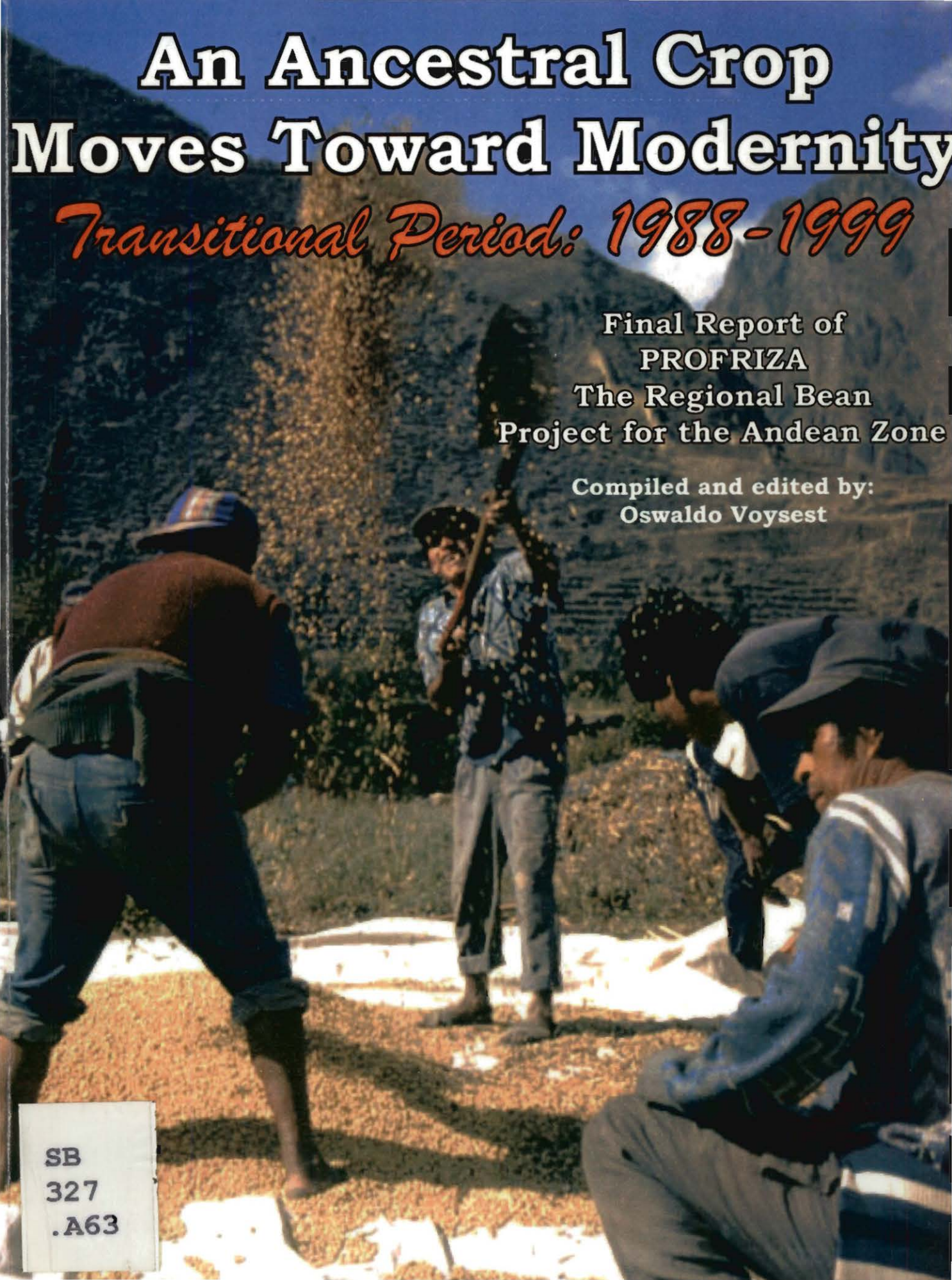
An Ancestral Crop Moves Toward Modernity

Transitional Period: 1988-1999

Final Report of
PROFRIZA
The Regional Bean
Project for the Andean Zone

Compiled and edited by:
Oswaldo Voysest



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Proyecto Regional de Frijol
para la Zona Andina
PROFRIZA

COSUDE
AGENCIA SUIZA PARA EL DESARROLLO Y LA COOPERACION

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Contents

Page

Preface

Mission accomplished!

To increase bean productivity in the Andean Region, the Regional Bean Project for the Andean Zone (PROFRIZA, its Spanish acronym) was created through an agreement made between the Government of Switzerland, represented by the Swiss Agency for Development and Cooperation (SDC), and the International Center for Tropical Agriculture (CIAT). From its beginnings in 1988, PROFRIZA operated as a regional project of CIAT's Bean Program until June 1998, when the SDC began managing PROFRIZA. In December 1999, PROFRIZA ceased operating as a regional network. As of 2000, a new strategy will be followed: the SDC's regional offices in Bolivia, Ecuador, and Peru will draw up bilateral agreements with national programs in these countries to carry out activities that will lead to the fulfillment of the project's original mission. CIAT will provide technical assistance.

When a mission has the ambitious goal of *contributing to the economic, social, and ecological development of bean-growing areas of the Andean Region*, it seems presumptuous to announce that the goal has been accomplished; more so when even the most untrained field observer can perceive how backward and deplorable living conditions still are in most rural areas of the Americas.

We should not forget, however, that the inevitable tasks that we committed ourselves to fulfill had to be accomplished within fixed periods. In the last resort, fulfilling our mission consisted in making contributions, fruit of those tasks that we ourselves proposed to carry out within the time periods agreed upon. The obvious dissatisfaction about how much was *not* accomplished and the new circumstances that could have arisen in that attempt are the new challenges that will have to be faced under new time periods, and with new strategies and actors.

To ensure that the poor find the path to well-being is the work of many, each doing his or her part. This report outlines PROFRIZA's participation in that effort, and the catalytic effect its contributions had. The project's most direct contribution was the development, identification, and dissemination of improved germplasm—new varieties that are more efficient in several ways. This new technology promoted changes in several areas, even outside the field of production, because of the commitment of those institutions leading the bean project in several countries. These institutions are the "Gabriel René Moreno" Autonomous University (UAGRM, its Spanish acronym) in Bolivia, the Colombian Corporation for Agricultural and Livestock Research (CORPOICA, its Spanish acronym) in Colombia, the National Autonomous Institute of Agricultural and Livestock Research in Ecuador (INIAP, its Spanish acronym), and the National Agrarian Research Institute (INIA, its Spanish acronym) in Peru until 1995, when it was replaced by the Exports Promotion Commission (PROMPEX).

These institutions not only achieved in committing other institutions of diverse interests to participate to varying degrees in the project, but also succeeded in turning PROFRIZA into a broad-spectrum regional network. CIAT's technical assistance and the SDC's financial support were decisive in helping a native crop, eaten and valued by the poor, to receive the attention it deserved, but was often denied on behalf of—paradoxically—demand.

The present report outlines PROFRIZA's achievements during 12 years of work, years that were decisive for the bean crop's modernization. In the late 1980s, any reference to bean in the Andean Region was commonplace, always alluding to its importance as a "poor man's food" and as the exclusive resource of small farmers.

Bean is still what was then, an inexpensive protein, a "meat of the poor", and the object of many other unsavory expressions. But today it is also a crop that is seeking its own niche in the modern world. The bean enters the new century with a new image in the Andean Region: as a competitor with other products for new openings in national and international markets. Bean farmers also have a new mentality; they no longer want to simply grow beans, but they also want to link themselves, somehow, to the commodity market.

How did this happen? In this report, we will illustrate PROFRIZA's participation in this process. You will read about how a cardboard box containing 10 kg of beans and arriving in Bolivia in 1978 from Colombia, could, 20 years later, turn into thousands of tons shipped from Bolivia in metallic containers to five different countries. You will read how Peru, against all statistical trends at the end of 1980s, converted forecasted deficits into impressive surpluses during the 1990s and is today an exporter. You will also find out how Ecuador changed the panorama for beans in the highlands by introducing bush varieties; and how Colombia compensated its loss in productivity, for explicable reasons, by increasing the area planted. You will see how, during this decade, societies, farmer associations, and new bean programs arose. And, when you finally read how the poor of the Andean Region now no longer suffer from a lack of beans and, moreover, benefit from surpluses, then you will understand why PROFRIZA can say "Mission accomplished!"

Oswaldo Voysest Voysest
Regional Coordinator

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Purpose and Objective

Purpose

To contribute to the economic, social, and ecological development of bean- growing areas of the Andean Region.

Objective

To generate and disseminate technology and mechanisms that will improve bean production and marketing in the Andean Region.

Specific Objectives: First Set

- To increase bean production to guarantee food security for the populations of the Andean Region.
- To increase bean productivity within existing cropping systems so that farmers may improve their incomes.

Results

Production

At the end of the 1990s, all countries showed sharp increases in production, especially during 1995-1996. The Andean Region increased its share in the Latin American bean production from 3.5% in 1964-1966 to 5.2% in 1997-1999 (Appendix E, Table 23), despite the devastating effects of the "El Niño" phenomenon in 1997-1998.

The annual growth rate of production during the 12 years of the PROFRIZA project ranged from 2.7% and 4.3%, depending on the country. In the Andean Region overall (i.e., Bolivia, Colombia, Ecuador, and Peru), this rate reached 15%. Impressive production levels were reached during 1994 to 1996—16.9% for Bolivia, 14.9% for Peru, and 8.7% for Colombia, contrasting with the negative values for Latin America as a whole (-4.5%; Appendix B, Table 27).

The growth rate of bean production during 1988-1999 was higher than that of the population during the same period. In three countries it was even higher than population growth rates during 1964-1975 (*compare* Tables 27, Appendix B and Table 28, Appendix C).

Bolivia is a unique case. Bean production has increased impressively since the 1980s, when the area planted to bean was an insignificant 670 ha, to 1999, when 20,000 ha were planted (Table 6).

Area Planted
Because bean is used as a rotation crop, the increase in area planted to beans is a very important criterion when measuring research advances. Increased area is used as an index of the efficiency of released varieties or of an attractive market.

All countries recorded significant increases in the area planted to beans, especially Peru and Bolivia during 1997-1999 (Appendix B, Table 24). Figures agree with the high growth rates (12.8% and 21.2%, respectively) shown by both countries in the previous 3 years (Appendix B, Table 27).

Yield
Bolivia had an important take-off between 1994 and 1999 (Table 6); Colombia maintained a steady increasing rate throughout the period (Table 18); and Ecuador and Peru maintained relatively stable figures throughout the period (Appendix B, Table 25).

When specific regions are considered, significant increases in productivity can be observed. For example, in the Peruvian coastal regions, yields of more than 1000 kg/ha were easily recorded (Appendix B, Table 26).

Productivity levels increased by 15% between 1997 and 1999 in the production areas of Chuquisaca and Cochabamba in Bolivia, and, in Santa Cruz, productivity increased by 8% as a result of the use of new bean varieties.

Varieties
New varieties account for most of the progress made. Between 1988 and 1999, countries released 50 new varieties that were disease resistant and had other agronomic advantages such as early maturity, erect growth habit, commercial grain types, and, in the case of climbing beans, less aggressive growth.

Bolivia released 8 varieties (Table 10), Colombia 12 (Table 20), Ecuador 14 (Table 17), and Peru 17 (Tables 12 and 13). Between 1996 and 1999 Peru identified 12 varieties with export-type grain that were released to farmers (Table 14).

Adoption of New Technologies

Bolivia
About 80% of farmers use improved varieties. During 1994-1996, 72% of bean farmers stopped planting 'SEL 1' in favor of the improved variety Carioca Mairana.

Of the area planted to beans in the Santa Cruz Plains, the Chaco Plains, and the northern valleys of Bolivia, 95%, that is, 18,000 ha, are sown with improved varieties.

Colombia
Colombia has been characterized as a technology exporting country: 11 varieties, first developed in Colombia, are now planted in 20 countries of Latin America, North America, Asia, and Africa (Table 19).

Of the area planted to beans in the Department of Santander, the fourth largest bean-growing region of the country, 70%, that is, 5000 ha, are planted to improved, anthracnose-resistant varieties.

Ecuador
Of the area planted to bush bean in the northern and southern highlands, 70% (i.e., 11,000 ha) and 80% (i.e., 1500 ha), respectively, are planted to improved varieties.

Peru
Once the most serious production problems of coastal areas–rust, viruses, and nematodes–were solved, the dissemination of Peruvian varieties was quick and extensive.

In Chincha, the most important bean-growing area of the Peruvian coast, 80% of the area planted to canario-type bean and 100% of the area planted to navy bean are now sown with improved varieties.

Along the northern coast, the varieties most used are also improved varieties developed by the project.

The varieties developed at the main research sites have been disseminated to neighboring departments (Appendix B, Table 26).

In Cusco, 94% of farmers of five provinces now use new varieties. Production increases and participation of varieties in this effort are high.

In Cusco, new varieties have had a "colonizing" effect, spreading to different valleys and neighboring departments (Table 11).

Seed Production
In Bolivia, not only 80% of farmers use improved varieties, but 50% of them also use certified seed.

In Bolivia, 14 farmers have established a small seed company (APROSFYM, its Spanish acronym) that produces certified seed, using artisanal methods.

In Peru, between 1991 and 1998, a group of farmers, although not formally consolidated as an enterprise, produced seed that was used to establish about 5000 ha.

In Ecuador, although two groups of seed producers were consolidated in 1994-1996, neither has shown growth during the 3 years.

Specific Objectives: Second Set

To improve the marketing of beans to

- Diversify local consumption of bean, favoring the consumer's access to both traditional and other market classes.
- Promote the different forms of natural bean consumption (dry and fresh grain, toasted grain, and green pods) and processed (packaged, canned, and frozen).
- Convert beans into an export product.

Results

Consumption

During the last decade, annual consumption per capita increased in Colombia, remained stable in Peru, and decreased slightly in Ecuador (Appendix D, Table 29).

Both urban and rural consumption figures for Santa Cruz, East Bolivia (Appendix D, Table 31), are impressive, having surpassed even those for Brazil.

In Cusco, Peru, the popping bean variety Q'osqo Poroto INIA helped disseminate new ways of consuming this type of bean. In Chincha, Peru, where 90% of the beans consumed belong to the canario type, navy bean began to be consumed on a mass scale, thanks to the dissemination of the improved, nematode-resistant 'Larán Mejorado INIA' among farmers.

Bean consumption in the Andean Region has become notably diversified (Appendix D, Table 30), representing an important advance because predilection for specific and traditional market classes has always been an obstacle for developing the bean trade in the Region.

Trade

In 1998, Bolivia exported 20,000 tons of beans, mainly to Brazil, Japan, and Colombia, for more than 8 million U.S. dollars. Bean has accounted for more than US$36 million in foreign exchange for Bolivia since this crop was introduced into the plains (Table 8).

ASOPROF, a small farmers' association, has turned out to be the driving force behind bean production and export in Bolivia (Table 5).

Between 1994 and 1998, Peru exported pulses (cowpea, broad bean, beans, and lima bean, in that order) for a value totalling more than US$46 million (Appendix E).

Peru has exported beans to 15 countries (Table 15) and pulses in general to more than 40 countries.

Ecuador sells from 25,000 to 30,000 tons of beans to Colombia for an estimated value of US$20 million.

Contributions toward Fulfilling the Project's Mission

Socioeconomic Effects of Increased Bean Production

Andean Region
Bean production generates many jobs in the Region (Appendix F).

Santa Cruz Plains, East Bolivia
Beans represent 43% of farmers' total income.

Bean production generates considerable casual employment, for example, in 1998, it generated between 450,000 and 500,000 workdays (Table 9), half of which involved the family.

In winter (i.e., the dry season), 86% of the area is planted to beans, thereby contributing to family stability. The farmer no longer needs to migrate in search of work during these months. Such planting also helps mitigate the so-called "fallow crisis" because the land is no longer left to invasion from weeds and secondary vegetation during summer.

Ecuador
About 50,000 families in the highlands grow beans. Other links of the production chain gather around these bean-growing families.

Peru
Of the estimated 19,000 families who cultivate beans, 5000 are located in PROFRIZA's area of influence.

The use of improved varieties has helped bean-growing families improve their income by 30%.

Developing Institutional Networks

Bolivia and Peru, in particular, have linked many institutions to PROFRIZA, giving it a network function, and encouraging the institutions to assume responsibility for several activities included on PROFRIZA's agenda (Table 21). These institutions are:

Bolivia:	UAGRM, ASOPROF, MEDA, CIPCA, CARITAS, OASIS, CEDICA, FIDES, CIFP, Federation of Mothers' Clubs	
Perú:	Bean programs:	INIA, PROMENESTRAS, UOPE-MA Pulses Program, ADEX-MPH Project
	Universities:	UNALM, UNPRG, UNC
	Associations:	IPEL, ADEX Pulses Committee
	Others:	IDAL, CODESE

International entities other than the SDC have also participated in bean-related activities:

PREDUZA	Netherlands	Disease resistance (Ecuador and Peru)
SOCODEVI	Canada	Marketing (ASOPROF, Bolivia)
FAO		Artisanal seed production (Bolivia and Ecuador)
ADEX-MSP	USAID	Alternative crops in coca-growing Areas (Peru)
CRSP—Univ. of Minnesota	USA	Studies on *Rhizobium* (Ecuador)
GTZ	Germany	Promoting the export of pulses (Peru)

Grain legume associations have been created:

Country	*Association*	*Year created*
Bolivia	ASOPROF	(1990)
Colombia	FENALCE	(1993)
Peru	IPEL	(1998)
	ANAPROME	(1998)
	+ 12 departmental farmers' associations	

The evolution of ASOPROF, an organization created in 1990 with the participation of 11 grassroot organizations, should be highlighted. This association began with 470 small farmers who planted beans during winter. In 1999, ASOPROF grouped 23 organizations, representing 2000 farmers, and selling beans to Japan, Colombia, Brazil, Italy, and Spain (Tables 1-5).

All national institutions supported by PROFRIZA have received contributions from foreign institutions and, in some cases, national institutions, indicating the level of credibility PROFRIZA has attained and its strength. Especially important is the PROSEM agreement in Peru through which private enterprises (through IPEL members) and the SDC (through PROFRIZA) contributed US$30,000 and US$3,000, respectively, to finance a bean seed production project to be executed by PROMPEX through PROMENESTRAS.

The regional exchange of experiences was encouraged between representatives of the most important associations of the Andean Region. PROFRIZA extended invitations and sponsored the visits of:

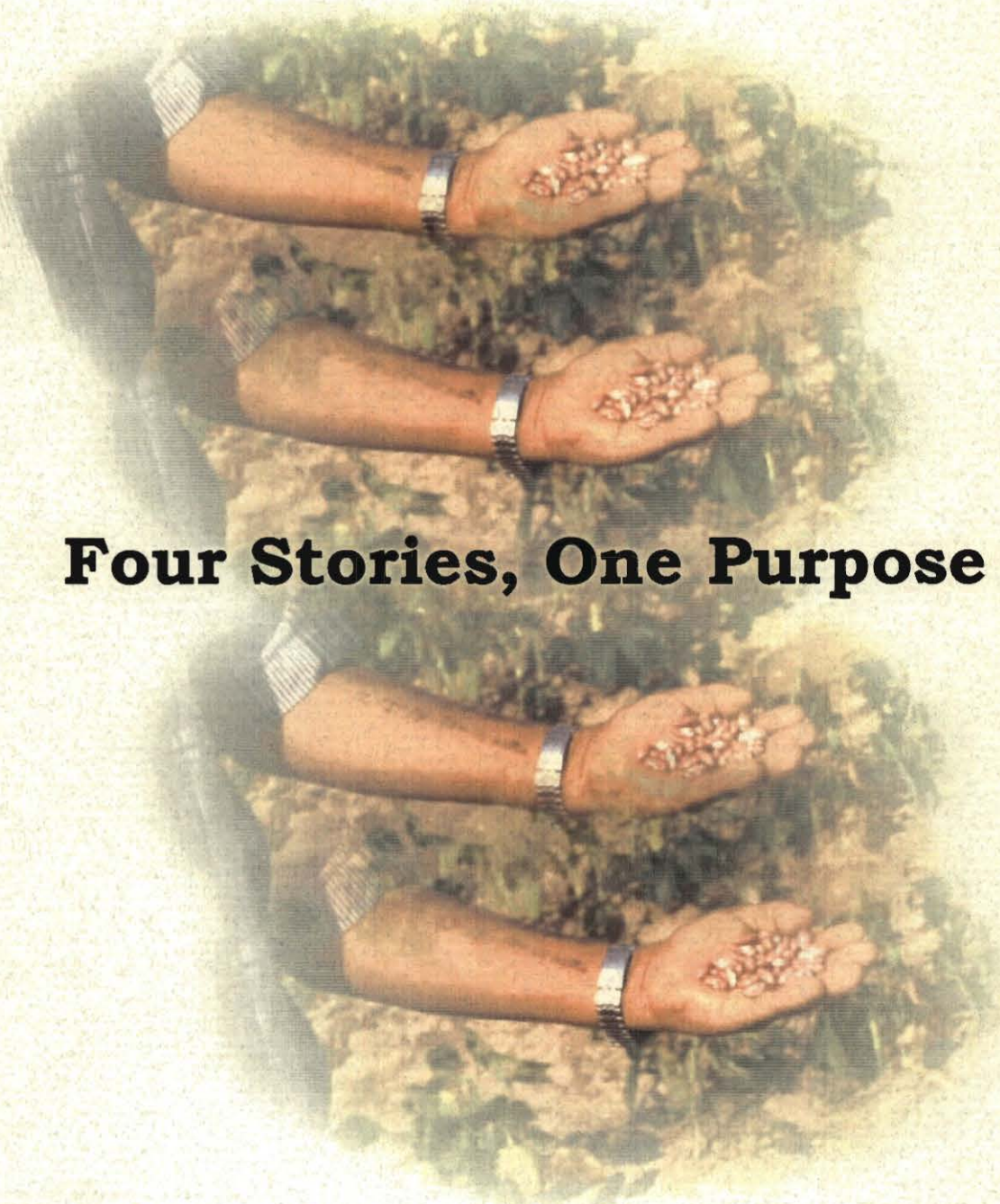
The president of IPEL (Peru) to Bolivia on two occasions

The manager of ASOPROF (Bolivia) to Colombia

The President and Manager of ASOPROF (Bolivia) to Peru

The Manager of Crop Diversification of FENALCE (Colombia) to Bolivia

The integration so far achieved through the regional network is seen as the first step toward forming strong national programs.



Four Stories, One Purpose

The First Story

The Bean Adventure in East Bolivia

Bolivia

Introduction

Until 1980, production statistics for the Department of Santa Cruz, East Bolivia, did not include figures for common bean (*Phaseolus vulgaris* L.). Twenty years later, bean production in the area is sometimes from as much as 20,000 ha, a striking fact in a country where bean consumption was traditionally minimal. Although this number seems insignificant when compared with those of other bean-growing countries of Latin America, they are extraordinary when placed in the social context of East Bolivia. The Bolivian case has no parallel in Latin America; the social impact of incorporating beans into the traditional production system is an example of what can be done by a people who want to get ahead with something in which it believes. It also shows the role that can be played (so that the people may achieve) by agricultural research and international cooperation in a special union of interinstitutional efforts led by the local university.

Some History

In August 1933, thanks to an earthern road that had recently been constructed, the first motorized vehicle entered Santa Cruz from western Bolivia. Yet, its momentous arrival gave little hint of the great significance that the Cochabamba—Santa Cruz Highway, asphalted in 1956, would have in the future of many Bolivians. Foreign missions, arriving in 1942 and 1951, recommended that plantations be modernized and programs of agricultural settlement be carried out to relieve pressure in Bolivia's overpopulated interior. In 1953, settlement and exploitation of new areas began, ushering in an era of dramatic changes for the once-desolate vast plains and sub-Andean mountains of East Bolivia.

Zones of Integration, Expansion, and Settlement

Without analyzing the advantages or disadvantages of this migration for the region's economic development versus its ecological balance, the fact is that, by the beginning of the 1980s, large-scale agriculture had developed in the northern, northeastern, eastern, and southeastern sectors of the Santa Cruz Department, in an approximate radius of 160 km from the Santa Cruz City. These areas, where land use comprised extensive cultivation of soybean, sugarcane, maize, and rice, and livestock raising, are known as "integrated", and were joined with other areas expanding under similar progressive technology. While these areas grew, areas of settlement (organized and voluntary) expanded, occupied by migrants from the country's interior (Departments of Cochabamba, Sucre, Potosí, and La Paz). The migrants were attracted by organized plans for settlement or by possibilities of manual labor that the rice, sugarcane, and cotton farms offered.

The Settler Problem Before the Bean

Developed agriculture cultivated mostly sugarcane, rice, cotton, soybean, sorghum, and maize, which were planted principally in the austral summer when temperatures and rainfall favored the establishment of high-value crops. In contrast to the large-scale farmers who could plant wheat and sunflower, small farmers found the cold dry winters a calvary: they had no crops to plant. They had to resort to the large-scale farms for seasonal work, competing with those settlers who, once they brought in their summer harvests of maize and rice, wandered in search of work. Small-farming settlers planted in summer, harvested in April and May, and, because they had nothing to plant during winter until the next sowing in September and October, abandoned their lands to work as day laborers, harvesting sugarcane or cotton.

The University and the Bean

The Universidad Autónoma "Gabriel René Moreno" (UAGRM) began work in beans by circumstance. In 1977, the Agricultural Experimental Center (CEA) of the UAGRM's Faculty of Agricultural Sciences was created, starting up agricultural research in that center of learning. In 1978, one of its staff, Francisco Kempff, attended the first course on beans given by CIAT at its headquarters in Cali, Colombia. In 1979, the CEA became the Institute for Research in Agriculture and Renewable Resources (IIARNR) and, in 1980, the IIARNR's Bean Program was created at Kempff's initiative after his experience in Colombia. The first research activities of the brand-new Bean Program were to evaluate bean lines from CIAT's international bean yield trial nurseries. Not even the most fertile mind had imagined, when Bolivia received the first cardboard box containing 10 kg of bean seed from Colombia in October 1978, that, 20 years later, Colombia would be receiving container loads of tons of red beans produced in the plains and valleys of East Bolivia.

Beans Go East

Bean lines of black-seed and Brazilian types, sent by CIAT to the UAGRM, were evaluated during thesis work and in trials in coordination with the "Abapó Izozog" Project. Other than studying, through thesis work, the most appropriate times for planting and weed control, the Program established, at the opportune moment, demonstration plots in two settlement centers, San Julián and Comando, to help farmers become familiar with the new crop. Kempff had the vision to realize the possibilities of beans as a winter crop and, because bean consumption in Santa Cruz was almost unknown, of selling them to Brazil. Although the small-farming settlers accepted beans, the large-scale farmers in the zones of integration and expansion did not, being reluctant to deal with a new crop and its insecure markets, and the abundant labor required for manually harvesting and threshing the crop. The University and settlers decided to gamble on the new crop, thus beginning their adventure with beans in East Bolivia.

"All's Well that Ends Well"

The proposal to plant beans as a winter crop, at first sight, seemed simple, so much so that it may even have had occurred to other people who knew the area. The difference, however, was that the UAGRM could effectively implement two basic measures:

- *To make decisions based on research.* That is, through research, to determine the answers to questions such as which varieties would be the most efficient, when and where they should be planted, and how to solve the problem of seed supply.

- *To use a participatory strategy.* The University established links with local agencies, involving their support from the project's very early phases. Once research began, an Interinstitutional Committee for Bean Production was established, whose functions were to consolidate the Program's activities through actions that guaranteed that, by the time the marketing phase was reached, markets and financial sources for seed production were identified. Committee member included the UAGRM, the Corporation for the Development of Santa Cruz (CORDECRUZ), the Agricultural and Livestock Chamber of the East (CAO), and the Departmental Office of the Director for the Ministry of Rural and Agricultural Affairs (MACA). Below we will see how interinstitutional participation grew.

The First Fruits of Research

Results of agronomic research included the identification of:

- Two recommended sowing dates for beans in the Department of Santa Cruz: winter months in the plains (400-600 m), and summer months in temperate valleys (1600-2000 m).

- The best two varieties of the black-seeded type—ICA Pijao and BAT 76, which were were used to initiate commercial production—and the best varieties of a differently colored seed for the Brazilian market, particularly 'Carioca' that, since 1983, was called 'SEL 1' and had markedly changed the export panorama.

The First Fruits of the Participatory Strategy

The UAGRM remained in charge of the winter production of basic seed in the plains. Certified seed was produced in the temperate valleys, identified as the most promising area for seed production because of possible planting in the austral summer. Here, the UAGRM directly controlled 40 ha of seedbeds and numerous small farmers (even as many as 100), who each sowed 1 to 2 ha. The commercial production of beans was, by commission of the CAO, in the hands of the PROMASOR Farmers Association, which negotiated, in 1981, with CORDECRUZ for credit to produce seed and promote the crop. The bean adventure in East Bolivia, thus, had a participatory focus from its initial phases.

An Authentic Model of Artisanal Seed Production

Artisanal seed production was begun in the valleys under the responsibility of small farmers. Land was worked with oxen, weeds controlled manually, diseases and pests controlled with manually operated backpack sprayers, and harvesting was manual (by pulling off pods). Threshing was done with *chapapas*, an artifact similar to a marimba, on which dried plants were placed and gently struck with a flat piece of wood. Seed with a low percentage of broken grains and impurities was thus obtained. Basic seed for planting seedbeds was proportioned out by the UAGRM, once the Regional Seed Certification Office qualified the seed. At harvest, the farmer should have received double the quantity he or she originally received or, in its absence, the cash equivalent at liquidation. Seed lots were selected by previous agreement among farmers and the Bean Program, and the selection confirmed by the Seed Certification Office. Pesticides were delivered by the UAGRM, at cost, which was charged against the harvest. During the growing season, the Program gave the certified-seed producers technical assistance.

The minimum requirements for producing seed encompass a guarantee of the genetic identity of the variety under multiplication, and the compliance with certain standards of germination and health to guarantee the product's quality.

In summary, the bean-seed production system established in Santa Cruz fulfilled the following minimum requirements:

- Planting for seed production occurred at a different season to that for commercial production;
- The production was from basic seed; and
- The control and supervisory agencies were involved in the process.

Only one small detail differentiated the artisanal system from a more elaborate and formal system of seed production: the producers were small farmers who used artisanal practices for bean production and sale. The Bolivian experience was, from the beginning, an authentic process of artisanal seed production, almost without parallel in Latin America.

The First Problems

The Achilles' heel of this excellent planning was in marketing, because production, for lack of domestic markets, was almost exclusively destined for unstable export markets, such as those of Brazil, which were accessed on an informal basis. Usually, black beans were sold or exchanged in Brazil for equipment, machinery, or inputs. Business, however, was not always successful. For example, in Montero, northern Santa Cruz, all the 1500 farmers, who formed part of the Integrated Services Cooperative "Santa Cruz Norte" Ltd. (CISSCN), planted black beans for sale in Brazil, but, on several occasions were not able to sell or exchange even one bag. Yet, bean production in East Bolivia grew from almost zero to about 2,000 ha.

New Actors

In 1986, Juan Ortubé became leader of the Bean Program of the Agricultural Research Institute at El Vallecito (IIA—El Vallecito), as the IIARNR came to be called. Under his direction the Program perhaps made its most important achievements. In 1987, 'SEL 1' ('Carioca') had already replaced the black-bean type and plans to encourage local consumption were being considered. The CISSCN had approved a project financed by USAID to plant 500 ha to carioca-type beans for export to Brazil and to promote consumption among the 11,000 people who formed the base of this cooperative of 1500 farmers.

Other organizations also developed activities to promote export and consumption of beans. These organizations included an institution whose efforts, together with those of the UAGRM, were key to the development of beans in East Bolivia: the Mennonite Association for Economic Development (MEDA). This NGO was established in the mid-1980s, beginning by entering the field of promoting the bean crop, giving technical assistance to the farmers of Colonia Berlín and helping to export their black beans to Brazil. In 1987, Colonia Berlín made its first legal export of 100 tons to that country with MEDA's assistance, particularly that of its then Executive Director, Calvin Miller, who, with Ortubé, was the motor in consolidating bean production in Santa Cruz.

Other institutions involved in promoting the crop in Santa Cruz were the Center for Rural Research and Promotion (CIPCA), an NGO operating under the auspices of the Jesuit Congregation; the Center for Rural Training (CEDICA), a private philanthropic entity; CARITAS; PRODESA; PLADERVE; and PROMASOR & C. A.

PROFRIZA Carves Out Its Name: 1988-1999

The funds that the Swiss Agency for Development and Cooperation (SDC) made available through PROFRIZA to the UAGRM's Bean Program in 1989 were decisive in launching the bean crop in Santa Cruz. The UAGRM could also install demonstration plots precisely where MEDA was organizing small farmers and thus contribute to consolidating the efforts of MEDA's leader Calvin Miller and leaders of other groups in organizing the farmers.

Various events highlight PROFRIZA's participation:

- ASOPROF was created.
- The area planted to beans gradually grew.
- A seed production system was consolidated.
- Both exports and domestic consumption grew.
- The "crisis of fallow land" (described on page 23) was mitigated.
- Employment was generated and family welfare improved.
- The crop expanded to other areas of the country.
- Useful germplasm was generated and disseminated.

Below we shall see how an activity that began as an adventure became reality—how the bean crop had come to stay in East Bolivia!

Small Farmers Become Entrepreneurs

MEDA's efforts to organize small farmers were rewarded on 16 March 1990, when the National Association of Bean Farmers (ASOPROF) was born, based on 11 grassroot organizations, made up of 470 small farmers who had been planting beans as a winter crop for about 7 or 8 years. The Association currently integrates 22 associations, bringing together 2000 small farmers (Table 1).

Table 1. Number of organizations and farmers who form the National Association of Bean Farmers (ASOPROF), East Bolivia, 1990-1999.

Year	Organizations (no.)	Farmers (no.)
1990	11	470
1991	14	1,781
1992	15	777
1993	16	1,550
1994	15	1,500
1995	17	1,600
1996	22	1,700
1997	22	1,800
1998	21	1,800
1999	22	2,000

Source: ASOPROF. 1999. Santa Cruz, Bolivia. 1999. Personal communication.

ASOPROF was born with the mission to promote the cultivation and consumption of beans in Bolivia through productive units based on the small farm. It aims to increase farmer income and improve farming families' diet. To do so, it promotes the development of the bean crop in new areas where beans can provide an economically profitable alternative for small farmers and be sustainable within their production system.

ASOPROF's principal activities are as follows:

- Producing and marketing certified bean seed.
- Providing technical assistance with production and postharvest handling.
- Marketing beans on domestic and export markets.
- Promoting bean consumption at rural and urban levels.

ASOPROF has legal status. Table 2 shows its current member organizations.

Table 2. Organizations and number of families that form the National Association of Bean Farmers (ASOPROF), East Bolivia, 1999.

Organization	Families (no.)	Organization	Families (no.)
CCAB	300	CARITAS	422
CCAVIP	350	26 de agosto	160
AFRENOR	450	APROSFYM (Mairana)	50
Cooperativa Progreso	175	CooperativaVilla Barrientos	150
Federación Club de Madres	250	Núcleo 15	45
PROCAL Caranda	154	Núcleo 17	78
Comunidad Tres Pozas	40	Núcleo 62	49
Área 5-18 de junio	176	Núcleo 63	55
Núcleo 14	45	Oasis	50
Núcleo 11 - San Antonio	193	Puerto Rico	185
Núcleo 18 - Villa Sinaí	35	Monteverde	196
Mon Rico del Sur	32	Private members	560
Total number of families			**4200**

Source: ASOPROF. Santa Cruz, Bolivia. 1999. Personal communication.

Since its foundation, ASOPROF has focused its activities in the Department of Santa Cruz. But, in 1992, its focus widened to include other departments: Cochabamba, Chuquisaca, and Tarija (Table 3), where it operates through the collaboration of other institutions: CEDEAGRO (Cochabamba), FEDEAGRO (Chuquisaca), and ACLO (Tarija).

The social unit of ASOPROF is the small farmer: almost 65% of the 3500 farmers making up ASOPROF plant an average of 5 ha to beans (Table 4).

Some indicators show the role played by ASOPROF in seed production and marketing and the economic benefits that these have represented for the Association's small-farmer members (Table 5).

Table 3. Sites where the National Association of Bean Farmers (ASOPROF) in East Bolivia works.

Department	Site	Department	Site
Santa Cruz	Colonia Berlin	Cochabamba	Mizque
	Las Brechas		Aiquile
	Área 5-18 de junio	Chuquisaca	Monteagudo
	CCAVIP		Muyupampa
	Pailón		Padilla
	El Sur (Basilio Mora)		Villa Serrano
	Chané		Zudañes
	Mairana		Sopachuy
		Tarija	Valle central

Source: ASOPROF. Santa Cruz, Bolivia. 1999. Personal communication.

Table 4. The average area planted to beans by farmers belonging to the National Association of Bean Farmers (ASOPROF), East Bolivia.

Area planted (ha)	Farmers (no.)	(%)
1 - 5	2200	65
5 - 10	710	21
10 - 15	300	9
15 - 20	100	3
20 - 25	40	3
25 - 30	30	
30 - 35	15	
35 - 40	5	

Source: ASOPROF. Santa Cruz, Bolivia. 1999. Personal communication.

Table 5. Seed production and grain produced and marketed by the National Association of Bean Farmers (ASOPROF), East Bolivia, 1990-1999.

Year	Seed production (t)	Commercial production		
		Area planted (ha)	Marketed grain (t)	Farmgate price (US$/t)
1990	2.8	1000	800	350
1991	23.4	1989	2320	227
1992	67.4	1350	1051	247
1993	58.8	2600	1340	316
1994	77.8	3026	1800	370
1995	93.5	3825	1630	320
1996	120.1	3750	1423	300
1997	51.1	2745	1852	350
1998	72.5	3000	1222	330
1999	144.0	3200	1500	400

Source: ASOPROF. Santa Cruz, Bolivia. 1999. Personal communication.

Growth of Area Planted to Beans Over the Years

So far we have described the bean crop's development in Bolivia since the beginning of the 1980s, but we have not discussed any growth figures. The reader should understand the bean's popularity in East Bolivia so that he or she can appreciate the development of other important activities related to the crop that were taking place simultaneously with the crop's development. Table 6 shows the growth of area planted to beans in Bolivia from 1983 to 1999.

Table 6. Area planted to beans, production, and yields in Bolivia, 1983-1999.

Year	Area (ha)	Production (t)	Yield (hg/ha)
1979:	*Bolivia receives two trials from IBYAN 1978: black and other colored seed* *Total number of experimental lines received: 50* *Total weight of grain received: 10 kg*		
1983	1,100	1,320	1,200
1984	2,200	2,640	1,200
1985	1,000	1,200	1,200
1986	800	960	1,200
1987:	*Paz-Sarney Treaty legalizes Bolivia's bean exports to Brazil*		
1987	670	804	1,200
1988	800	960	1,200
1989	1,500	1,800	1,200
1990	8,200	9,640	1,200
1991	18,000	23,400	700
1992:	*Exports to Japan begin*		
1992	8,000	5,600	700
1993:	*Exports to Colombia begin*		
1993	4,500	3,600	800
1994	6,900	6,900	1,000
1995	7,000	5,320	760
1996	9,200	10,028	1,090
1997:	*Bolivia has five international markets*		
1997	15,000	16,650	1,110
1998[a]	19,000	19,000	1,000
1999	20,000	20,000	1,000

a. Estimates based on impact assessment (N. Ruiz de Londoño, 1999 unpublished data).
Source: UAGRM. 1999. Informe del proceso de la autoevaluación de impacto del Programa Nacional de Frejol en relación con PROFRIZA: 1989-1999.Santa Cruz, Bolivia.

The fluctuations in the area planted observed between 1983 and 1987 reflect the uncertainty of the Brazilian market. The unexpected growth of area planted in 1991 is the result of the exaggerated expectations of large-scale farmers who, enticed by the Brazilian market prices of the year before, began producing beans. The sudden, severe shrinking of area planted the next year reflects the deception felt with the same market.

The true average of yields was 1000 kg/ha. Yields of 1200 kg/ha were obtained when the planting areas were relatively small. When more lands were incorporated, particularly of less favorable regions, such as the plains, the average yield dropped.

Yields of less than 1000 kg/ha can be attributed partly to "bad years", affected by climatic variations.

Seed Production: A Model for the Andean Region

At the beginning of the 1980s, once the varieties were identified and basic knowledge of the crop was developed, the UAGRM, under the leadership of Marco Koriyama, began a program for seed production near Mairana (at 1600 m). About 180 small farmers from 20 communities planted about 300 ha to beans during the austral summer (December-January). This crop was to produce seed for farmers to plant beans as a winter crop (April-May) in the plains (at 400 m).

By the beginning of the 1990s, the farmers of Mairana already had a small seed company. Its equipment had been donated by the CIAT Seed Unit, foundation seed by the IIA—El Vallecito, technical assistance by the University and the Regional Seed Certification Office, and administrative and marketing support by ASOPROF. The company was called APROSFYM, and was organized with the participation of 14 farmers. Thanks to the talent of one its members, Tito Orquera, who designed a stationary thresher, APROSFYM succeeded in interesting the FAO-Postharvest Project to help enhance the thresher's model and thus begin producing and selling the machine in series.

At the decade's end, the original seed production model is still being followed and encompasses not only Mairana and the plains but also other localities. The model's characteristics include:

Activity	*Time*	*Planting months*	*Production system*	*Site*
Seed production	Summer	Dec-Jan	Upland	Valleys (>1600 m)
Commercial production	Winter	April-May	Upland	Plains (400 m)

Functions are distributed between institutions as follows:

Research:	UAGRM
Variety record:	Regional Seed Office
Production of basic and foundation seed:	UAGRM or authorized companies
Quality control:	Regional Seed Certification Service

Thanks to its organized system of seed production, Bolivia can, unlike other countries with older traditions of bean production, exhibit adequate levels of certified-seed production (Table 7).

Linking Small Farmers with the Foreign Market

Until 1989, MEDA and CISSCN coordinated the entire chain of activities (distribution of seed, credit, and marketing) oriented toward bean export. From 1990 onward, when ASOPROF was created, the Association assumed these same responsibilities for the small farmers, while PROMASOR & C. A. and two private enterprises (DITEX and Cordillera) were in charge of marketing for large-scale

Table 7. Historical levels of production of certified bean seed in Bolivia, 1983-1999.

Year production	Certified seed	Area planted to certified seed	
	(t)	(ha)[a]	(% of total)
1983	48.9	978	88.9
1984	94.0	1,880	85.4
1985	37.5	750	75.0
1986	21.5	430	53.8
1987	13.8	276	41.2
1988	19.0	380	47.5
1989	20.6	412	27.5
1990	143.8	2,876	35.1
1991	665.4	13,308	73.9
1992	398.5	7,969	99.6
1993	58.0	1,160	25.8
1994	120.4	2,407	34.9
1995	86.1	1,722	22.9
1996	72.0	1,440	15.6
1997	87.0	1,741	11.6
1998	143.1	2,863	22.0
1999	160.0	3,200	21.3

a. Estimated area based on the use of 50 kg/ha.
Source: Koriyama M. 1996. Producción artesanal de frijol en la Zona Andina; Proceedings, Huaral, Peru. PROFRIZA. 116 p.Cali, Colombia.

farmers. Over time, ASOPROF continued to market beans for small farmers, whereas ESCOFUTURO, BOLSEMILLAS, BOLIVIAN SHOJI, BRASIBOL, and other private enterprises, and the Santa Cruz Chamber of Exports (CADEX) are in charge of the increasingly bigger volumes from large-scale farmers.

To enter the export market and compete with other companies, ASOPROF became partners with MEDA in an export company, ASOMEX. ASOMEX's members include the farmers, MEDA, and representatives of 20 communities. Bolivia currently exports beans to Brazil, Colombia, Japan, Italy, and Spain. Most of this production comes from small farmers who, 20 years ago, had scarcely heard of beans. The biggest export market is Brazil, which had been accessed on an informal basis since 1980, a little after the bean adventure in Santa Cruz began. In 1986, export to this country was formalized on the signing of the Paz-Sarney bilateral agreement, which ensured a channel for free export for 70,000 t/year. The market begun to grow from 100 metric tons in 1987, through 300 in 1988 and 700 in 1989, to 2878 in 1990. The exported beans were mostly carioca type, but other types have also been exported: some *preto* (black) and *jalinho* (butter). Because of the high number of *nisei* Brazilans (Japanese descendants) living in Japan, Bolivia has recently begun exporting carioca-type beans to that country. Through research carried out in recent years by the UAGRM's Bean Program, new bean types have been adapted to East Bolivia, opening up new export markets in Colombia (Table 8) and Spain.

Table 8. Bean exports (metric tons), Bolivia, 1987-1998.

Year	Total (10^3 t)	Value (US$)	Exports by country				
			Brazil	Peru	Japan	Argentina	Colombia
1987	0.1	-	100	-	-	-	-
1988	0.3	-	300	-	-	-	-
1989	0.7	-	700	-	-	-	-
1990	2.9	1,747,565	2,736	142	-	-	-
1991	14.8	6,873,534	14,691	65	-	-	-
1992	6.1	1,893,492	5,936	94	77	-	-
1993	13.3	3,986,278	1,046	14	235	120	11,900
1994	4.4	3,439,317	2,275	-	379	-	1,700
1995	2.3	2,058.170					
1996	2.9	2,916,260					
1997	12.3	8,758,020					
1998	20.2	8,723,237					

Sources: Ministry of Economic Development, National Secretary of Industry and Trade. Years 1990, 91, 92, 93, and 94. Compendio estadistico de exportaciones no tradicionales.La Paz, Bolivia.
J. Ortubé. 1998. Personal communication.

The Vital Role of Women in Promoting Domestic Consumption

The social impact of introducing beans to East Bolivia has several aspects. One is the growth of bean consumption in the region. Women have played a major role in efforts to develop a domestic market in Santa Cruz. With the UAGRM as always the motor behind these activities, a large group of organizations, including PROSALUD, the Civic Women's Committee, the Federation of Mothers' Clubs of Santa Cruz, and ASOPROF, developed a series of activities to promote bean consumption in East Bolivia. The activities included presentation of videotapes to emphasize the highly nutritional value of beans and disseminate ways of preparing various plates. Portions of different dishes were also distributed at farmer meetings, field days, etc., including at the XIII National Agricultural Fair conducted in Santa Cruz in 1991, which was attended by 2500 people. At training workshops for home promoters and leaders of mothers' clubs, the different forms of preparing beans were demonstrated and the nutritional value of beans discussed. If we take into account that the Departmental Federation of Mothers' Clubs is made up of about 250 clubs, each of which has a membership of 20 mothers, the size of the effort can be seen.

A 1994[1] study found that in urban Santa Cruz, 60% of the population consumed *camba* beans (*Vigna unguiculata*, or cowpea) at an annual rate of 2.2 kg per capita. On introducing the common bean (*Phaseolus vulgaris*), the offer of beans became more diverse, resulting in the new grain becoming incorporated

1. Manrique B, R. 1994. Estudio de consumo y mercado de frejol *Phaseolus vulgaris* L. en el departamento de Santa Cruz (Bolivia). B.S. thesis. University Autonóma "Gabriel René Moreno". Santa Cruz, Bolivia.

into the diet of 53% of consumers, so much so that the annual average of consumption rose to 3.9 kg per capita. The introduction of common beans affected the consumption of traditional *camba* beans in that the number of their consumers dropped to 49% of the original number and the quantity consumed was reduced by 16%. However, the net balance of consumption of these two grains (*Vigna unguiculata* and *Phaseolus vulgaris*) increased to 160% as the per capita bean consumption rose from 2.2 to 5.7 kg/person.

In the rural sector, before beans were introduced, 37% of the rural population consumed cowpea at an annual average rate of 4 kg/person. Now, 70% of the population consume both *Vigna* and *Phaseolus* beans. Unlike in the urban sector where consumption dropped, *Vigna* bean consumption went up by 29%. Total annual consumption of *Vigna* and *Phaseolus* beans rose from 4 to 11 kg/person, that is, by an increase of 168%.

Up-to-date figures from a 1998 study by Norha Ruiz de Londoño, of CIAT, showed impressive bean consumption rates in the various social strata of the urban and rural sectors of Santa Cruz:

- In the study area, 75% of rural families, and 50% of urban families, consumed beans. Consumption rates in low-strata families reached 84%.

- Consumption per capita estimated for the rural population surpassed the average for Brazil. In Santa Cruz, annual consumption is 23.5 kg/person (in Brazil, it is 18). In the urban sector, overall consumption is 6 kg, but the population's lower strata annually consume 12 kg/person.

- If we consider the average amounts consumed by bean eaters only, then figures are about 31 and 12 kg per capita/year in the rural and urban sectors, respectively.

- Beans contribute one-third of a rural person's daily protein requirements and 17% of those of an urban dweller's.

Balancing Environmental Sustainability Against Human Welfare

In Santa Cruz, land grants to settlers varied from 10 to 50 ha. Smaller grants were considered as undesirable because settlers with only 10 or 20 ha were found to rapidly exhaust virgin bush and to become caught in the trap of the so-called "crisis of fallow land". This crisis sets in when secondary vegetation invades the land left under fallow and settlers find it impossible to combat it. They then have only two options: to use machinery or to raise cattle to take advantage of the grass that eventually invades everything. Because both options represent heavy investments, the small farmer must abandon his land and look for more virgin forest. In many cases, receiving more land only meant postponing the crisis that inevitably came. Fallowing, a widespread in subsistence agriculture, is not a practice opposed to modern agricultural systems; it can be improved with the inclusion of crop rotation, alley cropping, plant cover, or agroforestal.

For the Santa Cruz settlers, the lack of a suitable winter crop motivated most to migrate in search of temporary jobs. The introduction of beans into the region allowed settlers to farm their fields in winter and to introduce highly recommended practices such as rotating cereals (maize in summer) with legumes (beans in winter). Beans also enabled farmers to develop capital that would one day allow them to mechanize their property, buy livestock, or do a combination of both.

Although introducing beans reduced the problems of the so-called "crisis of fallow land" for farmers, it probably also induced them to incorporate more land under agriculture—beans being profitable and solving a series of daily problems, often far removed from production, but intensely united to their well-being. For example:

- In winter, 86% of the area cultivated is under beans. Before the crop was introduced, only 9% of the arable land was exploited in winter.
- Beans ensure better land use: cereal rotation with legumes.
- By hampering weed invasion during winter, beans are estimated to reduce production costs of summer crops by as much as US$1.5 million.
- Beans eliminate farmers' need to migrate to other regions to find winter work by generating a source of work for the farmers and their families. Almost half of the workdays expended on bean cultivation are contributed by the family, representing about 222,500 workdays for the season. Table 9 shows the growing social impact that beans have on the region as an employment generator.

In Santa Cruz, in the areas of integration and expansion where modern agriculture is carried out, the felling of trees has been pitiless and irrational. In the land settlement areas, increased number of trees were felled in favor of a profitable crop that solved many of the farmers' problems, including those unrelated to

Table 9. Indicators demonstrate the economic and social impact of incorporating beans into the production systems followed in East Bolivia.

Year	Generation of employment (no. of workdays)	Investment in pay of workdays (US$)	Net income for families (US$)
1978: CIAT (Colombia) introduces beans to East Bolivia			
1982	39,600	198,000	235,400
1985	28,800	144,000	59,200
1989: PROFRIZA begins to assist Bolivia			
1990	684,000	3,240,000	1,728,000
1995	331,200	1,656,000	1,315,600
1997	468,000	2,340,000	2,080,000
1999	475,000	2,375,000	2,111,111

production. Farmers of the land settlement areas are part of a tragic scenario: they come from the high plateau, fleeing from misery and desperation, to "invade" a piece of their own country, covered by jungle. They discover the land and cultivate it, thus offering their children food, stability, family identity, and improved well-being. To their country, and to the world in general, they show that poverty such as that which they suffered in the Plateau can be surpassed, that they can always help themselves, provided they have the resources and can be supported when these fail.

The impact of farmers' actions in this case should also include improved living conditions that give their lives more dignity. Hence, when judging the role beans play in East Bolivia, environmental losses should be balanced against the gains of these human nuclei in terms of growth as people. Man is part of the environment and his well-being is the best example of sustainability—what better example than precisely this one of the human condition!

Bean: Another Settler

As we have already shown, beans initiated their pilgrimage to Bolivia in 1982, being first planted in the Department of Santa Cruz in the plains (at <500 m) as a winter crop and in the mesothermic valleys (1500-2000 m) as a summer crop. Between 1990 and 1998, beans became consolidated in localities other than Santa Cruz: Muyupampa (province of Luis Calvo) and Monteagudo (province of Hernando Siles) in the Department of Chuquisaca, and the area of Mizque (province of Mizque) in the Department of Cochabamba. In 1999, the bean began entering the valleys of the Departments of Tarija and Potosí. What a settler!

Improved Germplasm: A Catalytic Agent for Change in East Bolivia

Those lines and varieties that CIAT introduced to Bolivia in 1979 began to yield between 1982 and 1985 with the first commercial planting of black-seeded varieties: BAT 76, a line from CIAT, and ICA Pijao, a Colombian variety. Varieties of other seed colors then followed, such as the Brazilian Carioca, Carioca 80, Catu, Aroana, Ayso, and Rosinha. Of these, the most outstanding was 'Carioca', which had started, in 1983, with the name "SEL 1" and began to predominate. 'SEL 1' had the virtue of encouraging bean consumption in East Bolivia where black beans had been rejected. In 1990, when Bolivia became a member of PROFRIZA, the flow of improved germplasm became more intense. The UAGRM's Bean Program strengthened its genetic improvement team, and new market classes of beans (jalinho, calima, cranberry, navy) were incorporated into the Program's work portfolio and new cultivars were launched (Table 10).

As a result of the development and dissemination of improved germplasm by the UAGRM, beans not only settled in Santa Cruz, solving the problems that small farmers had with winter, but were also disseminated to other regions of Bolivia to which they brought important changes. These changes functioned (without indulging in hyperbole) as a springboard for small farmers to modern agriculture, as shown by the farmers having:

Table 10. Bean varieties released in Bolivia during 1992-1999.

Year	Variety	Type	Disease resistance Level[a]	Disease
1992	Carioca Mairana	carioca	I	Rust, anthracnose, angular spot, common bacteriosis
	Mantequilla Mairana	Jalinho	I	Rust, anthracnose, angular spot, common bacteriosis
1995	Rojo Oriental	Calima	I	Rust, anthracnose, angular spot, common bacteriosis
1999	Rojo Casarabe	Calima	R I	Rust Anthracnose, angular spot, common bacteriosis
	Crema San Julián	Cranberry	R I	Rust Anthracnose, angular spot, common bacteriosis
	Carioca Antofagasta	Carioca	R I	Rust Anthracnose, angular spot, common bacteriosis
	Carioca 2000	Carioca	R I	Rust Anthracnose, angular spot, common bacteriosis
	Blanco Berlín	Navy	I	Rust, anthracnose, angular spot, common bacteriosis

a. I = intermediately resistant; R = resistant..

- Made changes in the structure of their production system by introducing a new crop.
- Adopted new technology, which had required training.
- Developed a capacity for management and thus could enter export markets.
- Achieved access to resources, including credit for working capital, machinery, and other equipment.

End Note

Although the bean adventure in East Bolivia has many participants, we must recognize that, without the UAGRM's cooperation and guidance, the adventure would not have begun when it did, nor would it have arrived so far. The creative and bold step that the University took beyond the academic and scientific to push ahead a socioeconomic project based on an unknown crop, ridiculed as a food for the poor, is worth pointing out. Local institutions also deserve credit for their altruistic response to the UAGRM's call to support a project aimed at society's general well-being. All benefited from those who dared to dream, and CIAT and the Swiss Agency for Cooperation in Development did well to have believed in them for over 20 years. The bean adventure in Bolivia is an example of collaborative spirit and steadfastness.

The Second Story

Working Together. Private Enterprise and the Government in Peru

Peru

The Hazards of Forecasting

In late 1989, outstanding CIAT professionals made an in-depth analysis of important FAO data and reached the following conclusions regarding the panorama of beans in Latin America for year 2000:

> *"Although the projection of current aggregate production and consumption trends do not point toward a* deficit *in the supply of beans for year 2000, the level of aggregation conceals the fact that projections for Brazil and the Andean Region establish annual deficits of 351 and 107 thousand tons, respectively. The estimated deficit for the Andean Region amounts to 34% of the production, and is mainly concentrated in Peru and Ecuador."*[2]

FAO statistics for 1988-1999 indicate that annual growth rates of bean production, area harvested, and yield in Peru were 4.3%, 2.2%, and 2.0%, respectively (Appendix B, Table 27), thus reversing the pessimistic forecasts. Peru is currently self-sufficient in bean production and even exports beans. How did this happen? All can be attributed to governmental support, a dynamic and motivated private sector formed by intrepid entrepreneurs, and small and medium-scale farmers who were confident about the future.

Different Situations and Strategies

In Peru, 97% of all landowners are small farmers. Here, as in the rest of the Andean Region, bean is not only a crop for low-income farmers, but it is also planted in small areas scattered throughout the country. This crop is planted in a diversity of environments, found in highlands and coasts, ranging from sea level to 3400 m, and under different production systems. In both regions, beans are not only an important component of the local diet, but also an important source of income for the rural population. But, because the conditions of production differ markedly between the two regions, their strategies for tackling bean problems also differ significantly.

Highlands

Peru has about 80,000 ha planted to beans. About 48% of this area is in the highlands (700-3200 m above sea level), accounting for 45% of the national

2. C. Seré, W. Janssen, W. Grisley, L.R. Sanint, L. Rivas, and J. Cock. The outlook for CIAT commodities towards the year 2000. p. 1-27. In: Trends in CIAT commodities. July 1989. 207 p.

production. In this region, climbing bean, planted in association with maize, predominates; 90% of the area is planted under dryland conditions and yield averages are less than 600 kg/ha.

Farmers search for climbing-bean varieties with nonaggressive growth, so they can be grown in association with maize in production systems where marketing the ear of tender maize (*choclo*) is the main objective. The release in 1989 of 'Kori Inti', an early maturing variety that develops in the lower two-thirds of the maize crop —a characteristic that prevents lodging—fulfilled this objective. 'Kori Inti' has successfully spread throughout Valle Sagrado in Cusco, and is planted in association with the economically important, large-grained, white Urubamba maize.

Farmers need disease-resistant, climbing-bean varieties to reduce pesticide use and to express genotypic yield potential. Examples of the advances PROFRIZA has made toward fulfilling this need are the varieties INIAA Cajabamba, a white bean resistant to rust and anthracnose, and Gloriabamba, a mesoamerican type resistant to anthracnose—both for the northern highlands. Another variety, Q'osqo Poroto INIA, a type of popping bean resistant to anthracnose, was developed for the southern highlands.

Farmers also need bush bean varieties with different planting times to expand the crop's cultivation frontier. Examples of such varieties are Jacinto INIA, a bush variety resistant to three diseases, including anthracnose and adapted to a broad range of altitudes (1600-3000 m.a.s.l.), and INIA 17, another bush variety that is broadly adapted (Table 12)

Coastal Region

This region accounts for 16% of the country's bean-growing area and 23% of production. Along the coast, all cultivated areas, regardless of crop, are under regulated irrigation. Average bean productivity ranges from 850 to 1200 kg/ha.

Farmers need bush varieties that are resistant to the most important diseases occurring in coastal areas: rust and common mosaic. By the end of the century, INIA had released disease-resistant varieties for all the market classes consumed nationally: navy or white (Blanco Larán, Larán Mejorado INIAA, Garza INIA), canario (Canario 2000 INIAA, Canario Centinela INIAA), bayo (Bayo Mochica INIA, Huerequeque INIA) (Table 13).

Export-type varieties also need to be identified that can be successfully planted on the coast. Twelve varieties of the following market classes were selected and disseminated: caballero, Great Northern, navy, alubia, white kidney, dark red kidney, light red kidney, red marrow, pinto, carioca, and black turtle (Table 14).

A New Paradigm in the Highlands

In Peru, to talk about Andean crops is to talk about potato, an endless number of tubers, quinoa, kiwicha, maize, wheat, barley, maca, and, if need be, broad bean

and lentil, but certainly not beans. The paradigm changed slightly as the century drew to an end, and bean became categorized as an Andean crop because of the advances this crop has made, especially in the southern highlands. Among the achievements are the following:

Better Companions for Maize

'Q'ello Poroto', a climbing bean with yellow, giant-sized grains, is the most popular variety in the southern highlands. Although farmers plant it in association with maize, its growth habit is characterized by copious vegetative production and a long growing period from planting to maturity. These characteristics can make the bean a difficult companion for certain types of maize, including the very popular starchy varieties Blanco Urubamba, grown for its high market value worldwide in the Valle Sagrado de los Incas (Cusco), and 'Amarillo Oro'.

'Kori Inti', an early maturing climbing bean with a well-balanced growth habit, can be grown in association with maize without significantly decreasing its yields. Its development has allowed bean production to increase by about 5000 tons of dry grain in the inter-Andean valleys of the southern highlands, such as the Valle Sagrado de los Incas, where maize is traditionally monocropped. This bean variety has spread to Limatambo, Mollepata, Paruro, and Acomayo in the Department of Cusco, and to Curahuasi, Abancay, and Andahuaylas in the Department of Apurimac, all in the southern highlands.

Another good companion for maize was identified within the class of popping beans, a traditional crop found in the inter-Andean valleys of the Departments of Cajamarca and Cusco. In Cusco, popping beans are grown in association with the maize varieties Blanco Urubamba and Amarillo Oro, among others, as a production alternative in which cultural practices are performed for the main crop (maize). 'Q'osqo Poroto INIA' is a popping bean of nonleafy growth habit and resistant to the main races of anthracnose (*Colletotrichum lindemuthianum*) and to halo blight (*Pseudomonas syringae* pv. *phaseolicola*). With its release, the cultivation of maize and popping beans in association has increased significantly in many Cusco valleys situated between 2600 and 2900 m.a.s.l.

Revitalizing a Forgotten Genetic Resource

Popping beans, also called toasting beans, are known in Peru as *poroto, ñuña, apa, numia*, among other denominations, and in Bolivia as *k'opuro*. These beans constitute a unique genetic resource of the Andean Region, distributed between Cajamarca in the northern highlands of Peru and the Department of Chuquisaca in Bolivia. In Cusco, popping beans are mainly planted in the high valleys of the Urubamba River at sites such as Ollantaytambo, Pachar, and Urubamba, at altitudes varying from 2800 to 2900 m.a.s.l.

The grains of this type of bean pop when heated in oil or placed in a hot frying pan. These beans present a broad variability not only in grain color but also in their capacity to pop. Tender, floury types with high popping capacity are the most

preferred. With low fat and high protein contents, the beans are also used to make a very nourishing "*ñuña* milk" in some parts of Peru.

Popping beans not only represent an important source of protein for the rural population of the highlands of Peru and Bolivia, but they also have possibilities as a cash crop. Their potential in the urban market is as great as that of peanuts, popcorn, and toasted broad beans, all significant snack foods. The popping bean could therefore represent an important source of income for one of the most marginalized sectors of Latin America: the Indian populations of the high Andes of Peru and Bolivia. Furthermore, popping beans require less fuel for cooking, and, as a result, the consumption of these beans may represent an economic and environmental component in regions where fuel is limited. In addition to its nutritive and fuel-saving attributes, popping beans have a potential for biological N fixation and can adapt to associations with other crops, such as maize, making it an efficient food crop. Despite all these advantages, the popping bean is little known outside its traditional production areas and its cultivation has never reached a large enough scale to plan large-scale marketing because:

- Although certain types (e.g., Chec'che, Angel Poroto, and Pava) are preferred, none have been disseminated on a large scale because of the wide diversity of consumer preferences.

- Most types of popping bean have a leafy foliage that makes them unattractive for planting in association with maize varieties of high market value.

- Most varieties are susceptible to diseases, especially anthracnose, Ascochyta, and halo blight.

- The best known types of popping bean have a varying capacity to pop that seldom reaches 100%, thereby hindering marketing.

- Most urban consumers have not even heard of popping beans, whereas broad beans and peanuts are well-known snack foods.

An individual selection conducted by Vidal Ortiz in 1991 in a collection from Limatambo, Anta Province, Cusco, was the origin of what later would be known as the variety Q'osqo Poroto INIA, the first officially released variety of popping bean. Mirihan Gamarra, who participated in the selection of this variety, and her team conducted a widespread campaign to disseminate the new variety, showing those major characteristics that differentiated it from other known types of popping bean:

- Nonleafy foliage that allows it to grown in association with maize without affecting yields.

- Resistance to anthracnose and halo blight, two major diseases.

- High market value: 100% popping capacity; the grains, when toasted, do not form rosettes; grains weigh less after toasting than do local ecotypes.

'Q'osqo Poroto INIA' is widespread in Cusco. The support of the Peruvian Government in setting good prices for popping bean and its inclusion in the National Food Program (PRONAA, its Spanish acronym) were decisive in encouraging plantings of 'Q'osqo Poroto INIA' on a commercial scale in Cusco. Many plantings used the trellis system that allowed yields to reach almost 3000 kg/ha. Although popping beans have not yet entered urban and international markets, the availability of a variety such as 'Q'osqo Poroto INIA' opens up endless possibilities for this ancestral crop, one of the many valuable legacies left by the Incas.

Bush Bean: A Highland Settler

Bush beans introduced to Cusco in the 1960s represented an interesting option for farmers because their early maturity meant they could be planted as many as 4 months after the last planting date for climbing beans. This flexibility of planting time allowed farmers to have food practically at any time. Despite these obvious advantages, the area planted to bush beans did not increase substantially and was restricted to a few valleys in Cusco, mainly because the introduced varieties Red Kidney, Puka, and Rojo Mollepata began to show, with time, susceptibility to the main bean diseases occurring in the highlands. Also, the red grain color was not particularly popular in the area.

In 1980, CIAT supplied a red bean that, despite its color, began to spread throughout the region. In 1995, this bean was released as INIA 17, becoming very popular in the Department of Madre de Dios, deep in the jungle, possibly because of its hardiness. The new variety showed resistance to halo blight and intermediate resistance to rust, anthracnose, and web blight. In 1994, bean variety Jacinto INIA was released; its golden yellow color was similar to that of the most popular variety, known as 'Yellow Giant' or 'Q'ello Poroto'. It rapidly gained popularity among farmers because of its commercially acceptable color, agronomic characteristics, early maturity, and disease resistance.

In the southern highlands, new bush bean varieties have had a colonizing effect, spreading throughout several valleys in Cusco, although they are still to achieve large-scale production in the areas where they are established.

In the northern and central highlands, bush beans have also assumed a "colonizing" role. Varieties such as Huerequeque INIA, Larán Mejorado INIAA, and Canario 2000 INIAA, developed for coastal areas, are being cultivated in the secluded inter-Andean valleys (between 800 and 1300 m.a.s.l.) of the Departments of Cajamarca, Ancash, and Lima.

Adoption of New Germplasm in the Inca Region

Examples of innovative germplasm for an ancient region—the so-called Inca Region integrated by the departments of Cusco and Apurimac—are new climbing-bean varieties whose less aggressive growth have made it possible to penetrate areas planted to monocropped maize; a truly spectacular popping bean variety; and early maturing bush bean varieties that have opened new frontiers for bean cultivation.

The advantages that this technology has brought to this area is reflected partly in the progressive increase in the area planted to beans in this region, being sometimes, as in Cusco, eight times more than the plantings of the early 1980s (Table 11).

Increased Bean Productivity in the Northern Highlands

Although the germplasm supplied by INIA, through its association with CIAT via PROFRIZA, has had a less dramatic impact, it has also brought benefits to the northern highlands, specifically in Cajamarca. 'INIA Puebla', an early maturing variety resistant to anthracnose, was widely disseminated among farmers of the bean-growing areas of the Department of Cajamarca, and can be found, even today, in marketplaces, together with 'Gloriabamba', another widely accepted variety that was distributed by CIAT in 1985. An adoption study conducted by CIAT in 1990 in bean-growing areas of Cajamarca determined that, 3 years after release, 65% of farmers were growing the variety Gloriabamba. About 35% of the bean-growing area showed a 90% increase in productivity, compared with areas growing local varieties. The adoption of 'Gloriabamba' meant, in 1988, a 27% increase in production for the study areas Chota, Santa, and Cajabamba, and a 22% increase for the entire Department of Cajamarca. The additional production was estimated at 3038 tons at a value of US$1,519,000. The rate of return on the research was estimated at 29%, with a cost-benefit ratio of 3.17.

Germplasm for the Highlands

Table 12 shows the varieties released by INIA for the highlands overall during the period of PROFRIZA's international cooperation activities.

A New Vocabulary for the Bean Crop

We could say that by the end of 1995, the nomenclature of beans along the Peruvian coast was limited to such terms as "canario", "bayo", "panamito", "caballero" when referring to the most popular beans in the region. In 1999, bean-related vocabulary had expanded to "cranberry", "pinto", "carioca", "alubia", "navy", "calima", "red kidney", "caraota", and others that identify internationally recognized market classes

Table 11. Variations in the area planted to bean and bean production in the Inca Region and Upper Jungle (Departments of Cusco and Apurimac), and the Department of Madre de Dios, 1982-1998.

Stage of PROFRIZA	Years	Production in Cusco (t)	Area planted (ha)		
			Cusco	Apurimac	Madre de Dios
Before	1982 - 1987	420	419	—	—
I	1988 - 1990	672		684	—
II	1991 - 1993	867	784	1151	166
III	1994 - 1996	3751	3529	7797	1070
IV	1997 - 1998	2588	2636	7969	800

Table 12. Bean varieties released in the Peru for the highlands, 1989-1999.

Name	Year	Market class	Growth habit	Agronomic value[a]
Climbing varieties				
Kori Inti	1989	Yellow	IV	R to anthracnose and halo blight; early maturing
INIA Puebla	1990	Yellow	IV	R to anthracnose
INIA Cajabamba	1990	Panamito	IV	R to anthracnose and rust
Q'osqo Poroto	1997	Popping (ñuña)	IV	R to anthracnose
UNAGEM 2[b]	1999	White	IV	R to anthracnose and Ascochyta
Bush varieties				
Chuyabamba INIA	1993	White	I	Early maturing
Jacinto INIA	1994	Yellow	I	Early maturing and R to anthracnose + two others
INIA 17	1994	Nima	I	Early maturing

a. R = resistance.
b. Variety released by UNALM's Legume and Oil Crop Program.

of bean. This enrichment in the vocabulary of farmers and entrepreneurs, and even consumers, can be attributed to changes in the production structure, technology, management, and access to resources. These changes have occurred as a result of a new economic model now being applied in Peru and which opens new opportunities for small farmers to compete in a market economy. Thanks to the technologies developed, beans have become a competitive crop in both domestic and foreign markets.

Varieties for the Peruvian Coastal Region

The climate prevailing in the Peruvian coastal region favors bean cultivation all year and is restricted only by water availability for irrigation. Land and water are both scarce and expensive; farmers therefore prefer highly profitable crops. However, bean has always been an ideal rotational crop in this arid region because of its low production costs, rapid economic returns, and high domestic demand. So that the bean can fulfill its role efficiently, it must not only be resistant to rust, common mosaic, root rot, and nematodes, but also be early maturing to cover the temporary spaces left by crops for the international market. A major INIA achievement was the release to farmers of varieties, resistant to rust and common mosaic, of all locally consumed market classes (Table 13). These varieties were developed by Angel Valladolid, and are the most preferred by farmers. Estimates indicate that they occupy no less than 50% of the area planted to beans along the Peruvian coast.

The Export Agroindustry and Small Farmers: A Productive Alliance

To increase exports of grain legumes, the Commission for Promoting Exports (PROMPEX), a governmental entity, created the PROMENESTRAS program in 1996

Table 13. Bean varieties released for the Peruvian coastal region, 1989-1998.

Name	Year	Market class	Growth habit	Agronomic value[a]
Blanco Larán	1989	Alubia	I	R to rust and common mosaic; early maturing
Canario 2000 INIA	1991	Canario	I	R to rust and common mosaic
Canario Centinela INIA	1991	Canario	I	R to rust and common mosaic
Larán Mejorado INIA	1993	Alubia	IIa	R to rust, common mosaic, and nematodes
Bayo Mochica INIA	1994	Bayo	IIIa	R to rust and common mosaic
Huerequeque INIA	1994	Bayo	IIIa	R to rust and common mosaic; early maturing
Garza INIA	1994	Great Northern	IIIa	R to rust and common mosaic; early maturing
INIA 17	1995	Nima	I	R to rust and common mosaic; early maturing
CIFAC 90106*	1998	Canario	III	R to rust and common mosaic; early maturing
CIFAC 90105*	1998	Canario	III	R to rust and common mosaic; early maturing

a. R = resistance.
b. Promising bean lines, disseminated in the Peruvian central coastal region, but which have not yet been released by INIA..

under the sponsorship of the private sector. PROMENESTRAS, headed by Valladolid and with CIAT's assistance, initially identified export-type bean varieties that best adapt to coastal conditions. Private enterprise, through the Association of Exporters (ADEX, its Spanish acronym), also implemented a proposal of productive alliances, through which agroindustries contracted small farmers to plant legumes, guaranteeing their purchase while providing technical assistance, seed, and direct credit. The program's success can be attributed to the crop's short vegetative period (from 90 to 120 days) and the low investments required (US$500-600/ha). By late 1999, not only had efficient bean varieties of several international market classes been identified (Table 14), but Peru had succeeded in exporting beans to at least 15 countries at a value of more than US$45 million, during the last 5 years (Table 15). Although this figure may not seem spectacular, it is significant if we consider that, only a few years ago, economists had predicted a dire panorama for bean production in this country.

The Socioeconomic Effects of New Technology

Beans is basically a small-farmer crop. The average farm size ranges from 3 to 5 ha in the highlands and from 3 to 10 ha on the coast. The area under bean cultivation is estimated to be less than 30% of the farm area. If 73,000 ha are planted to bean in Peru, then 19,000 farmers or rural families produce beans, of which 5000 were in PROFRIZA's area of influence.

Table 14. Export-type bean varieties selected for the Peruvian coastal region, 1996-1999.

Variety	Growth habit	Market class
Caballero Peruano	III	Caballero
Cristal Blanco Fênix	III	great northern
Cambridge Countess	III	Navy
Alubia	I	Alubia
WAF 78	I	white kidney
Blankid	III	white kidney
Dark 54	I	dark red kidney
Royal Red	I	light red kidney
RAA 15	I	red marrow
Pinto Can	III	Pinto
Carioca	III	carioca
Jamapa	II	black turtle

Table 15. Destiny of Peruvian exports of different market classes of beans.

Market class	Purchasing countries
Canario	USA
Larán	Venezuela, Spain, Portugal
dark red kidney	UK, Italy, France, Netherlands, Germany, Spain, Japan
light red kidney	Canada, France, Portugal, Japan, UK, Colombia
black turtle	Brazil, Japan
Marrow (caballero)	Spain, Italy, Germany, Austria, Korea

Source: Ministry of Agriculture. 1999. Lima, Peru.

On the average, 1 ha of beans requires 60 working days from planting to harvest, most of which involve family labor. The use of improved varieties has increased farmers' income by more than 30% because of their greater yield potential and lower production costs resulting from reduced use of pesticides. Improved varieties have also helped protect the environment by reducing the need for potentially polluting agrochemicals.

In the past, the bean offer showed strong seasonality, adversely affecting prices because of simultaneous harvests in highland and coastal regions. By planting improved varieties with broader adaptation and thus extending harvest time, seasonality of the bean offer is no longer so marked, and prices are more stable, thus benefiting farmers. Increased production and productivity have generated new and major sources of employment throughout the production and marketing chain.

The Third Story

INIAP: Ecuador's Custodian of Food Security

Ecuador

Beans as a Small Farmer's Crop

Of all the legumes cultivated in Ecuador, beans are the most widely grown and consumed. Dry grain consumption is as important as that of fresh grain: the national demand for dry grain in 1999 was estimated at 21,670 tons and that for fresh grain at 27,798 tons. The consumption of snap beans (green pods) is also important, although volumes are unknown. Table 16 presents several characteristics of bean cultivation in Ecuador.

In Ecuador, 90% of the area planted to beans is located in those altitudes where most Peruvians live and where most of the nation's crops are grown, mainly by small farmers. More than 40% of the bean-growing area is planted to climbing bean in association with maize, a production system that is used almost exclusively by small farmers. Areas producing bush beans are mostly located in highland valleys (1000 to 2500 m.a.s.l.) or in the foothills of the western cordillera (800 to 1200 m.a.s.l.).

This panorama shows that beans is a small-farmer crop, planted in a region where farmer-market linkages are precarious and where agroindustries do not provide support or advisory services for bean farmers. Most of the produce is destined for household consumption or the local market, except for beans produced in Carchi, Imbabura, Pichincha, and Chimborazo, departments that, each year, informally export to Colombia the product from about 29,000 ha planted to red beans.

Table 16. Characteristics of bean production in Ecuador.

Item	Total area		Highland area		Coastal area	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Area	76,370	100.0	68,800	90.0	7,570	10.0
Climbing bean						
Altitude range (m)			2,200-2,800			
Area	31,610	41.4	31,610	41.4	—	—
Bush bean						
Altitude range (m)			1,000-2,500		< 1,000	
Area	44,760	58.6	37,190	48.7	7,570	9.9
Cropping system						
Bean in association with maize	31,610	41.4	31,610	41.4		
Bean in monoculture	44,760	58.6	37,190	48.7	7,570	9.9

Social Responsibility and Commitment with the Future

INIAP began work with beans in the mid-1970s, its commitment to this crop increasing each year, unlike that of other Latin American institutions. Faced with the reluctance of other players to assume their obligations with the most deprived, INIAP took up the implicit challenge behind "if we don't do it, who will?". This response has certainly demonstrated the attitude of an institution that clearly understood its social responsibility and had the courage to assume its commitment with the future.

Although the common bystander may not see that anything important has happened in the Ecuadorean bean sector, analysis shows irrefutable results. At a time when the nation's production of agricultural export products increases and areas under crops for domestic consumption increasingly decrease, the annual growth rate of the area planted to bean grew at 2.9% during 1988-1999, while production grew at 2.7%. Growth rates of production and productivity in the 3 years previous to the "El Niño" phenomenon show Ecuador's path to progress (Appendix B, Table 27).

During the last 2 years, medium- and small-scale farmers of the central and northern coastal regions have shown considerable interest in bush beans as a monocrop or to plant in association with nontraditional crops. The idea is to market fresh beans (green pods or string beans) in the local market.

Impact of Improved Germplasm

The influence of varieties developed by INIAP with the support of PROFRIZA (Table 17) has been greater in the northern and southern regions of the country. In the northern region, red-grained varieties are important, especially for export, and, in the south, cream-white varieties are important for the domestic market and red mottled beans for consumption as green grain.

About 36% of the nation's bush beans are grown in the northern highlands, in the provinces of Pichincha, Carchi, and Imbabura, accounting for almost 16,000 ha. Of this area, 70% (about 11,000 ha) is planted to improved varieties developed by INIAP in collaboration with CIAT. About 38% of the country's bush beans are cultivated in the southern highlands, in the provinces of Cañar, Azuay, and Loja, accounting for about 17,000 ha, of which 15,000 are planted to improved varieties. Reliable estimates of the area planted to improved varieties in provinces of the central highlands—Bolívar, Chimborazo, Tungurahua and Cotopaxi—are not available. This region accounts for 26% of the area planted to bush bean, but, in general, the area planted to improved varieties would not be less than 50%. Based on studies, surveys, technicians' experience, and the opinions of farmers and agroindustrialists, estimates indicate that about 27,000 ha are planted to improved varieties, accounting for 60% of the area planted to bush beans in the Ecuadorean highlands.

Table 17. Bush bean and climbing bean varieties released by INIAP, Ecuador, 1988-1999.

Year	Outstanding varieties	Production area	Main attribute[a]
	Bush bean varieties		
Varieties for local consumption as dry or fresh grain			
1999	Blanco Imbabura	Southern highlands	R to rust
1998	INIAP 419-Chaupeño	Southern highlands	R to rust and anthracnose
1993	INIAP 414-Yunguilla,	Southern highlands	R to rust
	INIAP 413-Vilcabamba	Southern highlands	R to rust
Export varieties			
1996	INIAP 418-Je.Ma	Northern highlands	R to rust
1991	INIAP 411- Imbabello	Northern highlands	I to rust
1988	Paragachi	Northern highlands	R to Fusarium
	INIAP 404–Cargabello (selected)	Northern highlands	I to anthracnose
	INIAP 402	Northern highlands	R to rust and anthracnose
	Climbing bean varieties		
Varieties for local consumption as dry or fresh grain			
1999	INIAP 421- Bolívar	Central highlands	R to rust, anthracnose, and halo blight
1994	INIAP 416 - Canario	All highland areas	Early maturing, not very aggressive
1988	INIAP 403 - Bolón Bayo	All highland areas	High yielding
	INIAP 400	Southern highlands	R to anthracnose; early maturing
Export varieties			
1993	INIAP 412 - TOA	Northern highlands	R to anthracnose; I to rust

a. R = resistant; I = intermediately resistant.

Ecuadorean climbing beans consumed locally are called bolones; these are cream, yellow, and white in color and constitute a true national heritage. Their large round grains (>70 g/100 seeds) make them attractive to the eye and to the palate; their long vegetative period (>180 days), together with their staggered production, offers subsistence farmers a range of foods (green pods, green beans, dry beans) for many months. They associate readily with maize, improving the use of the limited land available, especially in the case of the small farmer.

INIAP has tackled the problem of climbing beans with the following strategy:

- *Select the best ecotypes of those traditional beans in highest demand from the large diversity that exists.* Bean types canario, bayo, red, and white *bolones* are the most preferred. These beans are late maturing, with an aggressive growth habit, and provide a source of food for rural populations over long periods. Rather than undertake a hybridization breeding program, which would have been complex and time-consuming, INIAP technicians opted to select ecotypes

with evident advantages over traditional ecotypes planted by farmers. As a result, INIAP 403-Bolón Bayo (1988) and INIAP 416-Canario (1994) were released.

- *Select early maturing types.* Climbing bean is planted in association with maize, but in traditional sweet-maize-growing areas or where prices for sweet maize justify cultivation. These early maturing climbing beans must have a harvest time that coincides with the ripening of the corncob. As a result, the early maturing varieties INIAP 400 (1988) and INIAP 421-Bolívar (1999) were developed.

- *Select export-type varieties.* While farmers of the northern highlands, who have access to calima-type (red mottled) varieties, can export their product to Colombia, farmers planting climbing beans could not export their produce. Now, thanks to variety INIAP 412–TOA (1993), they can do so.

- *Conduct improvement by gamete selection, using molecular markers* (1998). INIAP undertook the genetic improvement of the two most popular traditional bean varieties 'Canario' and 'Bolón Bajo', using modern breeding techniques. INIAP personnel were trained for this work, and additional resources and technical assistance were obtained from PROFRIZA and CIAT, respectively.

Employment, Women, and Profits

In Ecuador, bean cultivation generates employment for both men and women. For each hectare planted to beans, about 50 casual working days are needed. Women participate in probably 50% of the tasks for production (weeding and hilling) and postharvest handling (grain drying and classification).

Bush beans are the most important option in production systems of the Ecuadorean highlands because of their short growth cycle, ease of planting, market demand, and prices. About 50,000 families produce bush beans. As a result of INIAP's patient work during 25 years, Ecuador is now self-sufficient in beans and even exports. Thanks to the red-grained varieties that INIAP has released to farmers, about 8500 families of the northern provinces of Carchi and Imbabura export from 15,000 to 20,000 tons of beans per year to Colombia, representing a foreign exchange of between 10 and 15 million U.S. dollars for the country.

Small Things that Mean A Lot

In the southern highlands, most of the beans produced are consumed fresh (fresh grain or green pods). The dissemination of disease-resistant varieties and their broad range of adaption can be considered as significant contributions from INIAP, considering that the use of chemical products to control diseases in crops consumed fresh represents a high risk for human health.

Although farmers planting climbing beans are mostly resource poor and, as a result, invest little in seeds, an INIAP program has produced, for years, basic seed of the most important climbing bean varieties. This way, the program attempts to establish a constant flow of quality seed toward a sector that has not yet benefited from technological advances.

Much remains to be done in the Ecuadorean bean sector. The future will hopefully increase the number of actors. A work team at INIAP is proactive in the search for solutions to problems that are likely to arise in the future so that beans will continue to be served on the tables of Ecuador's new generations. INIAP's work over 2 decades has also included other crops such as peas, broad bean, lentils, and lupine, and has assigned them priority (at a level not seen elsewhere) so Ecuadoreans can have access to cheap sources of protein. Based on these results, INIAP can be seen as an efficient custodian of Ecuador's food security.

The Fourth Story

In Colombia Sharing is a Two-Way Road

Colombia

Colombia's Contributions to the Bean Crop

Statistics show that Colombia is a large producer and consumer of beans. However, this production is not enough, and Colombia has to import beans. Another aspect that statistics show is a sustained growth in production and productivity in the country, which reflects, in part, the contribution of technology. However, the reduction in area planted during the last 3 years is cause for concern and reflects the overall deterioration observed lately in Colombian fields because of the evident lack of incentives to plant traditional crops (Table 18).

Colombia has a longstanding tradition of bean production and consumption and a potential capacity to absorb greater amounts of beans than it now produces. Bolivia and Ecuador share part of their bean production with Colombia, a current importer. But sharing is a two-way road and what statistics do not show is the enormous contribution that Colombia has made to the bean crop, not only in Andean countries but also worldwide. Table 19 shows the different places in the world where Colombian varieties, developed by CORPOICA, are grown.

Other than having contributed 11 of its varieties so that 20 other countries could have improved germplasm for immediate use, Colombia has also contributed improved genetic materials so plant breeders around the world could use them in their own breeding programs. "La Selva" Research Center (2200 m.a.s.l.), Department of Antioquia, developed, with support from PROFRIZA, populations derived from interspecific hybridization between common bean (*Phaseolus vulgaris* L.) and so-called petaco bean (*Phaseolus polyanthus* L.). Petaco bean is resistant to the fungus *Phoma exigua* var. diversispora, a characteristic that was transmitted to common bean in a congruent backcrossing program. The materials generated by this program were made available to the national programs in the region. This contribution is important, given the lack of high levels of resistance to *Phoma* in common bean.

Table 18. Bean production statistics in Colombia, 1990-1999.

Aspect	1990 - 92	1993 - 95	1996 - 98	1999
Area (1000 ha)	141.8	147.6	144.2	140.0
Production 1000 t)	120.0	139.0	146.3	140.2
Yield (kg/ha)	846	942	1014	1001

Source: FAO. 1999. Internet.

Table 19. Varieties and lines, produced by the Colombian bean program, that have been released as varieties in several countries around the world.

Variety	Year	Market class	Growth habit	Adopted as variety	
				Country	New name
Varieties released by ICA between 1964 and 1974					
Diacol Calima	1966	calima	I	Panama	Calima
				Mozambique	Calima
				Tanzania	Lyamungu 90
				Burundi	Calima
				Malawi	Kalima
ICA Duva	1967	dark red kidney	I	Jamaica	Duva
ICA Bunsi	1968	navy	II	Canada	ExRico
				USA	ICA Bunsi
				Ethiopia	Awash 1
				Zimbabwe	Ex-Rico 23
				China	
ICA Pijao	1974	black turtle	II	Guatemala	Suchitan
				Cuba	ICA Pijao
				Costa Rica	ICA Pijao
				Bolivia	ICA Pijao
				Venezuela	Tenerife
				Mozambique	ICA Pijao
Varieties released by ICA between 1975 and 1993					
Línea 38[a]		black turtle	II	Brazil	EMPASC 201-Chapecó
78A10103[a]	1978	black turtle	II	Costa Rica	Talamanca
ICA Palmar	1979	calima	I	Peru	INIA 17
				Rwanda	Rubona 5
Frijolica P-1.1	1983	calima	I	Cuba	Guamá 23
ICA Caucaya	1991	calima	I	Ecuador	INIAP 414 Yunguilla
				Bolivia	Rojo Oriental
				Panama	IDIAP C-1
				Mozambique	PVA 773
Varieties released by CORPOICA between 1994 and 1999					
ICA Rumichaca	1994	calima	IV	Ecuador	INIAP 412 TOA
ICA 15541[a]	1997	—	—	Ethiopia	ICA 15541

a. Advanced ICA lines were not released as varieties in Colombia.

In addition, the Obonuco Research Center (2710 m.a.s.l.) distributed 68 climbing-bean populations that had showed resistance to rust and anthracnose and high yield under Colombian conditions to national programs of the Andean Region. This way CORPOICA has remained faithful to its tradition of being not only an important center for generating valuable germplasm, but also a generous donor of its resources.

Germplasm That Makes a Difference

For more than 40 years, CORPOICA during its various stages (as DIA, ICA, and now as CORPOICA) has always fulfilled its mission of making new varieties available to farmers according to the existing demand. The years during which PROFRIZA operated were no exception. As indicated in Table 20, between 1988 and 1999, Colombian agriculture continued to benefit from the contribution of improved germplasm generated through the CORPOICA—CIAT agreement.

The greatest virtue of this new germplasm has been its efficiency, that is, its capacity to be used under the different circumstances of a given production system. Beans have as many as eight different growth habits, they can mature in periods ranging from 75 to almost 300 days, and, in Colombia, grow at altitudes ranging from 800 to almost 3000 m.a.s.l. Plant breeders in Colombia have had to develop genotypes for the different environments and situations in which beans are cultivated, a task at which they have certainly succeeded.

Table 20. Bean varieties released by CORPOICA, Colombia, 1990-1999.

Variety	Year	Market class	Growth habit	Adaptation (altitude in m)	Reaction to diseases[a]
ICA Citará	1990	Calima-nima	I	1300 - 1800	I to anthracnose and angular leaf spot
ICA Caucayá	1991	Calima-nima	I	1000 - 1700	R to rust and anthracnose
ICA Cafetero	1991	Calima-nima	I	1200 - 2000	R to rust and anthracnose
ICA Cerinza	1991	Radical	I	2000 - 2700	R to anthracnose; I to rust
ICA Guaitará	1992	Calima-nima	II	2000 - 2700	R to rust and anthracnose
ICA Quimbaya	1992	Rojo duva	I	1200 - 2000	R to anthracnose; I to rust
ICA Jaidukamá	1994	Calima-nima	I	1200 - 1800	R to rust and common bean mosaic
ICA Rumichaca	1994	Calima-nima	IV	2000 - 2700	R to anthracnose and rust
ICA Bachué	1994	Rojo	I	2000 - 2700	R to rust and anthracnose
ICA Guanentá	1995	Calima-nima	I	1200 - 1800	R to anthracnose
CORPOICA Froilán	1997	Radical	I	1200 - 1800	R to anthracnose
CORPOICA ARS-59	1999	Calima-nima	I	1400 - 2700	R to anthracnose

a. I = intermediately resistant; R = resistant.

Associating with High-Value Crops: The Case of Coffee in Caldas

Coffee, a crop that is key to the Colombian economy, is highly technified. The coffee-growing area covers 8,500,000 ha, of which 1,010,000 are located on the slopes of Colombia's three major mountain ranges, with an annual precipitation of 1000-3000 mm (rains falling 350-750 times a year). Most of the coffee is planted on lands with a 20% to 90% gradient.

In coffee-growing areas, beans are socioeconomically significant, constituting not only an important source of proteins for local consumers but also a source of income for small farmers. Of the total domestic production, 80% is consumed in coffee-growing areas, which, however, produce only 15%. An alternative to increase the area planted to beans would be to intercrop with coffee. To do so, however, requires bean varieties that are not only preferred by consumers, but also have growth habits that do not interfere with the main crop—coffee—in any way. These beans should also be disease resistant because coffee crop management in Colombia dispenses with the use of pesticides. Moreover, the bean's vegetative period should be such that harvesting does not interfere with cultural practices for the coffee crop. In brief, the coffee-growing region needs efficient bean varieties.

CORPOICA accordingly developed, with the collaboration of CIAT and under the auspices of PROFRIZA, the bean varieties ICA Cafetero, ICA Caucayá, and ICA Quimbaya. The release of these varieties has increased the area of beans intercropped with coffee in the Department of Viejo Caldas (now the Departments of Caldas, Risaralda, and Quindío). The new varieties are now being planted in *zocas* (cleared squares of coffee land) and on land where traditional coffee is being renewed with the new variety Colombia. As a result, the income of coffee growers is diversified, a staple foodstuff is provided for the large floating population that appears during coffee harvest, and farmers can reduce costs by not having to weed between coffee rows.

Rescuing a Fragile Social Environment: The Case of Santander

The Department of Santander accounts for 10% of the country's bean production, surpassed only by the Departments of Antioquia (22%), Nariño (14%), and Huila (11%), according to 1987-1997 statistics. Within Santander, the provinces of Guanentá and Comuneros account for 50.2% of the Department's bean-growing area, with 7580 ha planted to the crop; 79.6% of Santander's bean production is located in the municipalities of Villanueva, San Gil, Barichara, and Curití.

Bean is a relatively new crop in Santander. In the early 1980s, it emerged as an economic alternative for local families during the crisis suffered with traditional crops such as tobacco, maize, millet, and pita fiber. Cultivation began with radical-type red-grained variety. Between 1982 and 1992, anthracnose became the most serious factor limiting bean production in Santander. CIAT lines began to be evaluated in 1987 and, in 1994, the first calima-type anthracnose-resistant variety (ICA Guanentá) and in 1997 another radical-type variety, also resistant to anthracnose, was released (CORPOICA Froilán). Although not officially released,

'AFR 166', an experimental CIAT line with radical-type grain that is also resistant to anthracnose, became widely adopted by farmers by 1995, thanks to the efforts of Adrian Maitre.

According to impact assessment studies conducted by CORPOICA[3], 49.4% of farmers adopted variety ICA Guanentá and 79% the variety CORPOICA Froilán. Factors contributing to the success of the newly released varieties included participatory research, a technological offer tailored to farmers' needs and expectations, a stable market demand, and the tobacco crisis. This last factor was especially important because the economic alternative of planting beans particularly benefited small farmers, who were mostly sharecroppers. The impact assessment study established that profits from the new varieties were highly attractive to farmers. The monthly profits from varieties Guanentá and Froilán was 8.9% and 12%, respectively, much higher than the opportunity cost for capital in the area. Moreover, the internal rate of social return of bean research in the area was 64%. By year 2000, these new varieties are estimated to generate close to 3000 permanent jobs, of which around 600 would be incremental.

3. Mantilla, J.C., I. Baquero, F. Cardozo, A. Arguello. 1999. Evaluación de impacto socioeconómico de la tecnología generada en frijol en las provincias de Guanentá. Santander. Informe final. Programa Regional de Sistemas de Producción. Regional Siete. Programa Nacional de Estudios Socioeconómicos. Regional Uno, CORPOICA. San Gil. Colombia.

One Purpose

Building a Future in Bolivia, Peru, Ecuador, and Colombia

Bolivia, Peru, Ecuador, and Colombia

Through its project "Strengthening the Network (PRO-RED)", PROFRIZA promoted the development of an efficient regional network in which both private and public institutions worked together, each with defined functions. Table 21 shows the interinstitutional participation in different countries.

Bean-related activities in Bolivia, Peru, Ecuador, and Colombia were carried out efficiently and seriously, with PROFRIZA assisting coordinating institutions in each country (UAGRM, INIAP, PROMPEX, CORPOICA-UDENAR) and, through them, other institutions (Table 21). Other national and foreign institutions began to show interest in the crop and some opted to finance special projects.

Table 21. Institutions[a] participating in national bean networks.

Country	Research institution	Seed production	Technology transfer	Training	Promoting consumption	Trade
			National research and technology transfer institutes			
Bolivia	-	-	-	-	-	-
Colombia	CORPOICA	CORPOICA	CORPOICA	CORPOICA	-	-
Ecuador	INIAP	INIAP	INIAP	INIAP	-	-
Peru	INIA[b]	INIA[b]	-	-	-	-
			Universities			
Bolivia	UAGRM	UAGRM	UAGRM	UAGRM	UAGRM	-
Colombia	UDENAR	UDENAR	UDENAR	UDENAR	-	-
Ecuador	UCQ[b]	UCQ[b]	-	-	-	-
Peru	UNPRG-UNALM UNAC	UNALM	UNPRG-UNALM	UNPRG-UNALM	-	-
			State or parastatal entities			
Peru	PROMPEX	PROMPEX CODESE	PROMPEX	PROMPEX	-	PROMPEX
			Association-type organizations			
Bolivia	-	-	PROMASOR	ASOPROF	ASOPROF	ASOPROF
Colombia	-	FENALCE	-	-	-	-
Peru	-	IPEL	-	-	-	-
			Private sector organizations or foundations			
Bolivia	CIF	-	-	-	-	-
Peru	-	-	IDAL	IDAL	-	-

a. For an explanation of acronyms in the table, see "List of Acronyms" on pages 71-75.
b. Funds are provided indirectly.

Events that illustrate the growing interest in grain legumes in the Andean Region, as a result of PROFRIZA's activities, are:

1. Establishment of small seed-production enterprises:
   Bolivia: 1990, creation of APROSFYM, an artisanal seed production enterprise.

2. Establishment of new grain legume programs:
   Peru: In addition to existing legume programs in INIA and the universities, three new programs were established, confirming the growing interest in this crop:
   1995 - ADEX-USAID/MSP agreement
   1996 - PROMENESTRAS (PROMPEX)
   1998 - Pulses-UOPE Program, Ministry of Agriculture

3. Establishment of grain legume farmer associations:
   a. Bolivia: 1990, creation of ASOPROF, an entity that groups 21 grassroot organizations in rural areas.
   b. Peru: 1998, creation of the National Association of Pulse Farmers and of the Associations of Pulse Farmers in the Departments of Tumbes, Piura, Lambayeque, La Libertad, Ancash, Lima, Ica, Arequipa, Moquegua, Tacna, Cerro de Pasco. and Huancavelica.

4. Consolidation of associations representing grain legume farmers:
   a. Bolivia: PROMASOR & C. A. (Farmers Association for Maize, Sorghum, Sunflower, and Alternative Crops)
   b. Colombia: FENALCE (National Federation of Cereal Growers)
   c. Peru: IPEL (Peruvian Grain Legume Institute)

5. National and international support:
   Although PROFRIZA was always identified as a SDC-financed program, national institutions supported by this project succeeded in consolidating themselves as strong and reliable programs capable of attracting other sources of funding for their projects. PROFRIZA considers this as an achievement of institutional strengthening because, in 1988, when SDC cooperation began, the grain legume programs of the Andean Region (except that of Colombia) were very weak and could not have received the support, recently given by other institutions for current projects. Table 22 indicates the assistance recently received by the programs.

Table 22. External contributions (US$) received by PROFRIZA-supported institutions for activities related to grain legumes.

Country	Institution	Years	Donor	Project	Amount (US$)
Bolivia	UAGRM	1995-96	World Bank	Tropical Lowlands Project	19,600
	UAGRM	1996-97	FIDA& CAF	PRODEPA Project	14,000
	UAGRM	1998	National funds (5 export companies)	Bean research	6,000
	ASOPROF			Canadá	
Colombia	UDENAR	1998	National funds (FENALCE)	Publications	3,500
	CORPOICA		National funds (FENALCE)	Seed production technology transfer	40,000
	UDENAR/ CORPOICA	1999	FONTAGRO	Climbing beans	Pending definition
Ecuador	INIAP		CRSP—Univ. of Minnesota	*Rhizobium* studies	75,000
	INIAP	1998-	PREDUZA	Durable resistance	21,000
	INIAP	2001	National funds (FUNDACYT)	Work on *Lupinus*	281,000
	INIAP	1999	FONTAGRO	Climbing beans	Pending definition
Peru	INIA	1998-2001	PREDUZA	Durable resistance	(*see* "Ecuador")
	INIA/ UNC/UNA	1999	FONTAGRO	Climbing beans	Pending definition
	PRO-MENESTRAS	1998-99	National funds (export companies)	PROSEM: (seed production)	33,000[a]
	PRO-MENESTRAS	1999-2002	GTZ (Germany)	Promoting exports from the northern coastal region	6 million marcs[b]

a. US$30,000 contributed by private enterprise members of IPEL and US$3,000 contributed by the SDC through PROFRIZA.

b. To be allotted to the following items: legumes, mango, sweet lemon, handicrafts, fishing, textiles.

APPENDICES

Appendix A

Historical Summary of PROFRIZA: Its Phases, Coordinators, Headquarters, Participating Countries, and Projects

Phase	Dates	Coordinator	Headquarters	Participating country	Projects
I	1988-1990	Guillermo Galvez	Lima, Perú	Ecuador Peru	• Artisanal seed production • Participatory research • Integrated control of anthracnose and Ascochyta
II	1991-1993	Rogelio Lepiz	Quito, Ecuador	Ecuador Peru Bolivia	• Artisanal seed production • Participatory research • Integrated control of anthracnose and Ascochyta • Production systems • Root rots • Promoting bean consumption • Integrated pest management • Strengthening networks
III	1994-1996	Rogelio Lepiz[a]	Quito, Ecuador	Ecuador Peru Bolivia Colombia	• Artisanal seed production • Technology transfer • Integrated control of leaf diseases • Soil management and conservation • Promoting bean consumption • Drought tolerance • Integrated pest management • Strengthening networks
IV	1997-1999	Oswaldo Voysest[b]	Cali, Colombia	Ecuador Peru Bolivia Colombia	• Germplasm development and evaluation • Seed production • Technology transfer • Consumption and marketing • Strengthening networks

a. Until 31 July 1996.
b. As of 1 August 1996

Appendix B

Bean Production Indicators for the Andean Region

Based on FAO data, statistics corresponding to the 12 years of the PROFRIZA project (1988–1999) are compared with those corresponding to the 12 years before the date on which CIAT began distributing improved germplasm (1964–1975).

Table 23. Bean production in the Andean Region, 1964 to 1999.

Country	1964-1966		1973-1975		1994-1996		1997-1999	
	(10^3 t)	(%)	(10^3 t)	(%)	(10^3 t)	(%)	(10^3 t)	(%)
Bolivia	3.2	0.1	2.1	0.5	11.5	0.2	12.7	0.2
Colombia	39.0	1.1	71.3	1.8	151.5	2.8	140.0	2.8
Ecuador	31.0	0.9	28.7	0.7	40.5	0.8	34.1	0.7
Peru	52.8	1.5	59.8	1.5	68.4	1.3	76.5	1.5
Andean Region	**126.0**	**3.5**	**161.9**	**4.1**	**271.9**	**5.1**	**263.3**	**5.2**
Latin America	3623	100	3951	100	5425	100	5058	100

Table 24. Area planted to bean in the Andean Region, 1964 to 1999.

Country	1964-1966		1973-1975		1994-1996		1997-1999	
	(10^3 t)	(%)	(10^3 t)	(%)	(10^3 t)	(%)	(10^3 t)	(%)
Bolivia	8.7	0.1	2.6	0.0	10.9	0.1	12.7	0.2
Colombia	72.0	1.1	99.5	1.4	154.4	1.8	139.3	1.9
Ecuador	64.3	1.0	65.0	1.0	61.5	0.7	61.5	0.9
Peru	58.2	0.9	71.1	1.0	65.8	0.8	80.6	1.1
Andean Region	**203.2**	**3.2**	**238.2**	**3.3**	**292.6**	**3.4**	**294.1**	**4.1**
Latin America	6318	100	6847	100	8485	100	7185	100

Table 25. Bean yields in the Andean Region, 1964 to 1999.

Country	1964-1966		1973-1975		1994-1996		1997-1999	
	(10^3 t)	(%)	(10^3 t)	(%)	(10^3 t)	(%)	(10^3 t)	(%)
Bolivia	366	64	810	140	1056	165	1026	146
Colombia	542	94	717	124	981	154	1004	142
Ecuador	482	84	441	76	659	103	555	79
Peru	907	158	841	148	1040	163	949	134
Andean Region	**574**	**100**	**702**	**122**	**934**	**146**	**884**	**126**
Latin America	574	100	577	100	639	100	704	100

Table 26. Bean production in areas under the influence of PROFRIZA in the Peruvian coastal region, 1992-1998.

Department	Unit	1992-1993	1994	1995	1996	1997[a]	1998[a]
			Northern coast				
Lambayeque	TM	2623	2223	360	645	252	690
	ha	3508	2202	357	652	426	2728
	kg/ha	748	1010	1008	989	592	253
La Libertad	TM	2922	1943	4263	4937	4190	3130
	ha	2521	1548	2968	3600	4048	3008
	kg/ha	1188	1255	1436	1371	1035	1040
Ancash	TM	4938	4967	2785	2576	3266	3643
	ha	3454	3413	2674	2391	2135	2510
	kg/a	1432	1455	1042	1077	1530	1451
			Central coast				
Lima	TM	2458	4749	5175	5581	3838	2929
	ha	1915	3507	3639	3567	2721	2160
	kg/ha	1279	1354	1422	1565	1411	1356
Ica	TM	1978	4063	2087	2421	2322	2095
	ha	1922	3571	2037	1869	2426	1707
	kg/ha	1032	1138	1025	1295	957	1227

a. Years affected by the "El Niño" phenomenon.
Source: Ministry of Agriculture. 1999. Monthly agricultural statistics. Lima, Peru.

Table 27. Growth rates (%) of bean production, area planted, and yield in the Andean Region during periods 1964-1975 (A); 1988-1999 (B); and 1994-1997 (C).

Country	Production			Area			Yield		
	A	B	C	A	B	C	A	B	C
Bolivia	-6.4	4.2	16.9	-15.1	6.6	21.2	10.2	- 2.3	-3.6
Colombia	7.0	3.8	8.7	3.5	0.6	3.4	3.3	3.1	5.2
Ecuador	-1.3	2.7	3.2	-0.2	2.9	-0.6	-1.1	-0.2	3.8
Peru	1.2	4.3	14.9	2.2	2.2	12.8	-0.9	2.0	1.9
Latin America	**1.1**	**1.7**	**-4.5**	**1.0**	**-1.4**	**-3.0**	**0.1**	**3.1**	**-1.5**

Source: FAO. 1999. Internet.

Appendix C

Population Growth Rates in the Andean Region

Table 28. Population growth rates in the Andean Region during the periods 1964-1975, 1988-1998, and 1994-1996; and total population (in 1000s) in 1998.

Country	Population			
	Growth rate (%)			Total
	1964-1975	1988-1998	1994-1996	in 1998
Bolivia	2.4	2.4	2.3	7,957
Colombia	2.7	2.0	2.2	40,803
Ecuador	3.0	2.2	2.7	12,175
Peru	2.8	1.8	2.4	24,797
Latin America	2.6	1.7	2.2	503,523

Source: FAO. 1999. Internet.

Appendix D

Bean Consumption in the Andean Region

Table 29. Annual bean consumption (kg per capita) in the Andean Region, 1980-1997.

Country	1980	1990	1996	1997
Colombia	2.5	3.0	4.7	4.3
Ecuador	2.9	2.3	2.4	1.4
Peru	2.6	2.1	2.2	2.2
Bolivia	0.6	0.2	1.1	0.5

Source: FAO. 1999. Internet.

Table 30. The diversification of bean consumption in the Andean Region.

Country	Traditional preferences	New trends in consumption
Bolivia	No tradition of consumption	• Nima and carioca classes, planted in plains and valleys • Offer of black bean on the rise
Ecuador	Light colors: white, cream, yellows	• Red bean disseminated in northern highlands • Red bean accepted as fresh grain in southern highlands
Peru	Light colors: white, cream, yellows	• Red bean disseminated in Madre de Dios • Red kidney bean incorporated into traditional offer • Navy bean shares preferences in yellow bean territory • Roasted bean gains acceptance outside traditional markets

Table 31. Bean consumption in Santa Cruz, East Bolivia, 1999.

Variable	Rural sector	Urban sector
Families consuming beans	*Total proportion of families (%)*	
• Of total number of families	75%	50%
• Of low-income families	-	84%
Amount of bean consumed	*Kilos per person per year*	
• Mean of total population	23.5	6.0
• Mean of consumers	31.1	12.1
• Mean of low-income consumers	-	14.0
Nutritional protein contribution of bean	*Contribution to daily requirements (%)*	
• Of the total population	26.3	6.7
• Of bean consumers	35.0	13.0
• Of low-income consumers	-	16.5

Appendix E

Peruvian Pulse Exports

Table 32. Volumes and value of Peruvian pulse[a] exports, 1980-1998.

Year	Volumen (MT)	Export value (US$ in 1000s)
1980-1989	555 (1982) - 2,079 (1988)	—
1990	1,698	—
1991	1,640	—
1992	2,205	1,547
1993	6,439	6,386
1994	13,335	10,268
1995	16,489	12,333
1996	10,656	8,624
1997	10,994	8,772
1998	8,291	6,192
Total 1994-98		**46,189**

a. Includes cowpea, pigeon pea, mung bean, common bean, and hyacint bean.

Source: Superintendencia Nacional de Aduanas. 1999. Lima, Perú.

Appendix F

Social Impact: Employment Generation

Table 33. Workdays involved in bean cultivation in the Andean Region.

Country	Work days/ha	Area* (ha)	Total labor
Bolivia	36	13,000	468,000
Ecuador	50	61,520	3'076,000
Peru	60	78,015	4'680,900
Colombia	70	148,621	10'403,470

Appendix G

Strengthening the Regional Network

Table 34. Summary of interinstitutional participation in PROFRIZA.

Country	Type of institution					
	INIA	University	State	Association	Private	Total
Peru	1	3	2	1	1	9
Bolivia	-	1	-	2	1	4
Colombia	1	1	-	1	-	3
Ecuador	1	1	-	-	-	2

List of Acronyms

ADEX-MPH	Peru	Asociación de Exportadores del Perú *Peruvian Association of Exporters*
ALPESA	Peru	Algodones Peruanos S.A. *Peruvian Cotton, S.A.*
ANAPROME	Peru	Asociación Nacional de Productores de Menestra *National Association of Pulse Farmers*
APROMEL	Peru	Asociación de Productores de Menestras de Lambayeque *Pulse Farmers Association of Lambayeque*
APROSFYM	Bolivia	Asociación de Productores de Semilla de Frejol y Maíz *Association of Bean and Maize Seed Producers*
ASOMEX	Bolivia	ASOPROF Y MEDA Exportadores *ASOPROF and MEDA Exporters*
ASOPROF	Bolivia	Asociación Nacional de Productores de Frejol *National Association of Bean Farmers*
BOLIVIAN SHOJI	Bolivia	Empresa Exportadora de Frijol *Bean Exporting Company*
BOLINVEST	Bolivia	Fundación Bolivia Inversión *Bolivia Investment Foundation*
BOLSEMILLAS	Bolivia	Empresa Boliviana de Semillas *Bolivian Seed Enterprise*
BRASIBOL	Bolivia	Empresa Exportadora Brasil-Bolivia
CADEX	Bolivia	Cámara de Exportación de Santa Cruz *Santa Cruz Chamber of Exports*
CAF	Bolivia	Corporación Andina de Fomento *Andean Corporation for Promotion*
CAO	Bolivia	Cámara Agropecuaria del Oriente *Agricultural Chamber of the East*
CCAB	Bolivia	Central de Cooperativas Agrícolas Berlín *Berlín Centre of Agricultural Cooperatives*
CCAVIP	Bolivia	Central de Cooperativas Agrícolas
CEA of **UAGRM**, now **IIA**	Bolivia	Centro Experimental Agrícola *Agricultural Experiment Center*
CEDEAGRO	Bolivia	Centro de Desarrollo Agropecuario, Cochabamba *Agricultural Development Center, Cochabamba*
CEDICA	Bolivia	Centro de Capacitación Campesina *Center for Rural Training*

CIAT	Bolivia	Centro de Investigación Agrícola Tropical *Research Center for Tropical Agriculture*
CIAT	Colombia	Centro Internacional de Agricultura Tropical *International Center for Tropical Agriculture*
CIFP	Bolivia	Centro de Investigaciones Fitoecogenéticas de Pairumani *Pairumani Phytoecogenetic Research Center*
CIPCA	Bolivia	Centro de Investigación y Promoción del Campesino *Center for Rural Research and Promotion*
CISSCN	Bolivia	Cooperativa Integral de Servicios de Santa Cruz Norte, Ltda. *Integrated Services Cooperative of North Santa Cruz, Ltd.*
CODESE	Peru	Comité Departamental de Semillas de Lambayeque *Lambayeque Departmental Seed Committee*
CORDECRUZ	Bolivia	Corporación de Desarrollo de Santa Cruz *Corporation for the Development of Santa Cruz*
CORPOICA, formerly **ICA**	Colombia	Corporación Colombiana de Investigación Agropecuaria *Colombian Corporation for Agricultural and Livestock Research*
CReA	Peru	Centro Regional Andino *Andean Regional Center*
CRSP	USA	Collaborative Research Support Program
DIA	Colombia	Departamento de Investigación Agropecuaria *Department of Agricultural and Livestock Research*
FAO	Italy	*Food and Agriculture Organization of the United Nations*
FDTA-TH	Bolivia	Fundación para el Desarrollo de Tecnología Agropecuaria - Trópico Húmedos *Foundation for the Development of Agricultural Technology - Humid Tropics*
FEDEAGRO	Bolivia	Federación de Asociaciones Agropecuarias *Federation of Agricultural and LivestockAssociations*
FENALCE	Colombia	Federación Nacional de Cultivadores de Cereales *National Federation of Cereal Growers*
FIDES	Bolivia	Fundación Integral de Desarrollo Económico y Social
FONTAGRO	Colombia	Fondo Regional de Tecnología Agropecuaria *Regional Fund for Agricultural and Livestock Technology*
FUNDACYT	Ecuador	Fundación para la Ciencia y Tecnología
GTZ	Germany	*German Agency for Technical Cooperation*
IBCE	Bolivia	Instituto Boliviano de Comercio Exterior *Bolivian Institute of Foreign Trade*

IBTA	Bolivia	Instituto Boliviano de Tecnología Agropecuaria *Bolivian Institute of Agricultural Technology*
IBYAN of **CIAT**	Colombia	*International Bean Yield and Adaptation Nursery*
ICA, now **CORPOICA**	Colombia	Instituto Colombiano Agropecuario *Colombian Institute for Agriculture and Livestock*
IDAL	Peru	Instituto de Desarrollo Agrario de Lambayeque *Lambayeque Institute of Agricultural Development*
IIA of **UAGRM**, formerly **CEA** and **IIARNR**	Bolivia	Instituto de Investigaciones Agrícolas *Agricultural Research Institute*
IIARNR of **UAGRM**, formerly **CEA**	Bolivia	Instituto de Investigaciones Agrícolas y Renovables *Institute for Research in Agriculture and Renewable Resources*
INIA	Peru	Instituto Nacional de Investigación Agraria *National Agrarian Research Institute*
INIAP	Ecuador	Instituto Nacional Autónomo de Investigaciones Agropecuarias *National Autonomous Institute of Agricultural and Livestock Research*
IPEL	Peru	Instituto Peruano de Leguminosas de Grano *Peruvian Grain Legume Institute*
ITAP	Bolivia	Instituto Tecnológico Agropecuario de Portachuelo *Portachuelo Institute for Agricultural Technology*
MACA	Bolivia	Ministerio de Asuntos Campesinos y Agropecuarios *Ministry of Rural and Agricultural Affairs*
MEDA	Bolivia	Asociación Menonita de Desarrollo Económico *Mennonite Association for Economic Development*
MSP	Peru	*Medium & Small Producers: Convenio ADEX-USAID (ADEX-USAID agreement)*
OFR	Bolivia	Oficina Regional de Semillas *Regional Seed Office*
PREDUZA	Netherlands	Proyecto de Resistencia Duradera para la Zona Andina
PROCIANDINO	Colombia	Programa Cooperativo de Investigación y Transferencia de Tecnología Agropecuaria para la Subregión Andina *Cooperative Program for the Research and Transfer of Agricultural and Livestock Technology for the Andean Subregion*

PROCOR	Bolivia	Proyecto de Comercialización Rural *Rural Marketing Project*
PROMASOR & C. A.	Bolivia	Asociación de Productores de Maíz, Sorgo, Girasol y Cultivos Alternativos *Farmers Association for Maize, Sorghum, Sunflower, and Alternative Crops*
PROMENESTRAS	Peru	Programa de Menestras (de PROMPEX) *Pulses Program of PROMPEX*
PROMPEX	Peru	Comisión para la Promoción de Exportaciones *Exports Promotion Commission*
PRONAA	Peru	Programa Nacional de Alimentación *National Food Program*
PROSEM of **PROFRIZA/ IPEL**	Peru	Producción de Semilla *Seed Production (program)*
PROVISA	Bolivia	Proyecto Villamontes Sachapera
SAVSA	Peru	Sociedad Agrícola Virú, S.A. *Virú Agricultural Society, S.A.*
SDC	Switzerland	*Swiss Agency for Development and Cooperation*
SEMEXA	Bolivia	Semillera Experimental *Experimental Seed Enterprise*
SIBTA	Bolivia	Sistema de Investigación Agropecuaria de Bolivia *Bolivian Agricultural Research System*
SOCODEVI	Canada	*Society for Cooperation in International Development*
TTA	Peru	Proyecto Transformación de la Tecnología Agropecuaria *Agricultural Technology Transformation Project*
UAGRM	Bolivia	Universidad Autónoma "Gabriel René Moreno" *"Gabriel René Moreno" Autonomous University*
UCQ	Ecuador	Universidad Central de Quito *Quito Central University*
UDENAR	Colombia	Universidad de Nariño *University of Nariño*
UMATAs	Colombia	Unidades Municipales de Asistencia Técnica Agropecuaria *Municipal Units for Technical Assistance in Agriculture*
UNC	Peru	Universidad Nacional de Cajamarca *National University of Cajamarca*

UNALM	Peru	Universidad Nacional Agraria "La Molina" *"La Molina" National Agricultural University*
UNPRG	Peru	Universidad Nacional "Pedro Ruiz Gallo" *"Pedro Ruiz Gallo" National University*
UOPE-MA	Peru	Unidad Operativa de Proyectos Especiales – Ministerio de Agricultura *Special Projects Operative Unit, Ministry of Agriculture*
USAID	USA	*U.S. International Development Agency*