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# SETTING A SEED INDUSTRY IN MOTION:

A NONCONVENTIONAL, SUCCESSFUL  
APPROACH IN A  
DEVELOPING COUNTRY



**Working Document No. 57**

**SETTING A SEED  
INDUSTRY IN MOTION:**

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APPROACH IN A  
DEVELOPING COUNTRY**

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National Seed Board of Bolivia**

**Report on the experience of Bolivia in the development of its seed program, in cooperation with outside donors and technical assistance. The authors worked in the implementation of an agricultural development project funded by the Agency for International Development (AID) in Bolivia during the early 1980s. Technical assistance was provided by a private consulting company, Chemonics International. Dr. Pattie served as project director, Dr. Garay was team leader for the seed activity to 1985, Dr. Landivar was the principal advisor and team leader to 1986, and Mr. Rosales was national seed certification director within the Ministry of Rural Affairs and Agriculture.**

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**The views expressed herein are those of the authors and do not necessarily reflect the positions of the institutions.**

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## FOREWORD

**“No matter how hard I work, a good crop is not possible with bad seeds”,  
said one Bolivian farmer.**

Indeed, leaders, scientists, and farmers all over the world agree that good seeds are essential for productive agriculture. Given this importance, many national and international organizations are paying attention to the development of seed programs, yet in many developing countries we are still far from accomplishing these goals. In the process, we are learning that organizing appropriate seed supply systems, especially under resource-scarce conditions, is not as simple as we may have thought. There is a need for information about the development of seed systems so that we can gain from the experience of others.

There is a relative abundance of information about the production technology of improved seeds. In contrast, there is no information about the organization of seed systems. Thus, the interest of the Seed Unit in documenting cases with successful features. The following case is one of several that the Seed Unit will document in the future. It presents an experience in developing seed systems under large, medium, and small farmer's situations. It is written by the people that participated directly in setting the process in motion. The paper challenges some dogmas that exist in seed development and introduces a fresh and nonconventional approach.

The information contained is aimed at leaders of governments and at nongovernmental organizations, at leaders of farmer organizations, of national and international agricultural research and development organizations. Institutions involved in technical and financial assistance, and other interested in technology transfer via improved seeds will also find this information valuable.

Cilas Pacheco Camargo  
Head, Seed Unit  
CIAT

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## EXECUTIVE SUMMARY

Efforts to improve agricultural productivity in less developed countries by providing improved seed to farmers have shown mixed results. The limitations have centered around the low acceptance of new seeds by farmers, the lack of initiative shown by the private sector in seed production and distribution, the lack of steady funding to provide services, and the rigid transfer of organizational models from developed situations to developing countries.

Bolivia constituted an example where the private sector did not become involved in seed production, and the government attempted to provide seeds to farmers, also with disappointing results.

During the early 1980s a new approach was used to implement the seed program in Bolivia. With cooperation of government agencies and the organized farm sector, policies and support services were developed which favored the formation of seed enterprises.

As a result of this new approach, hundreds of growers participating in dozens of seed enterprises entered the seed supply system; the production and use of seed rose steadily each year; new crops were added to the program; more efficient varieties were gradually incorporated by farmers to their farming systems; seed quality improved; yields of crops planted with improved seeds increased.

The Bolivia experience provides fresh

insights that can be applied to seed industry development in other countries. The objectives of this document are to generate a greater appreciation of the nature and functions of the seed industry, and offer new perspectives for its development.

## THE NATURE AND FUNCTIONS OF A SEED INDUSTRY

Crop improvement research has evolved considerably in Latin America in the last 20 years. New and more efficient varieties are being identified to suit the needs of farmers. Yet, the experience in many developing situations indicates that offering good varieties at the gate of research stations is not enough. To contribute to the development of a more efficient agricultural industry, a seed must be a complete technological package. In addition to carrying valuable genetic information given through breeding, a seed must carry quality. If the seed is not produced by the farmer himself, the commercial seed multipliers/distributors then become an essential component in the system. The seed grower produces seed quality attributes, such as germination, purity, freedom from disease, and freedom from noxious weed seeds.

“If the seeds of the miraculous varieties do not reach the farmer’s fields and if the seeds, when they arrive to the fields, are in bad condition, it will not be possible to achieve the noble objective of crop research, which is to increase crop productivity and food production.” ( John L. Nickel, Director General, CIAT. Opening

remark at the International Seed Course, 1988 at CIAT, Colombia.)

In developing countries, especially those located in humid tropics, conditions make it harder to couple quality attributes to the genotype in the same technological package: the seed.

Seeds have been identified as the most effective input for agricultural development. But unfortunately, a simplistic view is often taken wherein seed is lumped together with other inputs, limiting the imagination for innovation. Unlike other inputs--such as fertilizers, herbicides, and pesticides--seed is something that can usually be produced in the country and with limited resources.

Understanding the nature of the industry is of paramount importance to appreciate the interdependence of many activities and the limiting effect of weak links in the system. A seed industry implies that various functions--such as varietal improvement, foundation seed supply, multiplication to commercial quantities, services to assure high quality, marketing/ distribution, and final utilization by the farmer--are all part of a system that integrates complementary activities oriented towards a common goal. This understanding is especially important for the design of appropriate policies and strategies to promote the development of a functional system.

## **A NEW APPROACH ON SEED INDUSTRY DEVELOPMENT**

A seed industry and its various components do not appear spontaneously, much less in

situations where commercial driving forces are not operative. Governments have several options to assist farmers obtain improved seeds. Some government interventions are aimed at giving seed to farmers, leading to the establishment of government-owned production and distribution enterprises. However, the experience in Bolivia suggests that a more positive role for the public sector is to create an adequate environment that will cause many institutions to take part in the seed production/ distribution chain. It is evident that given favorable policies and supportive actions, participation in the industry from a wide range of organizations can be achieved, even in a poor country.

Given the right policies and some key services, local institutions rapidly incorporate seed production and distribution into their existing mandates. For example, agricultural research stations will produce and supply foundation seeds; cooperatives, associations, individual farmers, firms, and merchants readily initiate commercial seed production and marketing activities. Material and organizational resources locally available are often underestimated and underutilized. Governments must learn to identify and tap those resources to their fullest extent.

Special consideration should be given to small-scale seed enterprises, which seem most appropriate in the small and scattered markets predominant in many developing situations. Small enterprises can be highly efficient and competitive in many circumstances. In most situations, both large and small seed enterprises are needed to satisfy the needs of the agricultural sector. Both should be promoted if a country is to have a suitable seed system.

Establishing an institutional structure with key services is not enough. Setting the process in motion in most developing situations requires a change in traditional conceptions about the mandate of some institutions. The functions of agricultural research stations and seed certification require special consideration. The appropriate role for research institutions in the future is evident. They should establish effective foundation seed programs to make sure that the seeds of improved varieties will be available in a continuous fashion. The role of a certification service as a regulatory institution is inappropriate in situations where seed supply systems are not in place. Standards that are too high or procedures that are too complex inhibit seed enterprises from participating in the business. These barriers are especially damaging to small-scale seed operations. A more appropriate role for seed certification in nascent seed industries is that of technical assistance on quality assurance and promotion.

The financial limitations of most governments in less developed countries become a serious constraint to continuity in financing and implementing services. Yet, seed development from the country's perspective should always be a permanent process and continuity must be assured if seed systems are to evolve. Foreign assistance is a useful mechanism to get the process initiated; however quite often efforts lose momentum or fall back when projects reach their termination.

Fortunately, seed is a marketable form of technology. It comes in a package that can be transferred from one party to another over long distances. Because it is marketable, resources can be generated and channeled

back to finance part or all operating expenses of public services. This feature can be accomplished by promoting the participation of farmers' representatives in the decision-making process. Fees can be generated through: sale of foundation seed, certification services, and processing services. In the case of Bolivia, locally generated revenues already cover over 50 percent of operating costs of certification services, and virtually all the costs of conditioning services and foundation seed production.

## **LESSON LEARNED IN THE BOLIVIA EXPERIENCE**

In reviewing the process by which Bolivia's seed production and distribution system developed to become the present-day dynamic network of small- and medium-size enterprises, one cannot come up with a magic formula for success. However, some guidelines can be identified as being crucial in this type of undertaking. The lessons learned may be characterized as positive experiences to be copied or as negatives to be avoided.

### **What to Do**

1. Focus the seed program to satisfy local needs in cooperation with key leaders. Enlist the enthusiastic support of farm sector leaders in a seed production and distribution plan. This will link together previously dispersed organizations each trying to do things alone.

2. Tap private sector resources that exist in a wide range of shapes and forms, such as farmer associations, cooperatives, rural groups sometimes organized for non-agricultural purposes, and innovative farmers. The key is to seek out all available groups; they are an underdeveloped country's greatest resource in such an undertaking.
3. Foster cooperation between public and private institutions. Avoid the trap whereby the public sector attempts to accomplish everything on its own. The seed system cannot depend solely on a national-level Ministry of Agriculture (or similar public entity) to carry out the tasks of seed production, distribution, and certification.
4. Develop a model capable of achieving two essential tasks: a) come up with a strong research-production-distribution chain and b) generate policies and services in support of the chain.
5. Provide special encouragement to small- and medium-size seed producers, rather than promoting only large enterprises. Reduce barriers to entry into seed production. A source of foundation seed, conditioning services, and a quality assurance program are key to overcome these barriers.
6. Develop the seed industry following the simplest and most direct path. First identify the crop with a market for improved seeds. Identify the region where the greatest impact can be achieved in the shortest time. Identify the organizations that have a stake in those crops and build on their support. The strategy is that this "lead crop" will pave the road for other crops to be piggybacked gradually.
7. Create "regional seed boards" to link together dispersed organizations. Regional boards have a unique advantage in that they can focus on constraints that exist in their own region; have a clearer sense of priorities to solve problems; and support solutions upon which they agree. This is hardly possible with blanket approaches that emerge from central planning offices where quite often only the public sector is represented.
8. Develop a national seed board with public and private participation. The regional seed boards and national board become complementary and mutually supportive.
9. Keep in mind that operating costs of public seed services may be paid for--in part or totally--by collecting fees from seed producers. Without this

mechanism, effective services cannot be delivered in a sustainable fashion.

### **What Not to Do**

1. Governments should not “dole out” seeds to farmers; rather, they should aim at supporting seed industry development. One cannot rely solely on a national-level ministry of agriculture (or similar public entity) to carry out the process of seed production. A new administration could decide to change priorities and reduce funding levels or even terminate the program.
2. Avoid systems that are too elaborate; it is preferable to have a simple, functional system.
3. In the early stages of development, governments should not intimidate nascent seed enterprises by setting high standards, establishing complex regulations, centralizing decisions, and imposing other barriers. Rather, they should promote entry into the seed system. As the industry develops, controls can be upgraded if considered necessary.
4. Avoid unnecessary market interventions, such as price controls on seed.
5. Do not confuse development of an industry with the setting up of

elaborate physical infrastructure. We are learning that modern seed facilities, fancy laboratories, and a perfect seed law do not produce seeds; institutions and people working together do.

The results achieved in Bolivia indicate that seed industry development is an area of high economic impact. It is possible for lesser-developed countries with scarce financial resources to implement a successful seed production and distribution system. It is an activity that both international and national institutions can focus on together.

Seed program development is a logical step in the technology generation and transfer sequence to assure returns to investments made in crop research in the developing world. Seed production technology and organization of the seed industry can be tailored to the scale of production and to the stage of development of any country. In carrying out its functions, a well-established seed industry becomes a technology transfer mechanism by excellence.

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## ACRONYMS

<b>AID</b>	Agency for International Development(“USAID” when followed by a specific mission location)	<b>CIAT</b>	Center for Tropical Agricultural Research, Bolivia
<b>ANAPO</b>	Soybean Growers’ Association of Santa Cruz	<b>CODETAR</b>	Development Corporation of Tarija
<b>ASAR</b>	Association of Rural and Artisan Services	<b>CORDECH</b>	Regional Corporation of Chuquisaca
<b>CAO</b>	Santa Cruz Chamber of Commerce	<b>IBTA</b>	Bolivian Institute for Agricultural Technology (an agency within MACA)
<b>CBN</b>	National Brewery of Bolivia	<b>MACA</b>	Ministry of Rural Affairs and Agriculture of Bolivia (referred to in the text also as Ministry of Agriculture)
<b>CETREISEM</b>	Seed Training Center of Rio Grande do Sul, Brazil	<b>NSB</b>	National Seed Board
		<b>RSB</b>	Regional Seed Board
		<b>SEFO</b>	Forage Seed Company

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## CHAPTER I

### INTRODUCTION

The importance of seed supply systems is increasingly recognized by agricultural sector leaders in less developed countries and by officials of international development organizations. Seed provides a means of distributing new technology to farmers in a readily usable form. It is an input that can often be produced locally, avoiding the need for spending scarce foreign exchange every year. Efforts to develop seed production and distribution programs in developing countries, however, have shown mixed results. Some of the most challenging problems that arise are:

1. Convincing the private sector to take an interest in producing seeds for distribution in places where markets are small and fragmented.
2. Gaining farmers' acceptance of new seeds.
3. Obtaining a steady flow of funding for activities in the public sector, especially varietal selection and release.
4. Maintaining seed quality throughout the multiplication process of larger volumes of commercial seed.

Many less developed countries respond to these challenges in a similar manner. Where private companies have not taken the initiative to produce and distribute seed to farmers, the government steps in to establish

a national seed company. Relatively large capital investments are often made, especially in processing facilities. In an effort to achieve high-quality seed, rigid regulation of the industry is applied from the outset. Seed is distributed through government agencies at subsidized prices in order to stimulate its use among small farmers.

These measures, however, have not adequately solved the original problems. In fact, heavy government involvement and rigid regulation make private participation even less likely, especially the establishment of small- and medium- size seed enterprises. The heavy burden on the government increases the difficulty of maintaining adequate funding levels to keep the program going without interruption. Worst of all, the farmers' acceptance of improved seeds continues to be a serious limitation to its distribution and use.

The thesis of this document is that new concepts are needed to guide the development of seed supply systems in less developed countries. A seed supply system should provide sufficient quantities of high-quality seed to reach a vast number of farmers throughout the country, covering the major crops. Using a unified approach in cooperation with the government and with the participation of the organized farm sector, policies and support services favoring increased participation of farmers can be developed. An environment can be created where small- and medium-size seed producers become equally competitive with larger ones. A seed supply system based on many producers is better able to cover a diverse range of crops, and can expand into small, geographically separate or remote markets. This concept has particular

relevance in situations encountered in less developed countries where the vast majority of farmers is not currently using improved seeds.

Such an approach was used in the implementation of a seed development project in Bolivia during the early 1980s. At the outset, the problems and initial response were similar to those described above, e.g., private sector involvement was near zero, and the public sector was attempting to add commercial seed production and distribution to its responsibilities, spreading its limited resources even thinner. Over time, however, the concepts changed with the active participation of the farm community in several regions. Results were encouraging: hundreds of small producers participating in dozens of seed enterprises entered the seed supply system; production and use of seed rose steadily each year; new crops were added to the program; seed quality improved; and yields of some crops increased dramatically.

The first region to receive emphasis was one where some farms are mechanized and much of the agricultural production is on a commercial scale. The second region was one where smaller farms existed. Despite the small size, most production was market-oriented. Farm operations were carried out using a combination of mechanized, animal-powered, and hand methods. The third region was one made up of very small farms, in which nearly all agriculture was for subsistence. Mechanized methods were virtually unknown to farmers in this region.

It is hoped that this publication will generate new perspectives in seed industry development and technology transfer for developing countries, and will be useful for

technicians working in agriculture, local leaders in the public and private sectors who are concerned with agricultural policy and the effectiveness of local services, and officials of international institutions who participate in the design, financing, and implementation of seed programs. It is important to share this experience with others because it represents a realistic approach that could be applied to many situations in less developed countries.

The next three chapters of this document can be thought of as a unit. It begins with a description of the country setting and the initial status of the seed supply system in Bolivia. Next, Chapter III relates some of the earlier experiences in each of the three regions that helped set the stage for future developmental processes. The guiding principles that emerged during this early period are summarized. Chapter IV steps back from these experiences to examine the seed supply system, its objectives and functions, in the Bolivian context. It concludes by reflecting on the important actions taken to set the model into motion.

Chapters V through VII may also be regarded as a unit. These chapters provide a more detailed analysis of each function of the seed system presented in Chapter IV, starting with key support services and human resource development, then the formation and development of seed growers and enterprises, and finally the evolution of participating institutions and organizations.

Chapter VIII summarizes the final results and impacts of the seed supply system in Bolivia over the brief period covered by this document. The reader will see that, although seed activities were first developed in only certain regions, they gradually expanded to have a national impact.

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## CHAPTER II

# INITIAL STATUS OF THE SEED SUPPLY SYSTEM IN BOLIVIA

### PHISICAL SETTING

Bolivia lies at the center of South America (Figure 1). It includes high mountain plateau areas of the Andes on the western side which fall off into intermontane valleys in the central belt, then descend even further to the eastern lowlands. The lowlands themselves include the northern rainforest region, the central plains, and the drier Chaco to the south.

Most of the six million people live in the highlands and intermontane valleys; the most populous departments in these regions of the country are La Paz and Cochabamba. The native population in La Paz is made up of Aymar Indians, whereas that of Cochabamba and the southern valley regions of Chuquisaca and Tarija is of Quechua Indian background. The central part of the eastern lowlands in the department of Santa Cruz has grown rapidly in the last 20 years, with the majority of immigrants coming from Cochabamba. Mennonite, Okinawan, and Japanese farm communities are also important in the region.



Figure 1. Map of Bolivia showing main pilot seed production regions referred to in this study.

Bolivia is one of the poorest countries in South America, being landlocked with inadequate transportation facilities both within the country and to neighboring countries. The eastern lowland region of Santa Cruz is linked with Brazil and Argentina by rail, while the commercial ties of La Paz are more closely associated with Peru.

Foreign exchange earnings are chiefly derived from the export of mining products, but within the local economy, most Bolivians make their living from farming. In 1987, it was estimated that just about half the population lived in rural areas and the other half in urban. In the highlands and valley regions, families own small areas of land, typically two to five hectares (five to twelve acres), which allows for a subsistence type of agriculture. Recent migration into the eastern lowland areas has brought large expanses of land into cultivation.

Agriculture in this region is a new activity, ranging from the most rudimentary slash-and-burn systems to mechanized, commercial farming.

## INSTITUTIONAL SETTING

The Ministry of Rural Affairs and Agriculture (MACA) is composed of the central Ministry and several decentralized institutions. Two of the latter are directly responsible for research and extension: the Bolivian Institute for Agricultural Technology (IBTA) and the Center for Tropical Agricultural Research (CIAT) in Santa Cruz. (This should not be confused with the International Center for Tropical Agriculture in Cali, Colombia.) The Ministry of Agriculture had established a national seed



Small-scale farming predominates in Bolivia's highlands and valleys.

certification office and six regional offices. With the financial assistance of international donors, the certification office succeeded in building several seed plants. Personnel in each region were located at the plants and typically included one or two agronomists and a plant administrator.

In addition to the institutions within the Ministry of Agriculture system, departmental development corporations are active in the agriculture sector in most regions of the country. Their funds come primarily from royalties on mineral and petroleum resources.

In the private sector, farmer cooperatives were becoming increasingly important. These organizations are relatively small, usually having less than 2,000 members and covering a specific geographic area. Other similar organizations were formed in conjunction with development programs sponsored by organizations such as the Catholic Relief Service, CARE, Foster Parents Plan, and other philanthropic institutions. The activities carried out by these organizations and the nature of the services they provide to members vary widely.

Farmer associations specific to each crop and type of livestock had been developed in the Santa Cruz department. The initial objective pursued by most of the associations was lobbying, especially for prices and credit. Some of them became fairly strong in the 1970s. The Santa Cruz Chamber of Agriculture (CAO) included as its members all of the commodity specific associations in the department. Other departments adopted this model with some modifications. Many associations had recently begun to develop service activities.

Agroindustries are important in some

crops, such as sugar, soybean, cotton, wheat, and rice. Distribution of inputs is carried out through commercial importers who often coordinate their activities with the government, farmer associations, and banks. Importers usually offer inputs for sale to farmers only in central cities. Cooperatives and other groups often make inputs available in places where small farmers do their trading.

## **INITIAL STATUS OF THE SEED SUPPLY SYSTEM**

### **Traditional Seed Sources**

The majority of materials used for planting crops in Bolivia were grains and tubers that the farmer saved from one harvest for use as seed in the next crop season. Some of these varieties were native to the regions; others had been introduced from neighboring countries; and in other cases, they were introduced from international research centers. Whatever the source, after the materials had been cultivated in a region for some time, they became mixed with other varieties and degenerated to the point where desirable characteristics were no longer maintained uniformly and reliably. Indeed, this degeneration happens within a very few seasons. The results were shorter productive life of improved varieties, lower yields, and lower-quality products.

In cases where farmers decided to renew their plant materials, they either purchased grains or tubers in local markets, selecting those having the better physical appearance for use as seed. The groups that could afford it imported seed from other countries.

The latter alternative was limited because:

1. Exchange rates and transportation costs usually led to high costs.
2. Importation required coordination with credit institutions, farmer associations, government institutions, and commercial importers, all well in advance of planting time.
3. The varieties available in other countries did not necessarily adapt to the conditions in Bolivia.

Still, soybean and cotton growers in the lowlands of Santa Cruz imported large amounts of seed. The seeds of these two species are particularly sensitive to temperature and humidity, causing a reduction in vigor and germination. This characteristic makes it difficult for farmers to use their own, home-grown materials for planting. In other cases, such as wheat, corn, and rice, the varieties desired by farmers were not available from outside the country. Therefore, it was not possible to import the right kinds of seed.

Good data on seed imports are not available; however, in the late 1970s, the soybean growers association imported enough seed to cover about 50 percent of the area planted, and the cotton growers imported 100 percent of their needs. Corn growers also imported modest amounts of hybrid corn seed. Table 1 gives an indication of the volumes and the values of seed imports.

Other seeds were traditionally imported in smaller amounts. Among these are forage

Table 1. Volume of seed imports into Bolivia during a typical year in the late 1970s.

Species	Volume imported (t)	Cost in Bolivia (US\$/t)	Total cost (US\$)
Soybean	1050	900	945,000
Cotton	300	3,000 <sup>a</sup>	900,000
Total	1350		1,845,000

a. The high price of cotton seed is due to the costs of airfreight from the United States.

Source: National Seed Department, MACA.

seeds for temperate and tropical pastures, vegetable seeds of all kinds, and small amounts of foundation potato seed of European varieties. The value and volume of these imports are not known, but are thought to be significant.

### Introduction of New Materials

IBTA and CIAT/Santa Cruz and other local crop research institutions receive samples of promising materials from national and international research organizations and carry out trials in their experiment stations in various regions throughout the country. Testing these new varieties to determine which of them adapt to the conditions of the local environment is the main activity of the agricultural research program in Bolivia. Of the large number of varieties of a particular crop received each year, only one or two might be found to adapt to a region. The testing process takes three or more years to complete. At this point, a selected variety is recommended to the farmer, that is, it is "named" or "released" for use by farmers.

In some cases, however, such as soybeans and cotton, farmers were aware of varieties being used in agricultural regions of other countries with conditions similar to those of Bolivia. Although the varieties had not been officially "released," large quantities of seed were imported and the varieties became widely utilized.

The concept of a public institution testing new varieties before "releasing" them to the agriculture sector implies that new materials remain under the control of the government until they are officially approved, such as would be the case of a new drug proposed for human consumption. Three conflicts arose with the use of this concept:

1. The public testing and release process was often very slow, taking more than three years. Sometimes farmers could act faster on their own and obtain the varieties elsewhere.
2. Sometimes the research institutions did not approve materials that were either already in use or being brought in for use, creating a conflict between researchers and innovative farmers and other leaders.
3. At the end of a long testing process, the experiment station had just a few kilograms of breeder seed, the seed that the researcher harvested from the experimental plot. Therefore, the farmer had no effective access to the materials being recommended.

These conflicts were among the reasons for the lack of development of a

local seed program. New varieties were not being funneled through the system to reach the farmer in an effective manner.

### **Local Seed Production**

Production of improved seed was non-existent in Bolivia until the 1970s. Up to that time, the agriculture sector as a whole was not on the government's list of high priorities and commercial agriculture was so poorly developed that the private sector did not flourish. During this decade, the Ministry of Agriculture began to invest in land and equipment in order to produce within its own seed department.

"In view of the lack of interest shown by the private sector, the Seed Department dedicated its efforts to seed production, focusing principally on basic food crops, such as wheat, corn, rice, potato, and soybean. To that end, the department employed various means of action, such as attracting human resources, purchasing land, constructing facilities, installing processing plants, and equipping seed testing laboratories." (Morales, 1984)

Under this program, which began in the early 1970s, modest amounts of wheat and potato seed were produced in Cochabamba, Potosí, Chuquisaca, and Tarija. Farmers were contracted to multiply seed into larger volumes. Other inputs, such as fertilizers and pesticides, were supplied to cooperating farmers. At harvest time, an amount of seed

equal to the value of the initial seed and other inputs was received from the farmers and conditioned in Ministry-owned plants. It was then offered for sale by the Ministry under the "Fiscalized Seed" label. Unfortunately, the small amounts produced under the program were often of poor quality and were difficult to sell, even at subsidized prices.

Two other seed production activities were successfully initiated in Bolivia prior to 1980, both located in Cochabamba. Forages of various species were produced by SEFO, an organization set up with assistance from the Swiss Mission cooperating with the San Simon University of Cochabamba. SEFO marketed seed under its own label throughout the country. Potato seed was produced by ASAR (Association of Rural and Artisan Services), a church-sponsored organization made up of several hundred small farmers. Production of European varieties was concentrated in a mountainous area of Cochabamba for the market in the lower valleys of Santa Cruz.

### **Seed Quality**

Seed has many particular attributes of concern to the farmer who will use it. One of these is the genetic makeup of the variety that makes it suitable for a particular environment. Other attributes are germination, vigor, freedom from disease, freedom from weed seeds, freedom from inert matter, and varietal identity and purity. All of these come under the general heading of seed quality. For most crops in Bolivia, a diversity of appropriate varieties had been identified; however, commercial volumes of high-quality seed of those varieties were not available.

Seeds of most crops in the tropics are affected by adverse environmental conditions. The perishable nature of soybean and cotton seeds, coupled with the hot and humid environment in the Bolivian lowlands, made germination the crucial factor in these seed crops. In the case of rice, there was a critical need for seed free from dangerous noxious weeds, such as red rice (*Oryza sativa*) and rogelia (*Rotboelia exaltata*). This last weed was being spread rapidly in the Santa Cruz region by using uncontrolled common rice and soybean grains for planting purposes. Local wheat and barley consisted of mixtures of different types of grains, which included some desirable varieties. Therefore, varietal purity was the principal factor in seed quality.

Unfortunately, these attributes are not visible to the farmer who obtains the seed for planting. For example, seed of red rice cannot easily be distinguished from cultivated rice seed. Seed of a given variety of wheat may be difficult to distinguish from that of others. Corn seed with very low germination cannot be differentiated from one of high germination by simple observation. Therefore, most farmers were reluctant to purchase the small amounts of material offered for sale in the market as seed.

### **GENERAL ASSESSMENT**

At the end of the 1970s decade, Bolivia was the least developed Latin American country in seed production, according to the FAO (1980)\*. There was a feeling of

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\*FAO Seed Review 1979-80. pag. 131-135

frustration and discontent on the part of leaders in the public and private sectors because of the modest amounts of seed being produced locally and the high cost of obtaining seed of the right varieties from foreign sources. Yet there was no agreement on the actions needed to stimulate local production of high-quality seed, nor on the technical and economic feasibility of doing so.

Officials in the Seed Certification Department responded with a plan to form a national seed enterprise, i.e., a parastate monopoly. They cited the lack of initiative in the private sector, maintaining that seed production and, especially, distribution were the prerogatives of the state. The policies followed by the Ministry of Agriculture did not encourage involvement by others. Subsidized prices and the government policy to produce and distribute only through the public sector prevented most private interests from pursuing the activity. Even the aforementioned successful SEFO and ASAR programs for small farmers did not receive

support from the seed department of the Ministry.

Leaders in the farm sector, moreover, had no experience with seed production, and found themselves offering no alternative to the Ministry's position. They also saw seed supply as being a basic responsibility of the government. Although several Bolivians had received short-term training in various aspects of seed technology, a conviction or "seed mentality" among local leaders and technicians was not evident. In particular, there was no appreciation for the potential of the small producer and the medium-size entrepreneur in a seed program.

On the positive side, several farmer associations and cooperatives were just at the point in their development where they could become active participants in policy making and provision of services. Board members and managers of these groups were concerned about the supply of reliable seed to their members and associates, indicating that farmers in general were becoming aware of the need to use high-quality materials.

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## CHAPTER III

### EARLY EXPERIENCES

The first efforts in the initiation of a seed production program are the most challenging. In this phase many important lessons are learned. This chapter describes the experiences gained in the early phases of each of the three regional seed programs in an attempt to demonstrate the process of evaluation and decision-making by local leaders. Santa Cruz was the first target area. The central part of this department is characterized by mechanized farming on a medium to large scale. The second region was the Gran Chaco in the southeastern part of Bolivia. Farming here is on a small to medium scale, but semi-mechanized. The third target region was the department of Chuquisaca, where small-scale, subsistence farming predominates.

#### **SANTA CRUZ: MECHANIZED FARMING**

Farming in the eastern lowlands ranges from subsistence type operations to medium-scale mechanized farms with some larger enterprises. Sugar cane, soybeans, cotton, tropical grasslands, and wheat are grown on medium-size and larger farms. Corn and rice are grown on farms of all sizes, being cultivated by hand and also in

mechanized systems. Vegetables and tropical fruits are also grown, often for subsistence purposes.

An early diagnosis identified Santa Cruz as the area of Bolivia where a seed program was most likely to succeed (Garay and Pattie, 1981). This conclusion was based on an inventory of existing conditions that could accelerate the development of a seed program. The study showed that in Santa Cruz:

1. Commercial farmers were aware of the advantages of quality seeds of improved varieties. Soybean and cotton seeds were already being imported. Therefore, an effective demand existed for seeds of some crops.
2. Some major farmer organizations had identified seed as one of the top priorities.

The existence of these positive elements, however, were overshadowed by some serious constraints, such as the lack of seed conditioning and storage facilities, and the lack of qualified technical personnel to carry on the activities of the different components of a seed program. The identification of these deficiencies, nevertheless, pointed out areas where efforts needed to be concentrated.

#### **Poor Yields Create Need for Action**

The soybean growers association (ANAPO) was the first to take the initiative to support a seed improvement



Certification inspector evaluating a soybean field during the first attempts to produce seed locally in the Eastern lowlands

program for their growers. It was difficult for farmers in tropical areas to save part of their soybeans to be used as seed during the next season. In previous years, farmers had gone to the oil plants to acquire whatever grain was available for use as "seed."\* The poor quality of this material for planting resulted in very poor yields and crop failures for some farmers. Furthermore, imported seed was a problem due to high cost and low quality in many cases.

Leaders in ANAPO recognized the importance of performing quality tests on imported seed. This provided an opportunity to set up a rustic seed testing laboratory in 1980 at the regional Ministry of Agriculture seed department. About 120 seed lots of imported soybeans were sampled and tested, and the results were presented

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\*Personal communication, Mr. Mario Melgar, president of ANAPO.

to ANAPO's Board of Directors. Although the lots had been shipped from Brazil with an average germination in the high 80s, upon arrival in Bolivia germination averaged only 68 percent, ranging from a low of 49 to a high of 80 percent. The loss in quality was due to exposure of the seed to high temperatures and humidity while in transit from Brazil--a trip of up to a month with delays in transit and customs. Temperatures were found to rise as high as 60 degrees Centigrade (140 degrees Fahrenheit) inside metal railroad cars.

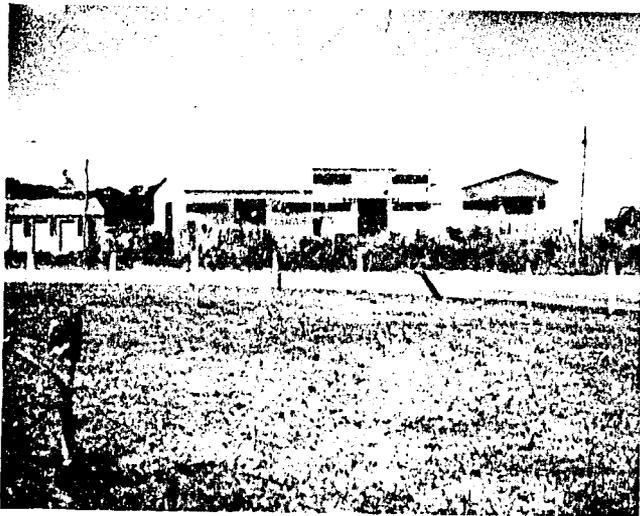
Because of the great demand for soybean seed, and the problems associated with importing it, farm sector leaders assigned the highest priority to developing the capacity to produce soybean seed locally. Consequently, soybean became the "lead crop" for the regional seed program.

### The First Attempt

Commercial soybean production was fairly new to Bolivia, having been initiated in Santa Cruz in 1969. Area planted increased rapidly until about 1976, when it leveled off to around 35,000 hectares, the figure recorded in 1980. Average yields at that time were in the range of 1,100 to 1,200 kilograms per hectare. Oil extracted from the grain did not satisfy the Bolivian internal market. However, soybean meal more than satisfied the demand for use in feeds for poultry and hogs. Indeed about 70 percent of the meal was exported, mostly to Peru and Chile.

Plans were made by ANAPO and the Ministry of Agriculture to produce soybean seed locally during the summer season of 1980 to 1981 (November to April). The 1,500 hectare production program was started at the same time that the designs, budget estimates, and contracts were being prepared for installation of equipment in the Ministry-owned conditioning plant in Warnes, just north of the city of Santa Cruz. Installation of the conditioning plant had to be completed in time for harvest in April. Because of the risks involved, the first attempts to produce seed were made with but a few of the more progressive farmers.

A complete seed supply chain as conceived in certification schemes could not be created all at once to go from foundation seed to registered seed, and from there to the certified category. Instead, better commercial soybean



First seed conditioning facility in Eastern Bolivia, located in the town of Warnes, ready to provide service to local seed producers.

fields were selected to be harvested as "seed." The selected fields had varietal mixtures below five percent and had low incidence of noxious weeds. These fields had been established with imported "fiscalized" class seed, and material harvested was assigned the same category.

Pre-harvest field inspections revealed that high-quality material was being produced in the field, but the Warnes conditioning plant had not been completed in time for harvest. Of the 1,500 hectares originally selected, 1,200 were considered suitable for the harvest of seed by April 15. Without drying facilities, however, maintenance of quality after harvest would have been impossible. It was hoped that humidity in the field would decline, thus permitting recovery of some of the seed without artificial drying. Unfortunately, conditions became even worse. Exposure to hot, humid and rainy conditions in the field after the seed reached maturity caused rapid deterioration and loss of germination. By the end of April, only 300 hectares remained suitable for seed. All of those were lost in May. Farmers harvested the fields for grain to be sold to the oil mills.

### Persistent Efforts

Although the first season was a failure, farm leaders were not discouraged. The experience pointed to the need for concentrating efforts, starting small, and building on experience. A winter seed crop was immediately planned for

1981. Yields in the winter season (May to October) were normally lower than those of the regular summer crop, but seed would reach maturity under better environmental conditions and could be harvested in time for summer planting. This had the advantage of minimizing the storage time and associated deterioration.

Only two technicians had been available during the first season, and they were often unable to perform field work because of administrative responsibilities. Because of the need to closely supervise and train farmers to become seed producers, more technicians were required. The Ministry of Agriculture was able to hire a laboratory technician, bringing the total number to three. Even in this small group, considerable turnover occurred during the first year. To partially compensate for lack of personnel during the winter campaign, four technicians came from other regions as in-service trainees. This group concentrated on field inspections of 600 hectares of soybeans.

Installation of conditioning equipment in the Warnes plant was completed by harvest time, however, seed growers showed serious doubts about the need to dry and clean the seed, services for which they were required to pay a fee. They were not convinced that the Ministry of Agriculture could provide reliable conditioning services. One of their concerns was that their seed might be mixed with other seed of a different variety or with poor quality lots from other growers. Demonstrations of the

operation and administration of the plant were given with the support of the president and the manager of the growers' own association, ANAPO. Gradually, the importance of these services became accepted.

After disqualifying some of the fields because of quality problems, 600 metric tons of seed were harvested. Conditioning was started on August 17, 1981 at the Warnes plant, which was the first to operate in Santa Cruz. Laboratory analyses were performed and bags were tagged in accordance with seed quality. Individual seed growers took possession of their own seed and offered it for sale on the open market. Prices were determined by free market mechanisms. ANAPO and the Regional Chamber of Agriculture worked to facilitate this process by providing information to farmers on the availability of seed--price, quality, and quantity--for different soybean cultivars. About 450 net tons of clean seed were obtained.

Quality tests demonstrated that local seed was superior to most imported seed. The program began to gain the confidence of buyers, and Bolivian seed sold for prices similar to those of imported materials. This made seed production an attractive enterprise for commercial soybean producers. The production levels achieved, though modest, set a record in Bolivia, satisfying 25 percent of the local demand for soybean seed and saving nearly half a million dollars in foreign exchange within only one year's time. Local leaders were proud to see that Bolivia could produce seed of equal or

superior quality to imported seed, and more economically.

### **Expanding Services: Roles of Public and Private Sectors**

Production and marketing costs were well below prevailing prices of imported seed, so interest from the private sector was running high. During the 1981-1982 summer season, the number of growers attempting to produce seed increased from around 20 to more than 100 in soybean and wheat. Whereas 600 tons had been received the previous season, more than 1,000 tons were now flowing into the conditioning plant.

It became impossible to visit all of the fields to check for quality problems and train farmers. Although a third technician was added, available personnel could scarcely keep up with basic sampling and laboratory testing. Lack of personnel also made it impossible to operate the conditioning plant for more than one eight-hour shift, even at peak harvest. Without more and better qualified personnel, the services needed to support seed growers could not keep up with the demand. Skilled seed technicians did not exist in the country, but could be trained. The problem was lack of funds and institutional mechanisms to provide competitive salaries.

Many different institutional alternatives were considered to provide conditioning and certification services. The approach agreed upon between Ministry of Agriculture officials and farm sector leaders for the pilot region was to decentralize the conditioning

services by turning the management of the seed plant over to a local institution. The plant management would be neutral, not becoming involved in commercial seed activities or in setting policy, but would simply provide services for a fee. Funds received would be used to pay the costs of operating the plant.

Certification would officially remain within the Ministry of Agriculture, but under a new organizational arrangement that permitted private sector financial support. The Chamber of Agriculture of Santa Cruz provided a mechanism for collecting fees from seed growers for seed testing services, and, under special agreement with the Ministry, used these funds to support the certification service. Leaders in ANAPO obtained agreement with seed growers on the fee schedule. This arrangement was formalized with the formation of a regional seed board that included representatives from the public and private sectors.

Over the following years, more farmers turned to producing soybean and wheat seed, expanding volumes to meet local demand and replace seed imports. Other farmer associations also took the initiative to join the seed program. Rice and corn were the next two important seed crops to be developed in the region. Later, the cotton growers also joined the program. All the seed produced was utilized in the region, having positive impacts on productivity. Table 2 shows the evolution of seed production in the region through 1988.

The decentralized approach used in

Table 2. Historical production levels<sup>a</sup> of certified seed<sup>b</sup> (in metric tons) in Santa Cruz, Bolivia.

Year	Soybeans	Wheat	Rice	Corn	Cotton	Common beans	Total
1980	0	—	—	—	—	—	0
1981	450	—	—	—	—	—	450
1982	801	166	—	—	—	—	967
1983	1017	470	160	200	—	49	1896
1984	1545	711	185	367	—	94	2902
1985	4507	484	180	297	—	37	5505
1986	3137	444	277	476	54	22	4410
1987	4333	378	653	655	73	13	6105
1988	7941	521	268	479	59	19	9278

a. A dashed line (—) is used to indicate that no seed was produced for the crop because it was not yet part of the seed program in the region. When some production was attempted, but none obtained for the crop, a "0" is used.

b. Certified seed refers to seed of all established classes.

Source: Regional Seed Office of MACA.

Santa Cruz, spearheaded by the regional seed board, became stronger as the numbers of producers and seed volumes increased. This experience gave impetus to the development of seed programs in other regions of the country.

## EXPANSION TO OTHER REGIONS

### Gran Chaco: Medium-Scale Farming

The southern lowlands (Gran Chaco Province in the Department of Tarija) was very reduced in size, having only about 20,000 hectares under cultivation contrasted to the half million hectares

in Santa Cruz. Land holdings ranged from very small, to farms of up to 300 hectares. Most of the cultivated land is in farms averaging 10 to 20 hectares. Corn and soybeans are grown using a combination of ox-drawn and diesel-powered equipment.

By 1983, the positive efforts made in the pilot region drew attention. Farmers in the Chaco were becoming aware of better varieties, and there was a demand for soybean seed. However, no reliable seed supply had been developed for this region. Conditioning facilities were not available in the Chaco. The Ministry of Agriculture's seed department had only one technician in the region, who was attempting to produce, clean, certified, and market

seed. There were problems with both quality and quantity. Farmers were skeptical about participating in the program, in part due to possible actions that the Ministry might take against them to protect its own interests in marketing seed.

The Gran Chaco region had environmental conditions favorable for summer seed production and winter storage--lower humidity and temperature from harvest time on through the winter storage season compared to Santa Cruz. Production was limited, however, to only one growing season.

Farmers were organized into smaller, community-level groups and one larger cooperative--The Integral Service Cooperative of the Gran Chaco. Contrary to the situation in Santa Cruz, farmer organizations were not strong enough to greatly influence the behavior of the Ministry of Agriculture. Unfortunately, neither the seed department nor the IBTA experiment station offered support to growers when

some of them attempted to produce seed for the first time.

Following the example of Santa Cruz, a regional seed board was formed--this time, however, at the outset of program development, rather than part-way through. Its membership included the following institutions: the Ministry of Agriculture and the Ministry's Seed Department, IBTA (research and extension), the Integral Cooperative, private seed growers, a representative of small farmers, the departmental development corporation, and the local chapter of agronomists.

This group encompassed all points of view in the region, and was formally recognized by Ministerial resolution. The board was charged with preparing a strategy for development of the seed program in the region. Whereas in Santa Cruz, it had been farmer associations acting individually that initially provided resources and credibility to the seed program, in the



A small air-screen cleaner borrowed from the Ministry of Agriculture and provisionally installed on a wooden bench permitted cleaning relatively large volumes of seed and created the focal point to initiate development of the seed system in the Gran Chaco region.

Chaco it was the unification of institutions in the seed board that provided this base. The board obtained the commitment of its members and channeled resources to strengthen services, such as certification, foundation seed, and conditioning

The board determined that private seed growers should be encouraged starting with the 1983/84 crop season. Several fields of interested farmers were selected for harvest as seed. Portable conditioning equipment in disuse was borrowed by the Integral Cooperative from different Ministry of Agriculture facilities plus IBTA. These were installed in a rented warehouse in order to provide custom drying and cleaning services. The first seed crop, a modest 80 tons, was only slightly above the levels produced earlier by the Ministry's seed department. However, for the first time, excellent quality was achieved.

Results in this region were not highly visible until the end of the 1985 harvest, in which a total of 350 tons of soybean seed were produced. Relative to the size of the region, this quantity signified a major breakthrough. This seed covered the regional demand, and more than half of the production was sold for use in other regions. Seed produced in the Chaco was readily accepted by local farmers and by seed dealers in other regions of the country. Production continued to increase modestly, and the regional program began to diversify to other crops (Table 3).

**Table 3. Historical production levels<sup>a</sup> of certified seed<sup>b</sup> (in metric tons) in the Gran Chaco, Bolivia.**

Year	Soybeans	Corn	Wheat	Total
1980	17	—	—	17
1981	79	—	—	79
1982	70	—	—	70
1983	70	—	—	70
1984	80	—	10	90
1985	350	—	0	350
1986	338	—	2	340
1987	405	2	2	409
1988	107	2	30	139

a. A dashed line (—) is used to indicate that no seed was produced for the crop because it was not yet part of the seed program in the region. When some production was attempted, but none obtained for the crop, a "0" is used.

b. Certified seed refers to seed of all established classes.

Source: Regional Seed Office of MACA.

### Chuquisaca: Subsistence Farming

The region surrounding the city of Sucre varies between high plains and mountain valleys. There are no large farms in these areas; most growers farm only one or two hectares. Major crops are potato, broad bean, barley, vegetables, forages, quinoa (a local grain, *Chenopodium quinoa*), wheat, and corn. Of these, barley was the only crop commonly sold for agroindustrial use--malting. The rest, including wheat, were primarily for home consumption. Nearly all land was cultivated with oxen and intense utilization of manual labor.

Environmental conditions were ideal for the production of high-quality seed. Still, seed production in this region of predominantly subsistence farmers

presented new challenges. Farmers in the region normally used their grain or potatoes saved from previous harvests for planting in the following season. Therefore, only a small local demand for seeds existed. However, in 1983 a major drought greatly reduced yields throughout the region, leaving many farmers without sufficient supplies of some commodities to both feed their families and use as seed.

Private initiative in the agricultural sector of the region did not arise through individual firms as in the Chaco or Santa Cruz. Instead, several different kinds of small farmer organizations existed:

1. Small cooperatives located in market towns.
2. A vegetable growers association.
3. Farmers cooperating with production programs run by the national brewery and the departmental development corporation.
4. Farmer groups organized around community development projects sponsored by non-governmental organizations.

To respond to farmers' needs after a disastrous drought, many of these organizations initiated wheat and potato seed production programs. The Ministry of Agriculture also had a small wheat seed production program, and a conditioning plant to serve the region. Besides the local need for seed, there was a growing market for wheat seed in

Santa Cruz. Many commercial farmers and merchants from the lowlands traditionally came to the Chuquisaca region each year in search of wheat to be used as seed. This assured market encouraged local leaders to promote seed production as a new opportunity for a cash crop. Nearly 1,000 hectares were planted for seed in the 1983-1984 crop year.

These initial efforts encountered many constraints. First, the wheat available to plant contained a mixture of varieties, and there was no source of pure foundation seed either within the country or from outside. Second, large numbers of small fields (as many as 700) in remote areas needed to be inspected. Each organization was responsible for the supervision of its own growers; however, an adequate number of trained personnel was not available. Third, individual farmers could not operate seed enterprises like those in the lowlands, taking their seed into the plant for processing and then marketing it on their own. Instead, the organizations needed to take possession of the seed at harvest time and carry out the cleaning, storage, and marketing operations. However, the organizations involved lacked funds to purchase the seed crop from farmers at the end of the production cycle. Consequently, much of the seed produced was used for consumption or was sold straight from the field to farmers in the lowlands.

Direct shipment of seed from the highland farmers to the lowland farmers with no conditioning or quality control practices could lead to serious

problems. Farmers in the Cochabamba valley had shipped seed contaminated with button weed, wild mustard, and oats to the lowlands the year before. Word spread rapidly among farmers in the lowlands, causing this market channel to shrink to nearly nothing. The following year, local institutions in Chuquisaca joined together in a regional seed board to support a certification service in a similar manner as in the two other regions. The seed board provided a means of organized marketing from one region to another. The Chuquisaca Seed Board negotiated standards with the board in Santa Cruz, and agreed on delivery dates. They also coordinated a strategy for improvement of foundation seed, accelerating its improvement by growing one crop in summer in the highlands and another in winter in the lowlands. One of the primary responsibilities of the certification service was to identify the best fields of the desired varieties of wheat and improve the seed by roguing (removing off-type plants in the field).

Seed quality improved considerably, and wheat seed from the region was regarded as being of excellent quality in the Santa Cruz market. However, local organizations were slow to achieve financial viability, and they could not purchase most of the seed produced. Consequently, the amount that found its way through the formal market channel (with inspections, conditioning, testing, and tagging) maintained a fairly constant level, between 50 and 100 tons per year. Fortunately, however, the variety

produced for the seed market in the lowlands also met with acceptance for home use by farm families in the highland and valley areas of Chuquisaca. Therefore, growers who could not market their seed through formal channels sold it locally to other farmers in the same community and local market places. In only two years, Saguayo wheat, a new variety, became a major variety grown by small farmers in Chuquisaca.

Seed production in this region increased less dramatically than in the previous two (Table 4). However, with the inclusion of potato in 1987, volumes will assuredly rise more rapidly. Perhaps more importantly, the experience in Chuquisaca demonstrated that an effective seed program can also operate in areas where volumes of seed required by farmers are relatively modest.

Table 4. Historical production levels<sup>a</sup> of certified seed<sup>b</sup> (in metric tons) in Chuquisaca, Bolivia.

Year	Wheat	Potato	Barley	Corn	Total
1980	17	—	—	—	17
1981	0	—	—	—	0
1982	25	—	—	—	25
1983	0	—	—	—	0
1984	97	—	—	—	97
1985	63	—	—	—	63
1986	100	—	—	—	100
1987	141	69	2	8	220
1988	114	209	60	8	391

a. A dashed line (—) is used to indicate that no seed was produced for the crop because it was not yet part of the seed program in the region. When some production was attempted, but none obtained for the crop, a "0" is used.

b. Certified seed refers to seed of all established classes.

Source: Regional Seed Office of MACA.

## **A NEW VISION**

As leaders in each of the three regions searched for ways to improve seed production and utilization by farmers, it became evident that the approach taken in the 1970s would not work. A central government approach had failed to separate commercial activity from the setting of norms and standards for the industry. The blanket approach throughout the country failed to focus on the specific needs of each region. It was also evident that relying on a single institution such as the Ministry of Agriculture to bear all responsibilities would limit the potential of the program. Services like certification and conditioning that did rely on the Ministry faced continual

crises in order to obtain funds for salaries and operating expenses. If at any time funds were not available, years of effort could be lost.

The richness of the country in organizational resources, and the early experiences of the regions, suggested that the development of a seed system based on small- and medium-size seed enterprises was feasible. A new approach was required--one which would respond to the conditions of the country and take advantage of existing resources. Some functions would have to be implemented by governmental institutions and others by private organizations in a complementary way. The following chapter shows how these functions were brought together into a cohesive organizational model for a seed supply system.

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## **CHAPTER IV**

### **EVOLUTION OF A DEVELOPMENT MODEL**

Through the experience in the three regions of Bolivia, a model for development of the seed supply system began to take shape. The elements in the model include the steps in the multiplication chain, as well as the key services and institutional mechanisms that allowed the seed programs to grow. In this chapter, these elements are identified within the framework of an integrated model.

The following chapters will show the importance of each of these elements to the development of the program, how each was created and strengthened in the Bolivian case, and what policies and strategies were adopted. An attempt will also be made to explain some of the alternatives considered and what their impacts might have been.

#### **OBJETIVES AND FUNCTIONS OF A SEED SUPPLY SYSTEM**

The objective of seed production programs is to multiply a few kilos of seed of improved varieties into sufficient volumes of high-quality seed to meet the needs of a vast number of farmers. To meet this objective, it is necessary to carry out the following functions:

1. Develop or introduce improved varieties.

2. Multiply small quantities of breeders' seed into larger amounts of foundation seed.
3. Multiply foundation seed into the large volumes of commercial seed needed by farmers while maintaining its quality attributes.
4. Distribute and market the seed.
5. Increase farmers' awareness and acceptance of high-quality seeds.

These functions can be visualized as links in a chain in which seed is multiplied and distributed for use by farmers. Two additional functions can also be shown as supporting and coordinating the entire chain, as follows:

1. Promote production of high quality seed, applying standards, and providing assurance to the buyer.
2. Obtain the participation of farm leaders in the program and coordinate among the various functions and institutions involved.

The multiplication chain and supporting functions are illustrated in Figure 2.

Each of the elements in the multiplication chain--from variety testing to utilization by the farmer--will be described briefly in the following sections.

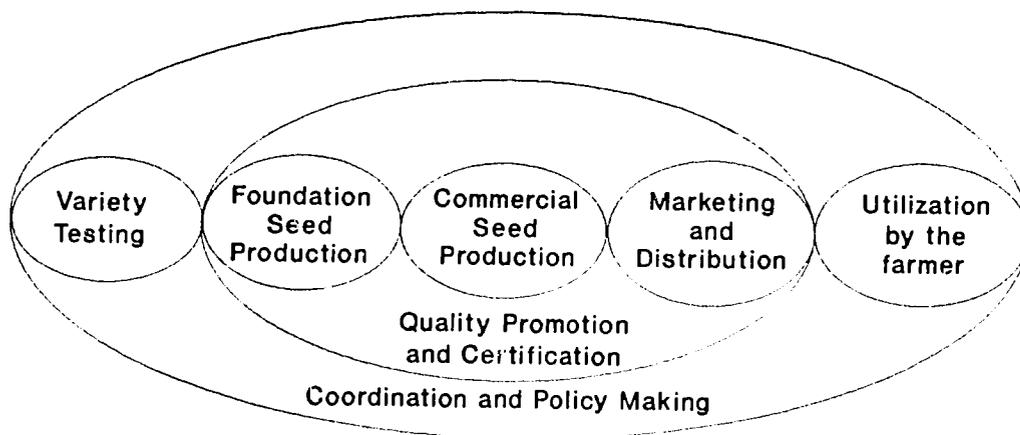


Figure 2. Essential functions in the Bolivian seed system.

## ELEMENTS IN THE MULTIPLICATION CHAIN

### Variety Testing

This activity focuses on the identification of suitable germplasm or varieties. (For the remainder of this document, the term "variety" will be used to include hybrids as well as varieties.) When the appropriate germplasm is identified as superior to existing varieties, it is named and released for commercial use. As part of this process, a small quantity of seed (breeders' seed) must be prepared, and a description of the new variety must be developed.

In most regions of Bolivia, improved varieties had been identified through years of testing during the 1970s. In the lowlands, CIAT/Santa Cruz introduced varieties of soybeans,

rice, corn, wheat, cotton, and others. In the highlands and valleys, IBTA had this responsibility for potato, wheat, barley, and other temperate crops. Other centers, including universities, a research foundation, private firms, and some development projects, were also carrying out this activity. In the context of the stage of development of Bolivian agriculture, the function of varietal testing and recommendation was being carried out widely and successfully. Despite these efforts, only a few varieties had reached the farmers.

### Foundation Seed Production

The role of a foundation seed program is to receive a few handfuls of breeders' seed and multiply it to obtain the quantities needed for planting by seed growers. Foundation seed should be supplied in a continuous and reliable

manner. The quality of this seed needs to be such that it will allow several additional multiplication cycles without loss of genetic characteristics.

In the lowlands of Bolivia, emphasis was initially placed on increasing volumes of commercial seed by selecting the best materials available from commercial fields. Efforts to improve quality by linking the multiplication chain to include foundation seed came later in the program. By contrast, in the valleys and highlands, more emphasis on quality was needed in order to increase acceptance of seed on the part of the farmer. Therefore, foundation seed was included in the program from the beginning.

### **Commercial Seed Production**

Foundation seed is received and multiplied into commercial quantities of seed. Sometimes this is not accomplished in only one step. If the amount of foundation seed supplied is small compared to the quantities of commercial seed needed, growers may multiply foundation into registered seed, and then multiply registered into certified seed. Certified seeds are sometimes multiplied again into other categories, such as "Certified-1" or "Fiscalized."

Commercial seed production encompasses several activities, including field production, harvesting, transport, conditioning, and storage. It also requires internal quality control on the part of the grower. In the three regions of Bolivia, no commercial seed

enterprises had been formed; only the Ministry of Agriculture and some experiment stations offered seed for sale. The involvement of public sector institutions created conflicting signals and disincentives for the development of commercial seed activities.

### **Marketing and Distribution**

Seed supply systems are often made up of several channels of both supply and distribution. The mechanisms of bringing these two ends together to close the gap in the chain is referred to as "the marketing process." Hence, marketing and distribution processes include information and communication, contractual arrangements, risk-taking, financing, transportation, storage and logistics, pricing, and government policy. In an effective distribution system, high-quality seed of superior varieties is available where it is needed, when it is needed, in the amounts needed, and at realistic prices for the parties involved.

The public institutions that produced seed in Bolivia were not effective in marketing. The potential to involve seed enterprises operating in an open, competitive environment was not appreciated.

### **Utilization by the Farmer**

The most important element in the chain is the farmer. Farmers need to recognize the benefits of good-quality seed. However, the farmer cannot visually inspect the seed and determine its quality when deciding which material

to purchase. Indeed, high-quality seed may appear to him to be similar to the product he sells in the market for consumption. Instead, he must rely on other signals to determine seed quality, such as his confidence in the supplier, advice from neighbors or farm sector leaders, or a recognized brand-name or emblem. His use of purchased inputs may also be closely linked to his access to credit.

Most farmers in Bolivia used their own materials, often of obsolete varieties, even when better materials had been identified for the area. Some farmers used imported seeds of improved materials from neighboring countries. Few opportunities were available to the farmer to break out of this pattern.

## **QUALITY PROMOTION AND INSTITUTIONAL COMMITMENT**

The five functions explained above are necessary for the product to be developed, mass produced, and utilized. However, in developing seed systems, these elements of the seed chain are rarely in place from the outset. The assistance of specialized services is needed to set up each of the elements and actually put them into operation.

### **Quality Promotion and Certification**

Certification is often thought of as referring to the regulation of the seed supply system, detecting deficiencies in seed quality, and imposing sanctions

when necessary. However, certification can carry out many other more positive functions to promote the production and use of high-quality seed, such as:

1. Advising and training seed growers to assist them in producing higher-quality seeds.
2. Creating awareness among farmers through educational and extension programs about the benefits of using good seed.
3. Informing distributors about the market for seeds of different kinds and suggesting ways of reaching the farmer.
4. Planning and coordinating production programs throughout the multiplication chain.

In a given program, some of these functions are emphasized more heavily than in others. Where seed companies are well established and have recognized brand names, certification may play a more passive role. In other cases, especially in less developed countries, certification can play a proactive role.

The Seed Department of the Ministry of Agriculture in Bolivia was the main producer in the country; it owned conditioning facilities in most regions, and it was also active in marketing seed. This same department was authorized to certify and set prices for its own seed and for others. From the standpoint of other seed enterprises and the farmer/user, these different

roles were in conflict. One of the participants in the market was able to control the rules that apply to all others. The Ministry placed emphasis on regulation, and had not recognized the importance of educating, orienting, and supporting the formation of seed enterprises.

### **Coordination and Policy Making**

Policy formulation implies much more than the development of seed laws. For instance, it may include: orientation of support services, development of institutional capacity, fomenting participation of farmers in decision making, attracting investment from private and public sectors, facilitating market development, consensus-oriented planning, and others. These activities often require much more effort by local leaders from the public and private sectors than anticipated at the beginning of a program. Usually, it is not possible to reach decisions on all policies at the outset. Instead, the program must reevaluate constantly and strategies must be adapted to new conditions as they arise.

In all development programs, support of key leaders is critical to success. Perhaps for seed programs this is even more true because of the large number of separate functions that need to be carried out and coordinated to reach a common goal. The capability and dedication of local leaders is, without doubt, the most important single aspect of the program. The identification and development of local leadership comes through the meaningful

participation of local institutions in the formulation of strategies and policies that guide the system.

Adequate legislation was already in effect in Bolivia. However, implementation of the seed program through the Ministry of Agriculture was centralized, with little involvement by the farm sector in activities or decision-making processes.

### **SETTING THE MODEL IN MOTION**

As was seen in the previous chapter, the initial efforts made in developing a seed program in Bolivia were a response to a need identified by local leaders, rather than a previously conceived technical plan. With the early successes in the first pilot region, a model began to take shape which was then adopted in other regions, with some modifications. It is now possible to look back on the experience and identify how the various aspects of the strategy contributed to its success. The actions taken to set the model in motion can be separated into three broad categories as follows:

1. Key services were meant to support and strengthen the production and distribution of seeds.
2. Specific steps were taken to promote and facilitate the formation and development of seed enterprises.
3. Institutional development and policy formulation received emphasis at the

regional and, later, at the national levels.

The material in the following chapters is drawn from experience in

the three regions. Instead of relating experiences in chronological fashion, as was done in chapter III, the remaining chapters attempt to draw insights and conclusions on the actions carried out.

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## CHAPTER V

### KEY SERVICES

#### AIMED AT REDUCING BARRIERS

As shown in the previous chapter, three services were identified as needing immediate attention to facilitate commercial seed production and enterprise development:

1. Seed certification service - focused on lending technical assistance and orientation to seed growers, plus field inspections and laboratory analyses to verify seed quality
2. Seed conditioning services, including drying, cleaning, and storage.
3. Foundation seed production.  
Foundation seed for certain crops, such as cotton, could be obtained from other countries.

Lacking these services, the only potential entrants into the seed supply system would be those firms or individuals capable of setting up a complete production system, from cultivating foundation seed, through the multiplication, cleaning, storage, and marketing of commercial seed. However, if these services are provided in a collective manner, available to all participants, then formation of small- and medium-size seed enterprises becomes feasible for farmers, entrepreneurs, and local organizations. This chapter will show how these services were developed and how they contributed.

#### SEED CERTIFICATION

Most people relate the concept of certification to government regulation: it is thought of as a policing function, rather than as a service to the producer and farmer/client who uses the seed. However, it was envisioned that certification could perform several important and necessary promotional functions in Bolivia.

First of all, some attributes of seed quality are difficult to identify by mere visual inspection. Therefore, if the farmer (or more precisely, the farm family) decides to buy seed from an input supplier at a price higher than the price of grain in the market, it is because he/she believes the seed to be better than his own. The farmer can only base this decision on secondary information, such as his/her confidence in the supplier, advice from informed neighbors or leaders, recognition of a brand-name or label, or the information on the bag or the label. Quality standards and seed classes established by certification are thus helpful to the buyer in making a decision.

Second, farmers and other entrepreneurs interested in forming seed enterprises require orientation about the seed supply system, technical assistance in the field throughout the production cycle, and specific training in seed technology. Certification is an efficient means of providing this service.

Third, where many organizations participate in a single multiplication chain, coordination and exchange of

information is essential. Seed may pass from a research center to a foundation seed unit, from there to several commercial growers, then through conditioning plants and storage units before being handled by distributors and eventual users. Several different institutions can be involved in this chain before the seed reaches the consumer. In the Bolivian program, certification became the grease that kept all the gears working together.

Below is described the evolution of the regional certification services in Bolivia, their organization, and the strategies adopted by certification to support the seed program.

### **Conflicting Responsibilities**

Because of a perceived lack of initiative and capability on the part of the private sector throughout the 1970s, the Ministry's Seed Department had decided to produce and market seed, rather than establish a certification service. Indeed, the Ministry could not certify something that barely existed. To be effective, the Ministry's Seed Department needed to operate on a similar basis as a seed company, i.e., it had to produce a superior product and demonstrate to the farmer that the seed produced was of high quality and worth the extra cost.

The product was identified by the "Fiscalized Seed" label on the bags, and was sold in modest amounts to a few farmers in diverse regions of the

country. Unfortunately, not all seed lots were of good quality. Word spread rapidly in areas where farmers had undergone a bad experience. Consequently, both the certification label and the concept of "improved seed" lost credibility. Seed prices were lowered to cover only operating costs in an effort to generate more sales. Even with subsidized prices, the Seed Department was unable to sell the small amounts produced. The low prices and lagging sales reduced even further the incentive for other organizations to invest in the area. Rather than promote the development of a program, the efforts by the Ministry resulted in serious restrictions.

When the Ministry entered into the production and marketing of seed, parallel efforts by other seed enterprises, such as the two development projects in Cochabamba (SEFO in forages and ASAR in potato) automatically became competitors. Therefore, they did not receive technical support from the Ministry's Seed Department.

This conflict of interest diminished the Ministry's authority to set industry standards, establish seed quality regulations and seed classes, and conduct official seed sampling and testing. Given this history, it was apparent that the first priority for the development of the seed program should be to organize certification services independent of production and marketing functions.

## Organization of the Certification Services

With the decision to emphasize the development of independent seed producers in Santa Cruz, the formation of an active promotional certification service became crucial. However, the Ministry's Seed Department depended completely on the central government budget. As is the case in many developing countries, operating funds were often disbursed several months behind schedule, if at all. Delays of 30 to 60 days in approving the procurement of a new battery or in buying fuel for vehicles for field inspections were commonplace. Personnel were underpaid and poorly motivated. Naturally, farmers who were considering investing in seed production had little confidence in a certification service facing these limitations. Therefore, administrative and financial autonomy of the regional service was identified as an immediate goal.

Several alternatives to the centralized public system were explored. At first, the best option appeared to be to shift the responsibility to a local, autonomous institution that seemed to have the capability and interest to implement an effective seed certification service. The primary candidates in the department of Santa Cruz were the research and extension organization, CIAT, and the Departmental Development Corporation, CORDECRUZ. Another option considered by the soybean growers association, ANAPO, was to form a completely private certification service. If this were done

through the Regional Chamber of Agriculture, CAO, certification services could be implemented for other crops as well.

The crucial factor was to achieve participation of client organizations in the new institutional structure of certification, and thereby obtain the commitment of local leaders to support the service. Specifically, farm sector leaders recognized the need to provide financial resources to cover operating expenses so that the service could overcome some of the limitations of the public administrative system. It was also recognized that the public authority vested in the Ministry would be necessary to make the service effective in the long run. This realization led local leaders and Ministry officials to join in a combined effort. Their decision was to maintain the certification service within the Ministry of Agriculture; however, regional private farmer associations took responsibility for supporting the operation of the service, including ensuring the generation of funds for this purpose.

The joint efforts of public and private institutions led to the creation of regional seed boards. A priority for the boards was to develop the necessary mechanisms to strengthen the seed certification service in their region. In the board's first meeting in Santa Cruz, the Chamber of Agriculture offered a grant to finance the certification operation in the first growing season and to provide office space. Along with this economic support from the chamber, the

participation of farmer associations in the seed board enhanced the credibility of the seed certification services.

The involvement of farm sector leaders rather easily dictated the promotional/educational role that the seed certification service should play in assisting the new evolving seed program. Daily activities focused on providing technical assistance and guidance to growers to prevent quality problems. As much emphasis was placed on educating farmers as on inspecting, sampling, testing, labeling and record keeping. Some of these same concepts had been successfully applied in varying degrees in other countries:

*“Still another vital aspect of quality control is the advisory function of a seed testing station, whether in a new or an advanced seed industry. The advisory function may require more effort than the station’s regular task of routine testing, particularly in a new seed industry. There may be many reasons for the industry’s problems, including high temperatures, high moisture content, or even fraud, but major causes are usually ignorance and negligence”*  
(W. J. van der Burg, The Netherlands, 1986.)

The regulatory aspects of the service were played down, and participation in the service was voluntary. Terms such as “certification service,” “quality assurance service,” and “quality promotion service” were all used interchangeably.

The new organization permitted the certification service to receive support not only from the Ministry, but also from the farmers themselves through regional seed boards. After the first year of using this new approach, the certification service in Santa Cruz had captured some resources and was on its way to obtaining financial self-sufficiency, including payment of competitive salaries to their employees. As the program evolved, the farmer associations became the greatest supporters of seed quality, convincing their members to use good quality seed of recommended varieties.

### **Flexibility in Standards and Seed Classes**

Basic, registered, or certified seed classes that are used in more advanced seed programs cannot be produced instantly by farmers-turned-seed growers. The idea was to set standards and procedures that not only allowed selection and use of the best materials available each year, but also prompted growers to improve quality over time. Therefore, the system had to allow for the production and distribution of seed of acceptable quality, while not necessarily meeting the quality and generation control standards of certified class seeds, while gradually adjusting the norms and tightening regulations.

Certification services were provided not only for varieties tested and formally approved by the local research institution, but also for the



**Inspector from the seed certification services discusses with seed grower how to avoid mixtures.**

so-called "traditional" varieties, at the farmer's request. Since foundation seed was not always available for these varieties, flexibility was allowed with respect to field inspection procedures, generation control, and quality standards. An important measure was the establishment of intermediate classes of seed under the names of "classified grain" and "fiscalized seed." The term "intermediate" is used to refer to material that does not meet certified seed standards, but is much better than common grain for planting.

Classified grain referred to a "seed" produced without a record of its parental material and without field inspections having been made. This

seed was conditioned and analyzed at the request of the grower. The seed was tagged in red as a symbol of caution and was intended for use by the grower who produced it. Of course, there were cases in which classified grain was sold, and it produced good results. Another intermediate class, "fiscalized seed," was produced without control of generations. This idea was adapted from a similar, successful Brazilian experience. In this case, fields were inspected, and final quality was either equivalent to, or slightly lower than, certified class. A yellow tag was used to identify this class of seed.

Because of the lack of generation

Simple sand flats came in handy for evaluating the germination level of seed lots. The results, along with other information, were used for labeling.



control, there were cases in which fiscalized wheat seed had a 5 to 7 percent varietal mixture, while soybeans had a 2 to 5 percent mixture. This did not pose any serious threat to its yield potential. By agreement, that seed was considered good enough since its germination, vigor, seed health, and absence of weed seed were adequate. It was the best material available in the country at the time; therefore, it was important that the seed program allow for its use by farmers.

During the first few years, most of the seed was of the fiscalized class. This held true over practically all crops and regions. Although this strategy is considered an intermediate step, it is thought of as one of the important strategies that facilitated the entry of growers into the seed supply system. It was not until the third year for soybeans (with two seed growing seasons per year) that a systematic process of production of basic, registered, and certified seed was in

place. Volumes of certified class seed were small in relation to total amount of seed available.

Even in the case where certified class was available, the seed certification office decided to maintain fiscalized seed as an important class within the certification program for crops such as wheat and soybeans. However, in soybean, the fiscalized seed class was limited to one generation past the certified seed class. In the case of wheat, additional multiplications were permitted. In crops such as corn and rice, where the multiplication rate of the species is high and the market is relatively small, adequate amounts of foundation seed were readily furnished; therefore, the intermediate classes were short-lived.

### **Quality Assurance and Market Expansion**

Most aspects of seed quality cannot be distinguished by simple visual inspection. In fact, high-quality seed

of some crops may have the very same appearance as lower-quality seed or even as common grain that may be completely dead. Therefore, the farmer who attempts to choose a seed must rely on different kinds of information or signals to reach a decision as to which materials to use. For example, the place of origin of the seed might tell the buyer something about it. The confidence the buyer has in the supplier often plays a role. The physical presentation of the product and the label on the container can also make a difference. These signals set seeds apart or “differentiate” them from common grains in the distribution process.

In Santa Cruz, farmers learned that their own association was supporting the certification process by providing resources to employ capable technicians who were also receiving in-service training and technical backstopping. Seed produced under the program was recognizable by the certification label and was therefore effectively differentiated from other materials. Certification became an effective means of assuring the buyer that the seed was of a high quality. It served both to protect the buyer and to assist the supplier in opening a market for his product. All seed producers had a stake in assuring that only high-quality seed be distributed. They became aware that offering poor-quality seed would damage the reputation of the system of which they are a part. Hence, the quality assurance service with participation of client organizations developed self-correcting mechanisms.

Certification of the product by an impartial entity allowed smaller firms to enter the market with less initial investment. The certification label became a common emblem for all firms, large and small. Once the emblem gained recognition by the farmer, it then reduced one of the greatest barriers to entry into the seed system, assisted by product differentiation. Small firms could operate just as efficiently as larger ones.

## SEED CONDITIONING SERVICES

Conditioning refers to the processes of drying, cleaning, sorting, treating, bagging, and storing of seed. The term “processing” is sometimes used synonymously. Drying promptly after harvest is especially critical for most kinds of seed in the tropics, in this case, Santa Cruz and the Gran Chaco. Storage for any length of time in Santa Cruz requires air-conditioned facilities, mostly to control humidity. By contrast, no special drying or storage facilities were needed in the high valley areas of Chuquisaca.

The Ministry had some equipment and facilities already on hand in each of the three regions. Most of the equipment was appropriate for small seed plants. One of the first tasks was to install the equipment and to put the plants into operation. The very presence of a seed conditioning plant has an influence over local leaders, especially if it is highly visible from a major highway. It becomes a common

point on which people can focus their thinking. Many farmers find it less intimidating to visit a seed plant than to visit offices located in the city.

During the early stages of the seed program, it was conceived that existing local seed conditioning facilities needed to work in close cooperation with regional seed boards. This was necessary in order to facilitate the implementation of policies that best suited the goals of each regional program. One of the policies defined in all regions was to provide custom cleaning services.

Since all of the seed program activities initially depended on a single plant in each region, it was critical that the plants operate under a clear mandate of "providing service to all seed growers." Custom conditioning was essential to facilitate the participation of small-size producers, for which investment in conditioning equipment was not economically feasible. The policy would allow producers and organizations to gain experience in seed production before committing large amounts of money into a business.

Administration of the plants could not provide efficient custom cleaning services under the central Ministry of Agriculture. It lacked flexibility since the facilities were controlled by the Seed Department in La Paz. For example, hiring extra temporary workers to operate a second, or even a third shift was necessary at peak times, particularly for reception and drying of seed. A government hiring freeze might hold up the approval, even though funds were available locally.

The result would be a loss for the producer whose seed would spoil before it could be dried.

Several alternate means of providing these services were explored in coordination with government representatives and farmer organizations. Among the options were the following: continue as Ministry-owned and operated, sell the plants to private firms, transfer to farmer organizations, turn over operation to a decentralized public institution, or set up a special administration under a mixed public/private board. Development models could be seen in other countries, in which conditioning services fall within the private or public sectors, or some combination. For instance, in Colombia, conditioning is mostly performed by private firms, while in Kenya, a national private/public parastate entity carries out this function. In India, both the public and private sector offer custom cleaning services. In Uruguay, the government provides some cleaning services with portable seed equipment.

Because of the large differences in the agricultural system of the various regions of Bolivia, no single policy could be effective. Therefore, different management schemes were adopted in the regions. The plant in Chuquisaca was run by a separate administration set up by the Regional Seed Board, and the plant in the Gran Chaco was run by a cooperative. In Santa Cruz, the Warnes seed plant was turned over to CIAT under lease. However, in all plants, the services

were provided on a fee basis that was designed to cover operating and capital improvement costs.

As other components of the program developed, the benefits of autonomous management for the seed plants in the regions became evident. Seed plant managers cooperated with certification services, facilitating quality assurance activities. As the seed volumes increased, the basic philosophy of the plants--that of providing services without delay--was put to test. The plants readily implemented two or three shifts during periods of high demand.

An open-door policy was also implemented in these plants. This welcomed seed growers and interested individuals to observe the facilities' operations. Every opportunity was taken to explain the program to the farmer and to provide technical assistance on seed plant design and feasibility studies. Consequently, the first seed plant in each region played an educational role in addition to the conditioning service rendered.

The efficiency of the conditioning services and the progress achieved in the seed multiplication component increased seed volumes to plant capacity. The need to increase conditioning capacity became an evident issue in the Santa Cruz region, where the quantities of seed produced increased rapidly, overloading the 1500 metric ton per year capacity of the only existing plant (Warnes). There was a general feeling among farmers, leaders, and officials that the existing public



Modern, yet small scale seed cleaning facility installed in the Gran Chaco region to satisfy the needs of the program in a more advanced stage of development

seed plant had to be expanded to satisfy the demand for services of the region. This need seemed dramatic since other crops were entering the program.

By this time, however, confidence created by the services that were being offered (custom cleaning, foundation seed supply and seed certification), along with the growing seed market, enhanced interest on the part of private growers to build their own conditioning plants. Feasibility studies conducted on different-size operations demonstrated that conditioning plants in Bolivia did not need to be of large capacity (Landivar et. al., 1983; Minot

et. al., 1985; Minot 1985; Barja and Cabrera, 1985). They could range from very small operations, using portable equipment, to medium-size, capital-intensive installations. In the central area of Santa Cruz, medium-size plants, similar to the first pilot plant in Warnes, or even smaller, had the greatest chances of success. The findings reinforced the decision to maintain existing publicly-owned plants at their current capacity, so as to become a model for private entrepreneurs. Additional investment by the government was not necessary.

As the years advanced, seed plants were installed by private seed growers in Santa Cruz, many as large as the Warnes plant, and others smaller. This evolution permitted expansion of conditioning capacity, avoiding dependence on any one seed plant and avoiding additional investments by the government. In

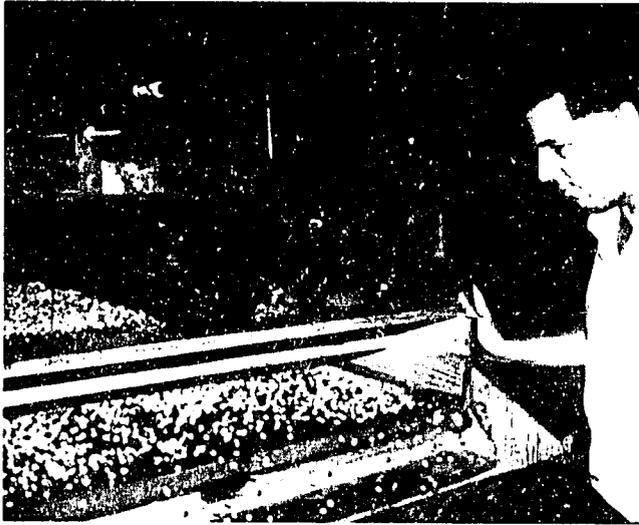
other regions, such as the Chace and Chuquisaca, volumes of seed produced were smaller. Investment in more than one complete seed conditioning plant was not justifiable. However, some portable air-screen cleaners were very useful in remote places far from seed plants.

Table 5 shows the dramatic growth in conditioning capacity from 1980 to 1986. The number of plants increased from 5 to 15, and capacity in metric tons per hour of finished seed went from 3.2 to 16.4. Only the major conditioning plants are included in the table. Several smaller, less permanent operations were also established parallel to the installation of the plants listed.

A brief explanation of the institutions that own each of the plants is in order. The ones designated with RSB were owned by the Ministry of Agriculture, and in 1986 were turned over to the regional seed boards.

Table 5. Seed processing capacity (metric tons per hour) in Bolivia, 1980-1986.

Institution/Region	Year						
	1980	1981	1982	1983	1984	1985	1986
RSB/Cochabamba	1.20	1.20	1.20	1.20	1.20	1.20	1.20
SEFO/Cochabamba	1.00	1.00	1.00	1.00	1.00	1.00	1.00
RSB/Tarija	0.25	0.25	0.25	0.25	0.25	0.50	0.50
RSB/Potosi	0.50	0.50	0.50	0.50	0.50	0.50	1.00
RSB/Chuquisaca	0.25	0.25	0.25	0.25	0.25	0.25	0.50
RSB/Santa Cruz		1.20	1.20	1.20	1.20	1.20	1.50
CBN/Chuquisaca				1.50	1.50	1.50	1.50
RSB/Gran Chaco				0.50	0.50	0.50	1.00
CAICO/Santa Cruz				1.20	1.20	1.20	1.20
ANAPO/Santa Cruz					1.20	1.20	1.20
SAIO/Santa Cruz						1.20	1.20
Libertad/Santa Cruz						1.20	1.20
Cordillera/Santa Cruz							1.20
CAISY/Santa Cruz							1.20
CIAT/Santa Cruz							1.00
<b>TOTAL</b>	<b>3.20</b>	<b>4.40</b>	<b>4.40</b>	<b>7.60</b>	<b>8.80</b>	<b>11.65</b>	<b>16.40</b>



Plant manager controlling the effectiveness of a cleaning operation at the Warnes seed plant

These are the custom seed cleaning facilities referred to above. They represent six out of the first eight conditioning plants built in the country, however, many of them did not begin serious operation until the late 1980s. The SEFO plant was established prior to 1980 for forages under a mixed (public/private) arrangement with assistance of a foreign donor. CBN, the national brewery, set up a seed plant within a barley cleaning and storage facility in Sucre. Unfortunately, this plant was underutilized. The next six plants, CAICO, ANAPO, SAIO, Libertad, Cordillera, and CAISY were all privately owned and operated. CAICO and SAIO belong to farmer cooperatives; while the ANAPO plant belongs to the soybean growers

association. Libertad is owned by an agroindustrial firm. Cordillera and CAISY are owned and operated by local seed companies. Finally, the CIAT plant was established in 1986 to condition the increasing volumes of foundation seed.

Figure 3 depicts more clearly the results of the strategy described above. Initially, public conditioning plants dominated, with one mixed public/private plant in existence.

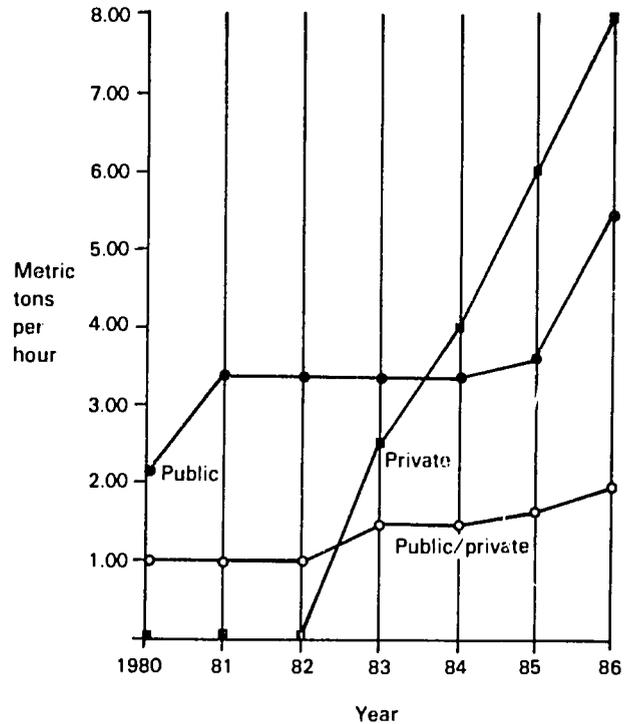


Figure 3. Capacity of public, mixed public/private, and private seed conditioning plants in Bolivia over seven years.

No private sector investments in conditioning capacity had been made. (The SEFO plant was installed entirely with public funds. Later it entered into a scheme of privatization.) After the Wames plant was completed in Santa Cruz in 1981, no other expansion of public facilities was made, despite a certain amount of pressure from seed producers to do so. This situation continued through 1982 and into 1983 while seed volumes increased, practically overrunning existing plant capacity. Finally in 1983, the first two private plants were built. The very next year, private conditioning capacity became greater than that of the public sector. New private plants were installed in 1985 and 1986.

By the end of 1986, some of the public plants were upgraded in regions where private sector investment in additional conditioning facilities was not warranted because of the small volumes of seed produced. At the same time, these plants were turned over to the regional seed boards. Figure 3 still shows the capacity in these plants as "public", in order to distinguish them as a group. However, to be accurate, all the plants listed in Table 5 as belonging to RSBs should be reclassified as "public/private." Therefore, the only public plant remaining in Bolivia is the CIAT foundation seed conditioning facility located at the Saavedra Experiment Station.

In summary, initially it was intended that the public seed plants provide services to all seed producers. This was achieved through different



Several small-scale plants, such as the ANAPO plant in Santa Cruz (top) --owned by a soybean growers' association and a compact seed conditioning equipment mounted on a trailer, (bottom) enable conditioning of large volumes of seed needed in the region.

management schemes that were approved and supervised by the regional seed boards. The publicly-owned facilities served as a model for private sector plants. In Santa Cruz, government investment in a single processing facility provided a model for

investments by the private sector in seven additional facilities.

## FOUNDATION SEED SUPPLY

Successful seed programs assign the task of receiving the small quantities of breeders' seed from research units and multiplying it into larger quantities to specialized foundation seed units. These units should work in close cooperation with the originating breeder in the multiplication of breeders' seed to foundation seed. The specialized role of the foundation seed unit, then, is to multiply breeders' seed in such a way that the desirable characteristics for which a variety was selected are maintained. Foundation seed is the source to which the seed grower can go back to procure pure, healthy seeds of the varieties that the farming community needs.

Foundation seed units are an essential element of seed programs which multiply public cultivars, as opposed to privately-held hybrids and varieties.\* The foundation seed units, usually based at agricultural experiment stations, serve as a vehicle in which the products of public research in varietal development are transferred to those farmers willing to multiply it.

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\*When private companies invest in the plant breeding and research necessary to develop new hybrids or varieties, production of sufficient quantities of foundation seed is carried out by the same enterprises, and is seldom in doubt. No local companies had entered into such programs in Bolivia at the time, and foreign companies had little involvement

Even though this is obvious in already advanced programs, confusion still arises in many developing situations where there is no working model to appreciate the paramount importance of this function. This was the case in Bolivia.

Research institutions in Bolivia had an abundance of good varieties already identified as superior to existing ones. These varieties were recommended to farmers, but experiment stations could not provide foundation seed for multiplication. The candidate institutions for forming foundation seed units were readily identified as the regional experiment stations (IBTA for the Chaco and Chuquisaca and CIAT for Santa Cruz). This conclusion seemed straightforward because of the broad mandate of these institutions in research and extension, the wide range of crops covered, the facilities available, as well as the experienced personnel on hand. However, both institutions had adopted a research orientation, and it was not easy to convince the officials in charge to engage in foundation seed production. Instead, they assumed that this activity would compete with the research and extension mandate.

About two years into the program in Santa Cruz, some advanced seed producers began to require more and better-quality foundation seed. They perceived the lack of interest of the research station, and they indicated they were prepared to produce foundation seed, provided their efforts would be supported by the regional seed board, and certification. Although

this approach might have provided an immediate solution, it implied that foundation seed would be available for only one or two species, and perhaps to only the more advanced seed growers. Only then did the regional experiment station under CIAT decide to form the foundation seed unit. It was recognized that this new activity would bring credibility and visibility to the institution. The fact that a foundation seed unit would also generate revenues, and thus finance itself caught the interest of the director.

The experience with the IBTA experiment station in the Gran Chaco was similar. Because of a centralized administration, IBTA lacked a degree of autonomy and flexibility. Without this, the foundation seed unit has to compete with research activities to use common resources, such as tractor time, day laborers, land, and petty cash funds. Despite these disadvantages, an attempt to produce foundation seed was initiated. Although small amounts of foundation seed were required, IBTA failed to meet the regional requirements during its first two attempts. Commercial seed producers in the Chaco obtained foundation or certified seed class from Santa Cruz.

The production of foundation seed did not occur in a serious way until about two years after the initiation of the programs in each region. Even then, volumes produced were insufficient and quality sometimes erratic. How did the seed supply system cope in the mean time? A time-buying strategy was the flexible standards used by the certification



Roguing off-types and mixtures by farmers and program personnel prior to harvesting a foundation seed field in Comarapa, Santa Cruz.

services, such as including the fiscalized seed class and extending the number of cycles of multiplication. As the foundation seed supply became more reliable, producers were required to plant certified seed to produce fiscalized class, thus completing the multiplication chain conceptualized in the previous chapter. This measure was taken for corn in Santa Cruz in 1985 and for soybeans in 1986. Foundation seed allowed the multiplication chain to be completed so as to link varietal research to the seed supply system, and vice versa.

## TECHNICAL ASSISTANCE AND TRAINING

A major problem encountered during the early stages of the program was the lack of qualified personnel needed to perform the different activities of the

seed production chain. This was due primarily to the low levels of seed production in the country, implying little demand for professionals in seed technology. The few agronomists who had specialized in seed technology had career opportunities only with the government.

Technical assistance and training played an important role in the formation and evolution of the three services discussed above. A range of formal and informal training activities was designed to suit the needs according to the stage of development of each region. Both in-country and overseas training opportunities were utilized to the extent possible. Although, initially the training activities relied heavily on international experts, the responsibility to continue this function was placed on seed certification services. This section details the types of training events carried out.

### **In-Service Training**

Initially, because only a few persons were involved in seed production activities, no formal training was offered. Instead, professionals who were directly involved in providing key services (seed certification, conditioning and foundation seed production) were trained on-the-job. This approach had the advantage that the production activities could be organized and operated at the same time technicians were being trained. As noted in a paper presented at a conference in CIAT, Colombia:

*“The personnel who receive (in-service) training are permanently assigned to work as local counterparts to foreign advisors. Superior results have been obtained with this method, where 29 technicians have been trained in specialized areas of seed technology. More importantly, all of these technicians can be found working in seed activities, and several of them are involved in training other technicians.*

*A small number of technicians have received in-service training with the variation that they are not permanently assigned to work with a foreign advisor. Instead, they work for one or two months each year in the Seed Certification Service, where an advisor is based. The trainees carry out field inspections, laboratory analyses, inspections of conditioning plants, and so forth. The personnel who attend this kind of training comes primarily from the private sector, plus agronomy students in their last year at the university.” (Rosales, 1985)*

This training approach rapidly produced a sufficient number of technicians. In-service training was soon followed by more formal courses with the purpose of complementing their practical experience.

### **Specialized Training Events**

As the regional programs developed, the need for training in specific

technical areas became evident. The in-country training activities were tailored to solve specific problems either encountered or anticipated. The training included a wide range of activities such as:

1. Study trips (when needed).
2. Short courses for seed growers (once before each planting season).
3. Regional short courses for technicians (frequent).
4. National short courses for technicians (frequent).
5. Private individual consultations (whenever requested).
6. Short seminars (one-day duration for extension agents).

The Santa Cruz region was used as a training center for holding many national short courses because of the winter crop season activities. This was the off-season for all other regions of the country. Every training session included two major components, one regarding technical aspects on how to produce seed, and the second concerning the development of actual production plans and approaches to be applied by institutions in each region. This approach complemented very nicely

the practical follow-up provided in the field and seed conditioning plants.

The courses in specific technical areas were complemented by more formal training in the international centers. A large number of individuals attended courses offered at the International Center for Tropical Agriculture (CIAT, Colombia). During the early 1980s, Bolivia provided the third largest number of participants after Colombia and Brazil. Candidates for this course were from private and public institutions, selected on the basis of the needs of each regional program. This was in contrast to the previous policy under which the government only financed international training for public employees.

### **Planning with Seed Producers and Sector Leaders**

An objective of human resource development that is often overlooked under the training component is planning meetings to reach decision-makers. A series of planning/evaluation meetings, round-table discussions, study trips and such were designed to reach decision makers. Many agriculture leaders and technicians who might otherwise have been on the fringe of the activity became well informed of the technical and organizational needs of a seed program, becoming effective supporters and leaders of the seed system.

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## CHAPTER VI

# SEED ENTERPRISE DEVELOPMENT

Private seed enterprise development is often not a target for government officials in developing countries. In Bolivia, many officials identified private enterprise only with large-scale, capital-intensive industrial complexes, rather than small- and medium-scale farming and commercial activities. Therefore, seed grower development seemed a conflictive concept to the Ministry of Agriculture Seed Department. The conflict arose in part because the Ministry had prepared a project to establish a parastate seed company of national scope that would be involved in seed production, processing, and marketing. However, after the first year of experience by farmers, their leaders, and certification personnel in the winter seed crop season of 1981, it was clear that the production and marketing of seeds could be carried out more readily by the private sector.

The policy of promoting private seed enterprise was gradually accepted in each of the regions. However, once established as an intended strategy, what could be done to make it happen in practice? One such mechanism is the provision of key services, as described in the previous chapter. Other specific activities to set the process in motion are described here.

In Bolivia, as in most developing countries, human, financial, and organizational resources are especially scarce and therefore the available

resources needed to be utilized as fully as possible. It was believed that this could be accomplished by implementing an open policy, allowing free entry, without favoring any one type of seed enterprise. Small and large farmers were encouraged to participate in the program. This strategy, however, relied primarily on the strength and organization of farmer associations to develop market channels for the seed produced.

The seed production process can be broken down into two overall phases: 1) field multiplication, and 2) postharvest handling, conditioning, storage, and marketing. In this document, the term "seed grower" is used to refer to persons involved only in the first phase--field multiplication. The persons or organizations that carry out the second phase of the process are referred to as "seed enterprises." Naturally, both phases are often carried out by the same persons, or organization. However, many seed enterprises do not grow seed in their own fields, but instead contract with cooperating growers. The term "seed producer" is used here to refer to both growers and enterprises.

## MARKET-ORIENTED APPROACH

Most innovative farmers, regardless of the size of their operation, recognize the importance of good seed. However, for a farmer to turn to growing seed, he must answer the universal question: "Who is going to buy it and at what

price?'. The lack of an answer to this question often defeats even the best intentioned seed development efforts. Confronted with this problem, a paternalistic approach would indicate that the government should buy and market the seed. However, this approach fails to consider the dynamics of market channel formation and the limitations of government institutions to adjust and respond. It solves an immediate problem in the sense that the seed grower is not left "holding the bag", but it removes the connection between the seed producer and seed consumer. The acceptance of the seed by the user is not transmitted back to the grower, which is a vital step to provide the incentives to improving quality and pleasing clients. Put simply, the competitive aspect of the market is diminished or eliminated. Incentives to innovate and improve are lost.

A clear strategy formulated by Bolivian farm sector leaders was to help the farmer to become not only a grower of raw materials for the seed industry, but to form a seed enterprise, taking the responsibility for conditioning and marketing his own seeds. Given the key support services, it was anticipated that seed growers could quickly go all the way from production to marketing of seed under their own brand names. This could be achieved by starting with crops for which a market for seed was already in existence, or where a demand was perceived. Demand for seeds obviously existed, since farmers in the Santa Cruz lowlands already used imported seeds. Also, farmers in the

Chaco expressed concerns about the quality of seed, and their organizations were actively looking for a means of supplying them. Besides producing for the local market, seed growers in the Chaco and Chuquisaca had the opportunity of supplying seed to Santa Cruz. Given this evidence of a market, the possibility of forming seed enterprises was not remote.

Policies favorable to the development of private enterprise were essential. The first of these was the use of free market forces to establish prices. It was felt that price controls would hold seed prices artificially low, reducing the incentive to make the investments and take the risks of entering the seed production system. Rather than controlling prices administratively, the idea was to create a competitive production system that would provide enough seed to satisfy the market. Seed producers would then compete both on quality and on price.

## **IDENTIFICATION OF PROSPECTIVE SEED PRODUCERS**

The approach was to let innovative farmers try their hand at seed production. To be a seed grower, a farmer did not have to be either large or small. Therefore, certification services avoided imposing restrictive preconditions to qualify as a seed producer. Since key services were available, interested growers were not required to have specialized technicians nor conditioning facilities. This

MAIZ VARIEDAD SWAN



**MAIZ VARIEDAD SWAN**

Using local services, a family-operated seed enterprise is able to market seeds under their own brand name.

reduced their fears and the risks involved in investing in a new activity without previous experience.

Even after providing a favorable environment for seed enterprises, the private sector did not spontaneously step forward to establish production and marketing systems. It was necessary to take further steps to set the process in motion by approaching some of the parties that might be potentially interested. As in any farming situation, there were some who were willing to take risks and give added value to their product. Some useful clues to identifying potential seed growers were: performance as farmers, climatological factors of the area, ease of access to fields, and

availability of field equipment, depending on the size of operation.

Some potential seed growers were hand-picked by their own leaders. This was the case when farmer organizations were active in a region. Other individual farmers were identified by certification personnel who were knowledgeable about the region. Farm leaders had to make serious efforts to identify interested farmers in the beginning, but when the first seed growers obtained good results, other innovative farmers actively looked for information and took the initiative. In addition to individual growers, many institutions were coaxed into forming seed multiplication programs, taking on the functions of a seed enterprise. These included farmer cooperatives, non-governmental organizations, and many others.

After the first experiences of some seed enterprises proved to be positive, other farmers jumped to the idea. Some who expected quick profits with minimal additional effort pulled away after a first or second trial, because of the additional, unanticipated detail involved in seed production. The detail consisted of giving tender loving care at critical stages in the growth cycle to arrive at quality rather than just quantity. Contrastingly, good farmers stayed in the program regardless of size.

## **ORIENTATION AND INFORMATION**

As discussed in Chapter V, the certification services provided technical

assistance to seed producers in all phases of production and distribution. During field inspections, certification technicians identified potential problems affecting seed quality and provided possible solutions. An immediate follow-up consisted of short courses aimed at addressing recurring field problems and tailored to the type of farmer being addressed. This kind of direct technical assistance is essential to the development of seed enterprises.

Seed certification services and the regional seed boards were instrumental in organizing and planning meetings among seed producers, farmer association leaders, and representatives of foundation seed units. These meetings were useful in determining the demand and the supply of seed of different varieties and classes. A substantial amount of information was exchanged in these meetings to answer questions about varieties, availability of foundation seeds, requirements for becoming a seed producer, where to dry and condition the seed, and so on. Quite frequently, the interested parties of different regions were put in contact with one another through these organizations. From the beginning, emerging seed enterprises displayed an extraordinary ability to sell their seeds.

As the program developed, large volumes of information became available from field inspections and laboratory analyses. In order to compile the information, a computerized system was implemented. The system readily summarized the field inspection results of hundreds of fields, providing information on the number of hectares



**Regional agricultural research and extension provides harvesting service under a special production project with 400 contract small seed growers, Comarapa, Santa Cruz**

planted of the different crops, varieties, and classes. As the cropping season progressed, the computerized system adjusted the acreage and yield projections, as a result of crop failures and rejected fields. Similarly for laboratory analyses, the system compiled information on quantities of seed tagged and provided information on quality levels of available seed. This information was updated daily and was available to any person who requested it.

The information generated was extremely useful to seed producers and farm leaders for planning and marketing purposes. The summaries were also useful to certification services to identify recurring quality problems originating in the field or in latter stages, such as postharvest handling, transport and storage. As a result seed producers were rapidly warned of the problem and its possible solutions.

## CREDIT FOR SEED PRODUCTION AND DISTRIBUTION

One way of drawing farmers toward the seed sector might be to offer credit for seed production and distribution. This could be especially effective if special credit lines were set up, making funds more easily available to seed growers than to other producers, or under more favorable terms. However, no special lines of credit for seed production were created in Bolivia until 1986. By then dozens of seed enterprises had already been formed, and some were reaching a stage of relative maturity. The significance of this is that special concessionary credit was not required to create seed enterprises.

Eventually, financial institutions became interested in establishing credit lines for production of seeds. The concept, however, was to structure the loans along the lines of regular agricultural production credit, which did not account for costs of marketing and distribution. Since seed enterprises were responsible not only for growing the raw material in the field, but also for turning it into a finished product and placing it in the market for the final user, they required different kinds of financial services.

Figure 4 depicts a typical cost structure of the seed production and distribution process. Production in the field before harvest represents perhaps only about 20 percent of the total cost. Harvest adds another 15 percent; so the total field operation represents about a third of the final value of the

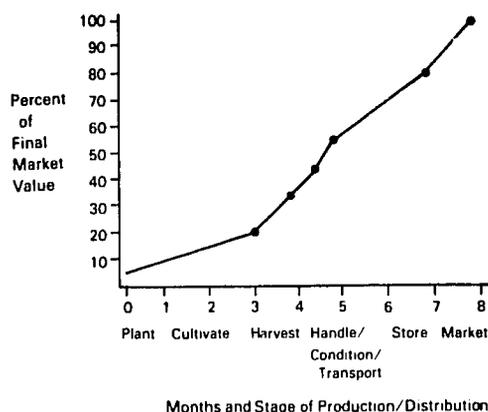


Figure 4. Representative cost structure of seed production and distribution over a crop-year.

product that the farmer eventually uses. Transport to the conditioning plant, handling, conditioning, bagging, transport to storage or place of sale is a major cost. Storage costs, and financial costs of carrying inventory are another large item. Finally, costs of promoting sales and completing transactions with buyers enter in. After a time, local financial institutions in Bolivia adapted their services to fit these needs, emphasizing the phases of production and distribution that begin with harvest and continue through sale to the user.

## TYPES OF SEED ENTERPRISES FORMED

The availability of basic services discussed in the previous chapter opened the door for the formation of a wide variety of seed enterprises.

Farmers, regardless of size, could immediately take advantage of one or all of the services provided, without having to invest large amounts of capital. As a result, the program did not have to choose among conventional seed enterprise stereotypes, such as national parastate seed companies or private capital-intensive complexes. The types of seed enterprises formed ranged from individual farmer/growers to larger organizations. Some were of the public decentralized sort, such as regional development corporations. Still others were non-profit, church-sponsored organizations, or groups linked to rural development projects.

By 1986, many types of seed producing groups were in operation, not only in the target regions (Santa Cruz, Chuquisaca, and the Gran Chaco), but also in much smaller agricultural regions such as Tarija and Potosí. The resulting seed producing organizations could be described under several groupings:

1. Private entrepreneurs invested in seed production/marketing. Some of these entrepreneurs were individual commercial farmers who turned to specializing in seed production. Others were partnerships among businessmen and farmers who formed seed companies. Some of these used public custom cleaning services, while others eventually built their own conditioning facilities. All had their own brand names and produced established classes of seed under the certification system. Most companies also hired local agronomists to help

supervise production and advise them on internal quality control.

2. Cooperatives incorporated seed production as a new line of activities. The motivation was often to supply seed to the members of the same cooperative, although some provided a means of reaching more distant seed markets. The cooperative took the role of a seed company, and some of its members became cooperating growers. Thus, at harvest time, the cooperative typically purchased the seed from its growers, had the seed cleaned and put it into storage for later distribution at planting time.

Cooperatives sometimes hired technicians and agronomists to operate these seed programs. This staff was trained and backstopped by certification personnel. Some cooperatives established their own conditioning facilities.

3. Agricultural research stations formed foundation seed units. Because of financial limitations of the experiment stations, regional seed boards and farmer associations sometimes contracted with these units to provide a given amount of foundation seed of particular varieties. In doing so, they often advanced the funds needed to hire workers and pay other operating costs.

4. Farmer associations participated directly in seed production and distribution on some occasions. Sometimes the association would

provide the conduit to channel credit to seed producers. Sometimes it would purchase seed from growers and hold it for later resale to members. One association established a seed conditioning plant to provide custom cleaning services to members.

5. Regional Development Corporations formed seed production programs that took on the responsibilities of a seed enterprise or cooperative. Cooperating growers produced under contract. Inputs were supplied to the grower, and an amount of seed was collected back at harvest to pay for the inputs. If funding was available, additional seed would be purchased from growers. The corporation would then market the seed in the same way as any other seed enterprise.

6. Agroindustry initiated seed production. Two examples could be seen where relatively large, well-established agroindustrial firms incorporated seed production into their activities. One of these was an oil seed plant in the lowlands and another a brewery in the highlands. Both used the seed to redistribute to farmers that provided them with raw material for processing.

7. Colonies, farmer settlements or informal groups of farmers are forms of local organization that often acted as producing units. Through these organizations, seed growers often share in the burden of obtaining

inputs, channeling credit, learning about markets.

8. Non-governmental organizations (NGOs) implemented seed programs which sometimes operated very much like those of the cooperatives. In many cases they worked through informal community based organizations as well. The NGO hired the technical staff to work with seed growers, and would usually purchase the seed at harvest time. However, most NGO programs hoped to eventually get local farmer organizations to take responsibility for postharvest handling, storage, and marketing.

9. Mixed public-private seed enterprises were also important. The two examples in Bolivia mentioned before--SEFO and ASAR--were both started with the help of international donors. Both were commercially oriented with the idea of generating income for their members and providing seed to existing local markets.

It should be recognized that a simple listing cannot catch the richness of the different forms of seed producing enterprises that were evolving in Bolivia. Comparing with seed enterprises existing in other countries, Bolivian seed enterprises would be characterized mostly as private, small-scale, site-specific, and dynamic. They were well-suited to the regions and stage of agricultural development of the country.

Initially in the three regions, only the Ministry of Agriculture attempted to produce any seed. Since one of the policies or strategies established early on was to separate production from certification, the Ministry offices abandoned their production programs within the first year or two. Hence, for practical purposes, no seed producers existed at the outset. By 1986, 55 different organizations were carrying out seed production and distribution programs in the three regions. They varied in size from individual farmers who formed seed companies to cooperatives and public institutions with hundreds of participating growers. Some of the companies and other producing organizations had their own seed

plants; others conditioned their seed in public plants. Many marketed seed under their own brand names.

Tables 6 and 7 show the number of seed enterprises and cooperating farmers by the primary crop that they produce.

The large number of new seed producers was one of the most noteworthy impacts. No producer was so large as to control or dominate a seed market, and all operated on an equal basis in a highly competitive environment.

## SUMMARY

The wide range of institutions, both public and private that gradually evolved in the production/marketing of

Table 6. Number of seed enterprises involved in seed production during the 1986 season.

Region	Soybeans	Wheat	Corn	Cotton	Rice	Beans
Santa Cruz	26	4	11	4	15	1
Gran Chaco	6	1	1	1	0	0
Chuquisaca	0	3	0	0	0	0
Total <sup>a</sup>	32	8	12	5	15	1

a. Some enterprises produced more than one crop. The grand total of enterprises is 55, avoiding double counting.

Table 7 Number of cooperating farmers<sup>a</sup> producing seed for the enterprises listed above.

Region	Soybeans	Wheat	Corn	Cotton	Rice	Beans	Total
Santa Cruz	66	125	12	9	16	19	247
Gran Chaco	51	1	1	1	0	0	54
Chuquisaca	0	450	0	0	0	0	450
Total	117	576	13	10	16	19	751

a. Two public-private enterprises and associated cooperators are not included, as they did not fall within the regions or approach described in this document.

Source: Regional Seed Offices of MACA.

seeds demonstrate several useful principles:

1. Even in the most remote and difficult situations, it is possible to initiate seed production activities if some barriers are removed, key services are provided, and proper orientation is provided.
2. In most developing situations it is easy to find innovative farmers, associations, cooperatives, agricultural development projects, patronatos, commodity committees, public research stations, and individuals concerned and frustrated with their agricultural development efforts. The Bolivian experience creates a strong suspicion that those organizations are underutilized. These organizations can indeed participate and should be encouraged to participate in production of seeds, at least for the needs of their own organizations. In doing so, they will not only provide this essential input to their farmers, but they will create a new and direct channel of technology transfer from the research plots to farmers' fields.
3. Most innovative farmers, even those with a bare minimum of facilities and organization, can become interested in seed production/marketing. However, the concept of organizational growth and development must be applied. If structures and procedures are too rigid for new seed enterprises, the initiation phase becomes impossible to overcome. On the other hand, if an



**In-country short courses, proved very effective in solving constraints in production technology.**

embryonic enterprise is allowed to start in a modest, simple--even imperfect--form, but is given room to operate, with time and experience, it will evolve and become more specialized. A high level of specialization should not be a condition to start, but rather a goal to be achieved in the future. This simple principle facilitated the initiation of a wide group of institutions, provided models which were easily understood and replicated by other farmer organizations, and attracted investment in seed production/marketing, as well as installations of seed conditioning facilities of their own.

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## CHAPTER VII

### INSTITUTIONAL EVOLUTION

At the outset, all of the institutions required to develop key services and carry out seed industry activities did not exist. The previous route chosen by government officials had been to give full responsibility to the Ministry of Agriculture. Given the wide range of pressing needs and scarcity of public sector resources, the intention to provide support may have never been translated into specific actions. Instead, it could have been erratic, depending on the mood of the decision makers in office. Despite the frequency of this situation in seed industry development, most countries have not seriously looked for alternatives.

A case in point was Bolivia; the main points of contention revolved around the roles of the private and public sectors, the nature and purpose of controls and regulation of commercial activity, the need for direct public intervention in marketing and distribution, and the best means of financing services. Often the decision-making process was caught between two polarized positions: one favoring a centralized form of organization based on public institutions and the other a mixed public/private form of organization with autonomy at the regional level. A complete organizational model was not developed at the outset. Instead, continual efforts were required to search for

options that would be workable at the regional level and still acceptable to officials at the national level.

### REGIONAL PARTICIPATION AND ORGANIZATION

#### Need for Action

The need to change the institutional framework became apparent when growers began producing seed, but personnel were not available to provide services--field inspections, sampling seed lots, laboratory analyses, operation of conditioning plants, and others. Initially, the Ministry of Agriculture attempted to implement all of these services, plus many production and commercial activities. However, revenues generated by the Ministry's program in each region were placed under the control of the national treasury, and it was clear that sufficient resources would not be assigned through public budgets to provide the necessary personnel and operating funds. Further, administrative restrictions imposed on public sector institutions severely limited the measures that could be taken--particularly adjusting salaries to competitive levels.

Another need for positive, deliberate action was coordination among institutions within each region. A typical regional seed supply system was comprised of perhaps a dozen principal institutions (working in research, seed production, distribution, credit,

education, and other areas), perhaps another dozen organizations representing seed producers and users, and hundreds of individual seed growers. Very few, if any, of these organizations produced the entire chain of seed generations--foundation, registered, and certified seed classes. Most of them did not have conditioning plants. Therefore, each required continual interaction with the others.

A partial solution to the problem of generating resources was provided through the commitment made by local farmer organizations to support the seed program in their respective regions. These organizations facilitated the establishment of fees from their seed producing members and managed the funds for the certification service. This initiative shown by the private sector to participate directly in the financing of services is not unique to Bolivia. Seed grower associations in some other countries frequently provide part of the funding for certification services and, in many instances, actually carry out the services, as is the case with crop improvement associations in the United States and lately in Chile. Other attempts were made to collect funds for supporting certification and conditioning services and foundation seed production in each region. Although effective in the short run, the measures taken were often isolated and tenuous in nature.

As a result of these initiatives by local leaders, the three regions operated differently than they had before. They now had the capability of making decisions locally. Meanwhile,

other regions in the country continued to depend on the central government for direction and resources. These contrasting situations made it imperative to develop an accepted legal framework in which to operate.

### **Organization of Regional Seed Boards**

Although Bolivia is not a large country, it is made up of several regions having contrasting climates, varying population densities, and people of different ethnic origins. The geographic separation among regions, due to distance and poor transportation infrastructure, has allowed them to maintain their distinct character, hence, the striking differences in their agricultural sectors, as described in Chapters II and III. Similarly, many private and public organizations had developed within the context of the regional environment. Farm sector leaders were also identified by their constituency at this level. Although several regional farmer organizations had gained a great measure of strength, no national organization existed. Over time, leaders in these organizations identified themselves with the seed production program and were serious in their commitments. It was not surprising that the initiative to strengthen the institutional structure of the seed system came from the regional level.

In 1982, a Ministerial resolution gave official recognition to seed boards in any region where local leaders wished to form one. Within a year, the first three boards had been formed. The regional seed boards (RSBs) had

two principal sets of functions: (1) they were to make regional plans and coordinate among institutions; and (2) they were to ensure the operation of the certification service in the region. Stated simply, they were to join up with the Ministry of Agriculture Seed Department in the region and form an effective certification service. They would help obtain financial resources through their organizations to make the service operable. The policies set by the boards would become the mandates under which certification would operate.

Board membership was originally to be comprised of representatives of the principal organizations participating in the sector. The original Ministerial resolution called for one member of each of the following:

1. The regional office of the Ministry of Agriculture.
2. The regional university.
3. The regional development corporation.
4. The official research and extension institution.
5. Farmer organizations.
6. The Regional Agronomy Society.
7. The Seed Certification Service

The regional director of the Ministry represented the central government. The next four members were included because of their functions

related to the seed sector--human resource development, specific development projects, research and extension, and production and distribution, respectively. The Agronomy Society was included to add balance to the board, providing an objective perspective. The regional head of seed certification was a non-voting member, and served as executive secretary to the board.

The intent of the Ministry of Agriculture in allowing the creation of the boards was to form a more participatory policy-making structure. Although such an approach is not uncommon in the more advanced seed industries, it represented a grand experiment in Bolivia at the time. It was a unique situation to have a Ministry of the central government recognize local boards with private sector participants and give them the authority to formulate and implement policy. In sum, this represented a major shift in strategy and, naturally, not everyone was in agreement with this approach. It was not clear if the boards were prepared to carry out this responsibility, nor was it certain that the government would abide by the wishes of the regional seed boards.

Fortunately, local leaders were already committed to supporting the development of the seed system. The flexibility to set up administrative structures with local autonomy was welcomed. The RSBs set competitive salaries and hired young, competent professionals to head the certification services. They set up administrative offices with competent staff, giving

them the authority to operate within their annual plans, under the direction of the regional head of certification. The RSBs accepted responsibility for the quality of the services provided, and they took responsibility for setting policies that promoted the development of the seed system in their region. Hence the RSBs became "boards of directors" for the certification offices.

Within another year, three more regions--Potosí, Tarija, and Cochabamba--formed seed boards, bringing the total to six. Later, a seventh was formed in La Paz, with an eighth board being contemplated for Oruro.

With the formation of each additional board, it was recognized that their structure and composition had to be tailored to local conditions. The overriding factor was the variation in the kinds of institutions that operated in the different regions in the country. This was true for public institutions, but even more so for private ones. For instance, whereas all the commodity groups in Santa Cruz were represented through the Chamber of Agriculture, in the Chaco and Chuquisaca few commodity groups existed. Instead, farmers were represented through an array of institutions, such as cooperatives and non-governmental organizations. Hence, members were added to the above list; the conformation and character of the RSBs evolved to fit the conditions of their area and stage of development. Particularly, private sector participation in most regions grew in proportion to the public sector. Eventually, the

concept of equality in participation emerged. Both sectors, private and public, were given equal representation in most instances.

### **Functioning of Regional Boards**

This was the first time that participants from the agricultural sector were given direct access to decision-making processes. Interestingly, though the nature of the regions varied widely, all the boards adopted similar policies in such critical areas as private sector participation and pricing. The public sector adopted a supportive role, promoting the development of seed enterprises, working in a highly competitive, market-oriented environment. The result was a positive marriage between the sectors, as well as a genuine spirit of public/private partnership emerging at the local level. Over time, this grew into a central/regional partnership as well.

Although not originally contemplated, RSBs felt compelled to become active participants in providing other services besides certification. For instance, credit institutions were ill prepared to service loans in the agricultural sector. They had to answer the following questions regarding their clients:

1. Were they really seed producers?
2. How much did each one grow?
3. What were the costs of production?

4. Where would the seeds be sold?

5. What were the terms of sale?, etc.

The certification services provided this information through the RSBs to the local banking institutions, thereby making the loan supervision process more meaningful and effective. A fee was charged to the banks for this service.

In some cases, RSBs took deliberate action to facilitate the development of market channels. In Chuquisaca, for example, the board authorized a marketing plan in conjunction with producers whereby wheat seed produced for shipment to Santa Cruz would be under the common label of "Chuquisaca Certified Seed." This concept varied from the usual system where the certification tag is separate from the brand name of the producer. The Chuquisaca and Santa Cruz Boards agreed ahead of time on the standards to be used in certifying seed in this fashion. The effect was that even the smallest of producers could channel his seed to a distant market, provided he could meet the quality standards agreed upon; and the name "Chuquisaca seed" become a sign of excellence in wheat.

Another area where some seed boards became involved was in taking responsibility for seed conditioning services in regions where only one plant existed. These plants were previously operated by the central government. Operating funds were often limited, and management was not able to respond to the dynamic

conditions of the local seed sector in a manner consistent with regional objectives. The RSBs provided a mechanism to decentralize the management of the plants. This became possible as a result of a decision by the Ministry of Agriculture to transfer the physical assets of the Seed Department in each region to the boards. This decision reflected the fact that the RSBs were becoming capable organizations and that the concepts of farmer participation and regional autonomy were generally well understood and accepted. In most cases, the boards did not hire personnel to manage the plants but, rather, identified another local entity to operate the plants under the supervision of the RSB. Rent charged for use of the plants was used by the RSBs to help finance other services.

## CONSOLIDATION OF THE NATIONAL STRUCTURE

Interestingly, as the regional seed systems developed, so did the need to coordinate among them. First, the momentum gathered in some regions stood in contrast to other regions where local initiative had not provided the necessary impetus. The uneven nature of regional development created a situation of conflict. Some regions were now able to command more resources than others to hire personnel and implement services. Salary levels paid to certification personnel, for example, were now higher in three regions than

in the others. No system for allocating resources, both human and financial, existed to assist the remaining regions in the country in catching up with the first three.

Secondly, no mechanism existed for working out differences among regions and agreeing on common strategies (e.g., uniform quality standards for different crops across regions). In addition, the need to coordinate the activities of different international donors with local institutions and programs was also cited. The seed sector lacked a unified voice to represent it.

Third, although many leaders in the agricultural sector were aware that the program was achieving positive results, few had any first-hand understanding of its organization or magnitude. The vast majority of leaders outside the sector was not aware of the program's existence. In order to gain a greater degree of political support, the need for national coverage was felt.

Another area of concern that continued to emerge centered around the need to better define the functions and authority of the National Seed Department and the autonomy of operation of RSBs at the regional level.

### **Linking Regional and National Leaders**

In order to bring the leaders of various regions together, a national Round Table on Seeds was organized in Cochabamba in 1983. Members of the three existing RSBs attended, along with interested persons from three

other regions of Bolivia. Also attending were national officials of the Ministry and representatives of donor institutions. One purpose of the meeting was to evaluate the progress made in different regions and to develop action plans for the following year.

Ministry policies affecting the seed sector were examined, and international donor organizations explained the kinds of support they provided. The round table allowed resources to be more wisely programmed according to the needs of each region. It also provided an opportunity to share experiences among regions, define common problems, and suggest solutions. A more unified focus for seed industry development began to emerge. The event was considered so helpful to the sector, that annual round tables were held in subsequent years. This yearly round table, became a means of evaluating progress and setting goals for the program.

### **Formation of the National Seed Board**

The desire to form a national organization had been expressed in both the first and second annual round tables. However, it was felt that the regions needed time to move their programs forward before creating a national structure to coordinate among them. It wasn't until the Third Round Table on Seeds, held in Sucre, that a resolution was passed forming the National Seed Board (NSB). The concept was to not to create a separate structure, but rather to unite and

consolidate the regional boards into a unified whole.

The NSB was made up of two representatives from each regional board, one from the private and the other from the public sector, plus the head of the National Seed Department of the Ministry of Agriculture. This was consistent with the concept of equality of representation between the private and public sectors that evolved for the RSBs. The first meetings held by the group pointed to the lingering conflict between two opposing view-points: one favoring private participation and regional autonomy, and the other inclined toward centralized control in a public institution. Reaching a consensus on this issue was essential to the operability of the NSB and to achieving a consistent national organizational framework.

To stimulate a dialogue in this regard, a series of seminars was held among members of RSBs and other leaders in six regions. Participants discussed the organization they saw as most desirable for Bolivia. All of the regions coincided with the participatory approach, decentralized at the regional level. However, in subsequent meetings of the NSB, the diverging views persisted. The issue was settled when the subsecretary of agriculture, speaking in behalf of the Minister, stated that decentralization of public functions was a deliberate policy of the Government of Bolivia, and that this strategy should be adopted and written into a new seed law for the country.

### **Formulating a National Seed Law**

Shortly thereafter, the NSB drafted a new seed law for the country. It provided a cohesive legal framework transferring authority and responsibility to the regional seed boards. By approving the law, the Ministry of Agriculture would officially recognize the RSBs as having the authority to certify seed; it would transfer to them the right to collect funds, select personnel, and provide services, and would transfer the property of the Seed Department in each region to the RSBs. It is evident that the boards were already carrying out most of these activities, but without having the assurance of clear, stable national policies to support their actions. The National Seed Department of the Ministry would become a normative office, providing support and orientation. The functions of the NSB were oriented toward supporting the regional programs, but not directing them.

The law met with the approval of all six regional delegations. Later the Minister of Rural Affairs and Agriculture signed Ministerial Resolution Number 443/86, putting the law into effect while it was being considered in the National Congress. Its passage can be considered the culmination of a long process of reaching understanding and agreement on major issues.

### **Functions of the National Seed Board**

Only after the law was accepted and put into practice, did the NSB become

operative. A coordination unit was established with two staff members to carry out the instructions of the NSB. The persons who filled these positions had been active in the development of the seed program since the early stages, and were able to provide a measure of continuity. The unit is housed in the Ministry of Agriculture building in La Paz, together with the National Seed Department, where both work hand-in-hand. In his annual report, Mr. Jorge Rosales, national director of the Ministry's Seed Department, commented:

*"It is worth emphasizing the importance of the constant coordination between the National Seed Department and the Coordination Unit of the National Seed Board, where both are always seeking a common objective:*

*"Increase the production and use of certified seeds in the various regions of the country." (MACA, 1987)*

One of the most important functions of the NSB was to publicize the importance of the seed sector in Bolivia. A video tape was produced in 1985 for the national TV. It depicted the stages in the seed multiplication process and demonstrated the importance of the activity in Bolivia. The video was widely shown by various TV channels in Bolivia, and also distributed to other countries in Latin America. With this impetus, other events began receiving more coverage by the local press--radio, TV, and newspaper. Press coverage included

short courses, results of seminars and board meetings, and interviews with seedmen and sector leaders. A second full-length TV program was produced by a local station in the later stages of the program. Over time, the visibility of the seed system within the agricultural sector became evident. The institutional model of the seed system, in particular, was often referred to by officials and leaders as a model for the entire agricultural sector\*.

Another vital function of the NSB was to work with financial institutions to set up special lines of credit for seed production, and especially for distribution. Credit requirements were prepared with input from RSBs at the request of financial institutions, such as the Central Bank and the PL-480 program office. When the funds available through these special lines were insufficient to cover the needs, it fell to the NSB to determine priorities among crops and regions. This was done in an open forum of discussion where interested parties were represented.

The board negotiated the terms of the fees which were charged to commercial banks for providing information on seed producers and distributors to facilitate loan supervision. The PL-480 program agreed to pay three percentage points for this service, reducing the amount paid to the commercial banks. The

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\*Personal communication, Dr. Guillermo Justiniano, Minister of Agriculture in 1988

seed grower paid the same interest rate as before. Only one-third of the funds collected remained in the region where the loans were given, and two-thirds went to the national level. Most of the funds collected for the NSB were used to support the coordination unit. PL-480 provided additional support for regions where seed production was in its initial stages of development. These funds were disbursed through the NSB's coordination unit.

National and foreign organizations coordinated technical assistance and training for the seed sector through the NSB. For instance, candidates for scholarships were no longer presented directly by each interested organization to donor institutions. Instead, opportunities for training were announced by the NSB to the regions. RSBs recommended candidates based on priorities set for local programs, and then presented the candidates to the donor institutions, working through the NSB. Equal priority was given to training personnel in the public and private sectors. The Board also channeled requests for technical assistance by acting as liaison among the regions and preparing development plans for presentation to the Ministry of Agriculture.

Finally, the board sponsored special events, most notably the annual round tables. The round tables were week-long conferences; business meetings were mixed with visits to fields and tours of local seed facilities. Technical presentations on seed technology and seed program development were introduced beginning

with the Third Round Table. Each local seed council extended invitations to selected leaders in its region and chose the persons to receive financial support in order to attend. The Fourth Round Table, held in 1986 in the city of Yacuiba in the Gran Chaco, had nearly 130 registered participants. The Fifth Round Table was held in the city of Potosí.

## SUMMARY

The success of the seed programs can be attributed in great part to the formation of regional seed boards. The boards provided a vehicle for local leaders and participants in the seed supply system to interact on program development strategies. They permitted taking advantage of the comparative strengths of private and public institutions at all levels, and provided continuity of institutional support for development of the seed industry.

Opening the door to private sector participation in the formulation of policy seemed like a drastic step in Bolivia at the time. It was a first experience in the agricultural sector where the private and public sectors were integrated into a working mechanism oriented toward a common objective. The evolutionary process that followed led to a sustainable model based on policies favorable to the development of seed enterprises in the private sector. Increasing amounts of funding were available to cover the operating costs of key services.

The seed law was drafted only after reaching a consensus on the basic structure. Though the law was vital to forming a cohesive legal framework in which to operate, much had been accomplished before it was drafted.

The bottom-up approach to decision making may not be the only way to develop seed systems and put them in motion. Each situation is different. In the context of Bolivia, it was a logical path to follow to gather support from the farmers and farmers' organizations. The bottom-up approach is certainly not exclusive; efforts to provide a positive environment at the national level was also essential.

Many Latin American countries

contemplate the existence of seed boards in their laws. The effectiveness of the mandate found in these laws, however, is often low because most of them are exclusive to the public sector and the national level. This approach misses the opportunity to join forces with the private sector. The expected result may be inappropriate policies, lack of cooperation, and sometimes friction. The Bolivian experience demonstrated that war is too important to simply leave it to the generals making decisions in the capital city. Many developing countries have a great deal of room to improve in the organization of institutional support for the seed industry.

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## CHAPTER VIII

### PROGRESS ACHIEVED AND ITS IMPACT

The previous chapters explained how a seed supply system was developed through a new approach that opened the door to the formation of a large number of small enterprises and a dynamic seed industry. Linkages with research, especially plant breeding and variety testing, were shown. However, investments in research and seed programs are only worthwhile if the farmer ultimately gains access to the new technology and applies it to his/her particular farming situation. This chapter provides a broader analysis of the process of adoption that occurred through the development of a seed program. It then summarizes the major impacts that was in evidence as the seed system evolved, and describes the overall magnitude and importance of the economic impact in the context of Bolivia.

#### INTERDEPENDENT EXPANSION OF SUPPLY AND DEMAND

It may seem curious that in the late 1970s the market for seed in Bolivia was apparently satisfied with only about 200 tons of locally produced seed and around 1450 tons of imported seed while two years later it increased to 1000; four years later to 3000; six years later to 6000; and eight years later to 10,000 tons/year. These amounts were being utilized by farmers and the market was

still unsatisfied. What caused this phenomenal growth in the acceptance of seed by the farmer? Since the analyses in previous chapters treat each component or function of the seed supply system separately, the factors that caused the market to expand have not been fully examined. The sequence of events summarizing the process of market expansion may be diagnosed as follows:

1. Farmer organizations recognized that they should play a major role in helping their members obtain inputs, including seed. They soon found it was more practical and less costly to have the seed produced locally, rather than imported. These organizations provided the resources to increase salaries and maintain competent personnel for regional certification services.
2. The backing of these organizations and the dedication of the personnel in the certification services and conditioning plants offered initial credibility to the program.
3. Encouraged by their organizations some farmers tried the seeds and learned about the advantages of planting high-quality materials. Sometimes the improved yields and other features were due to new varieties. More often in the hot, humid tropics the advantages seen by the farmer were because of higher germination and plant vigor. In other cases, high-quality seed offered only means of protecting

fields from noxious weeds which were becoming widespread. In still other instances farmers found advantages in using uniform seed, in terms of variety or size of seed. Whatever the particular characteristics that caught the interest of the farmer, higher yields and better products were the result.

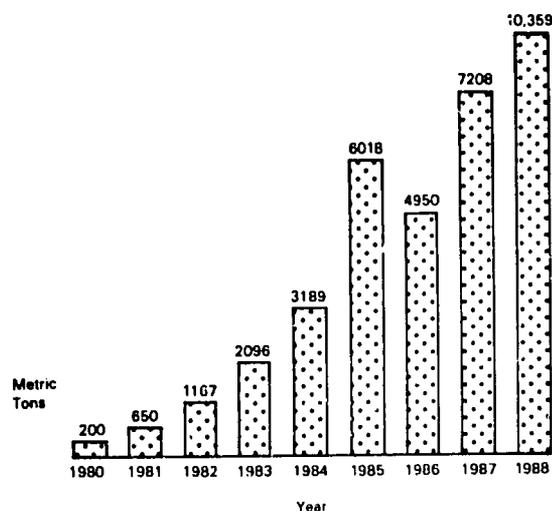
4. Other farmers saw the benefits obtained by the early adopters, and they identified the high-quality seed with the certification label. Use among farmers became widespread for seed of the lead crop. With the expanded market, more growers began to produce and distribute seed.

5. Farmers became interested in obtaining high-quality seeds of other crops. Growers produced and distributed them under the same quality assurance program. Again, these seeds were identified with the certification label. In Santa Cruz, corn and wheat entered the program after soybeans; these were followed by rice, cotton, and sorghum. In the Gran Chaco, soybean was followed by corn, cotton, and wheat. In Chuquisaca, wheat was followed by barley and potato. Other regions were expanding in potato, corn, wheat, forages, and other crops.

It can be seen from the above that demand increased in response to farmers experiencing the advantages of using high-quality seed, and supply then increased in response to greater

demand. The levels of production of major seed crops between 1980 and 1988 are shown in Figure 5.

Seed prices were unregulated. Prices tended to rise at times when farmers first recognized the benefits of using high-quality seeds, and lowered when supplies became adequate to meet the demand. Rice seed provides an interesting example in terms of the interaction of supply and demand, and the influence of prices. Production of



Source: Regional Seed Certification Services and National Seed Department of MACA.

a Only seed produced in regions following the approach described in this document is included in the figure. About 1,000 tons of forage and potato seed produced by two seed companies in Cochabamba should be added to the total in 1987 to come to the total amount of seed produced in Bolivia. These companies were developed under a different approach where foreign donors invested in each of these seed companies directly. However in 1988 both companies joined the certification program with a combined production of more than 1500 metric tons.

Figure 5. Production of certified seed in Bolivia<sup>a</sup>. (Includes all established seed classes.)

rice seed remained at a level of about 160 metric tons per annum between 1982 and 1983. Likewise, prices stayed around US\$350 per ton, just above the price of grain at planting time (which tended to be high because of scarcity at that time of the season). Demand for seed was weak for several years, but suddenly picked up when farmers recognized the benefits of using high-quality seed. In 1986, demand for rice seed suddenly jumped, and the price shot up to more than US\$700 per ton. The 275 tons supplied were not sufficient to meet the demand. The following year, seed producers responded with a harvest of 653 metric tons of seed, distributed among various classes reflecting their quality. Price for seed again fell, this time to about US\$400 per ton. Only the highest quality seed was sold; perhaps 30 percent was left over.

This experience provides an example of how free market forces adjusted in a stepwise fashion: when farmers recognized the impact of good seed, demand jumped, as did the price. Several competing seed producers responded with greater volumes. The farmer learned to choose between higher and lower quality seed, preferring the former, even at higher prices. The price then stabilized at a level that compensated the seed producer for the cost of producing high-quality materials.

In most instances, the decision to purchase and use good seed of established classes was made independently by farmers (more precisely, by farm families). There

was no general policy tying seeds to credit. In some other countries, in order to obtain a production loan, a farmer must show that he has purchased seed. There were cases where organizations, such as cooperatives and non-governmental organizations, formulated internal policies promoting the use of seed. Some of these probably required their members to purchase good seed as a condition to receiving other kinds of support. But these were isolated cases, and did not represent a consistent policy followed by the seed program in any of the regions.

Free market forces were largely at work, with limited direct governmental intervention. However, this does not imply a haphazard approach having no direction or goals. Many actions were taken to promote the development and evolution of market mechanisms. For instance, organizations involved in the seed supply system regularly shared information and coordinated production plans through their participation in regional seed boards. Market information was kept up to date and made available continuously by certification services. This constant and open interaction had the effect of directing energies to seed classes and crops where demand was greatest, eventually stabilizing supply to match the demand.

## **ADOPTION OF IMPROVED VARIETIES**

Before 1980, farmers had few cultivars available to them, despite the availability of recommended varieties at

the gates of agricultural research stations. Some of the varieties recommended, such as CICA 8 in rice, had long been in commercial use in other countries, but none was available to Bolivian farmers. A seed system was the missing link. Once the system was in place, many varieties that previously had been introduced, tested, and recommended by local research centers started flowing to the farmer (Table 8).

With the functioning of a seed system, there is faster and greater mobilization of more varieties from the research stage to the farmers' fields. The farmers learn to seek better and more efficient varieties for their farming systems. However, the system permits the utilization of improved varieties without forcing farmers to change their

traditional cultivars. Clearly one impact is the availability of a wider range of varieties and the choices this represents for the farmers.

## AREA COVERED AND INCREASED PRODUCTIVITY

Rigid production goals were not set by regional seed boards on a long-term basis. It was felt that rigid production goals might distort the efforts of some institutions, causing them to over-emphasize meeting target volumes to the detriment of seed quality. However, each year, all the RSBs and also the NSB reviewed the results of the previous season, and helped each participating institution formulate production plans for the next year. Over time, these year-to-year production plans formed a trend, from which initial short-term goals and long-term goals may be surmised. The result of this analysis is reflected in Table 9. In general terms, short-term goals refer to the 1980s while long-term goals imply the following decade.

The initial goal for most crops would be reached when 10 percent of the area planted nationally is planted with certified seed, implying seed of any of the established classes. For soybean and cotton, the short-term goal is set at 100 percent, and for potato, only 5 percent. The second to the last column shows that these initial goals are being met for soybean, corn, and rice, and--to a lesser extent--for wheat and cotton. Barley (grain, excluding

Table 8. Varieties commercially available to farmers in 1980 versus 1987.

Crop	1980	1987	Source of introduction to Bolivia
Soybeans	Mandarín	UFV-1	Brazil
	Pelicano	IAC-8	Brazil
		DOKO	Brazil
		CRISTALINA	Brazil
Rice	Bluebell	Bluebell (improved)	United States
	Bluebonnet	Bluebonnet (improved)	United States
	Pico Negro	Pico Negro	Local ecotype
		CICA-8 IK 1529	CIAT, Colombia
Wheat	Jaral	SAGUAYO	CIMMYT, Mexico Chile
		MILLALEU	
Corn	Cubano	Cubano Amarillo	--- CIMMYT, Mexico
	Amarillo	SWAN SAAVEDRA	

Source: Regional Seed Offices of MACA.

Table 9. Initial and long-term goals achieved by the Seed Program in Bolivia, 1987.

Crop <sup>a</sup>	Total area planted in Bolivia (ha)	Target area to be planted with good seed		Area covered with 1987 seed crop (ha)	Goal achieved	
		Initial (ha)	Long-term (ha)		Initial (%)	Long-term (%)
Soybeans	60,518	60,518	60,518	60,518	100	100
Corn	348,972	34,897	69,794	32,850	94	47
Rice	112,792	11,279	22,558	10,883	96	48
Wheat	100,242	10,024	20,048	6,044	60	30
Cotton	10,213	10,213	10,213	6,636	65	65
Barley	94,307	9,431	18,861	80	1	0
Potato	163,108	8,155	16,311	190	2	1
Minor crops <sup>b</sup>	66,693	6,669	13,339	455	7	3
Total	956,845	151,186	231,642	117,656	78	51

a. Forages and potato seed produced outside of the certification program are not included.

b. Minor crops include oats, quinoa, common bean, garlic, safflower, rye, and peanut.

Source: Composite from information provided by Regional and National Seed Boards.

barley for forage), potato, and minor crops have scarcely been affected. Hence, the progression from lead crops to other crops is apparent. Overall, 78 percent of the initial goal had been met by 1987. There is little doubt that the short-term goals will be met for most crops by the end of the decade.

Turning to long-term goals, which generally apply to the following decade, it is apparent that the seed program in Bolivia has a long way to go before it reaches maturity at the national level. Indeed, some regions were just beginning to organize seed supply systems in 1987. Potato holds the future as a lead crop for many of the valley and highland regions. A goal was discussed by national leaders of increasing average potato yield by 60-75 percent over the next decade, based on

better seed and better varieties. This would be achieved by providing high-quality certified seed for 10 percent of the area planted in the country. Most farmers using certified potato seeds multiplied these materials for their own use and also distributed to neighbors. A foundation seed program was being organized in Cochabamba and several community-level programs were being formed in Chuquisaca, Potosí, and Tarija to provide assistance to farmer organizations for potato seed production.

The most dramatic impact on productivity at the national level so far was obtained in soybean, the crop in which the seed program has been operating the longest time. National average yield increased from about 1200

kilograms per hectare to over 2000 from the 1970s to the 1980s. In recent years, it is not uncommon to find soybean fields yielding over 3000 kilograms per hectare. In most crops, national statistics gathered by the Ministry of Agriculture did not yet reflect much of the recent impact of the seed system. However, inferences can be drawn from experience in some of the regions. For instance, corn growers using good seeds usually averaged 40 percent over their previous levels. It should be noted that in Bolivia most growers do not use fertilizer on their crop.

Farmers using good rice seeds roughly doubled yields, from two metric tons per hectare to more than four. Rice farmers in the better areas often obtained more than six tons using good seed. Of more significance to some rice growers is freedom from 'red rice', a wild type of rice which constitutes a noxious weed that was spreading rapidly due to lack of weed-free seeds.

Many growers still have to switch from growing rice to other, less profitable crops in fields infested with red rice. By purchasing seed produced under a quality assurance program, growers might be able to avoid spreading the weed to additional fields.

Wheat yields in the high plains and valleys increased from 700 kilograms per hectare to about 1100 kilograms among farmers that adopted new varieties and used good seed. But more importantly for wheat growers, they were able to obtain a uniform group of varieties desired in the region, for both home consumption and for sale to flour mills.

Area planted to wheat in the lowlands during the winter season also expanded from only 2,000 hectares to more than 12,000 hectares, because good seed was available from valley regions. Before the wheat seed program, the Government of Bolivia provided credit for up to 10,000 hectares of wheat for the winter planting in the lowlands, but the Ministry's Seed Department could never provide the seed. Based on the new development, leaders in Santa Cruz now project that the region will be self-sufficient in wheat in another three years. The most interesting feature on wheat seeds was that high-quality seeds in the highlands were produced by small farmers who supplied the seeds at attractive prices to large farmers in the eastern lowlands.

In addition to formal channels, other informal exchanges of seeds worked effectively to pass on seeds of the varieties from farmer to farmer. This was the case in wheat, corn, and rice, especially in the drier years where drying and storage were not serious problems. The situation with wheat in Chuquisaca is of interest. The hundreds of small farmers participating in the process normally sold half of their production to seed enterprises, while the other half was saved for household consumption. In a few years the whole region was planting the new Saguayo variety. This demonstrates that seed saved by farmers moving through traditional channels does play a key role in the dissemination of improved varieties. Having not had the initial influx of seeds of new varieties through an

organized system, the informal spread of seeds from farmer to farmer would not have been possible. In conclusion, in this specific situation both formal and informal (traditional) seed supply systems were at work.

## ECONOMIC AND SOCIAL BENEFIT

The benefit of a seed program is to increase productivity. The agricultural sector, being more productive, is able to produce more and better products using the same amount of resources, or it can use fewer resources to produce the same amount of agricultural products. In a competitive farming situation, farmers' profits are usually short-lived. Instead, the benefits are passed on through the economy, to agroindustry and consumers. If the products are exported, or replace imports, the balance of payments

improves and the average consumer again benefits from a favorable trade situation.

The overall magnitude of the impact of the Bolivian Seed Program on productivity in the agricultural sector can be measured by taking the increases in yields associated with high-quality seed multiplied by the area covered for each crop, times the value of the commodity. As seen in Table 10, high impact on yields was evident in three crops in 1987--rice, corn, and soybean. More modest results were seen in wheat and potato. Still, the overall impact on productivity is sizeable, compared to the investments made in the program.

Table 10 on the following page, indicates the overall gross effect on productivity, i.e., on yield per hectare. It estimates increased production that could be obtained using

Table 10. Overall impact on productivity of the seed program in Bolivia, 1987.

Crop	Area covered with 1987 seed crop (ha)	Estimated yield impact of seed (t)	Local commodity price (US\$/t)	Total value (US\$000)
Soybeans	60,518	0.8	140	6,778
Corn	32,850	0.9	125	3,696
Rice	10,883	2.0	300	6,530
Wheat	6,044	0.4	150	363
Potato <sup>a</sup>	190	2.7	200	102
Total				17,469

a. Potato seed produced outside of the certification program is excluded.

the same resources as before but having changed to high-quality seed. However, the production levels in the country did not necessarily increase by these amounts, because demand for the commodities may not have warranted such an increase. In most cases, notably wheat, soybean, and corn, production did in fact increase. In others, increased efficiency meant using less land and resources to produce that crop and dedicating more resources to other crops as well.

The 17-million-dollars-per-year impact on productivity compares favorably with the investment from foreign sources in supporting the program, which was about one million dollars per year over six years, coupled with a contribution of the Bolivian Government of about US\$250,000 per year.

Another obvious impact of the Bolivian program was the amount of private investment stimulated. Chapter VI indicated that a surprisingly large number of seed enterprises emerged--a total of 55 in the three regions. Besides growing seed in their own fields, these enterprises contracted with more than 500 cooperating seed growers. In addition, the National Seed Department's Annual Report of 1988 showed 160 registered distributors, including the seed enterprises mentioned above, as well as importers and other input suppliers that handle seed.

Annual sales of locally produced seed were nearly four million dollars, with the average sale per enterprise being around \$70,000.00. Therefore,

all the enterprises formed in Bolivia are indeed small- and medium-scale.

Individual seed growers received about 40 percent of the final sales revenue, making their average annual gross income from seed production only about US\$3,200. Obviously, the majority of seed growers in Bolivia were small farmers.

Detailed estimates of costs were only occasionally available to compare with seed prices in order to determine net income to seed producers. Seed prices generally tended to go down over time as competition increased and volumes offered on the market covered most of the demand. Eventually, this led to prices that just covered costs, including direct out-of-pocket expenses and a reasonable return to the seed producer's own resources.

Operating costs also included most of the cost of technical assistance and certification, since these were paid for by the producer through user fees. As in the case of rice described above, the moments when seed prices greatly exceeded costs were short-lived. The supply response was usually quick and of a great enough magnitude to bring prices back in line with costs. Therefore, net income of seed producers consisted mainly of a fair return on their productive resources--land, capital, and managerial skills.

At the same time that seed production rose, imports declined. In 1985, soybean seed was no longer imported, cotton seed imports declined to 32 tons hybrid corn went down to 171 metric tons, and 104 tons of sorghum seed were imported. The total cost of

imports dropped from the US\$1,975,000 figure reported in Chapter III to US\$523,180. This came at a time of critical shortages of foreign exchange in Bolivia. Interestingly, in 1987, seed imports rose again, to 46 tons of cotton, 198 of sorghum, 277 of hybrid corn, for a total value of nearly one million dollars. This phenomenon is an interesting reflection of the growing demand, stemming from the recognition by the farmer of the importance of using good seed.

It is worth noting that the policies followed by the national government and by the NSB were designed purposely to promote free trade; therefore, imports were not discouraged. Quite to the contrary, imports of seed were welcomed when local production fell behind in quality or quantity, or when foreign production was more competitive in price. The only special requirement of the Ministry of Agriculture was that imported seeds pass local certification and phytosanitary requirements. However, all of the crops mentioned above--cotton, hybrid corn, sorghum, --had just recently entered the local system; therefore, some of the imports might still be replaced by local production.

In addition to becoming self-sufficient in edible oil production, agricultural exports from Bolivia also increased by around four or five million dollars per year as a direct result of the seed program. Bolivia became better able to compete in international markets. About 20,000 tons of soybeans were exported to Europe in 1987. Commercial imports of some crops

diminished, such as wheat from Argentina. Local prices of some agricultural commodities decreased in relation to other local products as a direct result of increased productivity.

In summary, a six-million-dollar investment from international institutions, along with a one-and-one-half million dollar expenditure from the Government of Bolivia, triggered an initial local private investment of perhaps five to six million dollars. These inputs have resulted in the production of four million dollars in seed each year, which has a 17-million-dollar impact on productivity. The national balance of payments was improved by over five million dollars per year. These results reflect the status as of 1987, only six years since the very early stages of seed program development. But the volumes of seed production are rising at a rate of about 1,000 metric tons each year. This implies that more than 10 million dollars worth of seed a year will be produced by the end of the decade, which in turn will have an impact of over 40 million dollars impact through increased productivity. As a result, local institutions and services are becoming increasingly self-sufficient. Needs for further investments from public and international sources are gradually declining for the crops that have strong seed production systems. In the context of Bolivia, a country where more than half the population is rural and most people make their living from farming, the evolving seed program is serving an increasingly larger percentage of the crop land; directly

or indirectly, this benefits a large portion of the country's population.

## **INSTITUTIONAL BUILDING**

Normally, the most obvious goals sought by seed programs are quantity and quality of seeds supplied, dissemination of more efficient varieties, and, naturally, yield improvement. These objectives are being achieved by Bolivia. However, one key question in every project-based seed development effort is whether the country can carry on with the development effort in a continuous and long-term fashion. Bolivia has demonstrated that it can do so. Furthermore, the country can do this at an accelerating rate. One thus wonders what the built-in driving force might be. When analyzing the case, one factor that stands out as the main contributor is the organization of the seed system. This system is based on the integration of public and private organizations, which leads to mutual support, efficient use of resources, formulation of cohesive plans and policies, and coordination. Linkages were developed among institutions carrying out the various essential functions of their seed system. Naturally, this integration permits a piling-up effect, with a greater accumulative effect. The results being achieved prove that an organized seed system can accomplish much more than isolated components trying to solve problems alone.

The principle of integrating existing local resources to achieve common goals

is readily accepted by leaders in most countries. However, this key principle is seldom put into practice. The most interesting discovery of the Bolivian Seed Program was finding a simple way to institutionalize this principle. This has been done by organizing seed boards. These boards were initially tested at a regional level in the first pilot region. Their success stimulated similar actions in other regions, which in turn triggered the formation of a National Seed Board. As described in more detail in Chapter 7, the process started at the bases and finalized at the top. This path is certainly different from many seed programs that are imposed from the top down. The seed boards seem to be the key feature that makes it possible to capture the richness in agroecological variations as well as the richness in research and development organizations throughout the country. This richness in diversity is also encountered in the National Seed Board.

The institutional model developed around the seed boards can be visualized as an important accomplishment in a seed development effort of a country because it gives an identity to a whole sector interested in seed industry development in a continuous fashion. This can be seen by briefly analyzing some of the following products arising from the presence of the seed boards.

1. Decentralization and regionalization.  
The seed program in the 1970s was based on central planning and seed production, distribution, and

certification based almost totally on the government. In contrast, the seed program in the 1980s is based on both the government and private sector at the regional and national level. The existence of regional seed boards has automatically resulted in decentralization. Local research and development organizations have an input in policy development, planning, orientation of key services, and other actions considered necessary for the agricultural system in each region. This permits addressing concerns in a country with highly heterogeneous needs. The product of decentralization is naturally autonomy at the regional level. This has been a key ingredient in the focus on specific local constraints and innovation from the bases.

2. Efficiency in resource identification and utilization. Resources are never enough and institutions do compete for them. Joining strengths among several organizations linked in a seed system, where they share a common objective, is facilitating two major products: the flow of resources within the seed system and the flow of resources from outside into the system. One clear example of the first can be seen in the flow of financial resources from seed enterprises toward the seed certification service. This has assured continuity of its quality assurance service, which could not have been developed based only on ever decreasing government

funds. Obviously, in an integral system, strong institutions do compensate for the weakness of other institutions, resources flow across components of the seed system, and institutions specialize in areas of their competitiveness. The end result within the system is synergism.

An example of the second product is the flow of financial resources to the system to make possible production and utilization of seeds and the flow of foreign technical and financial assistance for new seed development projects. Evidently, the new organization permits a flow of resources to a system where impact and social returns are more likely due to the presence of an organized seed system.

3. Cohesiveness in plans and policies. The participatory nature of the seed boards is conducive to the development of plans and policies based on input from interested parties. This facilitates reaching consensus at the planning level on issues of local and national concern. Participation in the planning stage is essential for the commitment of participating leaders, their institutions, and their resources. This contrasts with plans and policies sometimes conceived in a vacuum by a single government institution. Consensus in the planning phase facilitates coordination, which is a chronic problem among the following:

research and development institutions; government and private institutions; seed producers and seed users; and institutions dedicated to human resource development, such as universities and production organizations, etc. Yet, in an in-depth analysis, these organizations have some common objectives. They share objectives far beyond the generation and transfer of technology, and they need to work together to improve their effectiveness. The formation of regional and national seed boards, where these organizations take part, is therefore a good mechanism to coordinate functions of an integrated national system.

4. Flexibility. Challenges and difficulties abound in seed industry development. Problems arise because of the diverse institutional composition of a seed system; differences in needs and resources among regions; variations in needs among large commercial and industrial farmers and small farmers; and the dynamic nature of the seed industry. The seed industry in soybeans has reached a well-developed stage. Crops such as corn, rice, and wheat are still in early stages of development. Systems for potatoes are in the process of initiation. Indeed, there is a diversity of situations within a country.

These challenges normally cannot be clearly focused unless the seed

system is flexible. Participation obtained in regional and national seed boards is providing this feature of flexibility. One clear example is the new focus on potato seed production for small farmers of valleys and highlands. The ability of seed boards to adjust their focus and evolve to address new needs may hold the key to their contribution on a long-term basis.

5. Stability. The future does not necessarily need to be the mirror image of the present, but a seed program cannot be developed by constant detours either. Stability is needed to assure an attractive scenario that could invite public and private investment. Stability is also essential for the continuity of government functions in the seed system, and to attract productive and innovative human resources to the system and maintain them in it. The new pragmatic organizational model of the Bolivian seed sector, not pretending to be insensitive to political changes, seems to give the seed industry needed relative stability.

In summary, the institution building based on seed boards of the Bolivian Seed Program and the integration of government and non-government resources are regarded as positive results with potential long-term implications. These boards have facilitated identification of constraints, design of action plans tailored to solve those constraints, and identification of resources needed to carry out future

plans. Furthermore, this mechanism is facilitating the gathering of financial and political support for the seed system as a whole. Participation by a wide range of institutions, involving

government and non-government ones, has been the most important accomplishment of the Bolivian Seed Program in the end. This is regarded as a key ingredient that is setting the seed industry in motion.

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