

# Case Study: Collaborative Crop Research in Action

*The McKnight Foundation Support for Andean Grains  
Research and Development in Bolivia and Ecuador*

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# Foreword

The McKnight Foundation's Collaborative Crop Research Program (CCRP) funds collaborative crop research between smallholder farmers, leading local researchers, and development practitioners to explore solutions for sustainable local food systems. Currently the CCRP funds 120 grantee organizations in 70 research projects in 12 countries.

In 2012, the program decided to undertake a series of case studies to better understand the impact and lessons of their interventions and those of selected grantees over the years. The case study method was chosen to combine qualitative and quantitative data in a format focused on utilization. The program, grantee, and larger community can subsequently learn and improve research for development outcomes going forward.

This Andean Grains case study is the first in the series and is an excellent example of how this approach can provide insightful evidence and analysis that informs various hypotheses about how best to undertake more relevant and rigorous research. Ultimately, the goal is to embolden small-scale farmers in the Andes to improve their livelihoods.

The report affirms the benefits of the flexibility, support, and capacity strengthening the CCRP provides, as well as the power of its collaborative and participatory approaches. It points to the need to more fully engage outside actors in the quinoa sector in Bolivia and the Andean grains sectors in Ecuador to better understand how these two research programs fit into the larger market and consumption trends. Finally, it reveals the need for more systematic project level data on the impact and reach of seed and other technologies to better inform future case studies.

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## Acronyms & Abbreviations

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AEI	Agroecological intensification
APROSANAMY	Asociación de Productores de Semillas y Alimentos Nutricionales Andinos, Mushuk Yuyay (Association of Producers of Seed and Nutritious Andean Foods, “New Thinking”), Cañar, Ecuador
BYU	Brigham Young University
CABOLQUI	Cámara Boliviana de Exportadores de Quinua y Productos Orgánicos (Bolivian Chamber of Exporters of Quinoa and Organic Products)
CADEQUIR	Cámara Departamental de la Quinua Real del Departamento de Potosí (Departmental Chamber for Quinoa Real, Department of Potosí), Bolivia
CCRP	Collaborative Crop Research Program
CGIAR	Consultative Group on International Agricultural Research
CIAL	Local Agricultural Research Committee (Comité de Investigación Agrícola Local)
CoP	Community of Practice
CORPOPURWA	Corporación de Productores de Leguminosas y Granos Andinos del Pueblo Puruwa (Association of Producers of Legumes and Andean Grains of the Village of Puruwa), Chimborazo, Ecuador
DANIDA	Danish International Development Agency
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Online statistical database of the FAO
FFS	Farmer Field School
IBTA	Instituto Boliviano de Tecnología Agropecuaria (Bolivian Institute for Agricultural Technology)
IFAD	International Fund for Agricultural Development
IMEP	Integrated monitoring, evaluation, and planning: system developed by the CCRP to foster learning and program improvement
INIAF	Instituto Nacional de Innovación Agropecuaria y Forestal (National Institute for Agricultural, Livestock, and Forestry Innovation), Bolivia
INIAP	Instituto Nacional Autónomo de Investigaciones Agropecuarias (National Autonomous Institute for Agricultural and Livestock Research), Ecuador
IPM	Integrated pest management
NGO	Non-governmental organization
PROINPA	Fundación para la Promoción e Investigación de Productos Andinos (Foundation for Investigation and Promotion of Andean Products), Bolivia
R&D	Research and development
SDC	Swiss Agency for Development and Cooperation

## Summary

The McKnight Foundation commissioned a case study of its support to Andean grains research and development (R&D) in Bolivia and Ecuador through the Collaborative Crop Research Program (CCRP). Taking a systems perspective, the study was designed to assess the development and results of the national Andean grains programs, learn about CCRP contributions to these programs, and formulate lessons for improving the national programs and future CCRP support.

The study concluded that, although most of the factors influencing Andean grains production and use are beyond the control of national R&D programs, they have made important contributions to innovation with Andean grains in Bolivia and Ecuador. The programs have:

- Released new varieties, worked with farmers to improve seed quality, and identified new ways to manage pests with minimal use of chemical pesticides;
- Generated and disseminated information on ways to improve production and diversify uses of quinoa, lupine, and amaranth;
- Influenced public policies and, through improved relationships and networks involving economic actors and agricultural service providers, facilitated innovation processes and strengthened the capacity for innovation with Andean grains in the two countries.

Since the production and marketing conditions for Andean grains are constantly changing, national programs need to develop sustainable R&D capacities to respond to changing needs and opportunities. Critical is developing effective capacities for networking and brokering innovation processes. By emphasizing systems change through collaborative research, knowledge sharing, and capacity building, the CCRP has made important contributions to developing such capacities in the two countries. A growing concern for the national programs is developing sustainable financial strategies to reduce their dependence on external donors as well as on the national treasury.





## 1. Introduction

The McKnight Foundation began funding crop research with the Plant Biology Program, which ran from 1983 to 1992. The following year it launched the Collaborative Crop Research Program (CCRP) to provide support for agricultural research in developing countries. McKnight has commissioned a series of case studies to better understand the CCRP approach and its results in Africa and the Andean region of South America and to improve future grantmaking. The Andean case study, the findings of which follow, focused on McKnight's R&D support of Andean grains in Bolivia and Ecuador. The term "Andean grains" refers to grains and grain legumes that have been domesticated in the Andes and have long been considered neglected and underutilized.

McKnight has supported quinoa research in Bolivia at the Foundation for Investigation and Promotion of Andean Products (PROINPA), and quinoa, lupine, and amaranth research in Ecuador at the National Institute for Agricultural and Livestock Research (INIAP) through their legume and Andean grains programs. Begun in 2001 the Bolivian project is the longest-running CCRP-supported project in the Andes. The Ecuadorian project, which began in 2005, is part of the second cohort of CCRP projects in the Andes. Both have engaged in a wide range of activities over the years, including:

- Germplasm collection, characterization, conservation, and use in the development of new varieties;
- Development and promotion of improved practices for cultivation, pest management, and harvest and post-harvest operations;
- Diversification of uses of Andean grains, public awareness, and policy influence.

These are the only two projects in the CCRP Andes portfolio that include genetic improvement and the release of new crop varieties.

Although the initial motivation for analyzing McKnight's support for Andean grains R&D came from within the Foundation, the study was also to be of use to members of the Andean grains programs and to PROINPA and INIAP senior management for improving their R&D efforts. In this sense, it is a "utilization focused evaluation" done for and with specific intended primary users for specific, intended uses (Patton, 2012). It was expected that the study would also be of use to individuals and organizations concerned with the use and conservation of Andean grains, along with other neglected and underutilized species, to improve food security and promote sustainable development. These priorities were expressed in the study's three objectives:

1. To assess the development and results of the Andean grains R&D programs in the two countries
2. To assess the contributions of the CCRP to Andean grains R&D in the two countries
3. To formulate lessons for improving the Andean grains programs as well as future CCRP support

Following Hargreaves (2010) and Patton (2011), the study took an approach that reflected systems thinking. The CCRP's work in the Andes was viewed as a "systems change intervention" that aims to bring about changes in national Andean grains R&D programs. These changes, in turn, are expected to contribute to changes in the production and consumption of Andean grains and, ultimately, to poverty reduction, food security, and conservation of agrobiodiversity and other natural resources. Achieving the Andean grains programs' goals would require targeting many different systems: farming, marketing, policy-making, public opinion, and household consumption. Hence, the study was concerned with numerous interacting and "entangled" systems, which included the CCRP, the national Andean grains programs, their host organizations, and the broader innovation and food systems of which they form parts and seek to influence.

This case study was not intended to be an "impact evaluation" in the traditional sense. It did not seek to assess the *impacts* of the CCRP or the Andean grains programs on distant socioeconomic variables such as rural welfare, food security, or natural resource conservation. Rather, in the spirit of contribution analysis (Mayne, 2013), the study sought to understand the contributions of the CCRP to the capacity and performance of Andean grains R&D in Bolivia and Ecuador and the influences of these programs to changes in public perceptions, policies, and the production and use of Andean grains.

The study was based on case study research methods (Yin, 2009) and drew on four main sources of information:

1. Printed and digital publications and information on Andean grains
2. Unpublished reports on the CCRP and the Andean grains programs
3. Visits to field sites and key informant interviews with program stakeholders
4. Participatory review workshops conducted at the beginning and end of each country visit

In this study we distinguished R&D from innovation. Whereas R&D involves the generation and dissemination of scientific knowledge, innovation is a broader concept concerned with "the *use* of new ideas, new technologies, or new ways of doing things by people and in places where they have not been used before" (Barnett, 2004: 1, emphasis added). An innovation system extends beyond the creation of knowledge to encompass the factors affecting demand for and use of new and existing knowledge in novel ways (World Bank, 2007: 6-7; 2012).

Many people have contributed to the planning and execution of this study. I thank the farm families, businesspeople, researchers, and development professionals who met with me in Ecuador and Bolivia and who gave generously of their time and knowledge.

Eduardo Peralta and the members of INIAP's legumes and Andean grains program and Alejandro Bonifacio and the members of PROINPA in Bolivia made excellent arrangements for the country visits; prepared useful presentations on and documentation of their work; organized my visits to research facilities, farming communities, and markets; were excellent hosts during my visits to Ecuador and Bolivia; responded to numerous requests for additional information and

clarifications after the fieldwork; and provided detailed comments and suggestions for improving this report. The senior management teams of INIAP and PROINPA actively supported the study and took the time to meet with me and discuss their organizations' work and views on Andean grains R&D.

Claire Nicklin and Carlos Perez, CCRP's regional representative and liaison scientist in the Andes, respectively, provided abundant information and useful insights on the CCRP and its work in Ecuador and Bolivia. Claire also coordinated the overall study, greatly facilitating my work. The program's leadership team participated actively in planning the study and provided useful comments on a preliminary version of the final report.



## 2. The Andean Grains Programs

### Andean grains: their nature and dynamics in the context of agricultural development

The Andean region of South America is one of the world's major centers of plant domestication. Indigenous peoples domesticated a number of crops known as Andean grains, including quinoa (*Chenopodium quinoa*), amaranth (*Amaranthus caudatus*, *A. quitoensis*), lupin (*Lupinus mutabilis*), and kañiwa (also known as cañihua or cañahua) (*Chenopodium pallidicaule*). Prior to the Spanish conquest, these crops were highly prized for their rusticity, adaptation to highland growing conditions, and nutritional quality. However, during the Colonial and Republican eras, these crops were frequently disparaged as “food for Indians.” As other crops were introduced, the cultivation and consumption of Andean grains declined, practically disappearing from cities and many farming communities (National Research Council, 1989).

Andean grains are still minor crops in most of the Andes. Nevertheless, growing interest in quinoa and amaranth as healthful foods and in lupines<sup>1</sup> as a tasty snack food and ingredient in modern dishes is driving increases in their production and consumption throughout the Andes. There is strong external demand for quinoa, particularly organic quinoa, but limited production and R&D to support such production. Strong international demand also exists for organic amaranth, but production and market development in Ecuador and elsewhere in the region are extremely limited. Domestic demand is relatively strong for lupines, a significant sum of which is satisfied by Peruvian suppliers.

In Ecuador, quinoa and amaranth were important in the farming systems and diets of indigenous people in the highlands. However, their importance declined significantly in Colonial and Republican eras and, in many areas, they have practically disappeared. Many farmers have lost both their amaranth native varieties and the practical knowledge associated with their cultivation. Recent international interest in these crops has stimulated local interest in their cultivation. A number of non-governmental organizations (NGOs) have begun to work with small farmers to expand cultivation and exportation of quinoa. While local quinoa consumption remains low, the introduction of processed quinoa products has stimulated local consumption somewhat. Market agents have received expressions of interest in amaranth, but have been unable to identify local sources of supply to satisfy the potential international market demand.

In Bolivia, quinoa has been an important crop and food source since its domestication. It is one of the few crops that flourishes in the cold, semi-arid conditions of this unique ecological region. Quinoa cultivation has always been most important in the southern *altiplano*, in the departments of Oruro and Potosi, around the Uyuni salt flat<sup>2</sup>, a region ranging from about 3,500 to more than 4,000 meters above sea level. Here, a number of landraces (ecotypes) of *Quinoa Real* flourish and produce large grains that are preferred by both Bolivian and foreign consumers and that fetch high prices on international markets. Strong demand for organic quinoa in Europe and other

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<sup>1</sup> Lupin is known in Ecuador as “chocho,” in Peru and Bolivia as “tarwi” or “tarui,” and lupin or lupine bean in common English.

<sup>2</sup> The *Salar de Uyuni* is the world's largest salt flat.

foreign markets over the past decade has unchained a “quinoa boom” in Bolivia’s southern *altiplano* but also a rapid expansion of quinoa cultivation in new areas, both in the central and northern *altiplano* and in valleys at lower elevations.

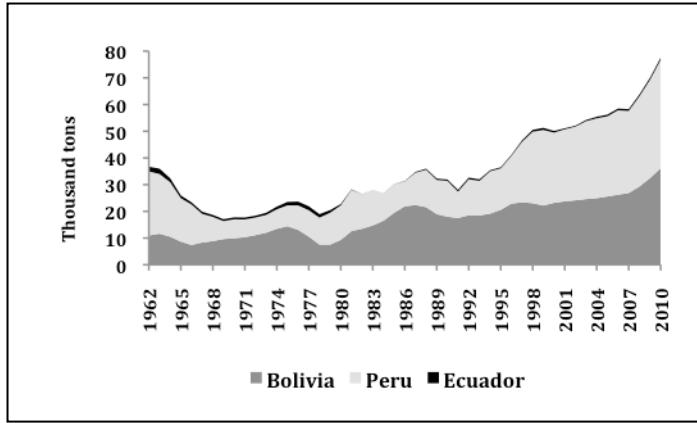
In the traditional farming systems of the southern *altiplano*, before the quinoa boom, few pests affected the quinoa crop and farmers did not apply chemical pesticides. Quinoa was part of an agropastoral system that included llamas. The boom has led to reduced crop rotation, fallowing, and llama herding, while intensified production has resulted in increased pest problems. These changes in farming practices also appear to be leading to reduced soil fertility and increased wind erosion, and some observers fear that the quinoa boom is converting the southern *altiplano* into an unproductive “dust bowl” and jeopardizing the livelihoods of local people (Jacobsen, 2011). Such fears have been widely reported in news outlets, including *The Guardian* and *Mother Jones*. However, as Winkel and colleagues (2012) note, the environmental and dietary impacts of the quinoa boom are far less clear-cut and negative than initial reports have indicated.

The available quinoa statistics (Figures 1–3) indicate that Peru was the largest producer in the 1960s, with Bolivia dominating since. Recently, estimated quinoa production has increased more rapidly in Peru than Bolivia and, if the current trends continue, Peru will surpass Bolivia as the largest quinoa producer in the near future.<sup>3</sup> Ecuador’s annual quinoa production has remained small: around 1,000 tons throughout the period. In both countries, the main force driving quinoa production has been change in the area harvested. Quinoa yields have generally fluctuated between 400kg and 1,000 kg/ha with no discernible trend, except in Peru, where yields have been increasing since the 1990s.

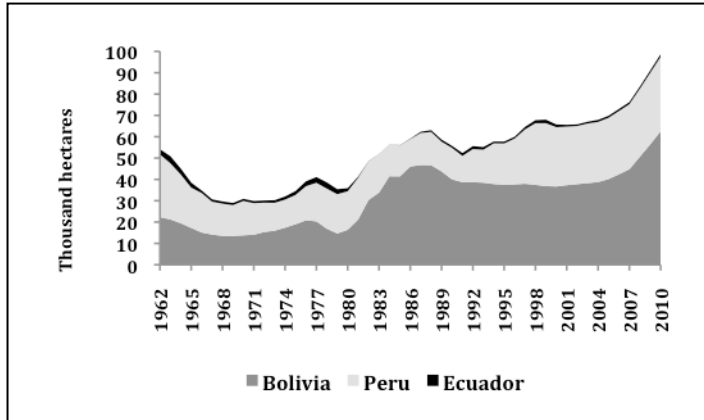
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<sup>3</sup> It is important to note, however, that an unrecorded and unknown but presumably significant amount of quinoa enters southern Peru each year from the Bolivian *altiplano*.

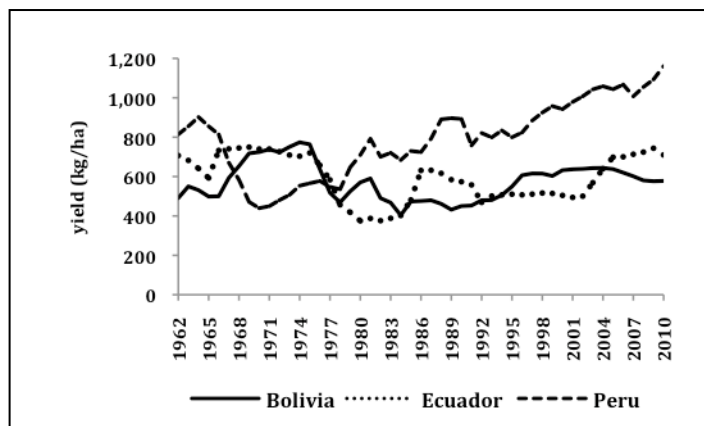
**Figure 1. Quinoa: Production by country (three-year moving averages)<sup>4</sup>**



**Figure 2. Quinoa: Harvested area by country (three-year moving averages)**



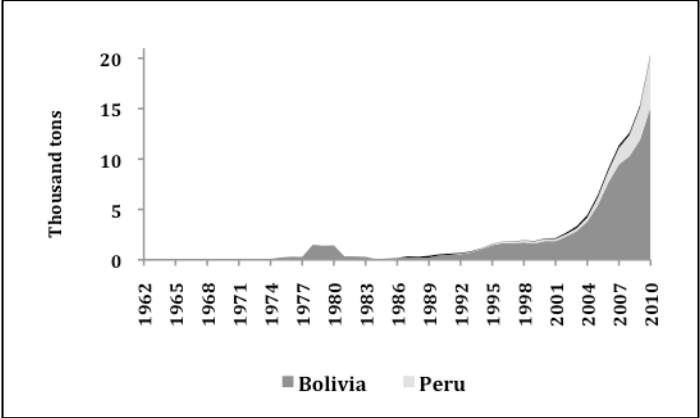
**Figure 3. Quinoa: Yields by country (three-year moving averages)**



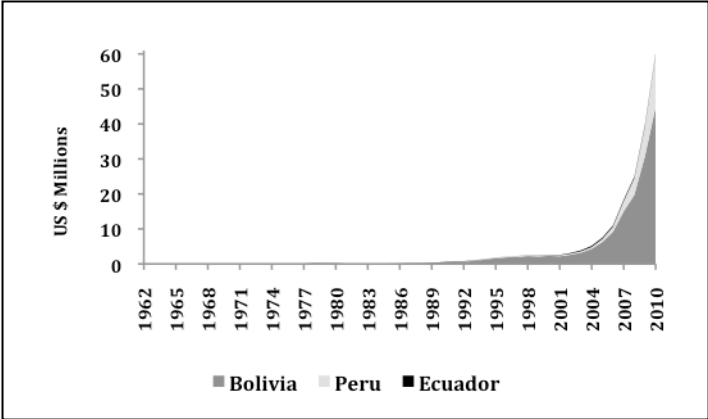
<sup>4</sup> The source is FAOSTAT, the online database of the FAO, which includes time series and cross sectional data relating to food and agriculture for 245 countries and territories from 1961 to the most recent year (accessed June 13, 2013). For Figures 1–9, FAOSTAT’s annual estimates were used to calculate and plot three-year moving averages. The years indicated on the horizontal axis of each figure correspond to the midpoint of each three-year moving average.

Available quinoa trade statistics show the clear dominance of Bolivian exports and the dramatic run-up in the volume and especially the value of quinoa exports over the last decade. Since 2000, the volume of Bolivian quinoa exports has increased nearly ten times and, since 2005, the price has tripled (Figures 4–6).

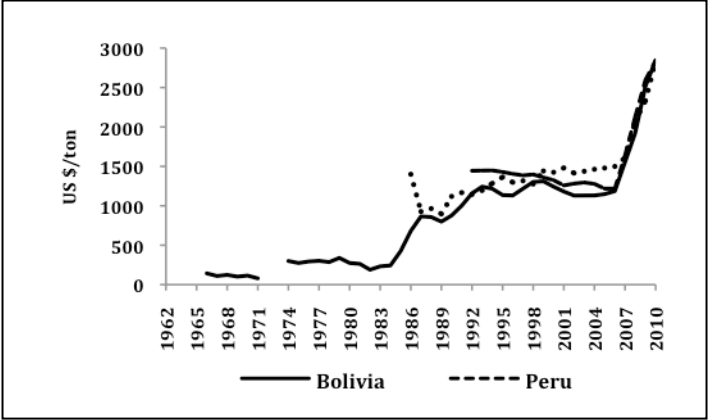
**Figure 4. Quinoa: Volume of exports by country (three-year moving averages)**



**Figure 5. Value of exports by country (three-year moving averages)**



**Figure 6. Quinoa: Export price by country (three-year moving averages)**

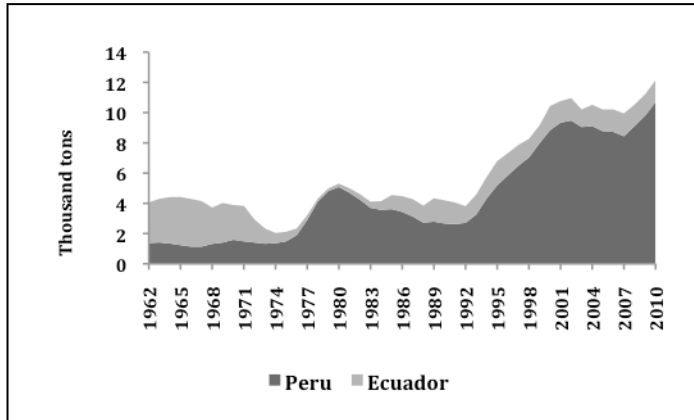


Available lupine statistics indicate that Ecuador was the leading lupine producer in the 1960s but its production has since been outstripped by Peru's. Peruvian lupine production fell during the

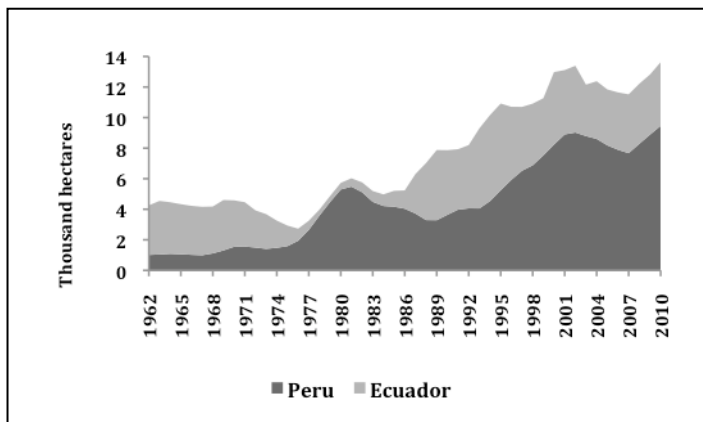


1980s when terrorism disrupted agricultural production but has increased dramatically since the early 1990s. In Peru, lupine yields fell during the 1960s, 1970s, and 1980s, recovering somewhat over the last two decades to just over 1 t/ha. Ecuador's yields fell until the mid-1970s, then increased dramatically until the mid-1980s, and then fell again to around 500 kg/ha. In Bolivia, lupines are produced in the northern *altiplano* and in highland valleys. An unknown but presumably significant amount of Bolivia's lupines is exported to Peru, with some shipped to Ecuador. Recent lupine prices have increased in Bolivia, stimulating interest in cultivating the crop (Figures 7–9).

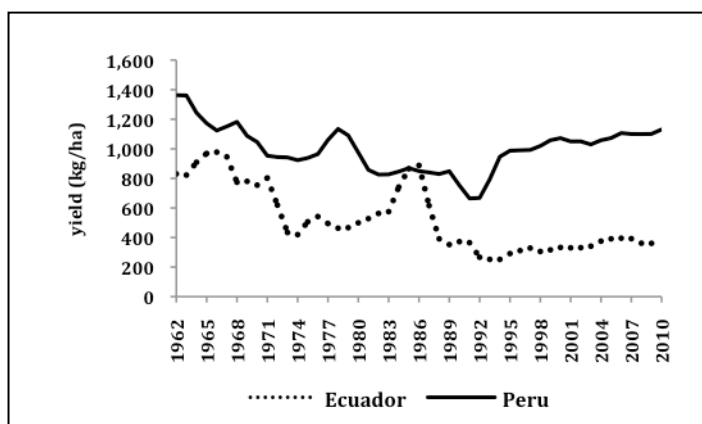
**Figure 7: Lupin: Production by country (three-year moving averages)**



**Figure 8: Lupin: Harvested area by country (three-year moving averages)**



**Figure 9: Lupin: Yields by country (three-year moving averages)**



*“Our grandparents planted quinoa and other crops in August. But now the rains don’t come until November. Climate change is very real for us here.”*

—Elías Vargas, small farmer, en Cachilaya, northern *altiplano*, Bolivia

*“We want to relive the agriculture that was from our ‘taitas’ [Quechua word for parents] and to protect the pacha mama [Quechua word for Mother Earth].”*

—Member, APROSANAMY farmer organization, Ecuador

*“We are working with a product [quinoa] that has changed the lives of many people ... But unfortunately many producers have a short-term mentality and think, ‘I’d better get rich now or I never will.’”*

—Paola Mejía, general manager, CABOLQUI, Bolivia

*“Farmland isn’t bought or sold here; it belongs to everyone in the community, but some people who left the community are now returning with money and they want to grab all the land they can to grow quinoa. This upsets our way of life ... Those who live here have their quinoa and their llamas. But those who return don’t have llamas and don’t want them either. They just want to make money fast growing quinoa.”*

—Sandro López, CADEQUIR, Uyuni, Bolivia

*“In my village there are only old people now. Once kids go to school in town they are not going to come back to the village to herd llamas. They want to apply what they have learned in some way ... You can make money fast with quinoa, but not with llamas. You have to take care of a llama for four or five years, and if you don’t take good care, a wolf or a mountain lion will eat it ... [Concerning yields] the key factor is rainfall. When it rains, you get good yields even on bad fields. But if it doesn’t rain, it doesn’t matter how good your seed is or how much fertilizer you put on; the yield will be bad.”*

—Receptionist, Hotel Girasoles, Uyuni, Bolivia

*“Without realizing it, we have done a lot of damage ... We have exterminated the llamas and alpacas ... We are also eating fewer potatoes and less quinoa and more noodles and rice ... As fields are cultivated, the yields definitely fall over time. Fields that have been cultivated twenty or more years have smaller plants and lower yields.”*

—Wilder Yucra, Chacala, Uyuni, Bolivia

*“The quinoa crop is a bit mysterious. How can it be grown in such arid areas? ... But it isn’t true that quinoa consumption has dropped because more quinoa is exported. The truth is that quinoa production and sales have grown a lot and that producers still keep part of their quinoa to eat ... It’s important to realize that quinoa has never been consumed in the city, except on holidays like Christmas. We city people are never going to eat quinoa every day. And it’s also a lie that yields are falling dramatically ... The agricultural frontier is being extended, but where is the desertification?”*

—David Soraide, director, Fundación AUTAPO, Oruro, Bolivia

*“Quinoa is now a luxury. It’s no longer accessible to people with low incomes.”*  
—Victor Pacosillo, owner and manager of a quinoa export firm, El Alto, Bolivia

## **Development of the national Andean grains programs**

### ***Institutional setting of Andean grains’ research and development***

In Bolivia, quinoa genetic breeding began in the Patacamaya Experiment Station in 1965 based on an agreement between OXFAM/FAO and the government of Bolivia (Gandarillas 1986). By the 1990s, a solid program had been developed within the newly established Bolivian Institute for Agricultural Technology (IBTA) that included germplasm collection, breeding, pest management, and agronomy. Over the years, IBTA released a number of new varieties of quinoa. In 1998, when Bolivia decentralized administrative responsibility for many of its public services and disbanded IBTA, the quinoa program was left without an institutional home. In 1999, the program was assimilated into the PROINPA Foundation. PROINPA<sup>5</sup> took up the mandate for quinoa R&D and, over time, reconstituted and further developed the program implemented earlier by IBTA. Since its inception, Andean grains R&D in PROINPA has focused on quinoa, with crops such as kañiwa and amaranth receiving minor attention.

PROINPA is an independent foundation dedicated to agricultural R&D in highland Bolivia. The fact that quinoa research is undertaken by an independent foundation is highly innovative in the Latin American context (Gandarillas et al. 2007). Established in 1989, PROINPA has its institutional roots in projects funded by the Swiss Agency for Development and Cooperation (SDC), which sought to establish a sustainable capacity for potato R&D in the country.

The McKnight Foundation’s support of PROINPA’s quinoa research started in 2001 with funding for the sustainable production of quinoa project, a collaboration between researchers from PROINPA and Brigham Young University. Its support for quinoa research continues and has been decisive for reconstituting and consolidating Bolivia’s quinoa germplasm collection and later for expanding the collection, characterizing and evaluating it, and developing protocols for the collection’s conservation and management. It provided PROINPA’s and Bolivia’s core quinoa research funding until 2010, when the Bolivian government established the National Institute for Agricultural and Forestry Innovation (INIAF). At that time, responsibility for maintaining the national quinoa germplasm collection passed from PROINPA to INIAF, which also began the development of a comprehensive quinoa research program. However, development of the INIAF research program has been slow, and PROINPA continues to be the country’s recognized leader in quinoa research. Recently, PROINPA and INIAF signed a cooperative agreement for conducting R&D on quinoa, potato, and wheat.

In 1962, Ecuador established the National Agricultural Research Institute (INIAP) as a semi-autonomous entity attached to Ecuador’s Ministry of Agriculture and with a core budget from the

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<sup>5</sup> PROINPA started in 1989 as the continuation of the defunct IBTAs Potato Research Program (Programa de Investigación de Papa) with technical and managerial support from the International Potato Center (CIP) and funding from the Swiss Agency for Development and Cooperation (SDC). In 1998 it became the private Foundation for the Promotion and Research of Andean Products (Fundación Promoción e Investigación de Productos Andinos) and expanded its range of researched crops beyond potatoes (Gandarillas et al. 2007).

national treasury. INIAP has benefitted from a number of institutional strengthening loans from the Inter-American Development Bank and other multilateral and bilateral funding agencies. In recent years, agricultural development has not been a national priority, and resources for INIAP field operations need to be generated by programs through externally funded projects or the sale of products and services. INIAP's Andean crop research activities therefore rely significantly on external sources of funding.

INIAP did not carry out research on Andean grains until the late 1980s, when work on lupin began in the Andean crops program, which was dismantled in the late 1990s, transferring work on lupin to INIAP's legumes program. Later, quinoa was added and, most recently, amaranth. Few universities or organizations conduct research on Andean grains, and INIAP continues to be the lead organization in this field. McKnight's initial support for INIAP's lupin/quinoa project dates from 2005 and continues today.

### ***How have the programs evolved over time?***

Both country programs are relatively small. Annually, PROINPA's quinoa program employs about 7.5 person-years of scientific staff, while INIAP's Andean grains program employs about 3.3 person-years. The Bolivian program has more highly trained researchers and attracts several students for thesis research each year, augmenting its research capacity.

Over the past decade, to expand its impacts and enhance its relevance, the Bolivian program has broadened its scope from germplasm collection and breeding to include integrated crop and pest management, diversification of quinoa uses, and, most recently, soil conservation and natural resources management. Meanwhile, to bring its scope of activities in line with available resources, the Ecuadorian program has over time narrowed its focus.

In recent years, to improve the linkage of research with development efforts, disseminate research results, and achieve more widespread impacts, both programs have intensified their partnering and addressed issues beyond the farm level and along the market chain.

Bolivia's quinoa program has responded to strong commercial demand for organically cultivated *Quinoa Real* and the threat of environmental degradation by moving aggressively into R&D aimed at improving food security, expanding the development and use of bio-inputs to manage quinoa pests and improve soil fertility, and reintroducing native shrubs to protect soils on the *altiplano* from wind erosion and serve as hosts for beneficial insect populations. In contrast to the PROINPA program, INIAP's Andean grains program has not yet begun R&D work on organic cultivation methods. This reflects the institutional position of INIAP, which is skeptical of the feasibility of organic cultivation in Ecuadorian farming systems. Consequently, there is little communication between INIAP and organic producers and the NGOs that support them.

Throughout their histories, both PROINPA and INIAP programs have sought not only to improve cultivation but also to expand consumption of Andean grains. One very significant change is that, over time, both programs have become much more explicitly participatory and client- and systems-oriented.

When, beginning in 2000, the quinoa program was incorporated into PROINPA, it was guided by

a traditional “Green Revolution” model of innovation that centered on breeding and genetics (Vanloqueren and Baret, 2009). The initial priority was to reconstitute the germplasm collection, which would form the bedrock of the quinoa-breeding program.

Collaboration with Brigham Young University (BYU), financed in part by McKnight, played a crucial role in characterizing the Bolivian germplasm collection and establishing a core quinoa collection based on agro-morphological characters, geographic origin, and molecular markers. Initially, PROINPA’s quinoa genetic improvement program used Bolivian research facilities belonging to the Benson Institute of BYU for research on drought tolerance and salt stress. The leader of Bolivia’s quinoa program, Alejandro Bonifacio, obtained a PhD from BYU, and Amalia Vargas and completed a MSc degree at BYU with a thesis on quinoa. BYU plant pathologists traveled to Bolivia to score segregating populations for mildew resistance and collect fungal isolates from these populations. Work at BYU also aided breeding efforts in Bolivia by evaluating starch content in quinoa germplasm and developing methods for using genetic markers to assist in selection of genetic lines with specific traits. Through work at BYU, a method was developed for reducing the moisture content of quinoa seeds for long-term storage.

As the germplasm collection became established and characterized, program priorities shifted to varietal improvement, seed production, and distribution, as well as to integrated crop and pest management and farmer training. When the production of organic quinoa for export became a national priority, PROINPA responded by intensifying its work on integrated pest management and bio-inputs. Due to emerging environmental problems associated with the quinoa boom, the program’s perspective has broadened from a focus on the quinoa crop in isolation, to understanding and improving quinoa cultivation in the context of local farming systems and ecologies. Currently, the program is grappling with issues of agroecological intensification, with particular attention to soil conservation. Its systems-oriented R&D work seeks to ensure that future expansion of quinoa production in the central and northern *altiplano* does not lead to environmental destruction.

*“In the central altiplano, we want to avoid what happened in the south ... When you work with living systems—with crops and their pests and diseases—you must continuously be on guard for new problems and look for new solutions. The job is never done ... To improve soils here, it’s necessary to combine scientific information with local knowledge. Local people classify soils very differently from the way scientists usually do. Farmers on the altiplano generally classify soils by their capacity to retain water.”*

—Alejandro Bonifacio, plant breeder and leader, quinoa program, PROINPA

For many years the PROINPA program carried out participatory research grounded in work with small groups of reference farmers. This approach was important for technology development but inappropriate for technology diffusion. Today, PROINPA is going beyond its traditional work with farmers. Its emphasis has shifted to working with NGOs and other development-oriented organizations to expand the use of research results and promote farmer innovation through an initiative known as “scaling up” (“escalamiento”). It has also begun to address technical issues that emerge throughout the market chains processes (e.g., pest problems in storage, industrial quality of distinct quinoa ecotypes and varieties, and tracing the sources of pesticide residues in export shipments). Whereas initially PROINPA viewed itself as a research organization, increasingly it is functioning as a service organization that serves not only agricultural producers

but also a broad range of stakeholders concerned with production, marketing, and utilization of quinoa and potatoes.

In Ecuador, INIAP's Andean grains program initially addressed a wide range of topics, including varietal improvement, seed systems, agro-industry, strengthening farmers' research capacity, and promotion of micro-enterprises. Since 2005, the program has reduced its work on agro-industry and micro-enterprises, focusing more on varietal improvement, integrated pest management (IPM), non-conventional seed systems, and promotion of consumption.

Initially, a traditional research-and-technology-transfer innovation model guided the program. Nonetheless, over time it has expanded the involvement of farmers and market-chain actors in its reviews, planning, and research operations. This is reflected in the use of Local Agricultural Research Committees (CIALs) in selection of varieties and in the involvement of stakeholders in annual program reviews. In its work in three parts of the highlands (communities in the provinces of Cotopaxi, Chimborazo, and Cañar), the program has applied an integrated approach for promoting both cultivation and consumption of Andean grains. Building on innovative work in Ecuador and elsewhere, the program has worked with community-based organizations to develop non-conventional seed systems that can provide good-quality seed without resorting to the complex and costly procedures of formal seed certification systems, which have not proved feasible for minor crops such as the Andean grains (Mazón, Peralta, and Rivera, 2012). Since the beginning, the Andean grains program has aggressively and successfully promoted the consumption of Andean grains at both the community level and on the broader national stage.

The Andean grains programs of Bolivia and Ecuador depend heavily on project funding from national and (mainly) international funders. PROINPA finances a portion of its core costs from an endowment, but virtually all of the operational expenses of its research programs, including salaries, are financed through projects based on external sources of funding. A small amount is also generated through sale of products and services. In INIAP, researchers' salaries and expenses associated with basic infrastructure are paid from the public treasury, but virtually all expenses directly associated with research operations (e.g., transportation, inputs, labor, and use of equipment) must be paid from funds acquired through projects or (secondarily) the sale of products or services.

Since McKnight began supporting the Andean grains programs (in 2001 in Bolivia and 2005 in Ecuador), it has provided the most continuous long-term support of any funding agency, providing these programs with more than half (59 percent of total project funding in Bolivia and 54 percent in Ecuador) of their project funding over the same period.

### ***Program personnel and facilities***

PROINPA's quinoa program has a total of twelve technical staff members, including one individual with a PhD in genetics, six with MSc degrees, four agricultural engineers, and one technician. Six of these individuals work full-time for the program while five work part-time. The program's total scientific staffing equals 7.45 person-years.

INIAP's Andean grains program has a total of six technical staff members, four of whom have MSc degrees, and two agricultural engineers. All work part-time on Andean grains. The program's

total scientific staffing amounts to 3.3 person years.

Each year, PROINPA staff members supervise a number of students working on MSc theses, augmenting the program's research capacity considerably. All current members of the Ecuador's program are relatively senior. INIAP has difficulty attracting and retaining highly trained young professionals, including thesis students. In contrast, the PROINPA program has a more age-diverse staff, with young professionals assuming important roles in the program and providing better prospects for renewal of program staff over time.

PROINPA has a research center with about twenty hectares of land in Quipaquipani near La Paz, where they conduct quinoa research. Most of the program's research is undertaken with farmer collaborators. In addition to its headquarters at Quipaquipani, the program has offices in Oruro and Uyuni in the central and southern *altiplano*. In Ecuador, because the Santa Catalina experimental station is not ideally suited for Andean grains research, the program conducts most of its field research on farmers' fields and on land at the Simon Rodriguez Technical Institute.

Conducting most of their research on farms has the advantage of bringing researchers into frequent contact with farmers and the conditions under which they operate, helping researchers develop a deep knowledge of the diverse farming systems and market environments in which Andean grains are cultivated and utilized. On the other hand, the lack of dedicated research facilities limits the programs' ability to conduct some types of advanced research under carefully controlled conditions. It is worth mentioning that PROINPA's partner Brigham Young University does have controlled greenhouse conditions where researchers do drought-stress and salt-tolerance breeding work.

### **Partnerships**

Multi-organizational collaboration is rare in Ecuador and Bolivia, and there are few examples of successful joint efforts to link agricultural R&D activities. It is no surprise then that, initially, both programs tended to work in isolation. Over time, as the programs pursued more client-oriented approaches and demands escalated to scale up results and demonstrate larger impacts, the programs found it useful to strengthen their working relations with other service providers as well as with farmer organizations and market agents.

In Bolivia, three recent initiatives have helped link PROINPA with other service providers:

- A concerted effort by the quinoa program to scale up impacts
- An effort to identify the source of pesticide residues in a quinoa shipment to Europe
- Collaboration in planning and execution of a visit to Bolivia of major quinoa buyers from around the world

In its efforts to scale up the use of its varieties and other research results, PROINPA negotiated collaborative agreements with several businesses and NGOs. In the second initiative, PROINPA worked with the four organizations that certify organic cultivation practices and with the country's main quinoa exporters. Their goal was to identify possible sources of pesticide residues and measure that could limit the possibility that pesticide-contaminated shipments of quinoa were certified as organic. In the third initiative, led by the Bolivian Chamber of Quinoa

Exporters (Cabolqui), PROINPA staff members provided technical inputs and contacts for field visits, organized a visit to PROINPA's laboratories and plant for producing bio-inputs in Cochabamba, and accompanied the group during their visit to the country. The successful development of each of these activities required close work with a range of stakeholders, which led to expanded and strengthened working relations.

From 2005 to 2009, INIAP's Andean grains program worked with a NGO to integrate local Andean grains R&D efforts into the NGO's broader program for nutritional improvement and education. The results were disappointing. The NGO did not prove to be committed and eventually withdrew from the area. Since then, the program has worked directly with community-level organizations in three parts of the country to improve the cultivation and processing of Andean grains and expand consumption.



### 3. Results of the Andean Grains Programs

Traditionally, program planning and monitoring functions have been weak in agricultural research organizations in general, with evaluation being especially weak (Horton and Borges-Andrade, 1999). Over time, attributed in part to the urging and support of McKnight, the Andean grains programs have improved these functions considerably. PROINPA's technical manager has played a key role in strengthening planning, monitoring, and evaluation processes in that organization. In Ecuador, two significant improvements have included the formulation of more realistic program objectives and the initiation of annual review meetings at which program staff and stakeholders review the year's accomplishments and identify areas for improvement.

In both programs, the elaboration of a “theory of change” (Vogel, 2012) has helped program staff understand more clearly the various changes that would need to be brought about—by the program on its own or in collaboration with others—to identify action priorities and for the desired outcomes to be achieved.

Both programs have produced a number of valuable products. They have also contributed to public awareness and policies, innovation capacity, and, to some extent, changes in production and use of Andean grains.

#### Products produced and services rendered

Both programs have collected landraces and wild species of Andean grains and have developed ex situ germplasm collections. Bolivia has a full-fledged quinoa-breeding program—one of few and perhaps the most productive in the world. The Bolivian collection has nearly 3,200 quinoa accessions, 800 accessions of cañahua (*Chenopodium pallidicaule*), and between twelve and 224 accessions of six other Andean grains and legumes. PROINPA has a full-fledged quinoa-breeding program that has released seven new varieties since 2003 during the period of McKnight support. The PROINPA program is now the most comprehensive and productive quinoa-breeding program in the world. The program also evaluates traditional quinoa varieties and has selected several promising ones for distribution to farmers. Most varieties are intended for use in the central and northern *altiplano*, but two new varieties have been selected for the southern *altiplano*. The Bolivian program is now working on varieties that are adapted to growing conditions at lower elevation in inter-Andean valleys. Furthermore, the program now has seven additional advanced lines that have resistance to mildew and are adapted to cultivation at lower elevations.

Between 2001 and 2010, PROINPA worked to characterize the germplasm (using agromorphological and molecular variables), distribute promising germplasm to farmers, and develop a “nuclear germplasm collection” for use in genetic improvement. The support and collaboration of Brigham Young University has been critical, especially in mapping the quinoa genome and in developing methods for genetic-marker-assisted selection for specific traits such as saponin content. In 2010, PROINPA turned the germplasm collection over to INIAF, which has the national mandate for germplasm collection. PROINPA maintains a nuclear collection for use in quinoa breeding.

Ecuador's program has about 600 quinoa accessions, 480 lupin accessions, and 434 amaranth accessions. The Ecuadorian program has not released newly bred varieties but has identified and recommended to farmers varieties that have been selected from existing genetic materials. Varietal selection has been led by geneticists with active involvement from farmer collaborators. To date, the Ecuadorian program has named and recommended five quinoa varieties, one during the period of McKnight support and four previously. Similarly, it has recommended two lupine varieties—one with McKnight support—and one variety of amaranth. A quinoa-breeding program is being established and expects to begin releasing new varieties in the near future. Over the last few years, with the support from PROINPA, INIA-Chile breeders, and McKnight, INIAP has started a quinoa and lupine breeding program, and it expects to begin releasing new varieties in the near future.

Both programs have worked to produce seed, improve the quality of farmers' planting material, and disseminate improved crop varieties. Ecuador's work with non-conventional seed systems is particularly interesting and may have applications in other countries. PROINPA was among the first suppliers of certified organic quinoa seed and continues to produce high-quality seed, including certified, in collaboration with small-scale producers. According to PROINPA reports, since 2002, Bolivia's quinoa program and farmer collaborators have produced about thirty tons of improved quinoa seed that was distributed to farmers in several regional markets and, more recently, through collaborating NGOs in efforts to scale up the use of new varieties and better-quality seeds. According to INIAP records, since 2005, Ecuador's legumes and Andean grains program and its farmer collaborators have produced 5.9 tons of quinoa seeds, 21.3 tons of lupin seed, and 285 kg of amaranth seed.

PROINPA has a specialized team working on integrated pest management (IPM) that has gathered and systematized basic information on quinoa pests, beginning with the taxonomic identification of the main pests study of the insects' life cycle during the cropping season and fallow periods. In Ecuador, McKnight funding has allowed the University of Greenwich's Natural Resources Institute (NRI) to support study at INIAP on lupin pests.

Tables 1 and 2 present a summary of the most important products generated and services rendered by the two programs.

**Table 1. PROINPA's main Andean grains products generated and services rendered**

***Germplasm collection, conservation, and utilization***

- Rescue of IBTA's quinoa germplasm collection (1999–2000), which was in danger of being lost
- Consolidation, *ex situ* conservation, evaluation, and utilization of the National Germplasm Bank for Andean Grains (2001 – 2010)
  - Development of protocols for collecting germplasm
  - Agro-morphological, molecular, nutritional, and agro-industrial characterization
  - Development of a protocol for long-term storage of accessions
  - Promotion of the National Germplasm Bank for Andean Grains
  - Distribution of promising accessions to farmers
  - Development of a nuclear germplasm collection and its use for breeding
- Delivery of the National Germplasm Bank for Andean Grains to INIAF (2010) after ten years of building up and conserving the germplasm collection
- Continued use of the nuclear collection for breeding (2010+)
- In situ conservation of quinoa genetic diversity (2010+)
- Publication of catalogues of the ecotypes of Quinoa Real (2003 and 2012)

***Breeding program***

- Development of one of the most advanced quinoa breeding programs in the world (late 1960s – present)
- Fourteen new varieties released by IBTA (1970–1988)
- Seven new varieties released by PROINPA (2003–2011) (mainly adapted to growing conditions in Bolivia's north and central *altiplano*, some adapted to cultivation in lower valleys)
- Seven advanced lines with mildew resistance and adapted to cultivation in lower-elevation areas

***Seed produced and distributed***

- Thirty tons of seed produced and distributed in the northern and central *altiplano* since 2002. Improved seed is now estimated to cover between 60 and 75 percent of the quinoa in these regions.

***Integrated pest management***

- Basic information on main insect pests, including scientific identification, life cycles, and natural enemies
- Management options (including pheromones and eco-insecticides) identified or developed, tested, and combined in a strategy for “ecological pest management”
- Development with U.S. and Dutch partners of pheromones for the quinoa armyworm, and associated traps and guidelines for their use, now applied on 8,000 ha in the southern *altiplano*

***Inputs***

- Development with colleagues in PROINPA of bio-inputs for quinoa cultivation now used on 10,000 ha in the southern *altiplano*
- Small-scale equipment for threshing and cleaning grain, widely used by farmers

***Information disseminated***

- *Topics covered:* Improved varieties, quality seed, EPM, harvest and post-harvest technology, utilization, recipes
- *Form of distribution:* FFS; training courses; field days; participation in scientific, development and public conferences and fairs; partnerships for scaling up with development organizations; sales of seed; pheromones, and bio-inputs

**Table 2. INIAP's main Andean grains products generated and services rendered**

<p><b><i>Germplasm collection, conservation, and evaluation</i></b></p> <ul style="list-style-type: none"><li>• 608 quinoa accessions</li><li>• 481 lupine accessions</li><li>• 434 amaranth accessions</li></ul> <p><b><i>Breeding and varietal selection</i></b></p> <ul style="list-style-type: none"><li>• Five quinoa varieties selected (one with McKnight support)</li><li>• Two lupine varieties selected (one with McKnight support)</li><li>• One amaranth variety selected</li></ul> <p><b><i>Integrated pest management</i></b></p> <ul style="list-style-type: none"><li>• Study of the lifecycle of a major lupin pest (<i>Delia platura</i>) and estimation of damage caused</li></ul> <p><b><i>Seed production, 2005–2012</i></b></p> <ul style="list-style-type: none"><li>• Quinoa: 5,934 kg</li><li>• Lupine: 21,280 kg</li><li>• Amaranth: 285 kg</li></ul> <p><b><i>Information dissemination</i></b></p> <ul style="list-style-type: none"><li>• <i>Topics covered:</i> Varieties and cultivars, non-conventional seed systems, agronomic practices, harvest and post-harvest technology, nutritional composition and quality, dietary uses</li><li>• <i>Form of distribution:</i> recommendations, guidelines, extension bulletins, recipe books, print and electronic publications on INIAP website, radio spots, short courses, workshops, conferences, responses to individual requests</li></ul>
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To support farmers to produce quinoa without resorting to chemical fertilizers or pesticides, PROINPA has established a private firm, Biotop, which markets bio-inputs for the organic cultivation of quinoa and other crops. The bio-inputs encompass use of fungi, bacteria, plant substances, pheromones (produced in partnership with a Dutch commercial firm), and other natural ingredients to strengthen plants, improve soil fertility, and manage insect pests. In 2011 and 2012, Biotop marketed pheromones and other bio-inputs that were used on 8,000 hectares of quinoa, i.e. approximately 15 percent of the area planted to quinoa in the southern *altiplano*. Biotop is currently the principal commercial source of bio-inputs in Bolivia. The successful development and widespread application of bio-inputs in Bolivia reflects positively on PROINPA's foresight and proactive approach in responding to emerging demands.

Two topics that stand out in PROINPA publications are germplasm and eco-management of pests. A catalogue of the quinoa collection in the National Bank of Andean Grains was published in 2001. Ethno-botanical catalogues for Bolivian Quinoa Real were published in 2003 and 2012. In recent years, a number of fliers and extension-type bulletins have been published on the use of pheromones and traps for monitoring quinoa moth (*ticona*) populations, disrupting mating, and reducing populations.

## Contributions to networking, innovation, and policies

Traditionally, members of the Andean grains programs, like other professionals in PROINPA and INIAP, played the role of researcher/expert. Recently, they are also “networker” and “innovation broker” (Table 3). PROINPA has worked with traders, processors, and firms that certify organic crops to find ways to avoid pesticide contamination in quinoa exports. PROINPA has also worked with the Chamber of Bolivian Quinoa Exporters to facilitate communication among market chain actors and agricultural service providers, articulate demands for innovation, and foster innovation processes. Additionally, PROINPA has used a promising new vehicle for dissemination of technical information in Bolivia, working with eight development organizations. Whereas previously the program usually worked directly with farmers and their organizations, in this initiative, staff members trained NGO personnel who later were responsible for the front line work with farmers. Last but not least, PROINPA is supporting the government’s efforts to define standards for organic production of quinoa and other crops. Additionally, government officials frequently consult the program’s members on technical issues, and PROINPA prepared the scientific paper that supported the government’s proposal to the United Nations to declare 2013 as the International Year of Quinoa.

*“PROINPA has done a lot of research and has developed many new technologies. But these are useless unless the people who need them use them. Unfortunately, there has been a lot of ‘research’ but little ‘innovation’ on farms... Time is short. Quinoa has many problems that need solutions now.”*

—Paola Mejia, general manager, CABOLQUI, Bolivia

*“PROINPA’s research and bio-inputs have been very important for us ... but we want PROINPA to produce results quicker. We need to shorten the time needed for research to yield practical results.”*

—Sandro Lopez, CADEQUIR, Uyuni, Bolivia

*“We now see more clearly how important it is for research to produce tangible products. We also see the importance of working on a large scale. Before, we thought we should continue to work on a small scale until we had determined the superiority of a new technology. Now we see the importance of beginning to work earlier at a large scale [to determine the feasibility and performance of research results under real-life conditions].”*

—Member, quinoa program, PROINPA

*“By the 1970s, quinoa had practically disappeared and was forgotten. Now, with the new varieties and seed from INIAP, we are beginning to cultivate and consume it again.”*

—Member, APROSANAMY, Ecuador

*“Whatever you do, don’t let the Andean Grains Program die.”*

—Nelly Moreno, owner, Granmolino, a firm that processes and packages amaranthus, Ecuador

*“The success of our organization is due entirely to the Andean Grains Project ... Of all the programs at INIAP, the Legumes and Andean Grains Program is the one that works most with small farmers. In other projects most researchers are from the city and they don’t know or understand our lives here. They give us resources but there is no follow-up”.*

—Member, CORPOPURUWA, Ecuador

INIAP has worked with a nascent association of Ecuadorian quinoa exporters to help consolidate the organization. INIAP’s promotional campaigns on the virtues of cultivating and consuming quinoa, amaranth, and lupine—including radio spots, recipe books, workshops demonstrating diverse food preparations, and participation in conference and fairs—appear to have stimulated public interest in Andean grains as healthful foods. In the policy sphere, program members have contributed to development of a new law and accompanying regulations that recognize and promote development of non-conventional seed systems that, in many cases, are more appropriate for small farmers growing Andean grains. They have also provided technical inputs for the development of the government’s quality norms and standards for products based on Andean grains. Table 4 reviews INIAP’s support of networking and policy development.

**Table 3. PROINPA's contributions to networking, innovation, and policies**

***Networking and innovation brokerage***

Program members have:

- Led a participatory study to improve “traceability” throughout the quinoa market chain in order to ensure high product quality, food safety, and application of norms for certified organic quinoa cultivation and handling
- Actively participated in organizing the 2013 visit of main importers of Bolivian quinoa from around the world
- Contributed to the recent development of a mutual fund for financing quinoa production in Bolivia

***Public awareness***

- Participated in fairs and exhibitions and disseminated information on the nutritional value of quinoa and innovative uses for and preparations of it, generating renewed interest in quinoa

***Public policies***

- Prepared the technical document for the International Year of Quinoa
- Contributed to development of quality norms and standards for organic products, including quinoa

***Contributions to innovation capacity***

- Through the traceability study, PROINPA has helped strengthen relations among producers, traders, processors, and others involved in the quinoa market chain, and also with external service providers (e.g., organizations involved in certification, research, and development activities)
- Established a number of partnerships with development and commercial organizations to scale up use of new technologies
- Provided leadership in development of pheromones, eco-insecticides, and other bio-inputs and support for production of bio-inputs in PROINPA's Cochabamba plant
- Supervised program staff members' MSc theses, strengthening students' appreciation of the importance of linking research to practical problems and illustrating practical ways to do so
- Through participation in such projects as NUSIFAD, program members have helped connect researchers, development organizations, farming communities, and entrepreneurs in the quinoa market chain

**Table 4. INIAP's contributions to networking, innovation, and policies**

<p><b><i>Networking and innovation brokerage</i></b></p> <p>Program members have:</p> <ul style="list-style-type: none"><li>• Worked with community leaders to link with service providers, donors, and markets</li><li>• Communicated via Internet with the “Friends of Andean grains” network</li><li>• Helped link traders and processors to possible supply sources of Andean grains</li><li>• Assisted in strengthening nascent association of quinoa exporters as well as facilitating technical and institution innovation processes</li></ul> <p><b><i>Novel R&amp;D approaches</i></b></p> <ul style="list-style-type: none"><li>• Model for non-conventional seed systems</li><li>• Model for integrated production-and-consumption intervention</li></ul> <p><b><i>Public awareness</i></b></p> <ul style="list-style-type: none"><li>• Staged promotional campaigns on the virtues of cultivating and consuming Andean grains</li><li>• Led or facilitated the Fourth World Congress on Quinoa, the International Symposium on Andean Grains, and other activities associated with the International Year of Quinoa, raising the public profile of Andean grains</li></ul> <p><b><i>Public policies</i></b></p> <p>Program members have participated in the development of:</p> <ul style="list-style-type: none"><li>• A new law and regulations on seeds, agroecology, and agrobiodiversity</li><li>• Quality norms and standards for products based on Andean grains</li></ul>
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INIAP has made especially effective use of radio spots on local and national radio stations that promote the cultivation and consumption of Andean grains. The program has also contributed to a series of widely disseminated recipe books, co-published by Nestle and INIAP, which include recipes employing Andean grains (Nestle, 2012). Another innovative form of information dissemination has been the co-publication with a farmer organization of experiences and approaches for non-traditional seed systems for Andean grains (CORPOPURUWA, 2011).

The Andean grains programs have developed and applied novel R&D approaches that are at different stages of systematization and could be of potential use in other settings. Most notable are the following:

- An integrated approach, developed by INIAP, for promotion of Andean grains cultivation and consumption
- A model for non-conventional seed systems developed by INIAP
- A model, developed by PROINPA, for working with development organizations to scale up the use of research results
- A farming/landscape system approach, developed by PROINPA, centered on quinoa, which employs native vegetation (legumes, shrubs, and pastures) in establishing multi-purpose strips as well as multi-cropping

***Public awareness and policy influence***

In Ecuador, INIAP's promotional campaigns on the virtues of cultivating and consuming Andean grains appear to have helped shift public opinion in favor of Andean grains. In the policy sphere,



program members have participated in the development of a new law and regulations promoting the use of non-conventional seed systems. They have also provided technical inputs for the development of quality norms and standards for products based on Andean grains.

In Bolivia, participation by program members in fairs and exhibitions, plus dissemination of information on quinoa's nutritional value and its innovative use and preparation, appears to have contributed to renewed interest in domestic quinoa consumption. As an independent foundation, PROINPA has not often been invited to work with governmental agencies on policy issues. However, program members are frequently consulted by government officials on technical issues. Notably, PROINPA was invited to prepare the scientific paper that supported the proposal of the Bolivian Government to the United Nations to declare 2013 as the International Year of Quinoa.<sup>6</sup> INIAF also invited PROINPA to form an alliance for conducting R&D programs for quinoa, potatoes, and wheat.

## Lessons learned

1. R&D programs have little control over most factors that influence Andean grains production and use. Programs need to continuously assess their operating environments and concentrate on areas where they can make the greatest contribution.
2. The multi-pronged, multilevel "opportunistic" R&D approaches used by the Bolivian and Ecuadorian programs are appropriate for intervening in complex systems such as those of Andean grains production and use.
3. In some but by no means all cases, the Andean grains programs have played important roles in facilitating innovation processes. Successful cases should be documented and assessed in order to learn lessons that can improve future R&D work.
4. Production and marketing conditions for Andean grains are constantly changing. R&D programs need the capacity to respond effectively to changing needs and opportunities.
5. There are no "universal solutions" to the problems of producers, market agents, or consumers. Research should look for "complementary alternatives" and options that can be adopted and adapted by users to fit local conditions and changing circumstances.
6. Collaborative approaches, good working relationships, frequent interactions, and alliances have been essential for capturing research demands and promoting the use of research products.
7. Adaptive management that combines diagnostic work, frequent review, and subsequent adjustment of implementation plans is an appropriate management approach for the Andean grains programs.

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<sup>6</sup> The official website of the International Year of Quinoa is <http://www.fao.org/quinoa-2013>.

## 4. The CCRP Approach to Supporting Andean Grains R&D

### The McKnight Foundation's Collaborative Crop Research Program

The McKnight Foundation assists nonprofit organizations and public agencies to improve the quality of life for all people, particularly those in need. Through grantmaking, collaboration, and support for strategic policy reform, the Foundation seeks to build and maintain vibrant communities, enrich people's lives, protect the natural environment, and promote research in selected fields. With assets of around \$2 billion, the Foundation gives about \$91 million in grants annually. About one quarter of the amount of the Foundation's grants supports improvements in rural livelihoods and food security in developing countries.

McKnight began funding international crop research in 1983 with a Plant Biology Program. The Collaborative Crop Research Program (CCRP) began ten years later with a budget of \$12 million for six years. In 2000, McKnight committed another \$41.5 million over nine years and, in 2008, \$47 million over ten years. The CCRP also received \$26.7 million from the Bill & Melinda Gates Foundation to be used over five years. This funding allowed expansion of grantmaking in Africa and provision of regional support and non-grant assistance.

The mission of the CCRP is to support smallholder farmers working under risky and resource-limited conditions to improve their efficiency and resilience through the flexible application of ecological principles to improve their production, diets, and livelihoods. CCRP grant making reflects five guiding values related to innovation, continuous learning, balance of R&D, respect for culture and the environment, and mutual respect.

The CCRP supports clusters of projects in Eastern and Southern Africa, West Africa, and the Andes. In each region, it brings grantees together to operate as a Community of Practice (CoP) that collectively supports agroecological intensification (AEI). The CCRP approach promotes AEI in local farming systems by building local capacity and promoting integrated interventions that address production, nutritional, and environmental goals in locally appropriate ways. In each region, the CoP targets constraints to food and nutritional security through applied natural and social science research related to specific crops and value chains. The research agenda is refined over time to contribute to AEI in ways that promote better livelihoods, sustainability, and nutrition. CoPs aim to strengthen the capacity of R&D organizations to generate knowledge and facilitate innovation processes that contribute to agricultural innovation, farmers' food security, and family wellbeing. They seek to foster the use of collaborative approaches that reinforce local innovation capacity and collective action, and they emphasize the importance of understanding local context, harnessing AEI principles to inform local change and then effecting change at scale through multiple pathways.

Regional teams translate the program's values and principles into practice in several ways, including:

- Strategic grantmaking in support of a regional strategy
- Project inception periods that provide time for refining project plans

- Regular interaction with grantees through revision of annual reports, site visits, and annual meetings
- Annual regional meetings that bring grantees together to interact with one another, the regional team, and external resource people
- Training and technical assistance initiated either by grantees or the regional team
- Support (provided by statisticians from Reading University) for improving the research methods used by grantees
- Use of integrated monitoring, evaluation and planning (IMEP) approaches that foster learning and program improvement

## **Evolution of CCRP support**

The CCRP approach has evolved considerably in the Andean region. When the first projects (including support of Bolivia’s quinoa program) were formulated and approved in 2001, they reflected a traditional research-centered model of innovation. The first phase of McKnight support for quinoa R&D in Bolivia focused on reconstituting the quinoa germplasm collection and its use in breeding. The project was a collaborative initiative involving the PROINPA Foundation and Brigham Young University (BYU). The role of BYU in supporting PROINPA’s work was central to the project design. The principal scientists in PROINPA and BYU signed the project contract and had, together with the McKnight representative, considerable independence in decision-making. There was little dialogue between the project team and the Foundation except during project preparation and infrequent site visits. During this phase, according to members of the quinoa program, the Foundation acted like a “traditional donor.”

During the second phase of support for the Bolivian program and when support for Ecuador’s Andean grains R&D began, McKnight posted a representative with a development background in the region (in Quito) and a scientific director based at Cornell University. The emphasis was on applied research and cross-sector collaboration. An Andean community of practice was established for grantees in the region. In 2007, the CCRP regional teams (three in Africa and one in the Andes) were reorganized around a liaison scientist and a regional representative, supported by a statistics specialist. An anthropologist in the U.S. joined the regional team as liaison scientist, and a statistician based at the University of Reading in the U.K. provided grantees with support in research methods and statistics. The CCRP regional team began to emphasize capacity building and social and institutional innovation. Communication between the CCRP and the project teams became more frequent and substantive, as did communication among project teams. Since 2005, project teams in the region have met annually as a “community of practice” (CoP) to review progress with each project, share knowledge and experiences, and discuss a topic of general interest, such as indigenous knowledge, non-conventional seed systems, and participatory monitoring and evaluation.

In the past seven years, the Foundation has stressed explicitly linking research with development processes and improving programs on the basis of lessons learned from experience, in order to ensure that programs produce useful results that benefit a large number of poor people. To this end, the regional team has worked with local project teams to prepare “theories of change” for each project and to implement a system for integrated monitoring, evaluation and planning (IMEP) (CCRP-Andes, 2011). McKnight has encouraged project teams to go beyond a narrow focus on specific production constraints and seek ways to improve the

systems in which Andean grains are produced, marketed, and consumed. The Foundation's support has helped legitimize research and evidence analysis as platforms for sound development practice. It has likewise supported innovation and biological and social experimentation as components in the development of collaborative strategies for linking research and development initiatives, achieving large-scale impacts, and contributing to global knowledge via the production of "public goods."

The McKnight Foundation has contributed significantly to the capacity of the Andean grains programs in Bolivia and Ecuador. Had it not been for McKnight's support, Andean grains R&D would likely be a shadow of its current presence in the two countries. PROINPA leaders state emphatically that, without the Foundation's support, PROINPA would not have a quinoa program. Moreover, INIAP probably would not be doing any research on quinoa or amaranth. CCRP support has also helped legitimize R&D work with Andean grains in both countries and bolstered the host institutions in establishing their current leadership position in Andean grains in the R&D world.

The CCRP has contributed to individuals' capacities by providing opportunities for short-term professional training, advanced-degree education, networking, and knowledge sharing among professionals from different organizations and countries. The CCRP has also contributed to the capacity and performance of the Andean grains programs by encouraging and providing resources for them to:

- Improve planning, program formulation, and learning from periodic reviews;
- Work with other development partners in scaling up activities;
- Serve as information hubs and innovation brokers that stimulate and facilitate innovation processes with Andean grains.

Program members greatly appreciate the flexibility of the CCRP's project management during implementation. Resources have been made available, on flexible terms for operations, consultancies, and training. In Ecuador, flexibility in grant disbursements is especially appreciated because of frequent delays in government funding, which can disrupt field operations and cause experiments to fail. Recently, the CCRP adopted an approach that recognizes that no plan is perfect, allowing for projects to experiment, correct, adapt, and refine project plans during inception periods that range from a few months to one year after project funding is approved. This approach allows for flexibility, innovation, and freedom to try, make mistakes, and learn from the experience, all of which are greatly appreciated by project teams.

*"A unique, and very important, feature of The McKnight Foundation's support is its openness and flexibility. This allows projects to adapt over time and focus better on real needs. The Foundation's flexibility allows project teams to adjust their plans and activities as they learn from the field. Most other donors insist that projects implement their original plans, without changes. This makes it impossible to learn and change.*

—Vivian Polar, biological and social scientist, PROINPA

*"One unique feature of The McKnight Foundation is its flexibility. This allows the projects to evolve*

*over time. With other donors, after projects are planned, they are implemented, the final report is submitted, and they die.”*

—Edson Gandarillas, technical director, PROINPA

*“With The McKnight Foundation, we have improved our project review and planning very much ... Our planning has become more realistic; it reflects not only our own aspirations but the views of farmers and others who we consult in planning and review meetings.”*

—Member, legumes and Andean grains project, Ecuador

*“The McKnight Foundation has an ample vision, but sees things up close, too. Whereas other donors provide funding and then only want a final report, The McKnight Foundation also wants to know why things went well, or why they didn’t, and how to improve future work.*

—Amalia Vargas, plant breeder, PROINPA

*“The McKnight Foundation understands research processes. They are not like other donors that make grants for short-term projects and expect quick results... Additionally, no other donor provides money for genetic improvement for crops outside the CGIAR centers.”*

—Member, quinoa project, PROINPA

*“The McKnight Foundation is very different from other donors. One important difference is that they want us to develop our personal capacities and also have access to the tools and methods needed to do our work well—things like statistics, technical writing, GPS, and facilitation of meetings. They have provided us with training and resources for all these things outside of the project budget.”*

—Member, Andean grains project, INIAP

The McKnight Foundation has encouraged national Andean grains programs to work more actively with economic actors and service providers to promote innovation processes, and has provided resources to support these activities. Consequently, trust has built up among diverse stakeholders who are now working together more effectively. In Ecuador, the Andean grains program has brokered innovation processes in three communities. Results have varied, depending on the local setting. In Bolivia, PROINPA’s recent work with the Chamber of Exporters of Quinoa and Organic Products (CABOLQUI) and the Departmental Chamber for Quinoa Real in Potosi (CADEQUIR), as well as with development-oriented NGOs, has helped to build trust and establish working relations. Expanding collaboration among economic actors and agricultural service providers augers well for strengthened innovation capacities with Andean grains in the two countries. It would be useful to review these experiences with networking and innovation brokerage, documenting the strategies employed and identifying influential factors.

*“Before we worked with The McKnight Foundation, each of us worked alone. With the Foundation’s support, we have developed a team and consolidated a program.”*

—Member, quinoa project, PROINPA

*“Thanks to the support of The McKnight Foundation, PROINPA now has a quinoa program—not a project but an institutional program.”*

—Alejandro Bonifacio, plant breeder and leader, quinoa program, PROINPA

*“Before, it was thought that the knowledge of indigenous farmers was worthless. But now we value this knowledge. In our work with farmers, we learn a great deal and so do they. There’s a constant exchange of knowledge.”*

—Genetic resources specialist, quinoa project, PROINPA

*“We now plan more in response to consultations with stakeholders and evaluation results.”*

—Member, Andean grains project, INIAP

### **CCRP contributions to program-level capacity and performance**

In both countries, individuals identify four general ways in which their work with the CCRP has contributed to their personal capacity and performance. It has:

1. Increased their motivation for achieving practical results and benefits for poor farmers;
2. Improved their applied skills in technical aspects of their work (e.g., breeding and agronomy) and also in “new” areas such as research methods (surveys design, experimental design and statistical analysis, and qualitative research and analysis); participatory planning, monitoring, and evaluation; meeting facilitation; geographical information systems; and partnering and innovation brokering. Doing so allowed for better use of research to promote innovation and socioeconomic development;
3. Expanded their knowledge of useful in-country and regional experiences with R&D and innovation processes;
4. Broadened their professional networks within their own countries, across the region, and with key individuals outside the region. In Bolivia, two individuals have obtained partial support from the CCRP to obtain PhD degrees, and three others have obtained MSc degrees abroad. The PhDs have received their degrees at Brigham Young University, an important strategic partner of the PROINPA breeding program. All of these individuals have returned to continue their work with PROINPA.

In both countries, the CCRP support provided a sense of program legitimacy and a base from which they could obtain additional project funding. CCRP support in research methods helped both programs improve their planning, research protocols, data analysis, and reporting, contributing to the quality of research designs and results. The emphasis on partnering with development organizations, the work with IMEP, development of theories of change, and emphasis on achieving concrete results at the community level have contributed to the “impact orientation” of the programs, the relevance of the research, and the outcomes achieved.

*“The contributions of The McKnight Foundation to PROINPA have been fundamental. Without the*

*Foundation, there simply would be no quinoa program. Nor would there be a research center at Quipaquipani. The continuity of the Foundation's support has been essential for the continuity of quinoa research. Moreover, without the security that the Foundation's support has given us, we would not have been able to develop the other projects that make up the program today."*

—Edson Gandarillas, technical director, PROINPA

The Foundation's support has allowed the reconstitution and further development of Bolivia's National Germplasm Bank for Andean Crops and the development of a Nuclear Germplasm Collection for use in plant breeding, while ensuring the continuation of the quinoa program over the past twelve years. An additional Bolivia highlight is encouragement and support for experimentation in emerging fields such as the use of genetic markers in breeding, development and use of pheromones and bio-inputs in organic cultivation, and re-establishment of native plants for soil conservation in the southern *altiplano*. Finally, in Bolivia the CCRP has provided motivation and support for PROINPA to develop a number of inter-organizational collaborations to scale up innovation processes and results.

Without McKnight support, PROINPA would not have had the resources to establish a quinoa program or to consolidate the germplasm collection, which currently is the most important collection of quinoa germplasm in the world. In Bolivia, CCRP support has allowed PROINPA to establish itself as the leader in quinoa research in Bolivia and as one of this field's leading research programs internationally. It has also allowed PROINPA to work with leading R&D professionals and institutes around the world in such areas as the use of genetic markers in quinoa breeding and development of pheromones for monitoring and control of quinoa pest populations. In Ecuador, CCRP support has ensured the continuity of Andean grains R&D within INIAP, and has helped legitimize the use of collaborative and systems-oriented R&D approaches.

### ***Broader system-level contributions***

In Bolivia, CCRP support has helped strengthen the role of PROINPA as the leader in quinoa research and as a facilitator of interactions and partnerships that led to real-world changes in quinoa production, marketing, and consumption. A recent initiative to trace potential sources of pesticide contamination in shipments of "organic" quinoa and improve quality assurance in the future has helped improve inter-organizational relations. Distrust and competitiveness continue to characterize the institutional setting, but relations are improving, thanks in part to McKnight's encouragement and support for PROINPA to engage with a broader range of partners in addressing emerging issues. CCRP support has also helped strengthen links between Bolivian researchers and leading researchers around the world, connections that have already led to practical improvements in quinoa cultivation.

In Ecuador, CCRP support has helped raise the institutional profile and enhance the legitimacy of INIAP's Andean grains program. Innovation capacity appears to have been strengthened in the communities that have partnered with the program. The partnership with the Simon Rodriguez Technical Institute, supported by the CCRP, is contributing to the practical orientation of education in the institute. The program's dynamic networking, encouraged and supported by McKnight, is strengthening relations among public and private actors, with the Andean grains program serving as innovation broker.

*“With The McKnight Foundation, we have learned that we are one among many actors in a larger innovation system, and we have learned to value alliances with other important actors.”*

—Milton Pinto, researcher, genetic resources, PROINPA

*“We used to think that the only option was for us to work directly with farmers. But now we realize that we can work with other organizations that maybe are better equipped to reach large numbers of farmers. This is been an important lesson for us.”*

—Wilfredo Rojas, *altiplano* coordinator, PROINPA

### ***Long-term, dependable program support and a “different vision of development”***

Leaders of the Andean grains programs and senior officers at PROINPA and INIAP all note the value of the continuous, dependable support provided by McKnight. The CCRP has provided *more* resources for Andean grains R&D than any other donor, and its support has been continuous over a *longer* period than that of any other donor. People in both organizations stressed that the continuity of their Andean grains programs has depended directly on the continuity of support provided by The McKnight Foundation.

*“The McKnight Foundation is committed to success of the projects it supports. The Foundation monitors work, keeps in touch with project teams, and allows changes in plans if they are justified. There is a joint commitment to achieve results. They expect us to move ahead together.”*

—Member, quinoa program, PROINPA

*“The McKnight Foundation is a different kind of donor. They know how to guide institutions toward realistic goals and how to detect problems and respond rapidly.”*

—Wilfredo Rojas, *altiplano* coordinator, PROINPA

Program members feel that the Foundation’s vision of development processes is unique in stressing the importance of both technical and social innovation, in emphasizing the importance of both production and consumption of Andean grains, and in fostering knowledge sharing, learning, and development of local capacity at the individual, program, and innovation system levels.

Individuals in both countries—in the Andean grains program and senior managers in PROINPA and INIAP—note that members of the CCRP regional team make a greater effort to understand the local setting, needs, and opportunities than is the norm with donor organizations, and they appreciate this concern for identifying and addressing local problems. A related point: It was noted that the CCRP’s regional team helps project teams formulate appropriate goals, supports them in achieving them, and then holds them accountable for the results.

*“There are no universally valid formulas or recipes. In each location we need to understand the context of the crops and the customs of the people.”*



—Member, INIAP Andean grains project, Ecuador

*“The McKnight Foundation is very committed to resolving real problems in the Andes. I don’t know of any other donor that sees things in the same way—that looks beyond the objectives and expected outputs of the specific projects they fund.”*

—Wilfredo Rojas, *altiplano* coordinator, PROINPA

CCRP regional team members are in frequent contact with members of the Andean grains programs through site visits, reviews of annual reports, and annual regional CoP meetings. Program members consider the frequent and substantive (in contrast to administrative) communication with members of the CCRP as one of the CCRP’s most positive features. These practices distinguish it from most of the funding agencies (both international and domestic) with which they have worked.

*“Normally, when you deliver a project report, that’s the end of it. The difference with The McKnight Foundation is that they read the reports and send comments and questions. Sometimes the Foundation’s comments are strong or their questions are difficult, but they are always pertinent and make us think about our work in new ways.”*

—Alejandro Bonifacio, plant breeder and leader, quinoa program, PROINPA

With most donors, there is little communication aside from the negotiation of project documents, the delivery of periodic reports, and the occasional site visit or external evaluation. Open dialogue with donor representatives is very rare. With the CCRP, there is frequent communication and interaction, and the regional team is open to new ideas and approaches for achieving project objectives. Some of these (e.g., an approach for conducting a survey or engaging farmers in research) have been communicated to other project teams for assessment and possible application.

*“The caliber of The McKnight Foundation’s staff is very important. They are not like others who come here to impose their views or oblige us to accept their goals and conditions. The Foundation’s representatives are open and simple and inspire horizontal, collegial communications and relations.”*

—Member, quinoa project, PROINPA

The CCRP provides opportunities for face-to-face interaction and open dialogue with a wide range of individuals, including those from the region who hold different experiences and perspectives, and experts in key areas from other parts of the world.

*“In the CoP everything is discussed with everyone. That is very valuable.”*

—Member, INIAP’s Andean grains project, Ecuador

*“It is very useful and stimulating to discuss important general topics like climate change. We never have the opportunity to do that in our normal daily activities. I really love the discussions of these*

*'new' topics."*

—Alejandro Bonifacio, plant breeder and leader, quinoa program, PROINPA

Program staff and senior managers at INIAP and PROINPA feel that their project teams are working with (not for) the CCRP, and that the CCRP itself is co-evolving with the projects. As a result, there is a feeling that the results obtained have been co-generated by the CCRP and the programs working in tandem with farmers and other market chain actors.

*"In our ranking of donors, The McKnight Foundation is near the top. Something we value very much is that we learn and develop things together with them. We have very rich discussions and they listen to us."*

—Antonio Gandarillas, director, PROINPA

*"I really like the way the Foundation works, which is much less formal than other donors. The Foundation does not have a rigid bureaucracy. It has rules and is strict in applying them, but it also trusts grantees... The Foundation does not dictate what people should do. It helps the project teams formulate their own objectives and then it demands results. Other donors tend to impose their own objectives... I particularly like the CoP, which motivates creative thinking and action and strengthens ties among participants. At CoP meetings, the regional team moderates discussions on topics of importance to participants. For that reason, participants respond favorably to the Foundation's ideas."*

—Iván Reinoso, director, Santa Catalina, INIAP

## **Lessons for the CCRP**

1. Members of the national Andean grains programs value the CCRP's commitment to capacity building, its flexibility and openness to new ideas, the intensive interactions between project teams and the CCRP regional team, the continuity of CCRP support, and the co-development of priorities, programs, and results.
2. The CCRP approach aligns well with the needs and possibilities of the Andean grains programs, and program members have few suggestions for improvement.
3. A major concern of the Andean grains programs is the development of sustainable financing strategies, which would rely less on funding from external donors. Support for developing such strategies should be a CCRP priority.
4. Another CCRP priority should be supporting the systematic evaluation of the collaborative approaches used by the Andean grains programs to facilitate learning and program improvement and to gauge the potential utility of similar approaches elsewhere.
5. Greater CCRP encouragement and support for the presentation and publication of research results and lessons would be useful for the national programs.
6. Project team members consider the "regional CoP" to be very valuable; however, it does not function as a traditional CoP with frequent, spontaneous interactions among the members. It might be useful for the country project team members and the regional team to reflect jointly on CoP's approaches and experiences and experiment with options for further strengthening knowledge sharing, learning, and collective action among the participants.

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## **ABOUT THE McKNIGHT FOUNDATION**

The McKnight Foundation, a Minnesota-based family foundation, seeks to improve the quality of life for present and future generations. Through grantmaking, collaboration, and encouragement of strategic policy reform, we use our resources to attend, unite, and empower those we serve. Program interests include regional economic and community development, Minnesota's arts and artists, early literacy, youth development, Midwest climate and energy, Mississippi River water quality, neuroscience, international crop research, and community-building in Southeast Asia. Our primary geographic focus is the state of Minnesota, with significant support also directed to strategies throughout the U.S. and in Africa, Southeast Asia, and Latin America.

Founded in 1953 and endowed by William and Maude McKnight, the Minnesota-based Foundation had assets of approximately \$2 billion and granted about \$86 million in 2013. In 2013, McKnight invested \$6 million, or about 7% of total grantmaking, in efforts to explore solutions for sustainable, local food systems through the Collaborative Crop Research Program.