Designing Successful Farmer-managed Seed Systems

Sharanjit S. Bal
Johnson E. Douglas

Winrock International
Institute for Agricultural Development

January 1992
Designing Successful
Farmer-managed Seed Systems

by
Sharanjit S. Bal
Johnson E. Douglas

Winrock International Institute for Agricultural Development
Development Studies Paper Series
January 1992
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgments</td>
<td>v</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Small-farm Background</td>
<td>2</td>
</tr>
<tr>
<td>Contribution to national economies</td>
<td>2</td>
</tr>
<tr>
<td>Small-farm profile</td>
<td>3</td>
</tr>
<tr>
<td>Small Farmers' Perceptions of Seed</td>
<td>3</td>
</tr>
<tr>
<td>Factors That Promote Use of Off-farm Seed</td>
<td>4</td>
</tr>
<tr>
<td>Conventional Seed Programs and Their Relevance to Small Farmers</td>
<td>5</td>
</tr>
<tr>
<td>Certified and commercial seed supplies to farmers</td>
<td>6</td>
</tr>
<tr>
<td>On-farm seed production</td>
<td>7</td>
</tr>
<tr>
<td>Improved seed delivery systems</td>
<td>7</td>
</tr>
<tr>
<td>Projects for Farmer-managed Seed Systems</td>
<td>8</td>
</tr>
<tr>
<td>Nepalese experiences</td>
<td>8</td>
</tr>
<tr>
<td>On-farm seed production experiences in the Gambia and Senegal</td>
<td>12</td>
</tr>
<tr>
<td>Experiences in Latin America</td>
<td>14</td>
</tr>
<tr>
<td>Essential Components of Well-designed Farmer-managed Seed Systems</td>
<td>16</td>
</tr>
<tr>
<td>The strategy</td>
<td>16</td>
</tr>
<tr>
<td>Policies in support of the strategy</td>
<td>17</td>
</tr>
<tr>
<td>Institutional support and coordinating mechanisms</td>
<td>17</td>
</tr>
<tr>
<td>Local support</td>
<td>18</td>
</tr>
<tr>
<td>Technical input</td>
<td>18</td>
</tr>
<tr>
<td>Seed harvesting, drying, cleaning, and storage</td>
<td>19</td>
</tr>
<tr>
<td>Seed quality maintenance and assurance</td>
<td>20</td>
</tr>
<tr>
<td>Stimulating seed use and marketing</td>
<td>20</td>
</tr>
<tr>
<td>Sustainability and institution building</td>
<td>21</td>
</tr>
<tr>
<td>Financial support</td>
<td>21</td>
</tr>
<tr>
<td>An Integrated National Seed System in Brief</td>
<td>22</td>
</tr>
<tr>
<td>One national seed system</td>
<td>22</td>
</tr>
<tr>
<td>National seed board</td>
<td>23</td>
</tr>
<tr>
<td>Public sector development activities</td>
<td>24</td>
</tr>
<tr>
<td>Seed legislation</td>
<td>24</td>
</tr>
<tr>
<td>Research focus</td>
<td>24</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Extension support to seed program</td>
<td>25</td>
</tr>
<tr>
<td>Public sector commercial seed activities, if required</td>
<td>25</td>
</tr>
<tr>
<td>Private sector</td>
<td>25</td>
</tr>
<tr>
<td>Literature Cited</td>
<td>26</td>
</tr>
</tbody>
</table>
Acknowledgments

We wish to thank the many people who contributed to this paper, especially Tom Osborn, who provided much of our material on seed programs in Africa, and Winrock's Jim Yazman, Steve Grant, and Doug Collin, who provided ideas and corrections to earlier drafts. We also appreciate reviews of these early drafts by Richard Harwood, Henk Knipscheer, and Pierre Antoine. In addition, we thank Enrique Ospina and Dil Athwal for their institutional support and the many people on Winrock's staff who provided editorial and secretarial help in preparing this paper.
Designing Successful Farmer-managed Seed Systems

Introduction

Many developing countries are striving for consistent increases in food production. The green revolution tremendously boosted food production following the mid-1960s, but the ability to sustain that rate of increase is highly doubtful. In fact, in the past 20 years the increased yield potential of some crops with high-yielding varieties is said to have improved only 10%. Now, although every possible resource is being mobilized to increase production, limited amounts of arable land in most countries means that the major focus must be on improving crop productivity. Thus, millions of small farmers must increase their productivity if future food needs are to be met. Good varieties of seed developed in crop-breeding programs give farmers the genetic potential to do just that. When used in conjunction with other inputs such as fertilizer and pesticides, seed of improved varieties can lead to substantial increases in farm output. Improved seed and easy access to it is a major key to more-productive agriculture.

However, a sound seed strategy is a prerequisite to action. In many countries, the demand for vegetable and hybrid crop seeds is being met by the private seed industry as the production and sale of these seeds become commercially viable business ventures. But the same is not true for self-pollinated food crops, such as wheat and rice or the straight varieties of maize, millet, and sorghum. For these basic food crops, alternative approaches must be explored.

Many countries have developed parastatal seed corporations to supply seed to farmers. Supported by direct or indirect subsidies, the parastatals supply large quantities of seeds to farmers; but the cost of certified seed, even at subsidized rates, still is often higher than small farmers can afford. Besides, the total requirement is too large to be completely satisfied, especially in the small-farm sector and in remote regions. Produced as they are through several generations of multiplication, supplies are seldom adequate. Therefore, only a small percentage of farmers may be planting seeds from these organizations and enjoying the fruits of research.

The answer does not lie in increased subsidies, which are not sustainable in the longer term and which adversely affect the growth of a private seed industry. In cereal seeds, the traditional farmer-to-farmer system of seed dissemination still predominates because it is dependable and cost effective. Properly strengthened and supported, these on-farm seed production systems offer an opportunity to produce better quality seed at the least possible cost. Extension agencies and nongovernmental organizations (NGOs) are well positioned to provide stimulus to such seed systems. Besides motivating farmers to improve their seed-saving practices, these organizations can easily promote farmer-managed, small-scale seed enterprises at the
village level. Individual entrepreneurs can also be encouraged to serve farmers with a variety of seeds for crop production.

To be effective, these farmer-managed seed systems need strong linkages with extension, research, good seed technology, and management/marketing training opportunities. National seed programs in developing countries should be reoriented to promote more local seed production by these kinds of farmers. This course has been successful in several situations. The example of field crop seeds in the Indian Punjab is relevant in this context. The local agricultural university and the extension service together have established direct seed linkages with farmers so that new and better seed varieties are continually flowing from breeders to farmers. The impact is definite.

In this paper, we first look briefly at farmers of small holdings and their contribution to their national economies. Second, we examine how farmers perceive seed and what factors govern their adoption of new seed and seed technologies, ranging from traditional farming patterns and economic considerations to information provided by support and research organizations. These factors influence the success of any program designed to make farmer-managed seed production systems significant contributors to national requirements. Third, we discuss conventional national seed programs and how they are relevant to small farmers. Fourth, specific programs in Nepal, Senegal, the Gambia, Guatemala, Colombia, and Bolivia are considered. The results show that these varied approaches can produce good quality seed of improved varieties with farmer participation. With this increased source of readily available seed, the goal of increased production may be realized.

Small-farm Background

Most farmers in developing countries have relatively small landholdings, ranging from less than 1 ha to 3 ha. Somewhat bigger farms may be found in rainfed agricultural regions. Depending on the context, these farmers are variously referred to as subsistence, resource-poor, marginal, disadvantaged, or small farmers. They may be either male or female depending on the culture, the crop, and the work to be done.

Small farms have very little mechanization—manual labor and animal power are extensively used for farm operations—yet they often must support large families. It is imperative to improve their productivity by applying adequate methods and supplying appropriate inputs. Improved seed supplies are one of the most critical components of this production package.

Contribution to national economies

Agriculture is the mainstay of the economy in most developing countries, contributing substantially to gross domestic product and exports. Small farmers are a
major group among agricultural producers. For example, in Latin America it is estimated that they produce 32% of rice, 77% of beans, 51% of maize, and 90% of cassava. The agricultural economy is greatly influenced by their level of productivity and efficiency: They can be a national asset for generating needed food supplies, or they may become a liability requiring costly subsidies. It is in the interest of developing countries to enhance the capability of small farmers to maximize their contribution to the national economy.

The green revolution in India has taken hold on millions of small farms. These farms have become productive units largely due to the use of fertilizers and good seed of high-yielding varieties. Within a span of 25 years, food grain production has increased from less than 80 million tons to more than 145 million tons (Seckler and Sampath, 1985). Given the goal of producing 240 million tons of food grains for the projected population by the end of the century, small farmers must play an even larger role. But as population grows farms are becoming ever smaller, and the challenge becomes greater.

Small-farm profile

M. S. Swaminathan, 1987 World Food Prize laureate, is credited with the view that the new production technologies are "size neutral" and should benefit all farm holdings. Indeed, under optimum conditions, the smaller the farm unit to be managed, the better the potential for gains in productivity. Small farms unfortunately often lack the resources for investment. Only a small percentage of farmers practice irrigated agriculture, produce high-value cash crops for market, make use of better technologies, and obtain seed from off-farm sources. The vast majority can be characterized as resource poor, unable to take risk, in debt, and operating at a subsistence level of production. This category of farmer has the greatest need for good seed of better varieties appropriate to the conditions of the farm.

Small Farmers’ Perceptions of Seed

Small farmers usually give the highest priority to staple cereals – rice, maize, wheat, millet, and sorghum. Yet crops such as vegetables, oilseeds, grain legumes, and fodder that are needed by the family and can provide raw material for specific agro-industries are also important. Seed shortage, however, often limits production.

Small farmers have chosen for generations to use their own seed of traditional varieties. Often these varieties are well adapted to the conditions of their farms and provide a quality of grain to which the farm family is accustomed. Such traditional varieties, though frequently not highly responsive to fertilizer, yield at a consistent level. Modern plant breeding opens new choices – improved varieties responsive to fertilizer. But small farmers first must be aware that such varieties exist, convinced that they are truly better than what they have, and able to procure seed. If the plant-breeding program develops a hybrid for a crop such as maize or sorghum, farmers
need an annual supply of such seed. But the fact remains that the farmers’ easiest choice is to continue to use what they have. The reasons for this include

- doubtful performance of new improved varieties compared with the existing traditional variety
- reluctance to purchase seed because of scarce resources
- insufficient motivation to use modern tools and inputs to increase farm income
- uncertainty that the seed being offered is of better quality than their own seed
- inadequate information from the extension system or the seed supply agencies about the value of good seed and improved varieties
- nonavailability of improved seed at the right time near the farm
- high cost or nonavailability of fertilizer
- lack of credit for the purchase of seed and fertilizer
- limited market for their produce so money is not available to invest in seed and other inputs

For these reasons, governments, crop research programs, extension systems, and conventional seed supply agencies often feel frustrated over the slow pace of acceptance of their improved varieties. Regular seed renewal schedules are usually advocated to fully exploit the genetic potential of high-yielding varieties.

Assuming farmers accept the new variety, they then have a choice of maintaining their own seed or purchasing new seed periodically. Customarily, farmers choose to use their own seed. Frequently this seed is actually stock from their food grain supply or may come from a neighbor. Current estimates are that 80% to 90% of the seed planted by small farmers is from their own production of either traditional varieties or improved ones.

Factors That Promote Use of Off-farm Seed

Significant genetic superiority. Regardless of results on agricultural experiment stations, farmers need to be convinced that new varieties are truly and consistently superior under their own conditions. Farmers are reluctant to change if the new variety appears to be only marginally better. When convinced the variety is significantly better, farmers will purchase seed if it can be found. They will save seed from their production as long as the variety continues to perform well, until a better
variety becomes available, or until they are convinced the quality of off-farm seed is better.

Affordability and economic benefit. Small farmers need to perceive an economic benefit before they will invest in off-farm seed. They often will opt for seed exchange or barter systems rather than spend cash for seed. Considerations of affordability and economic benefit are extremely important when designing seed systems tailored especially for small farmers.

Seed quality. Appearance and germination capacity are the key factors in seed quality identified by small farmers. Good quality seed can be produced more easily by farmers with some crops than with others. Methods exist to help farmers improve the quality of their own seed, but these need to be identified, adapted for local conditions, and promoted. Small farmers look to seed sources off the farm much more readily when suppliers consistently deliver seed of better quality than the farmers themselves can produce.

Support from extension. Use of good quality seed of improved varieties only will increase when small farmers see the benefits and know where to get it. Extension systems need the capacity to conduct many on-farm demonstrations of improved varieties. They also require a few seed extension specialists to help farmers locate seed supplies and use appropriate technology to maintain their own future seed supplies. An effective extension system that provides these services is an essential link in the chain to reach small farmers.

Access to seed. Experience in many countries shows that easy access to seed is a critical factor in enhancing seed use. Often this means seed supplies must be available within a day’s walking distance because vehicles are scarce. Only a decentralized system of seed production and marketing can address the issue of providing seed to millions of farmers in widely scattered villages.

Conventional Seed Programs
and Their Relevance to Small Farmers

Conventional seed programs include activities ranging from plant breeding to the delivery of seed to end-users. The major components and related activities are shown in figure 1.

Leadership at the national level is normally provided through a ministry of agriculture. A national seed board or central seed committee frequently provides the means for the many interests involved in the components of a seed program to assist the government in establishing policies, coordinating activities, and monitoring the progress of the seed program.
CERTIFIED AND COMMERCIAL SEED SUPPLIES TO FARMS

Source: Dougan, 1980.

Figure 1. Components of a Seed Program.
Public sector efforts. In their zeal to get seed to farmers, governments often have initiated seed production and supply programs directly through their own channels or by forming a public sector seed enterprise. Although these efforts helped make seed available to farmers in the early years of many countries' seed programs, these organizations continue to have great difficulty in meeting their objectives and often must operate with subsidies. These subsidized operations tend to limit opportunities for the private sector to become involved in the commercial seed industry. Theoretically, these subsidized seed enterprises should play a special role in supplying seed to small farmers; but they usually do not have strong marketing programs and are not effective in meeting more than a small fraction of the needs of small farmers. The actual percentage supplied often varies considerably depending on the crop involved.

Private sector enterprises. Countries increasingly are developing policies to encourage private sector participation in the commercial seed industry. Private sector enterprises may have their own plant-breeding programs, or they may rely on the results of public sector crop research programs. Enterprises with their own plant-breeding programs are larger, often operate in more than one country, and tend to concentrate on high-value seed such as hybrids of maize, sorghum, sunflower, and vegetables. Small farmers may buy these seed, but they frequently lack the funds or credit to do so. A few enterprises have developed extensive marketing programs to reach large numbers of small farmers, but the tendency is to sell to the more easily reached larger farmers.

Private seed enterprises that produce and sell varieties and hybrids developed by the public crop research programs play an extremely valuable role in moving seed supplies to farmers in many countries. These enterprises may vary in size and are often dispersed over a country to meet a wide range of local seed needs. They may be organized as family businesses, partnerships, associations, companies, corporations, or cooperatives. They are often effective in reaching small farmers in their local communities with a wide range of seed kinds. Few countries have put enough effort into developing these kinds of enterprises.

On-farm seed production

Most seed used by small farmers comes from their own production. On-farm seed is the major competitor to all off-farm seed supplies. Unfortunately, in the absence of reliable methods to continually supply improved planting material and appropriate on-farm seed production, the small farmers' seed can deteriorate, causing yields to fall far short of their potential.

Improved seed delivery systems

Although efforts to strengthen and accelerate the development of conventional seed delivery systems continue to be needed, few countries have moved beyond conventional strategies. New seed delivery systems that complement the old should be developed by placing more effort on improving the on-farm seed production system
and integrating small farmers into the process of improved variety evaluation. “Today, more and more countries are evolving strategies that place an increased emphasis on developing numerous seed growers, enterprises and sellers who cater to local needs...Some extremely small seed producing/selling units are operating in several countries such as Colombia, Nepal and India” (Douglas, 1989). These systems work to develop and utilize improved, more systematic methods of seed production at the local level.

Winrock International has been involved with Nepal’s effort to find a workable method of seed supply to farmers in the mid-hills. In the early 1980s, a system of “mini-seedhouses” was tried. Based on that experience, a more decentralized system involving small private seed producers-sellers was tested successfully. Both of these efforts were supported with funding from USAID (Bal, 1990). A more recent effort by Winrock International, the Joint PVO Center, and USAID has been made in Senegal and the Gambia through the On-Farm Seed Project to collaborate closely with nongovernmental organizations (NGOs) (Winrock, 1989a,b).

In 1982, the Seed Unit at the Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia, sponsored a workshop on improved seed for the small farmer (CIAT, 1982). A second workshop in 1986 reviewed actions taken by participating countries (CIAT, 1986). From these initiatives, several on-farm seed production programs have begun in Latin America. The section that follows summarizes some of the activities in Asia, Africa, and Latin America that offer valuable lessons for future efforts to improve the quality and quantity of seed available to small farmers.

**Projects for Farmer-managed Seed Systems**

Many alternative approaches are possible for establishing farmer-managed seed systems. The methods used are highly site-specific, yet some common steps are required for success. In all cases, it must be remembered that elements of a conventional seed system exist or are being built. These examples are not presented as alternatives to the conventional seed system, but rather as ways to reach beyond them.

**Nepalese experiences**

Nepal has a limited amount of land for agriculture. With nearly 3 million ha under cultivation, further expansion is almost ruled out, but the present food sufficiency is being eroded by the dynamics of demographics. Nepal’s population, now 18 million and growing at a yearly rate of 2.6%, is likely to reach more than 23 million by the year 2000. Doubling food grain production to a level of 8.6 million tons by the turn of the century is the target of the Basic Needs Program launched in 1986.
The origin of Nepal's seed program dates to the early 1970s. A beginning was made by an FAO-assisted seed project under which a high-capacity seed-processing and storage facility was built on the plains.

The Agriculture Inputs Corporation (AIC), an official public sector agency primarily involved with fertilizer procurement and supply, became the main source of off-farm improved seeds of major food grain crops. Hybrids are not yet in use. The private sector has only a modest volume of business in vegetable seeds because of the public agency's policies. Although AIC is surviving on a heavy subsidy from the government, only about 2% of Nepal's cropped area is receiving good quality seed from AIC. From the beginning most of AIC seed was used on the plains. Transporting seed to the hills was too costly even with a subsidy.

Winrock International became involved with Nepal's effort to find a workable method of supplying seed to farmers in the mid-hills in the early 1980s. At that time, a system of mini-seedhouses was started with a USAID-funded project - the Seed Production and Input Storage Project (SPISP).

Mini-seedhouse system. Working with AIC, SPISP staff carried out baseline surveys at a large number of sites and selected 20 key locations for building the mini-seedhouses (AIC, 1981). These were backed by a dozen warehouses to ensure availability of fertilizer and pesticides for increased production. Each mini-seedhouse was essentially a small facility for drying and cleaning seed, capable of storing about 40 metric tons. Located in the middle of an area potentially suitable for seed production, local farmers were identified, motivated and trained for producing good quality seed. The concept centered on multiplying locally a small quantity of pure seed of recommended varieties brought from the crop research stations rather than transporting large quantities of seed from the plains to the hills.

Simple, hand-operated equipment was utilized in the mini-seedhouses, but a small degree of mechanization was introduced. Farmers were reluctant to run the facilities themselves, preferring to wait until successful operation was demonstrated. Therefore, AIC staff managed most of the mini-seedhouses in consultation with farmers' committees. At a pilot site, however, a farmer-managed mini-seedhouse was tried, and the results were encouraging (SPISP, 1985).

During the production phase, an appreciable quantity of wheat, maize, and rice seed was produced. However, its distribution in the hilly terrain continued to pose serious problems. A single mini-seedhouse in a district could not meet demand for seed, but the cost of building more seemed prohibitive. The mini-seedhouse experience eventually led to recommendations that focused on an even more decentralized system to obviate the need for transportation (Development Promotion Centre, 1988). A totally privatized system was suggested, involving individual farmers and families in dispersed locations rather than cooperating groups of farmers around a mini-seedhouse.
Subsequent discussions on the issue of seed supply to hill areas led to a consensus that although the mini-seedhouse concept faced problems in the hills, it might be a good approach for the plain areas, where transportation costs were not prohibitive. For the hills, a modified version was conceived by creating satellite seed producers in selected areas that utilized the mini-seedhouses as focal points for promoting activities related to seed production and supply in a district. This new approach was known as the Private Producer-Sellers' Seed Program (PPSP) and became the responsibility of the Ministry of Agriculture instead of AIC.

The lessons from Nepal's mini-seedhouse system may be summarized as follows:

- A national seed board should be created at the apex to address policy issues and pave the way for appropriate strategies.

- The department of agriculture and the extension agency should take charge of on-farm seed production systems from AIC.

- Seed production in remote hill areas should be decentralized to the village level. Individual seed storage bins are preferable to storage of seed at central mini-seedhouses.

- Farmers' initiative to produce seed for themselves is affected adversely if seed generated by the organized sector is subsidized. The issue should be resolved through a policy dialogue at the highest level of government.

The Private Producer-sellers' Seed Program. The PPSP not only promotes on-farm seed production, it also is aimed at refining and improving the traditional method of farmer-to-farmer seed dissemination in Nepal's hills. Its purpose is to assure local seed sufficiency of improved seed varieties in remote areas (Rajbhandary and Bal, 1989). This grassroots program helps small farmers in isolated settlements help themselves. It focuses on an individual farmer or family as the seed production unit. To launch the program, a district's agricultural profile is prepared through discussions, baseline surveys, and other available information. This helps identify the pocket areas to be targeted and their seed needs. In these specific pockets, motivated farmers are selected for seed production.

Extension workers are trained so they, in turn, can train participating farmers to ensure good quality seed production. As seed production begins, extension offices make arrangements to provide the farmers with foundation or source seed for multiplication and to supply metal bins for storing seed at harvest. To minimize foundation seed requirements, selected farmers in a district multiply the foundation seed to produce source seed for other producers. The quality of this seed is certified by the Seed Technology and Improvement Program of the Ministry of Agriculture through field inspections and seed laboratory tests.
Extension personnel continually guide seed producers on agronomic practices, isolation, roguing, harvesting, and threshing. Women and other family members collect seed from the field, spread it out for drying, handle the cleaning by traditional methods, and store it in metal bins.

Extension personnel periodically inspect the seed during storage for moisture content and the presence of insects, helping with fumigation as needed. Near planting time, they inform other farmers about the availability of the seed and thus assure its use for crop production.

Experience in five hill districts shows that certain conditions must be met for progress to occur. With proper implementation, sufficient momentum can be built in about 5 years for the program to sustain itself if an assured supply of foundation seed and technical backstopping is available (Bal, 1990). The requirements of the program are

- supportive government policies using a national seed board
- program planning and coordination by appropriate offices of the department of agriculture
- identification of improved varieties and target areas
- selection of farmers for seed production
- training of extension staff in seed technology
- training and motivation of farmers
- assuring the supply of foundation seed
- provision of metal bins for seed storage
- technical support from the Seed Technology and Improvement Program
- backstopping and monitoring by extension personnel

**Measured impact in a pilot district.** A model for the PPSP is the successful program in Parbat District in Nepal's Western Development Region. After 3 years of operation, the program's impact was measured in 1989. The results were very encouraging.

Relying upon the availability of locally produced seed, production increases of 5% in rice and wheat and 10% in maize were estimated over 3 years. These represented approximately 6.5 million Nepalese rupees (approximately US$ 232,000) in additional income attributed directly to seed. The study also found that 2.3 million rupees were saved by avoiding transporting seed from outside the area and reducing packaging.
and storage costs. The most significant conclusion was that the PPSP seed potentially could cover almost 50% of the food-crop area within a few years, eliminating any need to bring seed from the distant Terai (Rajbhandary and Bal, 1990).

On-farm seed-production experiences in the Gambia and Senegal

Winrock International initiated the On-Farm Seed Project (OFSP) in cooperation with the PVO Joint Center, other NGOs and the governments of the Gambia and Senegal in 1988. The project was partially funded by USAID (Osborn and Faye, 1991). The goal of OFSP is to improve the nutrition, income, and well-being of small farmers. This innovative project includes two unique features: (1) specific interventions in the local farmer seed system based on information gathered in the field from farmers and (2) all field activities achieved through collaborating non-governmental organizations (NGOs) and the Peace Corps. The project addresses the farmers' demand for better seed by improving the farmers' own system of selection, production, storage and distribution. As this happens, their traditional seed system is better understood, improved, and linked to the national seed system. This link can create a situation where small-scale seed enterprises can develop. Although the objectives are the same in both countries, the implementation must be different because the existing components of the conventional seed system differ and the collaborating NGOs in the two countries are not the same.

The Gambia. The country's rapid population growth and its low level of self-sufficiency in major staples place intensified agricultural production high on the government's policy agenda. The principal crops are rice, groundnut, maize, sorghum, millet, and cotton. The Department of Agriculture includes a research and allied services group that has responsibility for the conventional activities of plant breeding, variety evaluation, and foundation seed production. A seed technology unit (STU) multiplies the foundation seed for distribution to collaborators who increase seed for commercial use. The collaborators may be private seed growers or NGOs who work with private farmers. The National Seed Council guides overall policy (Henderson and Singh, 1990).

In the early 1970s, when the seed program was started, the initial concept for the STU focused on it making large-scale multiplications on a government research farm. Although found to be effective, the costs were high. When the policy changed in 1986, the STU became responsible for seed certification, testing, and foundation production and distribution. However, supplies of foundation seed were inadequate even with this reduced role. The seed program now is assisted by the Overseas Development Administration (ODA), including the service of a seed development officer for a limited period.

Winrock's OFSP complements the ODA program through its training programs and technical services focused especially on the extension staff and leaders in cooperating NGOs. Examples of training include a seed management seminar for NGOs and
training for seed extension agents on the principles of seed production. Technical information is collected inside and outside the country to assist collaborators. Cooperation between the ODA seed development officer resulted in a new publication, *Seed Multiplication Manual for Extension Workers in the Gambian Seed Industry* (Henderson, 1988). The OFSP utilizes experts from Mississippi State University (a partner in the project) and is able to help collaborating NGOs solve problems in their seed activities.

Matching grant funds are available to help NGOs undertake seed activities that they would not be able to otherwise; but this facility has not been exploited by collaborators to date, even though the project's mid-term assessment considered this a useful tool. It is recommended that mechanisms should be found to make such funds more accessible. The OFSP helps stimulate NGOs to become more involved with farmers in seed production activities. The work of NGOs with private farmer seed multipliers can provide information on farmers' seed production experiences, their preferences about varieties, and a way to develop improved seed multiplication systems that meet their needs. The Gambian Advisory Council serves as a forum of discussion about seed activities, technical issues, and planning collaborative seed programs (Winrock, 1989b).

**Senegal.** The same population pressure affects Senegal as the Gambia, and both grow the same crops. New varieties from the national and international institutions are tested by the *Institut Senegalais de Recherche Agronomique* (ISRA), which also carries out early stages of seed multiplication. ISRA's *Direction de la Production et du Controle de Semence* (DPCS) multiplies later stages with contract growers. The DPCS is responsible for quality control and seed distribution to farmers through a rather conventional "top down" system combining public and private agencies.

The OFSP in Senegal has the same basic features as in the Gambia—it starts with farmers and improves what they do based on data collected about farmers' practices. For example, one of the major problems identified early was difficulty in storing peanut seed. Thus, in cooperation with the Peace Corps, the project undertook demonstrations with farmers to test various storage methods and develop appropriate recommendations. Storage losses that were 30% to 100% now can drop to 5%. Similarly, information gathering and farmer demonstrations have been undertaken to ameliorate seed-related problems of rice, millet, and cowpea (Winrock, 1990). About 44,000 farmers observed the 220 seed demonstration plots in 1990.

A series of workshops and training sessions were conducted for collaborators and government extension personnel. Training materials were designed, produced, and distributed for all training sessions.

As new collaborators continue to enter the program, opportunities to improve the quality of seed used by more small farmers increases. The reaction of farmers to the process approach has been extremely positive. Female farmers are the focus of seed extension efforts with rice, whereas male farmers are the target audience with millet.
cowpeas, and peanuts. Women are especially active in rice seed production and saving practices, and those who have seen the rice plots and the harvest are already approaching the demonstration farmers to obtain some of the "magic seed" (Osborn and Faye, 1991).

Experiences in Latin America

The conventional seed industries in many Latin American countries are well developed compared with those in Asia and Africa. Yet even in the countries where the seed industry is most developed, many small farmers in large areas such as the Andean Mountain range, Central America, the Caribbean area, and northeast Brazil do not benefit from improved agricultural technology. Better planting material of some crops such as edible beans, maize, cassava, and upland rice are rarely available to small farmers.

CIAT. For this reason, CIAT organized the two workshops in the 1980s mentioned earlier and has continued to provide training and to develop materials focused especially on seed production by and for small farmers. With the assistance of the Swiss Development Cooperation, the Seed Unit concentrates on three lines of work: (1) setting up pilot projects for production and distribution of seeds with farmer participation, (2) developing simple seed-production methods, and (3) developing human resources (CIAT, 1990). Information on these nonconventional approaches has been published by Camargo et al. (1989a).

CIAT developed a small seed-conditioning facility appropriate for small operations (Camargo et al., 1989b). The staff continues to develop simple methods and equipment for small-scale postharvest seed management. Guidelines for helping the small farmer improve seed-saving methods have been developed, and several Latin American countries now have their own brochures for use with extension personnel and farmers. An anthropological study of the strengths of indigenous communities for evaluation, production, and utilization of improved bean seed was concluded in Colombia and Ecuador. Other research geared especially to the needs of small farmers for seed supplies is ongoing at CIAT and the surrounding area. A number of publications have been prepared for local training and national programs.

Activities in several countries in Latin America specially focus on the seed needs of small farmers. Colombia, Guatemala, and Bolivia provide good examples.

Colombia. Over 30 years ago, Colombia initiated a seed program; now over 50 private seed enterprises and one public sector enterprise produce hybrids of maize, sorghum, rice, and soybeans. Yet the supply of bean seed is practically nonexistent; good quality planting material of cassava is limited; and hybrid maize reaches only about 20% of the farmers—most of the other 80% are in the Andean range. For these reasons, the government has mobilized the resources of the research, extension, cooperative development unit and the seed certification program to initiate seed producing and selling programs in the areas in which small farmers live.
The first such effort was with a small cooperative near San Gil in northern Colombia in 1983. The cooperative started with a local bean variety, but the members soon began planting demonstration plots to test varieties from the joint national and CIAT bean research program. Officials with the research program indicated that it was interesting to see these farmers carrying out their own agronomic trials — once they learned the value of good seed, they started looking for a higher-yielding variety. Bean seed sales continue to climb, and the combination of better seed and improved agronomic practices has increased bean yields 40% in the area (CIAT, 1987).

Other locations have started with beans and maize seed. A special program for systematic cassava stake multiplication has been organized around existing small cassava-drying cooperatives. Disease-free planting material originating in CIAT and the national program move through a series of multiplications involving small cassava farms (Garay, 1990).

Guatemala. In the early 1970s, the total seed program was managed through a research station that contracted with farmers to grow seed that the station then tried to sell. The system did not work, so policy changed to stimulate small-scale private seed production and sale. Custom cleaning was provided by the research program to those who wanted to enter the business, and new hybrids of maize were available for multiplication. Several small organizations were started. The use of hybrid maize sold by the private sector continues to increase.

Unfortunately, these same organizations failed to produce and market seed of improved bean varieties and open-pollinated maize for the highland areas. A technology transfer project determined that a different strategy was needed for these highland areas. Training by local project staff assisted by CIAT was offered initially to potential seed growers in one area in 1987. Production the first year was 2,727 kg and increased yearly by 10,000 kg. The scheme has gradually expanded to the whole country and to other crops. Now, efforts are under way to use the seed enterprise development concept as a way to institutionalize the gains that have been made using small-farmer seed producers (Garay, 1990).

Bolivia. In the late 1970s, the government of Bolivia tried to start a public-sector-managed seed multiplication and distribution program. Although some elements of a conventional seed program were involved, private elements and small farmers did not participate except as seed growers. The system failed.

A project developed with USAID support in 1980 concentrated on local soybean seed production for the eastern region of the country. The first year of production was a failure, but the project and farm leaders were not discouraged. As reported in Setting a Seed Industry in Motion: a Nonconventional, Successful Approach in a Developing Country (Garay et al., 1989), "The experience pointed to the need for concentrated efforts, starting small, and building on experience."
The second production attempt was successful—locally produced soybean seed sold well in competition with imported material. The next year interest in soybean and wheat seed production increased, and the number of growers rose from 20 to 100. One of the Ministry of Agriculture’s seed-conditioning facilities was placed under local management to assure easy access of services to all producers. The amount of seed flowing into the conditioning plant increased to 1,000 tons. All producers were responsible for selling their own seed based on market forces—no subsidy and no price fixing.

The experiences in the eastern region stimulated interest in others. One hill area became successful in producing wheat and potato seed planting material. The farms in this area were quite small, and as many as 700 fields in remote areas were brought under the program by 1984.

The model involved several innovative approaches; cooperation among many private and public groups has now spread to the entire country. Regional seed boards were formed with strong private participation to coordinate developments. A revitalized seed-certification system with fees collected from seed producers worked as a catalyst to stimulate developments. Adriel Garay, who was involved in the program from the beginning, recently reported (Garay et al., 1989) that “as a result, 55 participatory, nonconventional, dynamic, and production/marketing enterprises have developed. Among these, half can be characterized as medium to small enterprises, producing seed with hundreds of small farmers.” Interestingly enough, no multinational companies have been involved in this 10-year transformation of a seed industry.

**Essential Components of Well-designed Farmer-managed Seed Systems**

The components of a national seed program have been covered briefly above. This section discusses what has been learned from developing and implementing farmer-managed seed systems during the past decade. As the essential components of these systems are considered, however, it is necessary also to keep clearly in view the basic components of a national seed program. Farmer-managed seed systems are not a substitute for a conventional seed program. They do provide an improved, complementary source of seed not found in most countries, and as they evolve, the distinction between the two will fade. The total seed system, combining both farmer and national seed programs, is considered in the next section. (Additional useful reading is available in Successful Seed Programs: A Planning and Management Guide [Douglas, 1980]).

**The strategy**

A clear strategy based on understanding, improving, and linking traditional seed systems to the national seed system (assuming a viable national seed system exists) is
The scope and nature of the activities undertaken must be based on identified needs of farmers with respect to seed. As experienced in the Gambia and Senegal, it is important to identify and assemble technologies relevant and appropriate to on-farm seed selection and preservation. The promising technologies should then be validated and demonstrated in realistic settings with clients.

The strategy should include a description of the target clients' location. Although a national program might be possible, initial impact is greater if the program is decentralized and targeted to specific areas. The region should be one in which the greatest impact can be achieved in the shortest possible time with specific crops. In all cases, the crops and areas selected should be those with clear need and the potential for significant improvement.

Needs assessment should include the appropriateness of the crop varieties, ease of obtaining seed of new varieties from off-farm sources, ability to save seed successfully on the farm, suitability of cultural practices to achieve improved yields, and potential to produce and sell seed to neighbors.

Policies in support of the strategy

Policies that support the participation of the private sector in the national seed system are needed to stimulate the growth of farmer-managed seed systems. Policies that thwart private initiative and allow a monopoly by the government or government corporations are inappropriate. Seed pricing must be based on market forces without efforts by the government to subsidize public programs in competition with other initiatives.

Public sector institutions that can support seed systems managed by farmers should be identified and their role clearly defined. Support by these institutions should include providing reliable sources of foundation or similar seed, materials for local trials, technical support, training, and credit. Policies must support the development of the research, extension, and seed supply chain without the government attempting to do it all. If technical assistance from NGOs and outside agencies is desired, policies should support their efforts and link them to government agencies capable of providing networking.

Institutional support and coordinating mechanisms

The institution that plays the lead role varies from country to country as illustrated in the examples discussed. The most common governmental agencies are the extension service and the seed certification service. In Nepal, Colombia, and Bolivia, the seed-certification service was involved in local development in addition to controlling seed quality. Various bilateral and internationally supported projects, often using NGOs, may help.
The challenge is to find and draw upon all useful agencies and then develop a coordinating mechanism that assures their maximum productivity. Countries often develop a national seed board to help establish policies and guide the development of the overall seed program. The board can contribute to farmer-managed seed systems by establishing goals and policies. Regional seed boards, advisory councils, or local committees are also needed to link the organizations involved and to coordinate their activities. These more-decentralized coordinating groups can plan actions appropriate for an area, focus on constraints as they develop, evolve solutions, identify priorities, and achieve a high level of cooperation among participants.

Local support

Within each community, local farm leaders and many other potential groups can support the farmer-based seed system. Associations, cooperatives, and other rural groups may not be involved in seed activities, but they are potential supporters of the new effort to get more seed produced and used by small farmers. Their members, who are often small farmers, could become the focal point for organizing the new activity. Local groups of this kind should also be a part of the coordinating group to assure that they are properly integrated into the program.

Technical input

On-farm trials and seed-production interface. On-farm variety evaluation and on-farm seed production are highly complementary. The farmers involved in conducting on-farm trials are often the most logical persons to become leading seed producers and sellers in the area. The person multiplying seed is also one of the best sources of feedback on evaluation of varieties to research. Once convinced the variety is good, the same person is a good promoter of the merits of the variety, resulting in faster seed diffusion and greater impact of research results. Thus, it is logical for the extension system or other organization concerned with trials to be involved with the farmer-managed seed system.

The seed certification staff can certainly provide necessary technical support, but for additional technical input on seed, some programs have trained seed extension specialists who work with regular extension personnel and provide necessary seed production and technology leadership.

Simple guidelines outlining the best seed-growing practices possible for use by the small farmer must be prepared. Such guidelines are needed on each crop and should be based on technically sound seed production experiences.

Critical role of crop research. Crop research programs are often responsible for foundation seed production of released varieties. To sustain farmer-managed seed systems, a reliable source of seed is needed to feed into the system. This can be foundation seed or seed after one or two multiplications. Thus, a strengthened foundation seed program may be needed. Regardless of what class of seed is used,
the crop research program must play a role not only in ensuring seed supplies but also in helping to solve problems of the small-farmer seed system.

One basic problem is that new technologies and varieties frequently are not adopted by small farmers, often because these methods and varieties do not fit into the prevalent cropping patterns or farming systems. Research programs, thus, must bridge the gap between the perceptions of the researcher about varieties and those of the farmer. More crop varieties tailored to suit the local environment are needed. With a farmer-managed seed system, such varieties will be used rapidly if they meet the farmer's needs.

External support agencies. Farmer-managed seed systems must have strong support within a country, but assistance to projects from external agencies may also be important. Such projects create linkages with organizations outside the country that otherwise may be difficult to obtain. NGOs can contribute much to this kind of effort because they work at the farm level over wide areas of a country and frequently have strongly motivated staff. NGO staff may need training in the technical requirements for seed production.

Many of the crops on which research is conducted at the International Agricultural Research Centers (IARCs) are essential to small farmers' production programs. The IARCs can be expected to continue to generate technology especially suited to the needs of small farmers. Activities such as those of the Seed Unit at CIAT that focuses on small-farmer seed production and sale is required to support in-country efforts through the development of improved seed technology and training.

Training. Training of extension personnel and others associated with the farmer-managed seed system is an essential part of any program. Although such training should give these leaders a strong seed production and technology background, it must also be managed in such a way that they learn to train farmers with solid, practical, applied methods. Training material ultimately must be understood by the small farmer; thus, the emphasis must be on illustrations and demonstrations rather than on written material. Training small groups in the area in which farmers will produce and sell seed also helps keep what is presented more relevant.

Seed harvesting, drying, cleaning, and storage

Simple methods that improve farmers' traditional systems are required for seed harvesting, cleaning, and storage. Studying the farmers' methods and determining what improvements are needed and possible are the keys to building on such common practices as hand harvesting and sun drying, keeping in mind the more critical timing of harvesting for seed than for grain.

Small quantities of seed can be hand cleaned through traditional methods. As quantities increase, small-scale seed cleaners that use manual, electric, or oil power can improve the system.
Proper seed preservation usually proves to be one of the most difficult challenges at the village level. Once the exact nature of the problem is understood, innovation is required. Metal storage bins helped solve the problem in Nepal; other improved methods have been used elsewhere. While much has been written on seed storage, local studies, as in the case of Senegal, may be needed.

Seed quality maintenance and assurance

On-farm seed systems must generate seed of acceptable quality, but it is not necessary that such seed meet certified seed standards. Seed renewal through the regular supply of foundation seed, roguing of off-type and diseased plants, safeguarding against adulteration, adequate drying, and good storage with insect control are some of the key factors that need to be observed.

Simple germination tests need to be promoted, especially just before seed sale or planting. It is possible that small farmers or groups of small farmers can produce seed of certifiable quality or higher. As the program develops, they might be encouraged to participate in the seed certification system to help build their reputations as good seed producers. When their seed is sold locally to neighbors, there will be considerable social pressure to ensure that it is of good quality; but as seed moves into more distant areas, proper labeling and certification become much more important.

Stimulating seed use and marketing

A key role of the extension system is to stimulate the use of seed produced by the farmer-managed seed system. Demonstration plots or fields planted with locally produced seed of a particular variety continue to be the best way to convince farmers to use good seed. Meetings organized around such demonstrations are extremely effective, and discussions in small groups and radio announcements are excellent. The bean seed cooperative in Colombia almost ran out of seed after a simple radio announcement.

Farmers who produce or sell seed often need special guidance in simple business practices and seed marketing. Effective methods are setting up discussions with successful small seed sellers locally or from other areas and providing tours for small producers and sellers to successful areas. The extension system also can provide information about seed sources, lists of such sources, and the kinds of seeds producers have available.

It is extremely important that seed selling be discussed early with interested seed producers. The objective is not for farmers just to produce seed for someone else to sell; the ultimate goal should be for the farmers to sell what they themselves produce.
Sustainability and institution building

As small initial successes are achieved and more seed producer-sellers become involved, sustainability of the farmer-managed seed system can be assured if nurturing continues. Extension, crop research seed certification, and other local groups must continue to provide support, although the nature of that support might change.

One objective should be institution building – the formation of small-scale seed enterprises that cater to local needs. Many types of small enterprises are possible, including family operations, partnerships, cooperatives, associations, corporations, and companies. Opportunities to visit more-advanced programs inside and outside the country, more entrepreneurial training, and increased access to credit need to be added to the program to assist this development.

External assistance programs must recognize that developing farmer-managed seed systems is more than a 5-year project and be prepared to continue with the program until sustainability is possible. This also means that, in the early stages, such programs avoid making the small seed producers totally dependent upon them by buying all of their seed and selling it. Rather, these programs should encourage producers to develop their own marketing systems.

Policies must be established that encourage rather than restrict a wide variety of new, small seed enterprises to form. In the United States and Europe small, new enterprises continue to enter the seed industry even today.

Financial support

The financial support necessary for a farmer-managed seed system is relatively low compared to the more capital-intensive public sector corporations that have been developed in some countries. Individual farm units often can cover most of their own production costs since these are similar to grain production costs. They may need assistance if improved small seed-cleaning equipment is required and if special storage facilities are needed. Credit may be necessary for the seed producer-seller to hold seed from harvest until the next planting season if several months are involved.

The staff of support agencies may require training and increased budgets for transportation to reach the farmers. The capability of existing conventional seed industry will affect the amount of additional infrastructure required. Needs may vary from one part of the country to another and among countries; the resources of small farmers may also differ considerably. The objective should be to identify those farmers with the highest level of motivation and the means to carry as much of their own costs as possible.

Of interest is the matching funds program attempted by the OPSP in Senegal and the Gambia to stimulate NGOs’ active support of seed activities within their own
programs. The same approach might be used to encourage small farmers to enter the seed-production program. Another useful mechanism is to offer needed small equipment on a capital-lease arrangement. This provides a way for the potential small-scale seed producer to take advantage of some mechanization and other improvements without paying for the equipment in the beginning. Instead, the producer would pay gradually for items as the lease fee was paid.

As small seed enterprises form and institution building advances, easy access to credit will become a major requirement. Most seed enterprises grow through the effective use of credit, not profits alone. The banking system must recognize that relatively high amounts of working capital compared to equity capital are required for these new seed enterprises and develop loan programs to meet these needs.

An Integrated National Seed System in Brief

One national seed system

A conventional seed program and a farmer-managed seed system have been discussed, but the most effective system for the farmers is one that combines both in a single national seed system. Establishing such a goal and developing strategies to reach it, however, are often difficult.

In the past, unnecessary conflicts have developed over the roles of public and private sectors. Experience during the past 30 years now makes it easier for national leaders to assign responsibilities. The public sector clearly has a role to play in setting goals and strategies for the development of the seed industry, crop research, breeder and foundation seed production, and seed quality-control systems. It also is instrumental in promoting the use of good seed of improved varieties, assuring access to credit, developing human resources, and guiding the balanced development of the total seed system. Nevertheless, the importance of the public sector's role in commercial seed production and marketing is diminishing as seed systems become better established. This role in many countries now is limited to supplying seeds of crops not handled by the private sector and assuring emergency seed supplies. In some developing countries, the public sector no longer plays any role in production and marketing at the commercial or certified seed level.

The private sector, which includes small-farmer seed producer-sellers as well as small, medium, and large seed enterprises, continues to demonstrate its capacity to produce and market seed commercially. More and more countries have developed strategies that stimulate private sector participation. Increasingly, the private sector demonstrates the high level of management and the persistence needed to successfully deliver good quality seed to farmers. Progress is sustainable when responsibilities of public and private sectors are clearly identified and government policies that support these roles are consistently followed.
The present emphasis on seed produced by and for small farmers is much needed to help ensure that all segments of the farming community benefit from the use of good seed of the best varieties possible. This emphasis in no way should detract from the development of a total and well-integrated national seed system. The sections that follow are lists of the components involved and some of the key activities of each of these categories. These lists can be especially useful to national program leaders and donors as they work to further increase seed supplies for small farmers and improve their country's seed system.

National seed board

- Assure proper private sector representation, function through permanent committees, and implement policies with a technical secretariat.

- Develop and modify as needed a plan and strategies for developing the seed industry.

- Adopt policies that ensure the systematic growth of the seed program.

- Ensure that donor-assisted programs fit well within the national seed plan.

- Encourage the development of a competitive commercial seed industry.

- Develop appropriate mechanisms for testing, releasing, and registering varieties.

- Ensure that programs are established emphasizing seed for small farmers.

- Establish a suitable agency for seed certification, arrange for seed certification on a voluntary basis, approve certification standards, and monitor the operations.

- Develop a truthfully labeled seed system and set minimum limits for purity and germination.

- Provide appropriate seed legislation and enforcement mechanisms.

- Monitor and evaluate progress in seed production and marketing.

- Maintain policies that encourage use of good seed in the country.

- Provide for rules and regulations that facilitate seed import and export.

- Carry out seed studies to assess farmers' seed needs and measure the impact of using seed of new varieties.

- Foster the development of appropriate infrastructure such as seed-testing laboratories, seed-conditioning facilities, and seed-storage warehouses.
Public sector development activities

- Promote development of a broad-based seed industry including private seed enterprises and on-farm seed systems.
- Ensure effective operation of a national seed board and regional seed boards.
- Ensure long-term financial support to national seed programs.
- Create mechanisms for foundation seed production and sale with seed allocated on an equitable basis to all components of the commercial seed industry, including small-farmer producer-sellers.
- Address equipment and credit needs of all seed enterprises and on-farm seed producers.
- Provide training opportunities for public and private sector seed professionals.

Seed legislation

- Promote healthy development of a seed industry.
- Provide legal basis for seed quality control.
- Exempt seed from small-scale farms from seed regulations.
- Protect the interests of the seed user.
- Facilitate import and export business in seed.

Research focus

- Concentrate on developing varieties that will meet the farmers' needs.
- Maintain and multiply seed for further increase by the commercial seed industry.
- Build linkages with on-farm seed production systems.
- Provide technical support to the national seed program.
- Contribute to guidelines on issues such as seed production practices, treatment of seed against diseases, seed quality standards, and related seed technology problems.
- Support seed technology training programs.
Extension support to seed program

- Organize demonstrations with new varieties of seeds.
- Stimulate demand for seed and an increased consciousness of quality.
- Maintain linkages with research and seed technology programs.
- Provide technical guidance to farmers to help them improve the quality of seed they save.
- Cooperate with seed production and marketing organizations.
- Assist farm-level seed production activities by farmers themselves.
- Support seed law enforcement to protect farmers from inferior seeds.

Public sector commercial seed activities, if required

- Specialize in secondary seeds such as grain legumes, oilseeds, forages, green manures, etc.
- Arrange seed reserves to meet contingencies.
- Operate custom drying and processing facilities for small seed producers.
- Shift as much commercial activity as possible to the private sector.

Private sector

- Provide adequate representation on the national seed board.
- Organize seed production in support of national goals based on realistic market projections.
- Provide good quality seed to farmers using effective marketing strategies that can reach as many small farmers as possible.
- Organize seed associations involving all components of the seed industry.
- Cooperate with public research and extension programs.
- Enter plant breeding as business volume justifies.
Encourage participation by a wide range of groups including seed producers and sellers, family businesses, partnerships, cooperatives, corporations, companies, and service organizations.

Literature Cited


______. 1990. Some innovative aspects of Nepal's seed program. Paper presented at the International Conference on Seed Science and Technology, New Delhi, India.


Winrock International Institute for Agricultural Development. 1989a. Mid-Term Assessment, On-Farm Seed Project. Morrilton, AR, USA.

______. 1989b. Second Annual Report, On-Farm Seed Project. Morrilton, AR, USA.

Winrock International Institute for Agricultural Development in cooperation with The Center for PVO/University Collaboration in Development. 1990. On-Farm Seed Project, Third Annual Report. Morrilton, AR, USA.