b	Seasonal	Commercial large-scale enterprises
OPVS			
-- High sowing rate (e.g., maize)	High	Periodic	Small-scale commercial enterprises
-- Low sowing rate (e.g., sorghum, millet)	Low	Periodic	Government, NGOs, markets
Self-pollinated (Inbred lines)			
-- High sowing rate (e.g., groundnut)	High	Rare	Small-scale commercial enterprises
-- Low sowing rate (e.g., rice, wheat)	Low	Rare	Government, NGOs, markets
Special seed characteristics (e.g., difficult to store, disease risks, forage crops)	High/ low	Seasonal	Commercial enterprises

Source: Maredia, Howard, Boughton et al. 1999, adapted from Tripp (1997)

^a Recurring sales at regular or irregular intervals

^b The hybrid seed market is attractive to private enterprise because farmers must purchase seed annually; whether high or low volumes are purchased is less important.

1999. The seminar which was carried out with technical assistance from the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) and included representatives from public agencies, the private sector, NGOs, and donors. Seminar participants identified specific constraints, and actions needed to overcome them, in three areas: (1) production of breeder and basic seed; (2) production and distribution of commercial and emergency seed; and (3) production of seed at the community level and strategies for distribution. Key constraints in each area are summarized below.

Production of breeder and basic seed

Technical constraints

- Lack of plant breeders
- Lack of relevant breeding programs with adequate long-term support
- Lack of regular production of breeder and basic seed
- Lack of infrastructure for seed multiplication
- Lack of strategies (or strategies are not acted on) for crop improvement

Institutional constraints

- Weak linkages between breeders-extension-producers
- Lack of intellectual property rights for breeders
- Unfavorable work environment and lack of incentives for breeders
- National Committee of Seeds and the Sub-Committee for Release and Registration of Varieties do not function
- Lack of political commitment to research in general and for varietal improvement in particular
- Failure to set adequate research priorities, and to work with research partners to set priorities

Financial constraints

- Irregular and insufficient levels of financing

Production, import/export and distribution of commercial and emergency seed

- Inadequate linkages between NGOs and the private sector
- Failure to develop a retail network
- Lack of a regulatory structure and incentives for the private sector
- Disincentives caused by the free distribution of seeds
- Delays caused by excessive import/export bureaucracy

Production of seeds at the community level, and strategies for distribution

- Lack of information about community-level seed projects
- Lack of information about knowledge that community members have about seed-related matters
- Lack of training for farmers in techniques for seed multiplication
- Weak institutional support for seed multiplication by communities
- Lack of commercial orientation or purchasing power to buy seeds in rural communities
- Lack of clarity and regulations about the role of the informal sector in the multiplication and distribution of seeds

4. STRATEGIES FOR SEED SECTOR DEVELOPMENT

There are two key challenges in the future: (1) to encourage the continued expansion of formal sector seed production and sales for commercial crops in rural areas (such as SEMOC, PANNAR, and new seed companies); and (2) to facilitate seed system transformation by increasing smallholder demand for and access to a broader range of improved seed technology, for subsistence and semi-subsistence as well as commercial commodities. Since most smallholders get seed from the informal sector -- primarily other farm households -- this will require linking these informal groups with the formal organizations in Mozambique's seed sector -- e.g., public research and extension services, NGOs, and private companies.

The following section discusses lessons from several case studies in which improved seed (and other technology) has been produced and distributed through successful partnerships between public and private entities at different stages of the seed system. The case studies of improved maize, oilseeds, and orange-fleshed sweet potato are summarized in Annexes 1, 2 and 3.⁴

4.1. Lessons from the Case Studies

4.1.1. Adopted Technology Responds to Client Demand

Improved technology that is being successfully adopted responds to demand from farmers that is linked to (1) demand from the output market (e.g., improved maize seed and fertilizer to increase the supply of maize for domestic and export markets; improved seed and processing technology to meet village-level demand for cooking oil), or (2) the subsistence/nutrition needs of rural farm families (improved varieties of sweet potato), or (3) both (maize, sunflower oil). The common denominator of success in the field has been the creation of new linkages and alliances -- sometimes between unlikely partners -- to facilitate demand-led access to technology and output markets.

The demand-led approach is in contrast to the supply-led strategies that have dominated input sector policies and programs to date. Supply-led approaches provided little incentive for the creation of linkages between input suppliers, farmers, and output markets. In the absence of

⁴ The full texts of the case studies are forthcoming as DAP *Flash* reports:

- Howard, Julie, Jaqueline Massingue, José Jaime Jeje, David Tschirley, Duncan Boughton and Alexandre Serrano. 2000. *Observations and Emerging Lessons from the 1998/99 High-Input Maize Program in Nampula Province, Mozambique*. Volume 22E.
- Low, Jan, Rafael Uaiene, Maria Isabel Andrade, and Julie Howard. 2000. *Batata Doce de Polpa Cor Alaranjada: Parcerias Prometedoras para Assegurar a Integração dos Aspectos Nutricionais na Investigação e Extensão Agrícola*. Volume 20P, and
- Howard, Julie, and Bill Noble. Forthcoming. *The Case of Sunflower: New Varieties and Low-Cost Processing Technologies Improve Farmer Incomes and Nutrition*.

these demand-led linkages, appropriate technologies are developed or available but remain on the shelf or underutilized. Examples of supply-led strategies in Mozambique include the development of improved seed varieties by public sector breeding programs that are not being adopted by farmers because their characteristics may not meet farmer or market demands, or seed is not available through private or public sector distribution channels.

4.1.2. Roles of Formal/Informal Organizations and Public/Private Sectors Differ by Commodity and the Potential for Commercialization

The case studies demonstrate how the roles of formal and informal organizations, and public and private sectors, differ by commodity and the potential for commercialization. High-potential areas, which have good agro-ecological conditions and growing commercial markets for output commodities, are target areas for purchased technologies -- improved seed varieties, fertilizers, and pesticides (e.g., intensive maize). Commercial marketing of one or more crops in the farming system provides capital to invest in intensification. The amount of capital needed to invest in improved technology may be small (improved sunflower seed) or substantial (improved maize seed with fertilizer). In areas with immediate commercial potential, the public sector and NGOs play a facilitative role at the beginning to link farmers with input suppliers, help farmers and stockists understand how to use the technology, and assist farmers to link with buyers. As time goes on, these public and NGO functions are increasingly shared or transferred to the private sector (intensive maize and sunflower input delivery and commodity marketing).

Productivity improvements through technology development and dissemination are also vital in areas where subsistence or semi-subsistence systems dominate. In the short-term, improved technology will help increase food security, reduce malnutrition and decrease absolute poverty (sweet potato). In the medium- and long-term, commercial crops will begin to emerge and semi-subsistence areas will themselves become markets for commodities from other areas. Without a strong commercial crop in their farming system, farmers in semi-subsistence areas will have little cash to invest in purchased technologies. The most important technologies may be low-cost “renewable” ones such as cuttings from improved root crop varieties (sweet potato) and open-pollinated seeds that can be replanted.

Public or NGO funding of technology development, extension and commercialization activities may be needed over a much longer time horizon in semi-subsistence areas. These investments can be justified if the social benefits of increased food security, improved nutritional status, better soil fertility and reduction of absolute poverty among the nation’s poorest citizens are fully counted. The challenges are to (1) create a demand-led environment for technology in semi-subsistence areas, i.e., dynamic linkages between farmer-clients and sources of technology; and (2) reduce the cost of assistance and improve its quality by contracting out technology development and dissemination services to private companies, NGOs and public agencies that have a comparative advantage in the specific area.

4.1.3. Farmer Associations and NGOs can Reduce Transactions Costs for the Private Sector

The involvement of farmer associations and NGOs in technology dissemination and output marketing reduces transactions costs for private sector firms in several ways, allowing firms to reach out to new groups of clients. First, working through farmer associations allows firms to deal with a single entity instead of 30-150 individuals. Aggregating orders permits economies of scale in transport and distribution, reducing the farmgate cost of inputs. Second, dealing with a farmer association or an NGO known and respected by individual farmers reduces the credit risk for commercial firms. In the maize case study, CLUSA's involvement provided assurance that farmers were committed to repaying their input loans to Agroquimicos and SEMOC. Third, NGOs reduce transactions costs for the commercial sector by identifying and providing basic technical and business training for future stockists. CARE, Africare and World Vision have trained many sunflower seed vendors who will work as SEMOC agents in the future, for example.

4.1.4. Importance of Linking with Regional Partners

These emerging success stories also show the importance of developing input and output markets in a regional context, linking with regional as well as national partners. On the output market side, increased interest in improved maize technology has been driven in part by the expansion of export markets in Malawi and potential output markets in other countries. Improved technology being used by Mozambican farmers was initially imported outright from neighboring countries (ram oil presses from Zimbabwe), then adapted for local manufacture. Improved varieties of sunflower and orange-fleshed sweet potatoes were imported from regional sources for testing, adaptation and dissemination in Mozambique.

4.2. Partnerships to Accelerate the Development of the Seed Sector in Mozambique

The constraints to the development of the seed sector in Mozambique can be summarized under two major categories: constraints to seed supply and constraints to effective demand for seed. Resolving these constraints will require strengthening existing partnerships and creating new ones between the public sector, NGOs and the private sector with significant support from the donor community. The potential roles of the various players in resolving supply constraints are presented in Table 2, and roles in tackling effective demand constraints are summarized in Table 3.

The first part of this section describes how these potential partnerships could help overcome four major barriers to seed supply:

- 1) Insufficient quantities of quality seed produced and marketed nationally;
- 2) Regulatory barriers to seed multiplication and importation;

Table 2: Partnerships to Overcome Constraints to Seed Supply

Constraints	Role of Public Sector	Role of NGOs	Role of Private Sector	Role of Donors
<p>Insufficient quantity of seed produced nationally</p>	<ul style="list-style-type: none"> • Improve system for maintaining breeder + foundation seed stocks for public varieties • Improve access to foundation stocks for new seed producers 	<ul style="list-style-type: none"> • Provide technical + financial support to programs to increase breeder/foundation seed stocks and make them more accessible to private companies, NGOs and farmer association seed producers 		<ul style="list-style-type: none"> • Fund systems for maintaining breeder and foundation seed stocks, and making them accessible to new seed producers • Fund efforts of regional networks, international centers to test, disseminate germplasm
	<ul style="list-style-type: none"> • Auction seed production rights for varieties developed through publicly-funded research 	<ul style="list-style-type: none"> • Support outgrower relationships between formal sector seed companies and farmer associations 	<ul style="list-style-type: none"> • Expand seed outgrowing by farmer associations, private growers and companies • Providing technical assistance to outgrowers 	<ul style="list-style-type: none"> • Support innovative financing mechanisms/loan guarantees to encourage formal banking sector to lend to seed companies and traders • Create a competitive grants mechanism to partially fund business training for new outgrowers
	<ul style="list-style-type: none"> • Facilitate development, licensing of farmer-based seed enterprises to produce seed for crops/seed types which are less attractive to the for-profit private sector • Help link farmer-based seed enterprises with research and extension services, international research centers and NGOs • Involve business-oriented NGOs in training enterprise groups to manage a seed business and market seed 			<ul style="list-style-type: none"> • Establish competitive grants fund to help farmer associations set up farmer-based seed enterprises

Constraints	Role of Public Sector	Role of NGOs	Role of Private Sector	Role of Donors
		<ul style="list-style-type: none"> • Provide training in seed handling, business management and facilitate credit provision to commercial seed retailers in rural areas 		<ul style="list-style-type: none"> • Partially fund technical/business training for new seed stockists in rural areas • Provide loan guarantees for a limited period to lessen risk to the companies of during initial trial period with new stockists
Regulatory barriers to seed multiplication and importation	<ul style="list-style-type: none"> • Simplify variety registration and release process • Revise seed import regulations • In the short run, make bilateral agreements with major seed trading partners to hasten importation/registration process 	<ul style="list-style-type: none"> • Collaborate in revision of seed sector regulations to incorporate concerns faced by commercial and smallholder seed producers and users 		<ul style="list-style-type: none"> • Encourage multidisciplinary, participatory approach to reform of seed regulation
	<ul style="list-style-type: none"> • Establish a system of quality-declared seed 	<ul style="list-style-type: none"> • <i>Mount a promotional campaign to educate rural farmers on how to distinguish between certified and quality declared seed</i> 		<ul style="list-style-type: none"> • Provide technical support for the establishment of a truth-in-labeling/quality-declared seed system
	<ul style="list-style-type: none"> • Support the development and implementation of national and regional seed protocols 	<ul style="list-style-type: none"> • Form national association of seed producers and traders to (a) serve as a focal point for communicating with the government about design/ implementation of seed policies and programs and (b) establish and enforce norms of behavior 		<ul style="list-style-type: none"> • Finance workshops, technical assistance to complete regional harmonization process • Provide technical assistance, partial funding for establishment of a national seed producers/traders association

Constraints	Role of Public Sector	Role of NGOs	Role of Private Sector	Role of Donors
Poor seed quality	<ul style="list-style-type: none"> • Provide training on proper seed handling and storage to private sector companies, NGOs, and farmer associations 	<ul style="list-style-type: none"> • Provide training to farmers and associations on proper seed handling and storage 	<ul style="list-style-type: none"> • Assure quality management of seed storage facilities 	<ul style="list-style-type: none"> • Provide funding to train Mozambican trainers on proper seed handling and storage who will in turn train private companies, NGOs, farmer associations
	<ul style="list-style-type: none"> • Train and license private companies to carry out voluntary seed certification inspections under SNS supervision 			<ul style="list-style-type: none"> • Fund feasibility study on privatization of seed certification inspections • Provide funding to train additional inspectors
	<ul style="list-style-type: none"> • Strengthen local judicial system or alternative mediation mechanisms so that customer complaints about seed quality can be quickly addressed 	<ul style="list-style-type: none"> • Facilitate dialogue between farmers and private seed companies 	<ul style="list-style-type: none"> • Establish transparent protocols for responding to complaints about seed quality 	<ul style="list-style-type: none"> • Provide technical assistance for strengthening judicial system/creating alternative mediation systems
Insufficient seed/ill-adapted varieties for response to emergencies and chronic seed shortages	<ul style="list-style-type: none"> • Review coordination efforts of recent seed relief emergency programs for lessons • Assess performance of distributed seed • Evaluate feasibility of establishing an emergency seed stock 		<ul style="list-style-type: none"> • Advocate importance of not undermining the commercial seed sector through long-term distribution of free seed 	<ul style="list-style-type: none"> • Finance evaluation of emergency seed distribution efforts • Finance feasibility study for maintaining emergency seed stocks
	<ul style="list-style-type: none"> • Create a database of varieties available in Mozambique and throughout region suitable for distribution in areas historically most at risk of drought or flood 	<ul style="list-style-type: none"> • Assist in field testing of promising regional varieties 		<ul style="list-style-type: none"> • Provide technical, financial support for database development and its use in emergency planning

Constraints	Role of Public Sector	Role of NGOs	Role of Private Sector	Role of Donors
	<ul style="list-style-type: none"> Evaluate the feasibility of using seed vouchers and existing wholesale/retail outlets to supply seed during emergencies in areas with commercial seed markets 	<ul style="list-style-type: none"> Collaborate with government in design of voucher program 		<ul style="list-style-type: none"> Assist in coordination and financing of pilot voucher program

Table 3: Partnerships to Overcome Constraints to Effective Demand for Seed

Constraints	Role of Public Sector	Role of NGOs	Role of Private Sector	Role of Donors
Lack of Appropriate New Technologies	<ul style="list-style-type: none"> Set research priorities and staff incentives to ensure that the seed characteristics sought by smallholder farmers semi-subsistence farmers are addressed Modify institutional incentives in the research system to reward response to client demand 			<ul style="list-style-type: none"> Award partial grants to motivate collaboration between private commodity processors, traders, input companies, INIA and NGOs in identifying and testing new technology that meets specific market demands. Fund international center-INIA linkages to prioritize breeding, adaptive testing strategies in areas where material adapted to Mozambican conditions is lacking
	<ul style="list-style-type: none"> Create more NGO-INIA and INIA-farmer association partnerships to carry out widespread adaptive testing of varieties and increase the information base on varietal performance in different agro-ecological zones 		<ul style="list-style-type: none"> Cost share with public sector in developing/disseminating varieties for commercial seed crops (e.g., hybrid maize, sesame, sunflower, sorghum, soy, bean, pigeon pea and paprika) 	<ul style="list-style-type: none"> Establish competitive grant funds to encourage public-private sector partnerships to undertake adaptive testing of Mozambican and regional varieties

Constraints	Role of Public Sector	Role of NGOs	Role of Private Sector	Role of Donors
	<ul style="list-style-type: none"> Work with regional commodity networks, international research centers and private sector to map the suitability of varieties available in the region to Mozambican agro-ecological zones 			<ul style="list-style-type: none"> Finance mapping exercise Help strengthen communication between the public sector, international research centers, and the private sector
Insufficient Demand for New Technologies	<ul style="list-style-type: none"> Expand use of social communication techniques, radio advertising, posters, public meetings, community theater, demonstration plots, and seed fairs to increase awareness of, encourage adoption of new seed technologies 			<ul style="list-style-type: none"> Finance pilot activities to develop and test new materials and innovative communication techniques
	<ul style="list-style-type: none"> Purchase/modify equipment for packaging improved seed in very small quantities 	<ul style="list-style-type: none"> Market seeds in small quantities 	<ul style="list-style-type: none"> Provide partial grants or subsidized financing to facilitate purchase of packaging machinery for companies/NGOs to market seeds in small packages 	
	<ul style="list-style-type: none"> Pilot test seed voucher schemes to build demand for new technologies and reduce risk for seed companies 	<ul style="list-style-type: none"> Participate in pilot seed voucher programs 	<ul style="list-style-type: none"> Finance feasibility study of seed voucher pilot scheme and if promising, finance voucher scheme itself 	
	<ul style="list-style-type: none"> Support protocols entitling a variety officially registered in a SADC country to be released in other countries with similar agro-ecological zones 			

- 3) Poor seed quality; and
- 4) Insufficient seed of adapted varieties to respond to emergency needs.

The second part of this section explores the various roles different partners could play to improve effective demand for seed. Two major constraints have contributed to the slow development of the seed sector in Mozambique:

- 1) Lack of appropriate new technologies; and
- 2) Insufficient demand for new technologies.

4.2.1. Partnerships to Overcome Constraints in Seed Supply

There is one point on which all analysts agree: there is insufficient high-quality, reasonably-priced seed available to Mozambican farmers. Using policy and program tools to encourage the production of different seed commodities by partnerships of formal and informal seed suppliers likely to have a comparative advantage in producing them can accelerate seed production and facilitate seed sector transformation.

The relative importance of formal and informal seed suppliers is determined in part by biological and technical factors associated with seed production, multiplication, processing and distribution. In general, seed of self-pollinated crops (e.g., many grain legumes) can be easily multiplied by farmers and is more suited to dissemination through the informal seed system, regardless of the economic status of seed users. For cross-pollinated crops (e.g., maize, sorghum and millet) both formal and informal seed systems are important. In addition, crops that have a high multiplication factor and relatively low seeding rate, such as hybrid maize, sorghum and millet, are more attractive to the formal seed sector because fewer multiplications are required and, at each stage, there are smaller quantities to process, store and distribute. By contrast, grain legumes are characterized by low multiplication factors and high seeding rates, and these are consequently the least attractive crops for large centralized seed companies to handle. The rate at which new varieties succumb to biotic stresses both in the field and during on-farm storage also determines the level and frequency of purchases from the formal seed system by farmers. For example, wheat and rice are particularly susceptible to insect and disease pests, creating a demand for pest-resistant varieties as they are released from research systems.

Decentralized farmer-based seed enterprises have several major advantages over more formal centralized operations. Seed production costs are low, seed is available to farmers at the right time, users can purchase the quantity of seed desired, and seed producers are well-informed about the seed and varietal characteristics valued by farmers. However, there are several technical limitations which hinder the performance of the informal seed system. First, seed quality is not always good due to poor seed selection and storage facilities. Although farmers are aware of the relationship between the physical properties of seed and germination, they are less knowledgeable about the relationship between seed and plant health and of disease transmission through seed. Second, informal sector seed producers have difficulty in maintaining sufficiently clean seeds, i.e., recognizing and eliminating weed species. Third, farmer-based seed enterprises rely on retained seed from previous harvests and lack access to higher-yielding improved varieties from the formal sector.

One of the major challenges ahead will be to revise seed regulations in a way that facilitates the development of a heterogeneous, competitive group of seed producers while protecting the rights of all seed producers and consumers. Suggested policy and program actions to address the major constraints to seed supply are described below.

4.2.1.1. Policy and Program Actions to Increase the Quantity of Seed Produced and Marketed Nationally

There are four major areas where action is needed. These areas are:

(1) Improving the system for maintaining breeder and foundation seed stocks for public varieties and making it easier for new groups of seed producers to access foundation stocks. Many varieties on the current registration list have no breeder or foundation seed supply.⁵ Both NGOs and the private sector can contribute technically and financially to the development and support of public sector initiatives to increase breeder/foundation seed stocks. These stocks need to be made more accessible to private company, NGO and farmer association seed producers. Public sector operations can consider partial cost-recovery schemes for sustaining their stocks of foundation seed. However, maintaining breeder seed should be viewed as an essential public good. Donors need to support these initiatives, which may have substantial start-up costs, in addition to funding regional networks and international centers in their efforts to disseminate germplasm and collaborate with national programs.

To encourage the production and marketing of new, improved varieties, publicly-funded research institutions should consider auctioning rights to seed production for varieties developed through publicly-funded research.

(2) Expanding seed outgrowing by farmer associations and private companies with technical assistance from public sector extension, NGOs, and the private sector. Seed outgrowing with farmer groups is in its infancy in Mozambique. The SAGREV concession has worked with smallholder outgrowers to multiply certified sunflower seed in Manica Province. SEMOC has also been cooperating with CARE-assisted outgrower farmers in the production of sunflower seed.

Farmer groups working in collaboration with formal sector seed enterprises and NGOs trained in seed production can improve the technical quality of decentralized seed production and marketing. The initial transactions costs for formal sector seed companies to train smaller farmers in seed production techniques and marketing may be high. Public or donor support for some of these “learning” costs may be justified, since the social benefit of creating decentralized seed production capacity is likely to be higher than the private benefit accruing to the particular

⁵ DAP and ICRISAT are currently undertaking an in-depth analysis of problems with the breeder/foundation seed system, and strategies for improving it. Specific recommendations will be forthcoming in 2001.

firm involved in one or several seasons of outgrower production. NGOs could also assist producer groups in improving seed production and processing for eventual handover to the for-profit sector -- as CARE, Africare and World Vision are doing in the sunflower sector. Outgrower relationships between formal sector seed producers and farmer associations could be encouraged by offering incentives such as expert assistance in training farmers in seed production techniques, access to credit facilities, or managerial assistance.

Experience to date indicates that private sector companies and farmer associations beginning outgrower programs may benefit from business training in managing decentralized contract relationships, and credit assistance to permit timely collection and payment for seed. SEMOC, for instance, in the second year of cooperation with CARE-assisted farmers, was not able to provide ~~the~~ sacks for sunflower seed collection as planned, nor were funds available for purchasing the seed in a timely manner. Donors could consider creating a competitive grants fund for private companies which could be used to partially fund technical or business training for outgrower associations or companies working with outgrowers. Given the lack of medium-term credit available to formal sector seed companies and other agricultural traders, donors can also play a critical role by providing innovative financing mechanisms (e.g., loan guarantees) that would encourage the formal banking sector to support agricultural production and marketing.

(3) Facilitating the development and licensing of farmer-based seed enterprises to produce seed for semi-subsistence crops which are less attractive to the for-profit private sector. Farmer seed enterprises can be developed in partnership with research and extension services, international research centers, and NGOs. These partners can help farmer associations access foundation seed, and learn how to multiply and market it. For example, Ghana has mounted a network of small-scale seed enterprises for the multiplication and marketing of improved maize seed with assistance from the government, CIMMYT and Sasakawa Global 2000. Farmer-based seed enterprises are increasingly involved in producing and distributing improved bean seed, cassava and sweet potatoes in a number of countries. Since 1994 CIAT's regional program has supported efforts by farmer groups in Uganda to produce bean seed on a commercial basis. Zambian farmer groups produce improved plant material for cassava and sweet potato.

Studies of farmer-based seed group projects emphasize the importance of establishing direct links between the farmers and research centers that can provide a continuing link to germplasm sources. In a number of cases in southern and eastern Africa, NGOs failed to do this, interceding themselves to obtain the germplasm. Once the projects ended, seed groups continued to depend on outside mediation from another source or disintegrated.

In addition, NGOs have often failed to teach seed producers how to market their seeds, with the result that the seed enterprises eventually became financially unsustainable (Tripp 1999). Our case studies suggest the importance of linking prospective seed-producing organizations with NGOs that can give them sufficient business training to manage a seed business, from estimating costs and returns before the enterprise is launched, to identifying potential markets, controlling stocks, and keeping basic books. Greater involvement of business-oriented NGOs such as CLUSA and Citizens Network in the design and implementation of farmer-based seed enterprise programs could help ensure that farmer groups receive adequate training in managing a seed

business. Donors could assist by establishing a competitive grants fund that could be used by farmer associations to finance technical or business assistance or to fund contacts with national and international sources of germplasm.

(4) Strengthening commercial seed retailers in rural areas through training in seed handling, business management, and provision of credit. SEMOC has found it difficult to build a network of reliable local seed retailers, in part because of the retailers' inexperience with seed management and lack of access to credit. Good business and technical training are important. Retailers who do not store seeds correctly, or who mix in or distribute out-of-condition seeds, can ruin the reputation of the company they represent. This is partly a matter of labeling regulations, e.g., certified or quality-declared seed usually note the season for which the seeds are packed. However, even certified seeds packed for the current season can go out of condition if they are improperly stored. Donors could assist private companies interested in expanding their network of retail agents by providing partial funding for stockist training courses, and loan guarantees to lessen the risk of stock disappearance during an initial trial period for new stockists.

4.2.1.2. Policy and Program Actions to Address Regulatory Barriers to Seed Multiplication and Importation

Formal sector national agricultural research institutes and regulatory agencies such as INIA and the National Seed Service (SNS) may unintentionally impede the flow of new germplasm to farmers. Although they serve as important gatekeepers, e.g., assuring that imported technology meets phytosanitary restrictions, because of insufficient resources they are unable to meet the demand for adaptive testing, ensure timely varietal registration and listing, and process import and export paperwork without delay.

The June 1999 seed action plan highlighted, the need to review regulatory barriers to seed multiplication and access. MADER subsequently initiated a review of regulatory barriers, but to date key stakeholders such as representatives from other government offices/agencies concerned with input use, private sector companies, and farmer associations have not been included in the discussions. Donors should actively encourage a multi-disciplinary and participatory approach to seed regulation reform.

There are four aspects of the regulatory framework where policy and program changes are needed:

(1) Review and reform the variety registration and release process. Private sector and NGO efforts to test and legally register seed varieties are hampered by the poor functioning of the sub-committee on registration and release of new varieties. For example, extensive information is already available from NGOs on a number of tested varieties which could be candidates for official registration and release. Inaction on earlier submissions to the release committee, however, has discouraged NGOs from investing further resources to meet official submission requirements for other varieties.

SNS made a substantial commitment to update the official release list through the appointment of a staff member dedicated to this task in January 2000, and would like to officially establish a registration and release section within the unit. While substantial progress has been made in removing “dead” varieties from the list, the detailed information required for submission of new material has been difficult to obtain. Moreover, for the revised list to become “official”, it must be approved by the Comité Nacional de Sementes (CNS), which meets only twice a year.

New internal rules submitted by SNS for consideration by MADER also include provisions requiring any private company or institution to work with either INIA or UEM to develop a set of data (including two years of in-county testing) to argue the case for release. Forcing companies to work with institutions that may have serious human capacity constraints in some crops could block farmers' access to improved germplasm in the region.

(2) Review and revise seed import regulations. The increasing regionalization of input markets offers significant opportunities for technology development and transfer. Mozambique, with its weak seed supply organizations, could gain from streamlining regulations and reducing tariff and non-tariff barriers that impede the flow of germplasm beyond what is required for effective phytosanitary control. Seed organizations report that the most binding constraint affecting seed imports is the difficult process of varietal registration (discussed above). A review of regulations affecting commercial seed imports and sales is currently being undertaken by the Southern Africa Seed Regulation Harmonization Study. Recommendations will be forthcoming in 2001.

(3) Establish a system of quality-declared seed. The third article of Mozambique's Law Decree No. 41/94 allows MADER to designate classes of seed for sale or distribution other than guaranteed, certified seed. In practice, however, most producers and consumers continue to believe that improved seed must be certified as a protection to consumers, even if the law does not specifically require it. Some NGOs, for example, go to considerable trouble and expense to have government inspections carried out for seed crops.

Compulsory or *de facto* compulsory certification (as in Mozambique) constrains the multiplication and distribution of some seed types, e.g., open-pollinated maize and sorghum, whose low seed yields and profit margins cannot absorb the costs of stringent and frequent inspections needed to comply with certification standards. Removing the certification “compulsion” would encourage the production of quality seed (not certified, but multiplied following good agronomic practices under the supervision of an extension agent) by smallholders and sale among neighboring farmers. Seed companies could also more easily involve smallholders in contract seed production.

Establishing a truth-in-labeling/quality-declared seed system would permit seed of varying qualities and germination rates to be made available. To protect farmers and seed companies from fraud, regulations would state what must be on the label and labels must include pictographs for non-literate populations. While the public sector must take primary responsibility for establishing the quality-declared regulations, NGOs and the private sector can assist with its implementation -- mounting a promotional campaign, for instance, to educate rural farmers on how to distinguish between certified and quality-declared seed.

Seed laws and regulations can enhance the effectiveness of truth-in-labeling by: (1) listing information that must be on the label (company name and address, crop, variety, germination rate, testing date, expiration date, etc.); (2) assigning a government agency or other body to inspect retail stores, and to test seeds to determine whether or not they are truthfully labeled; and (3) empowering the seed agency or other designated enforcement agency, such as, in some countries, the national seed producers association, or local mediators, to administer fines. Donors and NGOs can provide technical and financial support for the establishment of a truth-in-labeling, quality-declared seed system.

(4) Support the development and implementation of regional seed protocols. SADC is developing regional seed protocols so that, after a variety is officially released in one SADC country, it can quickly be released in other SADC countries with similar agro-ecological zones. If successfully implemented, regional seed protocols could create commercial interest in producing and distributing seed at the regional level for commodities (e.g., short-cycle open-pollinated maize, beans) for which demand is too limited or sporadic to be attractive at the national level (Table 1).

Donors (particularly the World Bank, USAID and FAO) have provided significant technical and financial support to launch the SADC initiative, which is based on a successful experience with seed policy harmonization in South America and ongoing work in East Africa. Participating countries in South America agreed on (1) common standards for seed certification in 5 major crops, and developed common seed testing laboratory procedures and standards; (2) common phytosanitary restrictions, which were relaxed, except for one pathogen (in East Africa, designated quarantine pests within the region were reduced from 33 to 3); (3) reducing the period for variety evaluation, release and registration to 2 years (East African countries agreed on 1 year of data from breeders and 1 season of testing) ; and (4) plant variety protection.

Harmonization groups are also advocating the adoption of national plant variety protection laws to promote variety improvement by both private and public breeders and institutions. The TRIPS agreement under WTO requires that all signatory countries (including Mozambique) establish a plant variety protection system by 2005.

As an interim step to encourage regional seed trade, the government could consider making bilateral agreements with countries likely to become major seed trading partners. These agreements could hasten the importation/registration process by allowing varieties that had been officially approved by partner countries to immediately enter Mozambique for testing and rapid registration, if trial results are promising.

To ensure that seed producers and traders have a voice in developing the protocols which affect their livelihoods, NGOs and the private sector should support, with partial funding from donors, the establishment of a national association of Mozambican seed producers and traders. This body could serve as a focal point for communicating with the government about the design and implementation of policies and programs affecting the seed industry. It could also establish norms of behavior among members and enforce them, as well as provide training to member organizations. The national unit would represent Mozambique in the recently-formed Africa-wide association of seed producers/traders.

4.2.1.3. Policy and Program Actions to Improve Seed Quality

Expanding the amount of seed available, whether in the informal or formal sector, will be of little value if the quality of the material produced is so poor that the expected productivity increases are not obtained. Donors should consider funding three actions to help improve poor seed quality:

(1) Build Mozambican capacity to provide training on proper seed handling and storage. These public sector or NGO trainers would be available to provide instruction to private companies, other NGOs and farmer associations, and individual medium to large-scale growers.

(2) Train and license private companies to carry out voluntary seed certification inspections under the supervision of SNS. Production and sale of certified seed will continue to be important for some seed commodities and farmers producing for specific markets. SNS is responsible for seed certification, but the lack of resources often results in delays in inspection, which creates problems for the private sector and NGO seed producers. Zambia and Zimbabwe have addressed similar problems by licensing private inspectors and testing laboratories. As a first step, donors should finance a feasibility study on the privatization of seed certification inspections and for activities that would facilitate privatization, e.g., supporting training for additional inspectors.

(3) Strengthen the local judicial system or devise an alternative system so that customer complaints about seed quality can be quickly addressed. Currently, SNS does not have the power to physically withdraw seed that fails to meet germination standards from the market; it can only inform the seed producer of its findings. A possible alternative might be the appointment of district-level mediation committees which would have the power to investigate complaints and impose fines.

4.2.1.4. Policy and Program Actions to Increase the Availability of Adapted Seed to Chronically Seed-Insecure Farmers and Following Emergencies

For some farmers in particularly isolated or poor zones, it may not be possible to establish a commercial seed network in the foreseeable future, even at the village level. In these cases there may be social benefits (e.g., improved food security, health and nutrition) that justify public or donor expenditures to provide sustained access to varieties with improved drought and disease resistance to farmers who would otherwise be unable to purchase seed through the market.

For crops/regions where there is currently no commercial seed market, disseminating seed directly to farmers so that varieties are absorbed into the traditional system of seed supply may be a more effective strategy than trying to supply it through the higher-cost market channels, if potential users are unlikely to be able to afford them. Free distribution of seeds to introduce new varieties, plants and agricultural inventions was in fact an institutionalized program in the U.S. in the early nineteenth century and continued for almost a century until 1923 (McDonald and Copeland 1997).

Government also has an important role in overseeing the distribution of seeds for disaster relief. Poorly targeted seed relief programs can hamper seed markets by competing with commercial channels, however. In Mozambique the long-term distribution of free seeds has retarded the development of a commercial seed market in certain areas as farmers are reluctant to begin paying for something previously provided for free.

Where seed markets exist, seed aid should be monetized by distributing seed vouchers rather than providing seed directly to users (Gisselquist 1996, Rohrbach and Mutiro 1996). It is clear that options may be limited by the nature of the disaster. While commercial infrastructure remains in place during times of drought, flooding as seen in southern and central Mozambique during 2000 earlier this year severely affected the commercial sector, necessitating extraordinary measures, including free distribution in the short-term, to get seed to the most badly affected areas before the planting season.

Expanding the availability of quality seed will enhance public and private sector ability to respond during seed emergencies. Three additional actions are recommended to increase the supply of adapted varieties in emergency situations:

(1) Review coordination efforts of the most recent seed relief emergencies (past 5 years) to strengthen the design of future emergency programs. The public sector, with financial assistance from the donor community, needs to assess the performance of distributed seed and the mechanisms for seed procurement during emergencies, and examine the feasibility of establishing and maintaining emergency seed stocks of strategic varieties adapted to Mozambican conditions. The review should be careful to distinguish between seed distribution in response to drought vs. flooding, and compare the recent effort government-coordinated NGO distribution to previous NGO-managed efforts.

(2) Create a database containing (a) information on varieties available in Mozambique and throughout the continent that are suited to Mozambican agro-ecological zones; and (b) sources of seed for these varieties, for use in emergency response planning. The public sector should draw on local scientists, regional commodity networks, international research centers, and the private sector to compile this database. NGOs should assist INIA in field testing potentially suitable varieties so that knowledge concerning their adaptability is established prior to an emergency situation.

(3) Pilot test alternative approaches to seed distribution that do not undermine commercial seed markets and/or assure greater use of appropriately adapted material. Experience from the most recent emergency revealed that it is difficult to obtain consensus on testing alternative seed distribution mechanisms in the midst of a full-blown emergency. The donor community should consider financing pilot schemes using seed vouchers for obtaining subsidized and/or free seed through retail outlets or neighbors prior to an emergency situation. NGOs and the private sector should assist the government in the design and implementation of such pilot schemes.

4.2.2. *Partnerships to Build Effective Demand for Seed*

The actions proposed in the previous section assume that varieties are available for multiplication and dissemination that are adapted to local conditions and have the agronomic, consumption and storage characteristics that farmers want. In fact, as noted earlier, appropriate technologies are not readily available for all crops, and for a number of reasons farmers are often reluctant to purchase new seed, preferring to store their existing material. Creative public-NGO-private sector partnerships to test and disseminate public and private improved varieties from Mozambique and elsewhere can increase smallholder demand for and access to new technology. The sunflower, maize and orange-fleshed sweet potato case studies demonstrated the gains possible when (1) the technology offered responds to farmer/market demand; and (2) alternative organizations (in this case NGOs in collaboration with INIA, UEM and DNER) take an active role in sourcing, testing and extending the improved technology.

4.2.2.1. Policy and Program Actions to Address the Lack of Appropriate New Technologies

Three concrete actions can be taken to accelerate the development of appropriate new technologies:

(1) Set research priorities and staff incentives to ensure that the needs of smallholder farmers are addressed by the public sector. Varieties developed by formal public research organizations are often not well adapted to the needs of semi-subsistence smallholders. The formal training of breeders emphasizes the development of uniform genetic materials that are highly responsive to chemical inputs and embody specific characteristics (e.g., color, uniformity of grain size) rewarded by the market. These are important qualities likely to be sought by more commercial farmers. Subsistence-oriented smallholders may value a different set of characteristics such as drought tolerance, early maturity or good storage. NGOs engaged in adaptive testing should collaborate with INIA in identifying the key characteristics that different types of farmers want.

One important step in creating a more demand-driven public research system is to modify the promotion system so that researchers are recognized for developing varieties that are acceptable to users (including smallholders, agribusiness users and consumers). Researchers should also be rewarded for taking the initiative to collaborate with DNER, NGO and private sector partners, to ensure that the varieties developed are appropriate and accessible to farmers.

Donors should consider awarding partial grants to encourage private commodity processors, traders and input companies to collaborate with INIA and NGOs in seeking out and testing new technology that meets specific market demands. An example of this is the Technoserve effort in 2000 to bring Nampula Province pigeon pea traders and processors together with ICRISAT, INIA, and NGO staff to discuss trial results and possible sources of seed for short-duration pigeon pea for the Asian market.

(2) Expand MADER/NGO/private sector partnerships, including farmer associations working under the supervision of NGOs, to rapidly increase the information base on varietal performance

in different agro-ecological zones. Partnerships between INIA, NGOs, private companies and farmer associations could facilitate testing of candidate varieties in Mozambique. Several NGOs already have memoranda of understanding or less formalized partnerships with MADER under which they carry out adaptive research and development functions, such as multi-locational trials in collaboration with INIA. For example, private companies could contract site testing out to NGOs that already have a memorandum of understanding with INIA.

For more commercial seed crops such as maize, private companies will play an increasing role in cost-sharing with the public sector, or developing and disseminating their own varieties in the future. Both SEMOC and PANNAR are linked to major seed companies in the region. The potential is great for the direct importation and sale of hybrid maize, sunflower, sorghum, soy, bean and other seed varieties suited to Mozambique's agro-ecological zones. Before varieties can be approved for distribution in Mozambique they must be tested and meet other government requirements (see preceding section). Private companies can finance or share the cost of adaptive research that directly benefits them, e.g., multi-locational trials of privately developed varieties from Mozambique and the region. For example, private companies operating in Zambia, Zimbabwe and South Africa (including PANNAR, MRI, and Seedco) are already involved in crop improvement research.

Hybrid maize research is a particularly promising area for public-private collaboration in Mozambique. Zimbabwean and Malawian hybrids are already being informally acquired (on a limited basis) by commercial farmers and smallholders in higher-altitude areas of Mozambique. NGO, INIA and SEMOC trials show that some hybrids have considerable yield-increasing potential. A comprehensive adaptive testing program aimed at identifying hybrids suited for areas of commercial maize production in Mozambique could be jointly funded by the public and private sectors.

Meeting research needs for less-commercialized crops in lower-potential areas will remain the responsibility of the public sector in the short- to medium-term. To encourage research that meets the needs of semi-subsistence smallholders, donors could fund competitive grant funds aimed at promoting innovative partnerships between formal sector researchers, extensionists, NGOs, private sector and farmer groups to solve specific problems of importance to smallholders, e.g., development and testing of disease-resistant cassava, and termite control. Flexibility could be built into the program to encourage partners to seek out information and germplasm from multiple sources – international research centers, regional networks, international private sector – and to explore multiple pathways to solve problems – e.g., crop management techniques as well as breeding.

(3) Work with regional commodity networks to accelerate the identification of improved varieties that are potentially suited to Mozambique's agro-ecological zones (previously discussed in Section 4.2.1.4.)

4.2.2.2. Policy and Program Actions to Build Demand for New Seed Technology

Farmers must understand the characteristics of seed being sold or distributed, and improved seed

that is purchased must generate sufficient cash returns to justify the cost of the seed. Four actions can be taken to build demand for improved seed among commercial and more subsistence-oriented farmers.

(1) Expand the use of social communication techniques, radio advertising, posters, public meetings, community theater skits, demonstration plots, and seed fairs to increase awareness of and encourage the adoption of new seed technologies. Part of the marketing and extension challenge is to get information out to potential clients about new seed products. In peri-urban areas and regions where commercial crops such as cotton are grown, radio programs are an increasingly important source of market price information. Radio can be used to educate farmers about the advantages of new seed technology and tell farmers where they can get the new varieties. Posters, presentations at churches and schools, and information booths at local markets are examples of approaches that could be used to educate farmers about seed available through private, public, NGO or farmer association sources. Demonstration programs such as the Sasakawa Global 2000 program in collaboration with DNER could be more widely utilized to show farmers the payoff to using new technologies in commercial and semi-subsistence crops.

(2) Put new seed technology within the financial reach of most smallholders by marketing it in small quantities Seed should be marketed in small enough packages so that farmers can (a) easily pay for the seed in cash, and (b) buy small quantities for experimentation. SEMOC and NGOs in Mozambique have successfully marketed 2- and 1-kilogram packages of maize and sunflower seed. It may be useful to experiment with marketing even smaller quantities to facilitate farmer testing in his/her own field. Donors could partially fund or subsidize financing for the purchase of packaging machinery that would permit companies to package seeds in small quantities.

(3) Experiment with short-term voucher programs in places where producers are interested in adopting higher yielding technologies, but lack savings to finance the purchase of seeds and other inputs. Seed companies may be unwilling to carry the risk of lending to unknown customers, and may not have agents in the area if demand in the past has been low. A voucher signifying the government's willingness to pay a fixed amount toward the purchase of seeds can serve as a tool to introduce and build demand for new technology, and reduce risk for seed companies. The retailer accepts the voucher and the remainder is paid in cash by the recipient upon purchase. Thus the retailer does not face any risk. Producers will be more willing to adopt the technology, since their net returns are higher by the amount of the voucher, even if the production and price risks are unchanged. Donors could provide funding to analyze the feasibility of a seed voucher program – featuring partial grants by the government – to increase farmer demand for improved seed in commercial and semi-subsistence areas.

(4) Support regional protocols for simplifying seed registration and movement between countries. For many seed varieties, effective demand in national markets is too low to justify significant investments in commercial multiplication and marketing of seed. Easing restrictions on seed movement within the region could bring in new varieties for distribution in Mozambique as well as opening up export markets for Mozambican seed in the region (for example, open pollinated maize, beans, rice).

Annex 1.

Case Study: The Case of High-Input Maize in Nampula Province

Maize is Mozambique's most important cereal crop, grown on more than one-third of the country's total cultivated area. Many smallholders received improved OPV maize seed from NGOs as part of relief efforts in the early 1990s. After relief programs were phased out, improved maize varieties deteriorated as farmers saved and replanted the seed instead of buying new stocks. While the distribution of free seed introduced smallholders to the benefits of improved varieties, it also created a vicious circle for the Mozambican seed industry: (a) creating a demand for purchased seed among smallholders was difficult after many years of free distribution, and (b) because of the weak demand for purchased seed, very few of the officially released varieties are available on a regular basis from SEMOC. Fertilizer was not part of starter packs distributed by relief agencies in Mozambique. Mozambique has one of the lowest fertilizer consumption rates in sub-Saharan Africa, and fertilizer use by Mozambican smallholders is virtually unknown except in greenbelt vegetable areas and among tobacco outgrowers.

The DNER/SG Maize Intensification Program. Beginning in the late 1990s, the national extension service, DNER, in partnership with Sasakawa-Global 2000 (SG) and private sector input firms, began promoting the use of improved maize seed and fertilizer in high-potential areas of Mozambique. The program was intended to (a) improve maize yields through the introduction of science-based technologies and (b) increase the demand for purchased technology. Farmers received inputs on credit along with training in improved management practices. MADER and MSU researchers have collaborated on field research since 1997 to examine the profitability of improved technology use in the DNER/SG and similar programs in Nampula Province.

Profitability. Results from farm-level surveys undertaken during 1996/97 and 1997/98 showed that **significant yield increases are possible with improved technology, but actual yields achieved by program participants were well below the yield potential of 5-8 tons/ha.** High-input maize yields ranged from 0.8-2.7 tons, exceeding the provincial means for smallholders using no purchased inputs of .4 - 1.3 tons/ha. However, **given the high cost of inputs, in most cases traditional low-input maize was still more profitable than improved maize** on a net income/hectare basis. Profitability increased if farmers were able to store maize and gain from steep price rises that took place during both 1996/97 and 1997/98 marketing seasons. But these price rises were spurred by a surge in maize exports to neighboring Malawi. The export market collapsed in the two subsequent seasons due to increased domestic production, reducing producer prices in northern Mozambique.

During 1996/97 and 1997/98, maize yields were affected by the late delivery of inputs and inadequate extension assistance. Farmers were also given mixed signals about their obligation to repay input credit. In the 1998/99 season, in an effort to improve program implementation, DNER/SG began collaborating with Cooperative League of the USA (CLUSA)-assisted farmer associations. With CLUSA assistance, contracts for delivery of

improved seed and fertilizer were developed with private sector companies and signed by individual associations. Performance contracts were also signed with the extension service. At the end of the season, associations negotiated contracts with commodity buyers for the sale of maize produced in the program.. MADER/MSU researchers followed 5 of the 21 participating CLUSA-assisted associations to assess whether increased involvement of farmer associations improved coordination of marketing and extension services.

Impact of Farmer Associations on DNER/SG Program Implementation. **1998/99 high-input maize yields were 1.1-1.6 tons higher than the previous season.** Weather conditions in 1998/99 were somewhat better than 1997/98, but it is unlikely that the yield increase can be attributed entirely to improved weather. In 1998/99 farmers were able to plant high-input maize on time. Fertilizer and improved maize seed arrived in most association villages well before the planting season, compared to previous seasons, when planting was delayed by 2-5 weeks because of the late arrival of inputs. **Extension agent performance improved in 1998/99.** Most extension agents felt they were able to work more efficiently through the associations, and associations said extension agents were more responsive to their needs.

Credit repayment rates for 1998/99 are very high. Although program participants signed input credit contracts with DNER/SG in previous years, most Nampula participants were never required to repay. CLUSA personnel have worked intensively to help association members understand the contracting mechanism, the private sector obligation to deliver inputs on time, and the corresponding obligation of the farmers to repay input credit regardless of the season's outcome. As of November 1999, three-quarters of associations had repaid their maize input loans in cash. The remaining associations renegotiated with the input dealers to extend the repayment date in the expectation that maize prices would rise. **The high repayment rate is especially significant given the low profitability of improved maize production.** Even with the substantial yield increase realized by association farmers in 1998/99, net earnings per hectare were again higher for traditional maize than high-input maize. There were no price gains from storage in 1998/99.

Key Findings. **MADER/MSU study results from the last three seasons suggest that the improved maize technology package currently being promoted in Nampula Province (improved OPV seed, 100 kg 12-24-12, 100 kg urea/ha) is inappropriate as a primary anchor for commercialization.** It is important to ensure that the technology packages being promoted are financially profitable for smallholders and do not expose farmers to high levels of risk. **Future programs should include a cost and returns analysis as part of the training accompanying the technical package.** Improved maize as a primary commercial crop is excessively risky because potential smallholder yields are relatively low compared to competing maize-growing areas at higher altitudes in neighboring provinces and countries in the region, and maize prices are extremely volatile worldwide. Although improved maize produced solely for commercial purposes is excessively risky for most smallholders, it can be an important component of a diversified cash cropping system in which the earnings from other cash crops (such as cotton, sunflower, pigeon pea) ensure that credit can be repaid.

Farmer associations and fora (groups of associations) are beginning to play a critical role as facilitators/brokers for a range of agricultural services in areas previously characterized

as “service vacuums” at the smallholder level. Farmer associations and fora are facilitating private sector expansion by reducing marketing and other transactions costs. For example, farmer groups reduce input supplier marketing costs and risks by aggregating demand for inputs, facilitating local delivery of products and guaranteeing credit repayment. During 1998/99 254 CLUSA-assisted associations received credit worth nearly USD 180,000 in agricultural inputs for cotton, tobacco, maize and sunflower provided by agribusiness, agricultural chemical and seed companies. **Private sector input companies are responding to the increased demand for agricultural technology and reduced coordination costs by expanding their activities with farmer associations, including on-farm trials of pesticides and other products.** There are similar cost advantages for commodity brokers and joint venture companies working through associations and fora. **Associations serve as marketing agents for their communities, buying maize from individuals on behalf of private wholesalers and storing it for bulk collection.** New marketing and production opportunities are continuing to emerge (e.g., in sunflower, sesame, groundnut, bean and pigeon pea production) as mutual trust develops between associations and private companies. **Farmer associations are also significantly reducing technical assistance and marketing costs for cotton companies.** Associations participating in cotton outgrower programs now carry out input distribution, application and extension functions formerly managed by company employees, at an estimated salary savings of 5 million meticaï/ year for each 300 hectares moved to association management. Output marketing costs are also reduced by an estimated 60%, since associations have assumed many collection, weighing, grading and marketing functions. Some of the savings is rebated to the associations through price premiums.

The increase in agricultural opportunities is creating a demand for more effective public extension services and direct farmer training. As a result of the performance contract drawn up between associations and DNER, farmers participating in the maize program have clearer expectations of extension agents serving their villages. Many associations are also participating in a program that provides basic agricultural technical training to farmer fora representatives through a series of courses offered in conjunction with DNER.

Annex 2.

Case Study: New Sunflower Varieties and Low-Cost Processing Technology Improve Farmer Incomes and Nutrition in Manica, Nampula and Zambezia

Sunflower area and production have increased rapidly in Mozambique over the last 5 years. A key factor in this expansion has been the implementation of projects by Africare, CARE, and World Vision International to increase oilseed production and introduce village oil presses in Manica, Nampula and Zambézia Provinces. By November 1999 at least 43,000 households in the three provinces were growing sunflower. **The NGO projects introduced two science-based technologies to their project areas. First, NGOs acquired and multiplied basic seed for Black Record (BR), an improved open-pollinated sunflower variety** which had performed well in UEM/INIA trials. BR has a higher oil content (35-42%), higher yields (400-700 kg/ha under smallholder rainfed conditions and, with fertilizer and irrigation, up to 2000 kg/ha) and is easier to crush than colonial-era varieties. Unlike more traditional oilseeds such as groundnut, sunflower does not play a “dual role” as a food crop. Therefore access to oil processing equipment and markets are essential. **The second innovation was the introduction of hand-operated ram presses suitable for oil production at the village level.** These oil presses, brought from Kenya and Zimbabwe, retail for less than 3 million meticaís and can produce 12-15 liters of oil per day.

The NGO projects also improved marketing and reduced risk at several levels of the subsector. First, because improved sunflower varieties were not being distributed through the commercial seed system, **NGOs initially took the responsibility for acquiring basic seed, multiplying it through contract farmers, processing and selling the certified seed in one-kg packages through village agents.** Black Record is drought-resistant and net returns are favorable compared to cotton, tobacco, and maize. In the past oilseed production was risky for smallholders because large processors did not always follow through on agreements to buy the year’s production. **With the advent of village-based presses, farmers have the choice of selling locally or to the larger processors.** Oil production is very lucrative for the small press owners. If owners press 10-15 liters of oil per day, it requires only 5-7 weeks of pressing to pay for the equipment.

Villages benefit from access to lower-cost cooking oil. Cooking oil provides an important source of calories in many parts of the world, but oil consumption in rural areas of Mozambique is extremely limited. As a result of the NGO projects the availability of oil at the village level has increased markedly. Over 900 presses have been sold in Nampula, Zambézia, Manica and Sofala Provinces since 1997. If village presses process 10 liters of oil per day for 6 months of the year, an additional 1.6 million liters of oil is made available each year, at prices that are usually 20-25% lower than commercially-produced oil. The NGO projects have established a significant pool of demand for improved sunflower seed and sunflower oil. **The challenge ahead is to transfer functions from NGOs to the for-profit private sector and public agencies.** The process is already underway. In the 1999/2000 season SEMOC purchased, cleaned and packed seed from NGO contract seed growers and sold the seed through its agents. **Village ram presses and spare parts are now being manufactured and distributed by a Mozambican company, Agro-Alfa instead of by NGOs.** As a result of increased sunflower production, development of

outgrower operations and larger-scale oil factories is also accelerating. **The Mozambican public sector also has a critical role to play in research and development.** During the 1998-99 season there were reports of serious disease problems in some areas for the first time, a signal that BR is becoming susceptible to pests. INIA, UEM and SEMOC will need to intensify varietal testing to identify alternatives to BR and undertake basic seed production and multiplication for new disease-resistant varieties, including hybrids. With increasing interest in intensive oilseed production, it will be important for INIA/UEM and DNER to generate and transfer appropriate technical recommendations.

Low-cost oil produced at the village level currently meets a critical food security need in Mozambique and will continue to do so in the foreseeable future. But given today's climate of fast area and production expansion for oilseeds -- indicating a growing demand from larger processors -- **it is important to assess whether Mozambican medium- and large-scale oilseed production and processing will be competitive with other regional producers after SADC region tariffs are lifted.** Future policies and programs that facilitate expansion of processing facilities should be based on a realistic assessment of current regional capacity and the economics of production and processing for a range of oilseeds.

Annex 3.

Case Study: Orange-Fleshed Sweet Potato: Promising Partnerships to Combat Malnutrition and Raise Incomes

The use of high-cost inputs such as hybrid seed, fertilizer and pesticide is often not economically viable for crops such as sweet potato, cassava, legumes, sorghum and millet that are primarily used for home consumption in Mozambique. **Finding lower-cost methods of improving agronomic yields, processing and utilization of these crops can improve the food security, nutritional status and health of thousands of rural families in the short term, and facilitate increased commercialization over time.**

Sweet potato is already widely grown in many parts of Mozambique and serves as a classic food security crop. It is ideal for filling gaps in food availability from other sources because, once mature, sweet potato can be harvested “piecemeal” over several months. Sweet potato vines were widely distributed at the end of the war to provide an easily cultivable source of calories and greens to re-establishing households. **Early maturing sweet potato varieties yield higher amounts of edible energy per unit area than all other food staples**, producing 194 megajoules (MJ)/ha/day, compared to 113-149 MJ/day for rice, maize, cassava, and plantain. While sweet potatoes play an important role in assuring adequate caloric intake, most of the varieties currently grown in Mozambique are white-fleshed. White-fleshed varieties lack β -carotene, the plant precursor of Vitamin A, which is needed to assure the normal functioning of the immune system, the visual system, and proper growth and development. **Orange-fleshed sweet potato varieties are excellent sources of β -carotene**, and they are also higher-yielding and mature earlier than varieties currently used (15-18 tons/ha for improved orange, compared to 3-10 tons/ha for traditional white varieties (both unfertilized)). Consuming the minimum daily requirement of Vitamin A (½ cup of sw. pot.) can dramatically increase children’s chances of survival from diseases such as measles and diarrhea. **The introduction of improved varieties of orange-fleshed sweet potato is a promising strategy for reducing seasonal food insecurity and a major micronutrient deficiency.**

Mozambique’s Experience: Partnerships to Promote Orange-Fleshed Sweet Potatoes. The promotion of orange-fleshed sweet potato together with improved child feeding practices is part of the integrated approach for combating vitamin A deficiency outlined in the Min. of Health’s Micronutrient Strategy. At a 1999 FAO conference, INIA presented the orange-fleshed sweet potato program as the primary example of how INIA will integrate nutritional concerns into its agricultural research program. Through INIA’s collaboration with SARRNET, 38 orange-fleshed varieties were received in 1997 for testing. In 1999, additional funding by HKI enabled adaptive varietal testing to be undertaken at the provincial level. From the outset, the program has relied on partnerships between public sector organizations, NGOs and farmers. Government nutrition staff work alongside INIA agronomists; INIA works with NGOs at the provincial level; researchers involve local farmers in the evaluation of varietal performance; and a multi-disciplinary team conducts qualitative research on child feeding, agronomic, marketing and processing practices.

Future Pathways: Role of the Public Sector/NGOs in the Development and Dissemination of Improved Varieties of Less-Commercialized Crops. For crops such as sweet potato, cassava, and legumes, the evidence suggests that the public sector and NGOs will need to play a leading role in variety dissemination efforts in the foreseeable future. Commercial interest in seed production varies with the technical possibility of excluding non-buyers from using the products of the firm's research. Since there is little erosion in the yield potential with successive planting of vegetatively-reproduced crops such as sweet potato and cassava, and self-pollinated crops such as groundnuts and other legumes, rice, and wheat, farmers can reproduce the purchased seed themselves for future planting. Thus, **there is little commercial incentive to produce and market improved varieties of vegetatively propagated and self-pollinated crops beyond supplying the initial demand for new varieties.** Informal seed systems -- primarily farmer retention of varieties -- predominate for self-pollinated crops worldwide among subsistence and highly commercialized farmers. Research centers are continually developing improved varieties for these crops suited to different agro-ecological regions, but **it is very difficult for smallholder farmers to access new public varieties on a regular basis.** While new varieties are often successfully distributed on a one-time basis as part of relief programs, **ongoing access to new varieties is important to allow farmers to benefit from continuing advances in technology that increase yields and incorporate other key factors such as pest resistance, early maturity and nutritional improvement.**

NGOs in Zambia, Zimbabwe, Kenya, and Malawi have trained farmer groups to multiply and distribute planting material/seed for sweet potato, cassava, sorghum, millet and legumes (Tripp 1999, Tapio-Bistrom, Chiwele and Kasuta 1998). The objective in most cases was to create a small seed-producing business within the communities. While the projects were successful in disseminating improved varieties, there are few signs of entrepreneurial activity that would signal the beginning of sustainable seed provision at the village level (Tripp 1999). There are two general problems. **First**, farmers need to know how to contact research stations and acquire foundation seed. In most cases, project personnel made the arrangements without fostering direct researcher-farmer group contact. Thus seed-producing groups continue to be dependent on non-governmental organizations to secure new varieties. **A second problem** is the scant attention paid to marketing and resulting difficulty in finding buyers for the seed. These experiences suggest that it may be unrealistic to expect seed producer groups to completely "outgrow" the need for continued assistance from the public sector or NGOs to access and multiply new germplasm for distribution in the community. Although it may be possible for seed producer groups to market some of their production, for some commodities demand for seed may be too small in the immediate area or too intermittent to fully reimburse the costs of the activity. **Some level of subsidy may be justified on an economic basis, if the social benefits to providing new germplasm to smallholder farmers exceed the financial returns that may be generated by the seed scheme (e.g., because of potential impacts on child and family health and food security), and if for-profit businesses are unlikely to provide access to germplasm in the absence of public assistance.** The challenge is to build on the experience with seed producer associations in the region to create more direct and sustainable links between community seed producers, extension, and researchers or other providers of foundation seed. **Ongoing efforts to reduce regional barriers to seed trade may lead to increased commercial interest at the regional level in supplying seed/planting material for commodities where demand is insufficient to support businesses targeting only local and national markets.** E.g., a company with regional interests may find it profitable to multiply sweet potato, cassava, and legume varieties for sale in similar agro-ecological zones across several countries in the region.

Future Pathways: Improving Child and Family Health by Instituting Nutrition Education at the Village Level. Experience in Kenya and Zambia suggests that efforts to improve child feeding practices, both in terms of increased frequency of feeding and developing appropriate weaning foods, can have a major impact on child nutritional status and should be incorporated into general extension training. A Zambia NGO project trained both men and women in the preparation of child weaning foods. It was critical to include men so that they understood the importance of good nutrition and would allow women to spend money on food items for children. Improving vitamin A intake among older children and adults is simpler. The taste and appearance of improved orange varieties are usually acceptable in the traditional boiled/steamed form. The vitamin A content of other foods such as bread, chapatis, and fried doughnuts can also be greatly enhanced by replacing 1/3 of their wheat flour with sweet potato flour, as is being tested in Kenya and Uganda.

Future Pathways: Introducing Processing Equipment that Reduces Women's Labor and Increases the Potential for Commercialization. Sweet potato sales are an important source of income for rural women in Mozambique. In Malawi, Kenya, and Uganda, sweet potato is an increasingly important commercial commodity which is transported to urban centers. Introducing improved processing equipment for sweet potato and other root crops can reduce women's workload and facilitate the production of items for the urban market. In Zambia, LLFSP introduced fast and easy-to-use chippers that produce small, uniform chips which dry quickly. In the longer run there is significant potential to use sweet potato for animal feed. China, the world's largest sweet potato producer, uses large quantities of roots and leaves as an excellent pig, dairy cattle and goat feed, in addition to producing sweet potato noodles and starch for human consumption.

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