CROP PROTECTION PROGRAMME

Strengthening technical innovation systems in potato-based agriculture in Bolivia (INNOVA).

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FINAL TECHNICAL REPORT

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Executive Summary

The project "Strengthening Technical Innovation Systems in Potato-Based Agriculture in Bolivia," or INNOVA, has its origin in earlier DFID agricultural research and development in Bolivia and takes forward RNRRS outputs in activities where demands by poor farmers for technology innovation are met with an ongoing supply of research.

One of the main INNOVA's achievements has been to develop with groups of farmers an integrated set of mechanisms to link technology supply and demands and to evaluate potential new techniques. These methods include:

- Demand Sondeos for assessing farmers' demands for technology, Technology Fairs for gauging farmers' responses to new technologies, Retro-information, or local feedback meetings, and municipal "committees with teeth."
- Methods to involve farmers in preparing, adjusting and evaluating Technological Innovation Projects (PITAs) in SIBTA (Bolivian competitive funding system) and ensure pro-poor relevance**.**

As one of the important goals of INNOVA has been to validate technologies developed through research previously supported by DFID, the project team has evaluated about 30 technologies, and farmers have shown considerable interest in several of them. The most important ones are:

- Animal-drawn tillage implements, including reversible and multiple-use ploughs adapted with farmers to potato growing systems on the Altiplano. Enhanced adoption and sales of animal tillage implements in the valleys.
- New forage crops validated and promoted to increase productiveness of draught animals, conserve soil, and manage weeds and pests in the potato growing systems of the highlands
- An integrated strategy to manage potato diseases validated, promoted and used by farmers in the low valleys in Bolivia, to improve productivity and tuber quality.

INNOVA also sponsored innovative studies of the national potato market chain competitiveness, broadening the concept of "demand-led research" beyond to include demands from other actors of the market chain, besides farmers. INNOVA's participatory studies identified opportunities for adding value in potato chains in three regions. INNOVA's three case studies helped adapt the Participatory Market Chain Approach (PMCA). It generated innovations in four market segments: quality norms for chuño and for tunta products (dehydrated potato processed traditionally), native coloured potato chips and fresh native potatoes bagged for supermarkets.

INNOVA supported a study on the competitiveness and importance of potatoes in Bolivia as an input for policy makers to prioritise this commodity.

INNOVA developed a database with Bolivian research results for potato-based agriculture, and a strategy for disseminating INNOVA's results. The database was shared with Bolivian research partners and is available on INNOVA's web page (www.innovabolivia.org).

Another important achievement of INNOVA was bringing three research and development organisations together. In the past, these organisations all promoted technical Innovation in potato-based farming systems, but they worked in relative isolation from one another.

Helping professionals from different institutions to work in the same places on a common research agenda has improved their efficiency, allowed them to share ideas and talent to link technology supply and demand on behalf of poor farmers.

While INNOVA was conceived to fit the Bolivian context, valuable lessons and outputs could be applied elsewhere. For example, a new project funded by DFID/CPHP and implemented with CIP will synthesise and share proven research outputs on the market chain approach from INNOVA with R&D institutions in Uganda.

Background

INNOVA builds on agricultural research projects carried out in Bolivia in the 1990s with support from the United Kingdom's Department for International Development (DFID). A review of activities supported by DFID's Crop Protection Program (CPP) in Bolivia in 2000 concluded that an integrated crop management project should be developed to bring together and disseminate results of research already carried out in potato-based farming systems by DFID's Renewable Natural Resource Research program (RNRRS). The initial idea was to consolidate results of previous research supported by the CPP to enhance the impact of this research for poor farmers. As a result of the 2000 review, DFID invited Papa Andina to organise a project planning workshop in June 2001. Papa Andina is a CIP-hosted regional program that promotes strategic alliances for agricultural Innovation in Bolivia, Ecuador and Peru. Workshop participants represented the CPP's three main research partners in Bolivia – the Innovation Program for Andean Products (PROINPA), the Centre for Research in Tropical Agriculture (CIAT) and San Simón University (UMSS) and SIBTA representatives.

There was strong support from DFID's Bolivian research partners for developing an integrated project to address various problems affecting smallholders in mid-Andean valleys. Such problems include pests, diseases and weeds, soil erosion, declining soil fertility, lack of fodder and labour shortages. Several possible lines of action were identified. It was believed that inadequate dissemination and uptake of research results were key weaknesses of past research. Hence the new project should emphasise dissemination. To concentrate efforts and have an impact, the participating organisations should operate together in a few farming communities in partnership with municipalities and farmers.

In a second planning meeting in September 2001, a project proposal was prepared and discussed with key people in Bolivia's Ministry of Agriculture and DFID\La Paz. The initial proposal outlined:

- Validation of technologies in farmers' fields,
- Participation of farmer organisations as an interface between technology providers and intended users,
- Information management and communication.

A project proposal was approved by Bolivia's Ministry of Agriculture and DFID, and INNOVA started in July 2002. Funding was received from different DFID research programmes. For Working Groups 1 and 3 funds were obtained from the CPP and LPP. Funding for Working Groups 2 and 4 came from DFID's Bilateral Bolivia Initiative, with additional support for Working Group 4 from the CPHP.

The project's main objectives were:

- To expand and improve the use of research information generated with support from DFID,
- To validate and promote existing technologies,
- To improve mechanisms to link technology supply with small-farmers' demands.

A consortium of three research organisations – the PROINPA Foundation, CIAT (Santa Cruz), and the San Simón University (UMSS) – was formed to implement the project in three agro-ecological zones: the low valleys of Santa Cruz, the high valleys of Cochabamba and the Central Altiplano of La Paz. The project received the support of specialized expertise mainly from the UK and CIP. A project coordination unit was set up, and four Working Groups crosscutting these research organizations began to work on the following priority tasks:

- Improving the communication of research results,
- Identifying small farmers' technology demands,
- Validating and disseminating technologies,
- Analysing commodity chains for potato products.

The regional partnership program of the International Potato Centre (CIP), known as Papa Andina, managed the project. A Coordinating Committee governed it with members from the three consortium partners plus representatives of CIP/Papa Andina and the CPP.

Project Purpose

Strengthening technical innovation systems in potato-based agriculture in Bolivia

Research Activities

The project has been organized around and was brought together in 4 Working Groups that were set up to produce the project's 4 main outputs. Each output's report is presented separately in the following sections.

Output 1

The use of existing and new information generated by RNRRS projects promoted to national and regional researchers, development institutions, policy makers, donors and other potential users.

INNOVA's partners generated much information during previous projects. This information had to be selected, prioritized and made available to different users by various tools: electronic, written, and talks and demonstrations.

While implementing the project, Innova generated technical and methodological information and made it available. Innova needed to design systems to collect and disseminate this new information. These systems were to strengthen Innova's partners' capacities and be useful for other projects, research and development organisations, technology transfer agencies and policy makers (Ministry of Agriculture and the Bolivian System for Innovation in Agricultural Technology—SIBTA).

Working Group 1 (WG 1) needed to develop activities based on a dissemination strategy that would take the needs of its different audiences into consideration, whilst making use of the best tools and channels. WG 1 created a strategy that outlined all of Innova's products and activities.

Innova defined three target groups:

Macro: Donors and policy makers
Meso: Other development institutions, NGOs, etc.
Micro: Farmer groups and their local authorities.

WG1 characterised each group, determining their needs for information, dissemination channels, formats and frequency or periodicity of use. Then activities were structured to produce appropriate messages and media for each group.

The micro level (farmers) was the one with the most disseminated outputs. These were used widely to help improve the training implemented by Innova staff in the three pilot zones.

At the meso level, materials were disseminated amongst technical people and partner and non-partner institutions that also developed training for farmers, covering areas the project currently does not.

The database that gathered various reports, posters and audiovisuals, was one of the media promoted among other institutions.

Material diffused amongst farmers was well received, mainly because of the previous diagnosis. This material contained information farmers demanded, in a style they appreciated.

To respond to these needs, WG 1 structured its work within the following activities:

Activity 1.1 Database created for the storage and distribution of information generated by Bolivian research partners from past and future projects on potato production systems

This activity collected, sorted and prioritised information on technologies and methods created by INNOVA's partners, before and during its implementation. This information was disseminated among development institutions, SIBTA and policy makers.

This activity included:

- **Gather and select information generated by Innova partners related to potato based farming systems in Bolivia**

Since Innova's three partner institutions are devoted generating technologies, they had already produced much information prior to INNOVA. This information covered many subjects presented to various groups in different formats. This information was scattered and not easily accessible.

The first step was to take an inventory and prioritise (according to relevance and frequency) printed and audiovisual documents produced since 1990, including technical reports, scientific articles, and public outreach documents, such as flyers, pamphlets, radio shows, videos and charts.

	CD version database

- **Gathering and digitalization of printed and audiovisual documents**

Specialized services were hired to convert the information to a digital format.

- **Database design specifics**

Good user interface ensures trouble-free access and selection of the information in the database. This information is accessible through Innova's website (www.innovabolivia.org) or in CDs organised by topic, which that can be searched by keywords (category, topic, author, etc.).

The database includes the following:

- Documents
- Innova's distinctive image – its brand
- Author & partner details
- Links to other web sites

Activity 1.2 Internal system established for collecting, organising and exchanging information generated by the different working groups within the project

This activity consisted of designing and implementing formats that would allow partners and working groups to feed contents into the database and the website (www.innovabolivia.org), and to provide WG1 with the contents of printed and audiovisual materials.

Activity 1.3 Characterised target groups informed through communication mechanisms developed for facilitating the use, exchange and distribution of RNRRS project outputs

Innova's communication strategy identifies three target groups, and determines their needs for information, dissemination channels, formats and frequency of use.

Innova created a distinctive project trademark (including the name "Innova" and the logo), used consistently in every information product produced by the project.

Strategy for the Ministry of Agriculture, international cooperation agencies, research centres and foreign users
The strategy focused on disseminating institutional information electronically, via databases and websites as well as in presentations and workshops.

Strategy for the SIBTA foundations, technology service suppliers, development projects and other actors from the potato market chain
This strategy focused on disseminating technical and methodological information (electronic or printed), via databases, technical documents, and websites as well as via presentations and workshops.

Strategy for farmers
INNOVA's mid-term review in March, 2004 recommended emphasising the following strategy:

1. Research: Just as WGs 2 and 3 gathered farmers' technological demands, WG1 formed focus groups of farmers in each pilot area to learn their communication demands:

- What kind of information did farmers really want to receive?
- Which communication channels (TV, radio, meetings, workshops, presentations, calendars, posters, leaflets) farmers in the pilot areas had access to?
- Which channels did farmers prefer and why?
- In which format would they rather receive the information?
- Which delivery schedule suited them better?
- Which other characteristics or communication resources were also necessary or relevant for them?

The information was used to produce appropriate messages to be transmitted through the most effective channels.

2. Planning: Define messages to be transmitted, their contents and format, channels to be used and preferred frequency of transmission.

3. Production: Design and produce printed and audiovisual materials.

4. Control and adjustment: Validate for pertinence and coherence with the focus groups formed during the research stage.

5. Implementation: Distribute and use materials to support training, validation and technology dissemination by WG3

Outputs of Working Group 1

Activity 1.1 outputs

The database hosts:

- 18 technical reports targeted at researchers
- 24 papers on technologies and methods, written by project partners
- Three market studies describing consumer profiles in La Paz, Santa Cruz and Cochabamba
- Two posters for farmers on the biology and control of the Andean potato weevil
- Two posters for farmers on weeds and forage crops
- Three videos

- Three radio broadcasts for farmers on forage production

This database is constantly updated with new documents which users can access on the website (www.innovabolivia.org).

This product must be updated and disseminated more broadly to reach more institutions and researchers. Increasing its use will help avoid duplicating efforts where research, information and technologies are ready to be disseminated and adapted. Promotion online (pop up windows) as well as offline (posters, flyers, etc.) is needed.

Online version database

Activity 1.3 outputs

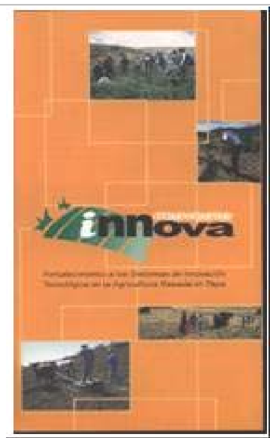
INNOVA's brand: creating a trademark

Consistent use of distinctive colours, name and logo helped make Innova easily identifiable by information users.

Logo and distinctive colours are consistently used in all of INNOVA's work

Strategy for the Ministry of Agriculture, international cooperation agencies, research centres and foreign users

Institutional leaflet. Photographs and a short text made it an effective publicity tool, accessible to a general audience. This leaflet enabled INNOVA to present what it was about, and its structure and action lines. This leaflet now needs to be updated.



The Innova institutional leaflet

Website

Nowadays a website is the first glimpse into an organisation, letting users interact with the host institution, sharing their work, methods, achievements, etc. A website provides a showcase (publicity section, newsletters and photographs) and allows organizations to communicate better with their internal and external audiences.

A glimpse of the INNOVA website

INNOVA's website (www.innovabolivia.org) holds the project's database, basic information (donors, reasearch and geography), institutional documents and news.

The website has been promoted through different search engines, networks and directories to achieve greater coverage. INNOVA has been registered on Google and is now registering with AltaVista and Yahoo. Links from other development institutions such the Livestock Production Programme's website (www.lpp.uk.com) and Proinpa (www.proinpa.org) have also been made to INNOVA's website.

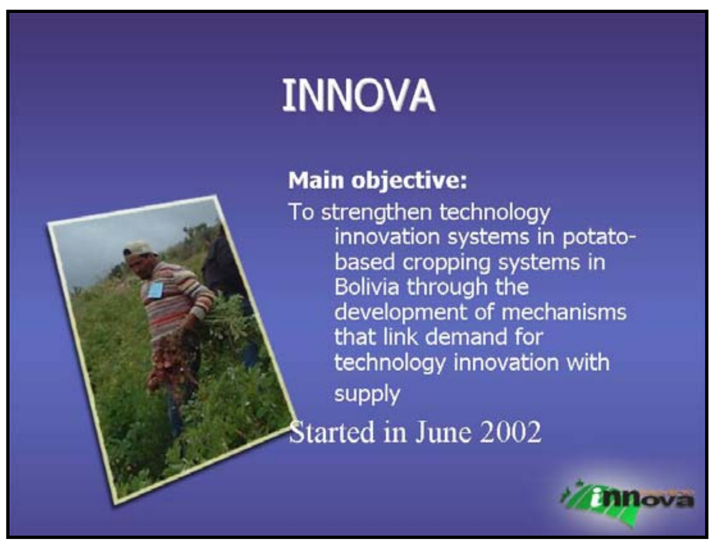
These actions allowed INNOVA to gain a better rank within Google. According to Google's page rank (web sites are rated from 0 to 10, with 0 being the least popular and 10 the most), INNOVA's website went from a 0 to a 4.

Institutional presentations
PowerPoint presentations are used for meetings or workshops INNOVA organised or attended. These presentations are provide a glimpse into INNOVA and help establish contacts.

Strategy for the SIBTA foundations, technology service suppliers, development projects and actors from the potato market chain
The website, institutional leaflet and presentations were also used for this target audience.

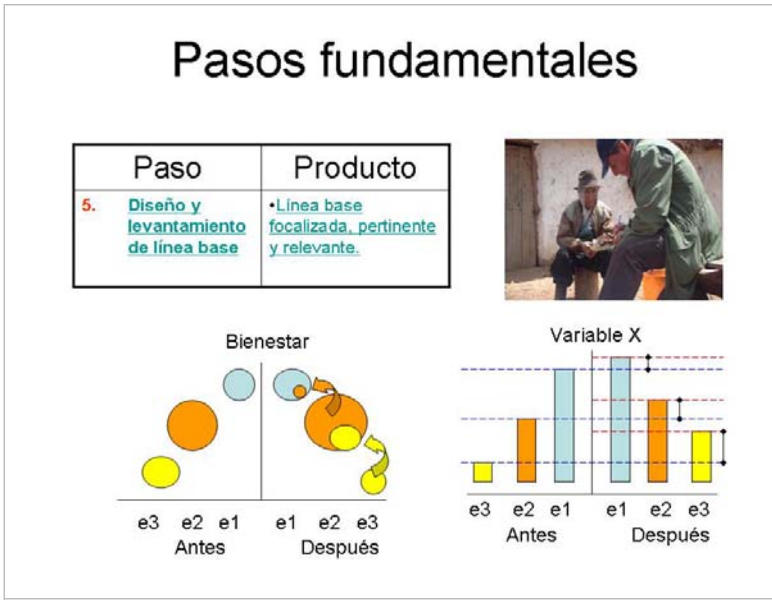
PowerPoint presentations on methods
These presentations share methods, training in pilot zones, and help start promoting INNOVA's methods.

INNOVA gives presentations on every method the project designed or implemented.



Documents on methods
INNOVA designed a set of methods that link smallholders' demands with technology supply. INNOVA is now writing a *folder* on these methods, targeted to development organisations, technological service providers and the SIBTA foundations. The folder

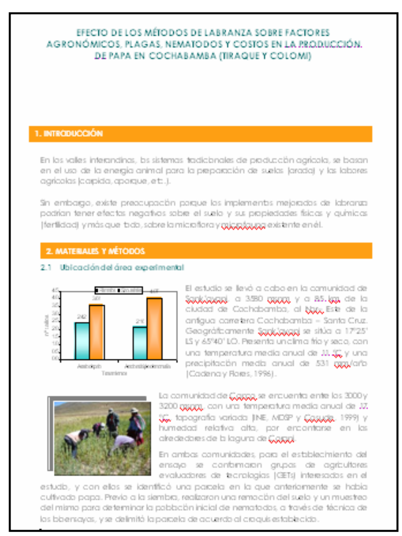
includes information on objectives, application contexts, use, steps, logistical and personnel requirements, support tools and implementation examples for each method. The contents of the *folder* will be updated with results from using the methods and feedback from new tests with different target groups.



Technical documents

These documents contain 18 reports on the results of participatory validation, adjustment and promotion of technologies by the project partners through WG. This information, besides promoting the technologies, must feed other technological assistance providers and SIBTA's databases.

Report: The effects of ploughing methods on potato pests, production and costs.



EFECTO DE LOS MÉTODOS DE LABRANZA SOBRE FACTORES AGRONÓMICOS, PLAGAS, NEMATODOS Y COSTOS EN LA PRODUCCIÓN DE PAPA EN COCHABAMBA (TIRAQUE Y COLOMI)

1. INTRODUCCIÓN

En los valles interandinos, los sistemas tradicionales de producción agrícola, se basan en el uso de la energía animal para la preparación de suelos (arada) y las labores agrícolas (carpida, aporque, etc.).

Sin embargo, existe preocupación porque los implementos mejorados de labranza podrían tener efectos negativos sobre el suelo y sus propiedades físicas y químicas (fertilidad) y más que todo, sobre la microflora y microfauna existente en él.

2. MATERIALES Y MÉTODOS

2.1 Ubicación del área experimental

Market surveys

WG1 socialised, reviewed and edited the following surveys WG4 conducted:

- Chuño and tunta in La Paz, Cochabamba and Santa Cruz to determine domestic and international market standards and preferences.
- Pre-fried frozen potatoes in urban Cochabamba to determine demand and consumer profiles.
- Study of consumer profile for potatoes products in La Paz, Cochabamba and Santa Cruz.
- Analysis of the competitiveness of the potato chain in Bolivia.

These documents are being edited to be published online and in print.

Other promotional resources

To generate global awareness about Innova, in early 2005 the BBC filmed a documentary for the show *Earth Reports: Hands On*. The programme airs on BBC World and so has a potential audience of 275 million viewers.

BBC crew in Cochabamba. Photo: Maria Elena Alva/ Papa Andina

In May of 2004 a display on INNOVA was selected as part of an exhibition with the Eden Project, called *Positive Developments*. The exhibition was later shown at the headquarters of DFID and was attended by, among others, the UK Secretary of state for International Development, Hilary Benn.

Strategy for farmers

WG 1 defined the need to produce three different multimedia packages for farmers. For La Paz, videos and posters on the biology and ecology of the Andean Potato Weevil; for

Santa Cruz, videos and flyers on Rhizoctonia and phytoplasm; and for Cochabamba posters and radio shows of forage crop production.

These types of materials support training and promotion by WG3.

The contribution of the project’s outputs towards its development objectives

The information produced by INNOVA’s partners in previous projects and during this project is available to the different target groups considered in the communications strategy.

The database and website model, as well as the system designed to collect, prioritize and disseminate information, can be used by INNOVA’s partners, other projects and development institutions, as guides to strengthen their own communications and information strategies.

The steps taken towards the implementation of the information strategy designed for the farmers became a model for technology supplying and transferring organizations. These organisations are now more likely to provide timely and pertinent information to their stakeholders.

Output 2
Technical Innovation Better Serves the Needs of Poorer Sectors through Institutional Mechanisms that Are Developed to Link Demand for Technical Innovation by Poor Farmers with Supply

The main goal of Innova was to finish a large set of technologies, actually some 10 groups of over 20 related technologies. The research to finish adapting those techniques was done by WG3. Even though WG3 used farmer participatory methods, and all of their research was done in farmers' fields, WG2 measured the demand for these technologies. Perhaps the main lesson was that there was demand, but it became more specific, more sophisticated with time. Farmer demand is not an object to find and pass on to researchers. Demand must continue to be measured even as the technology is designed. Output 2 had the following activities.

Activity 2.1: *Congruency between RNRRS technology and farmers' explicit and implicit demands assessed.*
Activity 2.2: *Mechanisms for capturing demand for technology innovation are developed and tested with poorer farmers and other actors in potato-based hillsides agricultural systems in Bolivia.*
Activity 2.3: *Improved response of RNRRS technologies to demand.*
Activity 2.4: *Practical methods for studying research demand and allocating research resources are available for policy makers and planners.*

In practice, Activity 2.1 is the result of carrying out Activity 2.2, so it is reported under the Outputs section and our description of activities begins with 2.2.

Activity 2.2. Mechanisms for Capturing Demand for Technology Innovation Are Developed and Tested With Poorer Farmers and Other Actors in Potato-Based Hillsides Agricultural Systems in Bolivia

The activities in this output were carried out jointly with Working Group 3, to capture farmers' demands for the RNRRS technologies already being validated and promoted.

Under the focus of demand-led innovation, it may seem counter-intuitive to gauge demand for new technology when the supply is already on hand. Innova's experience suggests that demands (especially explicit ones—see box) can be captured quickly. But it is indeed more complicated to capture demand when there already is a supply of partly developed technology. Matching demand and supply requires the permanent interaction of researchers and farmers. New (implicit) demands come from this interaction and changes can be made in the research agenda.

Two key concepts

Explicit demands are those, which farmers articulate when they are asked about their needs and problems. Classic questions include: What problems do you have growing potatoes? What improvements do you need? Farmers' answers generally express an explicit demand: for example, "My potatoes get worms when they are small. I don't have seed. I need higher yields. Market prices are low and we don't any make money when we sell."

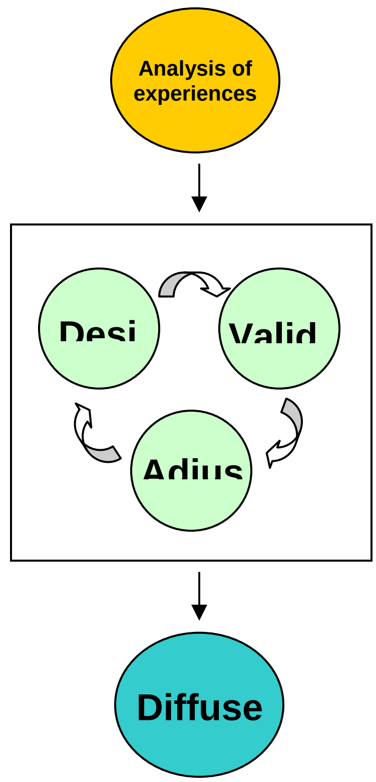
Implicit demands are those that require more collaboration and "seeking" between farmers and researchers. Farmers often demand chemical products for the control of certain pests, but they are less likely to ask for control alternatives they are unaware of. They mention problems with frosts, without demanding resistant varieties, because they do not know about them or do not know where to find them.

A better understanding of demand should allow:

- Evaluating the fit of technologies with farmers' demands.
- Adjusting technologies so they better serve farmers' needs.
- Improving the capacity of project partners to respond to demands.
- Adjusting the research agenda of those organizations involved according to an enhanced understanding of demands.

We will describe a menu of methods, results of this activity, developed and tested by INNOVA. The menu includes methods for participatory demand assessment and evaluating the fit between technology demand and supply: Demand Sondeos, Technology Fairs, Retro-Information and Committees with Teeth. A separate group of methods in the menu relate to participatory project development, which also include a dimension of demand assessment: Participatory Preparation of Innovation Proposals, Participatory Adjustment of Proposals, Participatory Mid-Term Review, and others. For a description of each method, see Annex 2.1).

To develop and test these methods demand, the research activities were structured as follows:



Analysis of related experiences. Reviewing and analysing literature, seeking allies to share experiences.

Design. Team meetings to develop a proposal for the method, and define the following:

- ✓ Benefits of the method (it should include all sectors of the community, be participative, easy to apply, quick, low cost, etc.)
- ✓ The context in which it will be applied.
- ✓ The actors who will help apply it and those who will benefit from the results.
- ✓ The steps to apply it and the tools to use.
- ✓ Results expected from the method.

Validation. Use the method as it was designed.

Reflect on the experience, and adjust. The team decides if the results of the validation meet the results expected and adjust the method. Validation, reflection and adjustment are repeated until the method has the characteristics that inspired its design.

Diffusion. Offer the adjusted method to other organizations.

The Methods

There are two sets of methods. The first set (demand assessment) was created by Innova to gauge farmer demand for technologies already being developed. These include the demand sondeo, technology fairs, retro-information and the committee with teeth. The second set (project planning) was designed by Innova with Focam to design PITAs with farmers. PITAs are innovation projects, although they emphasise *extension* of existing technologies more than research on technology. Project planning methods include participatory preparation of innovation proposals, participatory adjustment of pita proposals, and the participatory mid term evaluation. Full details of the methods, which are also project outputs, are presented Annex 2.1.

Demand Assessment Methods

Demand Sondeo

The first year of the project, between November 2002 and January 2003, Innova used the *sondeo*, modified by the Innova staff, to describe the way of life and the agriculture in one community in each of the three pilot areas (Altiplano, high valleys and low valleys) (Bentley *et al*., 2002, 2003, Oros *et al*., 2002). (See Annex 2.2 for a report on the Sondeo on the Altiplano in 2003). The second year of Innova, some of the staff wondered if the sondeo had captured the research demands of the poorest. So Innova did a second sondeo, in four communities, stratified by local categories of wellbeing.

Sondeos, first year, 2003	***References***	***Sondeos, second year, 2004***	***References***
Pomposillo, La Paz (Altiplano). See Annex 2.2.	Bentley *et al*. 2002	Pomposillo, La Paz (Altiplano)	Aguilera *et al*. 2003
Qolqe Qhoya, Cochabamba (high valleys)	Bentley *et al*. 2003	Sank'ayani, Cochabamba (high valleys)	Herbas *et al*. 2004
Los Pinos, Santa Cruz (low valleys)	Oros *et al*. 2002	Los Pinos, Santa Cruz (low valleys). See Annex 2.3.	Rodríguez *et al*. 2004
		Chilón, Santa Cruz (low valleys)	Franco *et al* 2004

The second, stratified sondeo, in four communities (December 2003-March 2004), used the wealth ranking method (Grandin 1988) to identify the very poor, and compare their demands with those of their neighbours. There were some differences, for example the very poor in the lowland valleys did not have cattle, fruit or vegetable production, and so they were uninterested in technologies for those items. There were certain 'scale-neutral' demands. All or most households in all the areas grew potatoes to eat at home, and all of them were worried about the same pests and diseases. For a more detailed description of a stratified sondeo, see Annex 2.3.

Technology Fairs

A few months after the first sondeos, in March 2003, Innova demonstrated its proto-type technologies to smallholder farmers in all three pilot areas, using a 'technology fair'. This was basically a field day, with a rapid evaluation of those technologies presented: which ones did local people see as useful, and which (if any) did they want to discard (Bentley *et al*. 2004).

There was another technology fair the second year (August 2004) in Chilón, Santa Cruz (Beltman 2004) that demonstrated eight techniques, all in the field, and most of them were shown by farmers, to other farmers. There was a second technology fair in Sank'ayani, Cochabamba. The third year (2005) Innova held technology fairs on the Altiplano (Kellhuiri) and in the high valleys (Qhochimit'a) (Bentley 2005a, 2005b). For a more detailed description see Annex 2.4 and 2.5

Retro-Information

From July to September 2003, in six communities, after harvesting the field trials which had been shown in the technology fairs, Innova used a new method called '***retro-information'*** to present findings of participatory research (see activity 2.3) and to learn farmers' recommendations for changing the technologies, to adapt them to their own demands. For a more detailed description see Annex 2.6 and 2.7.

Comité con Dientes

The *comité con dientes* (committee with teeth) was an idea first discussed during the Innova design workshop. The staff thought that a group of farmers, e.g. members of CIALs, could critique how technologies were developing. The farmers would not be merely consulted, but would have real power (teeth) to stop unpromising lines of research and to move resources to more promising lines. After Innova started working, Innova tried setting up committees with teeth as municipal level organizations in the project areas. These proved to be difficult to organise, logistically, i.e. they required many meetings, and it was difficult to get all of the people together. The first idea was that the committee would be made up of farmers from CIALs or GETs, but there were too many of them to organise into a committee with municipal government. Innova did set up one committee, which functioned in Comarapa, Santa Cruz, with four members of the municipal government.

Like other municipalities in Bolivia, Comarapa is now called upon to approve or to give counterpart support to projects. By 2004, Comarapa had over 60 projects in the municipality and it was becoming difficult to know what each was doing, yet the municipality did not have a formal evaluation method. The municipal government of Comarapa had tried to evaluate a project (not Innova). They judged the project a failure, saying "We only see their cars drive by." Later the council members recognised that they had criticised the project unfairly, without seeing its work or talking with beneficiaries. Later, with the help of the Innova staff, the municipal evaluation committee evaluated Innova. They designed some questions and then went to the field, in teams, to visit 40 or 50 farmer-experimenters and other community members. They concluded that Innova was actually working with farmers, and was fulfilling its work plan. Unfortunately, the committee was not able to give an opinion on the technologies, which was Innova's original idea for the committee with teeth.

Project Planning Methods

The PITA is the SIBTA method of providing communities (especially organised farmers' associations) with technical innovations linked with new market opportunities to improve livelihoods. The emphasis is on practical delivery of modern technology, rather than on research. The steps for preparing a PITA (applied technical innovation project) for approval by SIBTA are governed by the *Reglamento del Fondo Competitivo de Innovación* (Regulation for Competitive Innovation Fund). INNOVA has widened its menu and developed three methods for preparing and evaluating PITAs. They are: the Participatory Preparation of Innovation Proposals, Participatory Adjustment of Proposals, and the Participatory Mid-Term Review. These methods could be applied beyond PITAs, so we refer to them as participatory project development methods.

Participatory Preparation of Innovation Proposals

Once the SIBTA Foundations call for proposals for technical innovation to meet farmer demands, the technology service providers respond by starting "pre-investment" to generate a technical innovation project. They meet with community leaders, compose a list of demands, stratify local households by level of well being (Annex 2.8), make a map of the project area, and reconfirm the demands in a questionnaire with rank-and-file community members. Then the service provider presents the results at an open, community meeting. The most developed technology service providers, with the widest coverage and experience, with specialized staff and greater financial solvency, are more inclined to risk resources for competitive pre-investment. Service providers need methods to gauge farmer demand at an affordable cost during the pre-investment stage. In response to this need, INNOVA, in association with the FOCAM Project has designed and tested the Method for the Participatory Preparation of Innovation Proposals.

Participatory Adjustment of Proposals

This method is used once proposals that are pre-selected enter negotiations and are adjusted before a contract is signed. According to the Regulation for Competitive Innovation Fund, the technology service provider must adjust the proposal in close collaboration with the farmer demanders and define a project base line. To adjust proposals and strengthen the relationship with project beneficiaries, service providers request a general meeting with the community. The service providers present the project purpose, as defined in the previous method. The community members define activities and indicators, which are written on a chart. Local people use pebbles to weight these activities. The service providers then adjust the written proposal, in accordance with the communities' weighting of project activities. For a more detailed description see Annex 2.9.

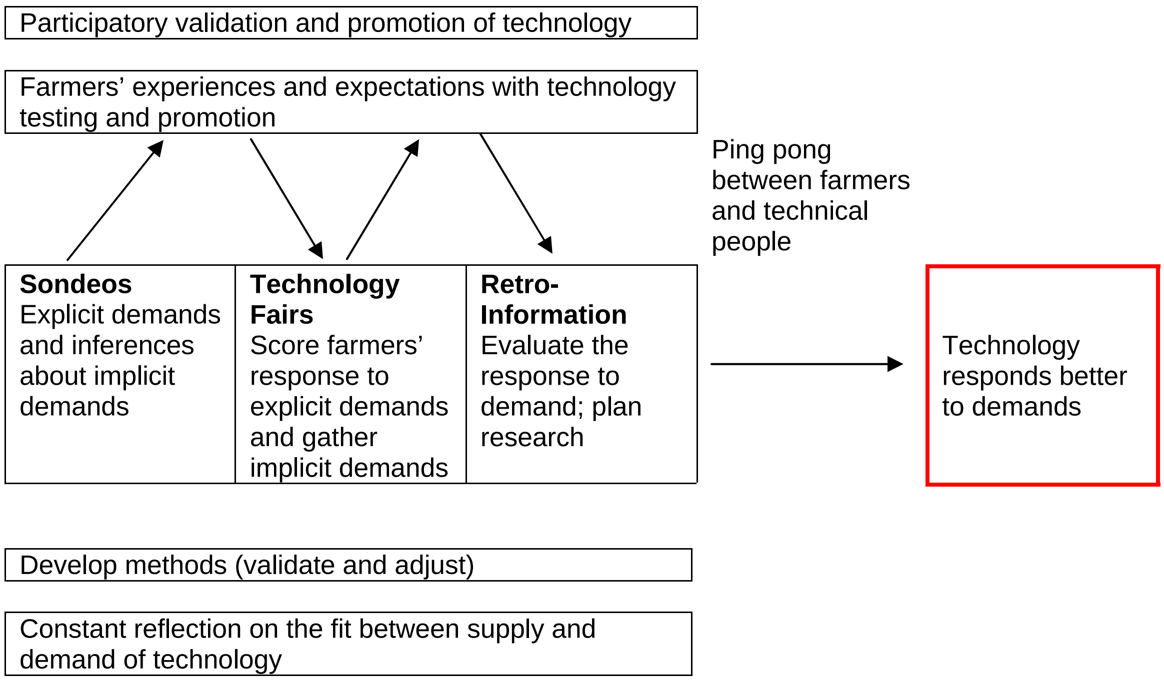
The Participatory Mid Term Evaluation

This method is used to evaluate the partial outcomes of a PITA currently being carried out. The evaluations follow a system of follow-up of activities completed and milestones achieved, according to the proposal's logical framework. The quantity of PITAs currently underway has surpassed the availability of staff time of the FDTAs to carry on this process at the desired quality levels. But the follow-up and evaluation system does not explicitly include variables that permit determining the beneficiaries' degree of satisfaction and so it gives no information on how well their expectations have been met. This shortcoming is addressed by the participatory mid term evaluation. For a more detailed description see Annex 2.10.

MIPITA

MIPITA stands for 'Modelo Innovador de PITAs'. In its last year, Innova created three of these 'Model Innovative PITAs', one in each pilot area. The Mipitas were like laboratories. The idea was that since many Innova technologies had now been finished, they should be formally extended and the MIPITA would be a vehicle to test the participatory project development methods under realistic conditions. For example the MIPITAs used participatory preparation of innovation proposals, participatory adjustment of proposals, and the technology fairs. The technologies presented in the 2005 technology fairs on the Altiplano and in the high valleys, were shown by enthusiastic farmers from the MIPITAs .

Articulating various methods from the menu
Each method offers results, but its true usefulness lies in combining it over the long term with research, reflection, and action with farmers. This can be illustrated as follows:



Explicit demands are easy to learn. The sondeos asks local people to list as many demands as possible, and not merely rubber stamp the project's agenda. For example, farmers say they want forages. This is a major explicit demand. This information goes back to the community as field trials, done with community members in GETs or CIALs (see activity 2.3 for a discussion of GETs and CIALs). The farmer-experimenters present their experience (with forages, for example) at the technology fairs, where farmers' evaluations help determine if the technologies respond to explicit demand, besides gathering (some) implicit demands. The technology fair also allows people to rank the technologies, which lets researchers see the approval ratings of their lines of research. The farmer-experimenters then propose changes in the technologies (and plan future research) during the retro-information. They discuss ways to improve the technologies to make them fit demand better (e.g. "We like forage, but we can't afford it unless we can produce the seed ourselves"). These improved technologies are tested, with the help of researchers, and presented the following year at a technology fair. The cycle may continue until the technologies are ready to diffuse, which can be done using a Mipita, or other extension methods.

The committee with teeth proved harder to put into practice, but may be used in the future by municipalities to evaluate (and approve or reject) projects operating within their boundaries.

The three project planning methods (PPIP, PAD, and PMTE) are still being evaluated.

Activity 2.3 Improved Response of RNRRS Technologies to Demand

Besides the methods to assess demand (sondeo, technology fairs, retro-information etc.), the researchers, had their own methods for actually *conducting* the participatory research with farmers.

CIAL
The CIAL (Spanish acronym for 'local agricultural research committee') is a platform for adaptive research at the community level. Farmers choose what they want to research after diagnosing problems. It was developed at CIAT in Colombia and has been well described in the literature (Ashby *et al*. 2000, Braun *et al*. 2000a, 2000b). Several Innova partners have had previous experience with CIALs (e.g. CIAT/Santa Cruz, and Proinpa). In Comarapa, Santa Cruz, CIAT continued working with previously established CIALs to test Innova technology

GET
The group of technology evaluators (*grupos de evaluadores de tecnología*—GET) are inspired by the CIAL method, but are simpler. They do not start with a diagnosis of the community's problems, but with the supply of technology offered by Innova. Each community selects a group of representative farmers to try the technologies, and report back to the community at the end of the season (during the retro-information, described above.) Innova researchers planned and conducted all of the trials with farmers from the communities (CIALs in Santa Cruz, GETs in Cochabamba and La Paz).

Both the **CIAL** and the **GET** rely on a committee of four to six people, in a community, who plant and tend the field trials with the agronomists. The CIAL and GET members were also the ones who helped Innova do the sondeos, and the technology fairs, retro-information. They also facilitated many of the other events and methods as well. In other words, every community had a few people who made things happen, who brokered information between the researchers and the communities. They played similar roles to the **promoters** (Bunch 1982), although Innova did not call them promoters. At the very least the agronomists and the promoters could speak freely, and make constructive criticisms. For example while spreading chicken manure with farmers in the low valleys, agronomist Ernesto Montellano realised that the manure got in people's eyes, and was irritating. The farmer allies suggested opening furrows, and laying the manure in the bottom of the furrows, instead of scattering it over the surface. Many of the other little adjustments in technology—inching closer to demand with each small change—happened while the agronomists and the promoters worked together on the field trials.

Back-&-forth
Prometa (an Innova partner) and its predecessor Cifema have used a method for years that they call *Ir-y-venir*, which we translate as *back-&-forth*. Prometa takes a prototype implement to the field and tries it with farmers, who suggest changes. Prometa takes the tool back to the shop, modifies it, and brings it back. In final stages, Prometa may leave the implement with the farmer, to try for several days. Prometa does not mass manufacture the tool until the farmers are completely satisfied with it (Bentley & Baker 2002).

Activity 2.4 Practical Methods for Studying Research Demand and Allocating Research Resources Are Available For Policy Makers and Planners

Folder of methods
Innova wrote a *carpeta*, or folder, which includes brief (2-3 page) descriptions in Spanish of the Innova methods for gauging demand (technology fair, retro-information, participatory preparation of innovation proposals etc.) They are written for Bolivian policy makers (e.g. staff of the SIBTA foundations) and for technology service providers. The folder will be published soon.

Joint implementation of methods with FDTAs
Surveys by the FOCAM Project, FIT 9 and by INNOVA, of the FDTAs and technology service providers, revealed critical stages in the life of a PITA. PITAs are governed by the *Reglamento del Fondo Competitivo de Innovación* (Regulation for Competitive Innovation Fund), which lists all the steps and requirements for funding innovation within SIBTA. INNOVA has worked in three of these critical stages, developing and testing a method for each one.

Stage one is the preparation of project proposals. Once the SIBTA Foundations announce a call for proposals, the technology service providers, according to their capabilities and interests, respond by starting a "pre-investment" stage to generate a technical innovation project.

SIBTA's competitive funding for innovation can strengthen the market for technical innovation. The most developed, financially stable technology service providers, with specialized staff, are more inclined to risk resources for competitive pre-investment. This is not so with the least-developed technology service providers.

Hastily written PITAs may not be very good. But the system expects the proposals to reflect a deep understanding of the demands of the farmers, and a solid alliance between technology service providers and demanders. For this to be possible, the technology service providers need robust instruments to prepare proposals with local people, but at a realistic expense for the pre-investment stage. In response to this need, INNOVA, in association with FOCAM designed the Method for the Participatory Preparation of Innovation Proposals.

The second critical stage starts when proposals that are pre-selected enter negotiations to be adjusted before a contract is signed. According to the Regulation for Competitive Innovation Fund, the technology service provider must adjust the proposal in close collaboration with the farmer demanders and define a project base line. The technology service providers and the technical staff of the FDTAs agree that the quality of the PITAs depends on instruments that identify the following limitations and needs:

- A simple documentation of the expectations of different types of farmers within a group of project beneficiaries.
- Strengthen the alliance between technology service providers and demanders.
- Adjustment the proposals technically as well as financially.
- Add variables to the base line that convey the outcomes farmers expect from the PITA.

To respond to these needs, INNOVA and FOCAM developed the Method for the Participatory Adjustment of PITA Proposals.

The third and last critical step is when the FDTAs must evaluate a PITA at mid term. The evaluations track milestones achieved, according to the proposal's logical framework. There are now more PITAs than the FDTAs can evaluate.

The evaluation system does not include variables to determine the beneficiaries' degree of satisfaction, so they cannot easily suggest actions to guide the future activities of the PITA to satisfy demands. To strengthen the FDTAs in this regard, INNOVA developed the Participatory Mid Term Evaluation**.**

INNOVA has strived to understand what Foundations need to improve PITAs. An alliance was established with FOCAM

The method for the participatory preparation of innovation proposals was applied twice in response to calls from the Altiplano Foundation. The first project was for integrated crop management of potato in Umala, La Paz, and the second was to improve the yield and marketing of broad beans in Colomi, Cochabamba.

The participatory adjustment of proposals was developed at the request of the Altiplano Foundation and validated in two PITAs. One was to strengthen the competitiveness of market-oriented potato growers of Pocona and Morochata, financed by the Altiplano Foundation. The second was a study of markets and marketing strategies by Brazil nut producers of Pando, being planned with the Humid Tropics Foundation.

Publication

An analysis of Innova methods (especially the sondeo and the technology fair), and their role in linking supply and demand for technology, has been published in English for an international audience of development professionals and policymakers. The article is available in print and on the ODI website (Bentley *et al*. 2004).

Outputs of Working Group 2: Technical Innovation Better Serves the Needs of Poorer Sectors through Institutional Mechanisms that Are Developed for Linking Demand for Technology Innovation by Poorer Farmers with Supply (at The Production Level in Pilot Areas)

Activity 2.2: Mechanisms for Capturing Demand for Technology Innovation Are Developed and Tested With Poorer Farmers and Other Actors in Potato-Based Hillsides Agricultural Systems in Bolivia

This activity generated a menu of methods that are described in detail in Annexes 2.1 through 2.10. Applying these methods yielded a better understanding of the fit between the RNRRS technologies researched by working group 3 with farmer demand.

Activity 2.1 Congruency between RNRRS Technology and Farmers' Explicit and Implicit Demands Assessed

The following table compares the technologies proposed in the log frame of Innova's project proposal with the summary of the first sondeo.

Technology proposed by Innova Feb 2002 (from log frame)	Main demands gathered, first sondeo (Nov 2002—Jan 2003)
1 improved fallow	Demand for forage, Altiplano, high valleys
2 grain and legume mixes	Demand for forage, Altiplano, high valleys
	Local people want to grow more quinoa (Altiplano)
3 Nacobbus aberrans (nematode) and weed management	Not an explicit demand
4 IPM for various pests and diseases of potato in the low valleys (Santa Cruz)	Various pests and diseases, especially in potato, especially late blight (all areas)
	Aphids in broad beans (high valleys)
	Improved management of fruit (especially peach, plum, and apple, strawberry), especially of pests and diseases (low valleys).
5 Management of the weed nut sedge (Cyperus rotundus)	Weed management, especially for nut sedge (low valleys)
6 improved tillage (aporques)	Not an explicit demand
7 promote adoption of tillage implements	Not an explicit demand
8 improved draft animal management	Various cattle and other livestock diseases (all areas)
9 New pasture species	(demand for forage, Altiplano, high valleys)
	More irrigation
10 live barriers of Phalaris grass for soil conservation	Not an explicit demand. Soil erosion was mentioned briefly in the Altiplano.

Soil erosion is an implicit demand. During the first sondeo, farmers in the Altiplano mentioned gullies in an offhand manner, but farmers express little explicit demand for chronic, sheet erosion, although they may show concern for severe gulley erosion (Thiele and Terrazas 1998).

The technologies Innova proposed (in the log frame) matched the explicit demands expressed in the sondeo, fairly well. For example people insisted on more fodder for cows and sheep, which was answered in at least three technologies (1, 2 and 9). Other Innova technologies also addressed explicit demand (e.g. 4, 5, and 8).

There was, however, little or now explicit demand for nematode control (3), improved tillage and tillage implements (6 and 7) or for soil conservation (10). And there were no Innova technologies for several explicit demands (e.g. quinoa, aphids, fruit problems and irrigation). But as we see shall below, most of these discrepancies later disappeared.

At the first round of ***technology fairs***, the fit between technology supply and demand improved dramatically. The demand for quinoa was addressed, and Innova learned that there was implicit demand for some technologies (e.g. improved tillage and animal drawn implements (see Annex 2.1 for more details).

Improved fallow (mixes of grass and legume species) was well received in the high valleys, in part because a farm family in Qolqe Qhoya planted a trial on their own, which they showed at the technology fair. The mixes of grain and legumes were well received in the high valleys, where they were shown in a thriving trial, managed by a local farmer.

At the first technology fair on the Altiplano, local people ranked new quinoa varieties as the most attractive technology. In part this was because local farmers showed the quinoa, thriving in the field. The agronomists also gave a good talk, and handed out pieces of quinoa cake. Innova staff learned that the better the presentations, the more likely the technology will be accepted by local farmers.

Quinoa was a hard act to follow at the technology fair in Pomposillo, with a thriving crop in the field, explained in Aymara, followed by attractive displays and cake. Innova learned that farmers respond to how well a technology is presented, besides their real demand for it.

The people ranked the improved tillage and the implements high on their list of techniques they wanted to try, even though farmers did not demand them in the sondeo. They were both implicit demands, items that people wanted to try after seeing them. Phalaris live barriers were shown in all three areas and were well received in the high valleys, and in the low valleys, where local people had more experience with this perennial grass, and could give other farmers a convincing account of it. In summary, by the first technology fair the Innova staff saw that most of their technologies were attractive to farmers and that most demands were being addressed.

The following table outlines the results of the ***retro-information***.

Technology proposed in log frame	***Major demands from first sondeo***	***Results of first retro-information (July—September 2003)***
1 improved fallow	Forage (Altiplano, high valleys)	The farmer who conducted the trial in Qolqe Qhoya (high valleys) made a detailed presentation of treatments, comparing the advantages & yield of each treatment.
2 grain & legume mixes	Forage (Altiplano, high valleys)	Innova & farmers conducted trials with 6 treatments, but all treatments did poorly at both sites on the Altiplano. In the high valleys, Innova conducted a solid on-farm experiment at one site (Qolqe Qhoya) & discussed it at another (Chimpa Rancho).
	Quinoa (Altiplano)	People liked one of the varieties, jach'a grano, because it was bitter & so was not attacked by birds. People asked for more quinoa seed. Innova had trials at two sites on the Altiplano (Pomposillo & Pomarasa).
3 nematode & weed IPM	**Not an explicit demand**	
4 IPM for potato in Santa Cruz	Various problems, especially late blight	A farmer in Los Pinos, Santa Cruz, reported favourably on a trial with Innova on chemical control of late blight.
	Aphids in broad beans (high valleys)	--
	Improved management of peach, etc. (low valleys).	CIAT (Innova partner) hired a local agronomist with much experience in peaches to give a course on peach tree management.
5 Nut sedge control	Nut sedge management (low valleys)	A farmer in Los Pinos did a trial on herbicides for the control of nut sedge.
6 improved tillage	**Not an explicit demand**	In all project sites, farmers showed high interest in improved tillage. They liked the new plough & asked for more copies of it to try. Results of trials were encouraging; e.g. in Los Pinos, farmers said improved tillage reduced the need for chemicals (for weevils & late blight) & that the practice was diffusing.
7 promote tillage implements	**Not an explicit demand**	Innova took a dozen implements to 12 communities in all 3 areas. Farmers had some concerns, e.g. on the Altiplano they said the plough was too heavy. Elsewhere the implements were being adopted, for example 6 households bought the improved plough in Chimpa Rancho (high valleys) & it was being adopted in Qolqe Qhoya.
8 improved draft animal management	Livestock diseases	Innova gave training events in how to plough with horses in Pomarasa (Altiplano) & in Chimpa Rancho, (high valleys).
9 New pasture species	Forage (Altiplano, high valleys)	Farmers in many places said the seeds were too expensive. But people wanted to try alfalfa on the Altiplano. Some of the species thrived in some places, e.g. *Vicia villosa* in Los Pinos & purple clover in the high valleys. In Qolqe Qhoya, one farmer described an experiment with 24 different combinations of species to his neighbours.
	More irrigation	--
10 live barriers of Phalaris for soil con.	Not an explicit demand.	Innova distributed 30 Phalaris plants to various households on the Altiplano. Many farmers in Los Pinos had already planted it.

In retro-information, farmers who had tried the new technologies could tell their neighbours about them, in their own words. For example, a farmer in Canco, in the high valleys told his neighbours in Quechua that the mixed grains and legumes were good because "*wakas sumajta mikhunku; pisiwantaj saqsanku y ratutaj kutirinku*" ("The cows eat it well; they get satisfied on a little bit and they recover lost weight quickly") (Almendras *et al*. 2004).

With the retro-information, most of the farmers' comments on the technologies were positive. But sometimes the farmers changed the technologies, i.e. made them fit demand better, subtly. For example, smallholders at most of the sites told Innova that the seeds for the new forages species (technology 2) were too expensive. In Sank'ayani, in the high valleys of Cochabamba, during the retro-information farmers explained that they could grow vetch seed themselves. They liked to grow oats, but they were slow, and were not mature until the vetch was. The farmers found that if they intercropped *barley* with vetch, they could harvest the barley before the vetch was mature, and so harvest the vetch as seed.

At the retro-information in Qolqe Qhoya, also in the high valleys of Cochabamba, Innova learned that farmers who had adopted improved fallow had made several changes. When a few farmers first began buying purple clover seed in Qolqe Qhoya instead of planting it with Festuca or Lolium, they planted it with oats, with which they were more familiar. Farmers also planted purple clover not on the dry, rocky hillsides, but on the best bottomland, which they ploughed carefully. Farmers also manured the purple clover and irrigated it. The way the farmers managed purple clover, it was not an 'improved fallow' at all; it was a meadow. Farmers were redesigning the technology, and making it fit their own demands more carefully.

Innova held another ***technology fair*** the second year, in the high valleys and the low valleys. At the fair in the low valleys all of the technologies were shown in the field, because Innova realised that farmers more readily accepted technologies shown in field trials than those merely shown in stands (with talks and photos). Eight techniques were shown.

Technology shown in second fair

Technology proposed in log frame	***Technologies shown at fair in Chilón, Santa Cruz, 2004***
1 improved fallow	
2 grain & legume mixes	
3 nematode & weed IPM	Fresh manure to control disease (and nematodes?)
4 IPM for potato in Santa Cruz	Three technologies for the control of insects and leaf spots
5 Nut sedge control	
6 improved tillage	Two improved tillage technologies
7 promote tillage implements	See above.
8 improved draft animal management	
9 New pasture species	Pasture garden
10 live barriers of Phalaris for soil con.	

Also by this time, Innova was experimenting with insecticides to control aphids in broad beans in the high valleys, which was a demand that had been expressed in the sondeos.

At the 2005 technology fair on the Altiplano, all of the presentations were by enthusiastic farmers, in Aymara. A mix of grain-&-vetch was shown prospering in a farmer's field and integrated potato cultivation (including improved tillage, use of quality native potato seed (Waych'a), organic fertiliser and integrated pest and disease management) was also shown thriving in the field (Bentley 2005a). At the fair in the high valleys, five technologies were show in farmers' fields (purple clover, alfalfa, a new variety of forage barley, animal traction implements and oat-&vetch). All the presentations were by farmers, in Quechua (Bentley 2005b). Compared with earlier years, there were fewer technologies, but they seemed more finished, and they were presented in a relaxed, convincing manner.

Contribution of INNOVA menu to matching technology supply with demand

The **demand sondeo** developed by INNOVA is a practical, participatory method to gather the explicit demands of farmers and to describe their farming systems. It complements other methods for gauging demand, e.g. the PRA. The sondeo is not enough to capture implicit demands. Analysing the interview data and the team's observations allows some inferences about implicit demands, which must be reconfirmed later. INNOVA's experience applying the four stratified sondeos suggests that when climate, soil, land tenure and water are uniform in an area, the explicit demands of the various strata are not very different. In other communities, the poorest households may not share the same demands as their neighbours.

The **technology fair** provides quick feedback on farmers' first impressions on seeing a new technology. The proof that a technology meets a demand is when farmers try it, adapt it and adopt it. The short questionnaires and votes applied in the technology fairs do not prove that a technology meets demand, but they are fast methods for suggesting which new technologies farmers prefer. In most cases, technology **explicitly** demanded by farmers during the sondeos received higher scores in the voting and in the short questionnaires during the fairs. This was the case, for example, of the intercropped cereals-&-legumes and of new forage species in Qolqe Qhoya. These results suggested that the supply responded to explicit demands. In contrast, new animal traction implements and improved tillage were not explicitly demanded during the sondeos, but they received high scores in the technology fairs. This interest can be interpreted as an implicit demand for the technology.

"It seems good to me; it will have to be tested first." (Silvestre Trujillo, farmer of Vituy Vinto, technology fair of Pomposillo)

"They had told me about it, but I hadn't seen it." (Tomás Herrera, farmer of Sank'ayani, technology fair of Qolqe Qhoya)

"The communities need it, we must continue." (Félix Pinto, farmer of Verdecillos, technology fair of Verdecillos)

The **retro-information** allowed some technologies that did not meet farmers' expectations to be discarded, to adapt some promising ones and to promote the diffusion of those that were accepted. This helped define the project's research agenda during later seasons. Retro-information is an easy, participatory tool for reporting experiences with new technologies to a community and a municipality. It allows farmers to be involved in defining the research agenda.

The PITAs designed with the **participatory project development methods** have not ended yet, so it is premature to judge the methods. However, they seem to take farmers' demands into account and promotes farmer ownership of proposals, at a financial and personal cost that technology service providers are willing to assume during pre-investment. The contributions of these methods will be seen when the results of the PITA are evaluated, as part of the Innova extension.

Activity 2.3: Improved Response of RNRRS Technologies to Demand

The following paragraphs summarize how some of Innova's technologies changed over time to fit demand.

Technology 1 improved fallow
Observing soil erosion, farmer demand for forage, and weedy fallow fields, researchers in previous RNRRS projects responded with a blend of grasses and legumes to plant in fallow fields. RNRRS projects had studied improved fallow in Qolqe Qhoya over several years, with field trials and student theses. Researchers also gave local people 200 gram bags of mixed seed to try on their own. So local people had previous experience with the technology, and during Innova's first sondeo in Qolqe Qhoya, the locals demanded trying the technology on a large scale.

Agronomists from Prommasel (an Innova partner) offered seed for sale in Qolqe Qhoya. Four households bought it. As mentioned above, one farmer who bought purple clover seed showed his field at the first technology fair. This man, the others who planted purple clover, and the members of the local GET, had five or six years of experience with the grasses and legumes, and knew, for example, that they did not thrive in dry, rocky, fallow oat fields. So they redesigned the system, completely.

'Improved fallow' as originally proposed by Innova	***Locally adapted as a meadow***
Festuca, Lolium and purple clover	Oats and purple clover
Broadcast and ploughed in	The soil is ploughed 2-4 times first
Field not fertilised	Field is fertilised with manure
Planted in a dry field	Irrigated
Planted in dry, rocky soil	Planted in better land
Sown after oats, which close the cycle, after the nutrients have been depleted and the weeds have built up	Sown after potatoes, near the beginning of the 4 year rotations

The technology no longer aimed at weed control and soil conservation, it now explicitly provided more forage. During 2004, in the Mipita, Innova agronomists took people from Qolqe Qhoya to the SEFO seed company, and allowed them to buy seed at half price. Households bought some 30 kilos of purple clover seed, enough to plant a two hectares of meadow, which suggests that they are attracted to the technique and want to keep experimenting with it. This was the technology that adapted the most, to meet demand.

Nelson Vallejos, collaborating farmer who planted his own meadow of purple clover. In 2003 (left) and in the same plot, now thriving, in 2005 (right)

Technology 2 grain and legume mixes

In the high valleys, the experimental plots were thriving during the first technology fair in 2003, and farmers wanted to try them. However during retro-information, farmers said that the vetch seed was too expensive, and that they wanted to grow their own seed. Farmers in the Innova GET in Sank'ayani had some success growing vetch seed, but farmers in other (lower, dryer) communities were unable to grow the seed. In the technology fairs in 2005, in the high valleys and on the Altiplano, farmers ranked the mixes highly, but the cost of seed still seemed to limit adoption.

Mixes of Grain and legumes are more convincing when the crops are healthier*.*

Left. In 2003 the grain and legume mix grew poorly on the Altiplano, shown here being demonstrated at the 2003

Right. During the 2005 technology fair in Kellhuiri, on the Altiplano a group visits the barley-&-vetch field of Humberto Cachaca, a member of the local MIPITA. The crop was much healthier than the ones planted in 2003, and visiting farmers wanted to try the technology themselves technology fair.

Technology 3 Nacobbus aberrans (nematode) and weed management
In the low valleys, Innova has tested fresh chicken manure on fields to control nematodes and diseases. While applying manure with farmers, Innova researchers learned that the wind blows the dry, dusty manure into people's eyes, and that this is very irritating. Farmers suggested that the manure could be laid into the bottom of the furrow, instead of broadcasting it. This change made the technology more comfortable to use.

Technology 4 IPM for potato in valleys of Santa Cruz
CIAT/Santa Cruz (an Innova partner) has done field experiments for several years, on several control strategies. In 2004-05, Innova added a trial to compare botanical and chemical insecticides, detergent and plain water to control whitefly. This experiment was added after researchers saw that farmers (encouraged by NGOs and extensionists from other projects) were using to use detergent to control whiteflies (laundry detergent is cheaper than insecticides). The experiment showed that detergent, two botanicals, and even an insecticide were no more effective than plain water in killing whitefly.

Don Ignacio (left) explains his experiment for whitefly control at the technology fair in the low valleys, 2003. Ernesto Montellanos (right), researcher for CIAT and Innova stands by him.

Technology 7 promote adoption of tillage implements
These include about 12 implements, i.e. a dozen technologies. Prometa took the implements to 12 communities in all three areas, and used these visits as an opportunity to keep adapting the implements to local demand. For example, Prometa responded to farmer suggestions and changed the shape of the wings of one of the ploughs, and introduced a smaller, 'mountain' plough for the Altiplano. The cattle are smaller in the Altiplano and work better with a lighter plough than those in the high valleys. These implements were adapted to local conditions using the 'Back-&-Forth' method, which Cifema (Innova partner and parent project of Prometa) has used since the 1980s.

Farmers at the 2003 technology fair in Qolqe Qhoya heft an ox-drawn harrow to see if it is light enough to use.

10 live barriers of Phalaris for soil conservation

Phalaris is catching on. It is a perennial grass, and it takes at least a year to become well established. It is planted from cuttings, not from seed, and so the planting material may be a limitation. On a few farms, where Phalaris is now several years old, terraces are forming behind the rows of Phalaris. Farmers value it for the fodder. It stays green even during the dry season, unlike most grasses. In the Altiplano, during the retro-information, some farmers reported planting Phalaris as a forage crop in whole fields, not as live barriers..

Left. Innova researcher Salomón Pérez looks at Phalaris growing on a farm in the high valleys. A terrace is slowly forming up-hill (left) of the grass, as it stops soil from eroding.

Discussion

As the following table shows, some of the Innova technologies have evolved, to become more responsive to demand (e.g. 1, 3, 4, 7, 10). Some technologies responded to an *implicit* demand (e.g. 6, 7). A few responded to a demand, but need to be adapted further problems, i.e. farmers need to be able to grow their own seed (e.g. 2, 9). Innova started some new topics (e.g. quinoa on the Altiplano, control of aphids in broad beans in the high valleys, peach management in the low valleys) in response to demands learned during the life of the project. There was only one major demand which was never addressed, and that was irrigation, in all three areas. But people were not demanding *research* on irrigation, so much as help with building dams, cement for ditches and other capital investment, which were beyond the scope of Innova.

Changes in technologies and methods used to document changes

Technology	Changes in response to demand	Methods used to facilitate or identify change
1. Improved fallow	Plough the land first, plant with oats instead of Festuca, irrigated, plant in good soil and fertilise the crop.	Technology fair, GET, retro-information
2. Grain and legume mixes	Farmers expressed interest in it, but want to grow their own seed to save costs. Farmers in Sank'ayani grew seed with some success.	GET, retro-information
3. Managing nematodes with manure	Put the chicken manure in the bottom of the furrow instead of broadcasting it. This keeps it out of people's eyes.	Participatory research with CIALs.
4. Potato IPM	Added an experiment on detergent sprays for whitefly.	Researcher's general knowledge of community.
5 Nut sedge control	Little change.	Technology fair
6 improved tillage	Little change.	Technology fair
7. Tillage implements	Changed the shape of the wings of the plough. Made ploughs smaller for the Altiplano.	Back-&-Forth.
9 New pasture species	People like the technology but cannot get planting material.	Technology fair
10. Phalaris grass	Planted in whole fields in the Altiplano.	Retro-information.

INNOVA researchers also dropped several ideas between 2003 and 2005 (e.g. sticky yellow traps for catching whiteflies, bokashi as fertiliser, an animal-drawn cart and chemical control of nutsedge). Many researchers do get carried away, and find ludicrous justifications for spending years looking at useless topics. Perhaps the clearest sign that INNOVA responded to demand is that INNOVA had methods to spot fruitless lines of research, and the honesty to prune them out.

Activity 2.4: Practical Methods of Studying Research Demand and Allocating Research Resources Are Available for Policy Makers and Planners

Innova has worked with three of the Foundations (Altiplano, Chaco and Humid Tropics), and collaborated with Focam in creating three *Project Planning Methods* specifically so technology service providers can work with local communities to design PITAs funded by the Foundations.

SIBTA and MACA invited Innova to give a presentation to the six FIT projects at the recent (28-29 April 2005) FIT workshop. During the meeting various participants said that Innova was the "father" of the FIT projects, because of Innova's early role supporting SIBTA. The leaders of FIT see Innova's strengths as: gathering demand, judging supply of technology and evaluating the fit between demand and supply, which are also important themes for FIT.

It is still too soon to tell what the effect of Innova's methods will be on the SIBTA Foundations. Innova sent the Foundations a report in March 2005 on the Project Planning Methods, and the Foundations have not had time to analyse it yet.

Decision makers are using some of Innova's concepts e.g. SIBTA's Roberto Arteaga (MACA, Director of Technological Development) discussed explicit and implicit demand in his opening talk to the FIT (Facilitating Technological Innovation) workshop in Cochabamba 28 April 2005. Thinking in SIBTA has shifted to giving supply a bigger role (for example, SIBTA asked the FIT 22 project to work on the supply and demand of technologies in each of Bolivia's four macro-regions) and Innova has helped to promote this shift in thinking.

Little progress was made persuading the FDTAs to use Innova's demand assessment methods. Because the methods are appropriate for adaptive research to finish a wide range of technologies they are not compatible with the extension-oriented PITAs. One option could be to try them in the context of the PIENs (national strategic innovation projects) or other research.

Good progress has been made in applying Innova's project development methods. This is because they were custom built for the FDTAs. Oswaldo Sorruco of the Humid Tropics FDTA explained that they filled a real gap in giving farmers a voice in the project design process and were very useful.

References Cited

Aguilera, Javier, Juan Carlos Huanca, Milán Canaviri, Félix Rodríguez, Jaime Herbas, Claudio Velasco, Vivian Polar, Rubén Botello 2003 Sondeo de Levantamiento de Demandas, Pomposillo, Umala, La Paz. Informe Innova.

Almendras, Fredy, Salomón Pérez and Vladimir Plata 2004 Oferta Tecnológica en los Valles Altos. MS. Innova.

Ashby, J., Braun, A.R., García, T., Guerrero, M.P., Hernández, L.A., Quirós, C.A and Roa, J.I. 2000 *Investing in farmers as researchers: Experience with local agricultural committees in Latin America.* Cali, Colombia: CIAT.

Beltman, Guillermo F. 2004 Encuentro Tecnológico, Comunidad Chilón. Innova Project Report: Santa Cruz, Bolivia.

Bentley, Jeffery W. 2005a Technology Fair in Kellhuiri: "What They Learned in Seven Years, We Learned in a Week." Cochabamba: Innova Report.

Bentley, Jeffery W. 2005b Technology Fair in Qhochimit'a: Desperate to Experiment. Cochabamba: Innova Report.

Bentley, Jeffery W. & P.S. Baker 2002 *Manual for Collaborative Research with Smallholder Coffee Farmers*. Egham, UK: CABI Commodities. 130 pp.

Bentley, Jeffery W. & Eric Boa 2004 Community Plant Health Clinic. Egham, UK: CABI Bioscience. Available at www.jefferybentley.com

Bentley, Jeffery W., Oros, R., Herbas, J., Botello, R., Rodríguez, F., Verduguez, C., Galindo, J.J. and Orellana, J. 2002 Sondeo en Qolqe Qhoya: ¿Si no sembramos papa, qué vamos a comer nosotros? INNOVA Project Report. Cochabamba, Bolivia. 18 November 2002.

Bentley, Jeffery W., Oros, R., Thiele, G., Botello, R., Esprella, R., Aguilera, J., Zambrana, L., Huanca, J.C. and Canaviri, M. 2003 Sondeo en Pomposillo: No hay nada fácil. INNOVA Project Report. Cochabamba, Bolivia. 17 January 2003.

Bentley, Jeffery W., Graham Thiele, Rolando Oros & Claudio Velasco 2004 "Cinderella's Slipper: Sondeo Surveys and Technology Fairs for Gauging Demand." London: ODI Agricultural Research & Extension Network (AgREN). Network Paper No.138.

Braun, Ann R., Graham Thiele & María Fernández 2000a "Farmer Field Schools and Local Agricultural Research Committees: Complementary Platforms for Integrated Decision-Making in Sustainable Agriculture." *AgREN Network Paper* No. 105. London: ODI.

Braun, Ann R., Graham Thiele & María Fernández 2000b "Complementary Platforms for Farmer Innovation." *ILEIA Newsletter* (July, 2000):33-34.

Bunch, Roland 1982 *Two Ears of Corn: A Guide to People-Centered Agricultural Improvement*. Oklahoma City: World Neighbors. 250 pp.

Franco M., Pablo, Marco A. Condorcett, Guillermo F. Beltman S. Ernesto Montellano, Ramiro Rojas F., Vladimir Lino, Eloy Galvis, Olivia Antezana, Bertho Villaroel 2004 Sondeo de Levantamiento de Demandas, Chilón, Saipina, Santa Cruz. Informe Innova.

Grandin, Barbara E. 1988 *Wealth Ranking in Smallholder Communities: A Field Manual*. London: Intermediate Technology Publications. 49 pp.

Herbas, Jaime, Freddy Almendras, Remy Crespo, Vladimir Plata, Félix Rodríguez, Rubén Botello 2004 Sondeo de Levantamiento de Demandas, Sank'ayani, Tiraque, Cochabamba. Informe Innova.

Oros, R., Eguino, S., Montellano, E., Antezana, O., Crespo, M. and Botello, R. 2002 Sondeo y taller de levantamiento de demandas. Comunidad Los Pinos, Municipio Comarapa – Valles Mesotérmicos**.** 24 y 25 de noviembre de 2002. INNOVA Report.

Rodríguez, Félix, Jaime Herbas, Bertho Villarroel, Ramiro Rojas, Ernesto Montellano, Rubén Botello 2004 Sondeo de Levantamiento de Demandas, Los Pinos, Comarapa, Santa Cruz. Informe Innova.

Thiele, Graham and Franz Terrazas 1998 "'The *Wayq'os* (Gullies) Are Eating Everything!' Indigenous Knowledge and Soil Conservation." *PLA Notes* 32:19-23.

Output 3

Consolidate, Validate and Promote Outputs from Relevant Previous RNRRS Projects within Pilot Areas, Using Participatory Methods that Take into Account Local Demand

Summary

The project proposal was developed at a time when the agricultural research programme of Bolivia was experiencing considerable changes. The Government of Bolivia had developed a new system for agricultural research and extension (SIBTA). Four foundations (FDTAs) were created within the SIBTA system, one for each of the four main agro-ecological zones. DFID supported the new system, in coordination with other donors. For SIBTA's mission (alleviate rural poverty, increase farmers' incomes and improve food security) technical innovation is critical and is consistent with DFID policy. Any new research initiative in Bolivia should be adjusted to, and support SIBTA.

The CPP, with support from the CPHP (Post Harvest Programme) made considerable investment developing and consolidating the INNOVA proposal, from an evaluation mission (December 2000), to the project planning workshops (June and August 2001), and finally a project design workshop (November 2001) which were organised in collaboration with the regional CIP project, Papa Andina. To design the proposal, the workshops brought together several partners: agricultural research and extension institutions in Bolivia; this assured a sense of ownership and the representation of their criteria. The participants included CIP, Papa Andina, RNRRS research partners (PROINPA, CIAT and UMSS), DFID (La Paz), SIBTA and the FDTA Altiplano. The main objective was to add value to the investments already made by the CPP (and other RNRRS programmes) by taking the results forward, so they would have an impact. The workshops also explored ways to articulate the proposal with SIBTA.

INNOVA is a pilot case for an alternative research focus implemented in an "inter-programme" way with Bolivian research partners and agricultural policymakers. The research developed methods to relate the supply of technology to farmers' demands. The project activities were carried out in three pilot areas, in three agro-ecological zones (low valleys, high valleys and Altiplano) and lasted three years (2002-2005).

As designed in INNOVA's structure, Working Group 2 supported the research, facilitating mechanisms that encouraged dialogue between researchers and technology users to evaluate explicit and implicit demands. Dialogue between researchers and users has been the basis for promoting technologies that actually respond to farmers' demands in order to achieve an impact. INNOVA also identified demands for technologies which do not exist or which are not offered by the project. SIBTA (PITAs or PIENs), DFID (RNRRS), or other donor agencies used this information to generate new calls for research proposals.

Working Group 3's activities were planned iteratively, constantly refined according to dialogue between researchers and users and as demands became clearer. At the start of INNOVA, activities were defined only for Year 1, and those for Years 2 and 3 were decided according to the results of the annual planning workshops. The results

responded to problems of low crop yields, identified during previous projects, and included strategies for controlling insect pests, diseases and weeds, soil and water conservation, improved use of animal traction and improved cultivation and harvest equipment. While the process started with a "supply" of technologies from RNRRS projects, which responded to problems, the research activities were adjusted over time, depending on whether or not the problems actually corresponded to demands by poor farmers.

Participatory research methods have been used to validate, adjust and disseminate previous results on improved fallow, intercropped forages, and the effects of rotations and other agricultural practices on the incidence of pests. INNOVA created institutional mechanisms to link technology supply with the demands of poor farmers, using participatory research. Through the food chain focus, the demands of the farmers have been complemented with those of the market by interacting with other actors on the chain. The activities done with national entities have been agreed upon and supported by SIBTA.

The municipalities have increased their mandate and their resources for supporting poor farmers, according to the Bolivian Law of Popular Participation. This allowed INNOVA to create and institutionalise mechanisms to evaluate innovation demand within the municipalities, in the pilot areas. INNOVA's technologies and mechanisms, even when promoted in the pilot areas, required developing strategies to allow NGOs or other CBOs to replicate the activities elsewhere, with support from INNOVA, in collaboration with the foundations.

Activity 3.1. Evaluate Forage Species for Improved Fallows, Fodder Production, Pest, Disease and Weed Management

On the Bolivian Altiplano and high valleys, farming is limited by low soil fertility, poor quality and quantity of forage, and fallows with native species. To give farmers alternatives for adapting pasture to improve fallow, based on previous favourable results of planting grass and legume mixes to produce high quality forage, reduce weed populations and improve the physical and chemical properties of soil, INNOVA proposed validating and promoting PROMMASEL technology for improved fallow management through forage production, which will also help manage pests and diseases.

This study was conducted during three agricultural seasons (2002-2005) in the high valleys of Cochabamba, in the communities of Chimparancho (municipality of Colomi), and Qolqe Qhoya (municipality of Tiraque), with an altitudinal range of 3300-3800 masl. Also during the 2002-03 seasons, test plots were planted in the communities of Tolerani and Cacawallu (municipality of Umala) and Vitu Calacachi (municipality of Ayo Ayo) of the Central Altiplano, with an altitudinal range of 3850-4000 masl.

The test plots were planted in plots just entering fallow, following a crop of potato or oats, at the start of the rainy season (November and December), with Technology Evaluation Groups (GETs) chosen by the farmers' union (*sindicato*) of each community. The GETs evaluate technologies, suggest changes and then accept or reject the technologies. The planting densities used in the mixed cropping of grasses and legumes were: *Lolium perenne*, 15 kg/ha; *Festuca arundinacea*, 15 kg/ha; *Dactylis glomerata*, 15 kg/ha; *Trifolium pratense*, 25 kg/ha. The treatments or associations evaluated in the test plots were:

(T1) *Lolium perenne* + *Festuca arundinacea* + *Trifolium pratense*
(T2) *Dactylis glomerata* + *Lolium perenne* + *Trifolium pratense*
(T3) *Dactylis glomerata* + *Festuca arundinacea* + *Trifolium pratense*
(T4) plot in traditional fallow

The treatments were arranged in a statistical design of randomised complete blocks with four repetitions, where the yield of dry matter (DM) and the weed populations were analysed with analysis of variance (Dunnet at 5%). Soil samples were taken to detect nematodes.

On the Central Altiplano of Bolivia, the introduced forage species grew poorly due to low rainfall. The species that performed the best were *Lolium perenne* and *Dactylis glomerata*, which the farmers accepted. The farmers also showed high interest in cover crops for their fallow fields, especially the open fields (*aynuqas*), which are fallowed for long periods with wild species and little cover.

Above. Purple clover (*Trifolium pratense*)

The improved fallow technologies produced nutritious forage, and allowed for the efficient control of weeds, avoiding seed multiplication or re-sprouting, and reducing the incidence and severity of soil-borne pests and diseases, breaking their cycle and eliminating weeds like *Spergula arvensis*, an important host of *Nacobbus aberrans*. Purple clover did not thrive without irrigation. Also, as farmers suggested, purple clover grew if manure (cow, chicken, sheep etc.) was applied: to maintain clover production for four or five years, obtain higher yields and more frequent cuttings.

Forage to improve fallow has been modified per farmers' suggestions, e.g. to plough the soil thoroughly when planting it, use manure, irrigation etc. Improved pastures (e.g. clover) should be mixed with barley at a lower density than 20 kg/ha, to use the first cut of barley as a forage while eliminating weeds, leaving only the forages and increasing the organic fertiliser at planting; excellent results were observed. The technology has been accepted and is being diffused by the farmers themselves, who are planting their own plots with seed the acquired themselves in areas of 1000 to 2500 m^2/farmer.

Fodder for Improved Fallows in the Mipita in Tiraque, 2004 - 2005

GETs in Qolqe Qhoya, Sank'ayani, Qhochimit'a and K'aspi Kancha, and the *sindicato* of K'aspi Kancha and Alturas		
Technology	**Adoption**	**Note**
Perennial forage legumes	32 farmers tried clover (Kendland variety) on a total of 3 ha, and 30 tried alfalfa (Bolivia 2000) on a total of 1.5 ha.	Farmers like the technology because it produces more forage, and are less interested in improving fallows.

(For more information see Annexes: 3.1a, 3.1b; 3.1c, 3.1d)

Activity 3.2. Validate and Promote Alternative Cropping Systems for Soil and Water Conservation; Pest, Disease and Weed Control; for Stabilised Crop Yield

Previous research suggested that intercropped cereals and legumes improved forage quality, controlled weeds and were an interesting crop rotation alternative in smallholder farming systems in the high valleys of Cochabamba. Intercropped forages offer INNOVA's beneficiaries an alternative that fits their existing practices and conditions. The technique will help improve the quality of fodder, and allow farmers to grow their own seed which will help them improve their income. Various training events helped farmers learn more about post-harvest forage management.

During the agricultural seasons of 2002-2004 on the Bolivian Central Altiplano, INNOVA worked in the municipalities of Ayo Ayo and Umala, and in the high valleys in the municipalities of Colomi and Tiraque. During the 2004-05 seasons, with the forage MIPITA, four other communities were involved in Umala and three more in Tiraque. The communities on the central Altiplano are at an altitude of 3850 to 4000 metres, with average annual rainfall of 350-450 mm, and an average annual temperature of 12ºC, while the high valleys are at 3300-3800 meters, with an average annual rainfall of 650-1000 mm.

The forage MIPITA on the Altiplano and high valleys used the methods developed by INNOVA (described in chapter 2). Farmers' felt demands were gathered with sondeos, and the participatory preparation of innovation proposals, on which the MIPITA proposal was written. Later a base line study was done using the method of participatory adjustment of projects to understand the current situation of farming, forage management and conservation, and to adjust the initial proposal.

Left. Oats, intercropped with vetch

The treatments used during the 2002-03 season were modified according to the participatory evaluations. On the Altiplano, at the farmers' suggestion, the barley variety IBTA 80 was dropped from the 2003-04 season because its long awns hurt animals' gums. In the Altiplano and in the high valleys purple clover was eliminated because it requires irrigation, which is not feasible since oats and barley are planted in rain-fed fields.

The first two agricultural seasons used trials designed as randomised complete blocks with four repetitions. In the 2004-05 season there was no statistical design because large demonstration plots were planted for the MIPITA. Several evaluations were conducted between planting and harvest, including the percentage of emergence at 40 and 70 days after planting, during the 2004-05 season, as part of the forage MIPITA. In the high valleys, beginning with the 2003-04 season, seed production was started with *Vicia,* because farmers demanded their own seed.

On the Altiplano production plots were planted for seed and forage on about 0.84 has of monocropped oats, 1.06 has of monocropped barley and 0.94 has of intercropped barley and vetch and 0.60 has of intercropped oats and vetch. Training was held in these plots, using the farmer field school (FFS) method, which compared the farmers' current practices with the project's innovations. Most of the training sessions were strengthened with written material (posters) and some with audiovisuals. The training sessions included: seed production, intercropping, live barriers with Phalaris, soil preparation, forage management and fertilisation, and forage storage. Twenty five percent of the people in the trainings were women. Neighbouring communities hosted farmer-to-farmer tours to see the demonstration plots in different places.

There were no statistically significant differences between treatments in the high valleys or the Altiplano regarding weeds, although populations tended to be lower in the intercropped plots. In general the weeds were very small, growing as mats along the ground, and not considered damaging to the crops.

The treatments had no statistically significant differences in the production of dry matter, although there tended to be more dry matter in the intercropped plots. On the Altiplano, oats intercropped with vetch had 24% more dry matter than monocropped oats, while barley intercropped with vetch produced hardly any more dry matter than monocropped barley. In the high valleys, the yield of dry matter was higher in the two intercropped treatments (oats and barley with *Vicia dasycarpa*), with an increase of 12.8% in oats and 19.8% in barley.

Technical and participatory evaluations suggest that the farmers accept the mixed crops, especially oats (Gaviota variety) with V*icia dasycarpa*, because the mix produces more fodder, although it would perform better in more humid areas. After observing three field seasons, agronomists and farmers agree that forage plots should be planted between November and mid December, even if it has not rained yet. In the high valleys the mix of cereals with vetch was well-adapted and accepted, even though diffusion is limited by the scarcity of affordable seed in the market, or local production, so plots were planted to study planting dates to rear seed.

On the Altiplano, vetch was affected by drought and cold, even when intercropped with cereals (2002-04), and by drought (2004-05), even though vetch withstands cold as low as -8°C, as long as the soil does not freeze. But farmers accepted vetch, even though its adoption will be easier if seed can be grown locally. The farmers recognise the importance of certified seed for improving production of seed and forage, and they are willing to pay for certified seed, especially of oats and barley. In fact, one group of farmers started producing forage barley (variety Capuchona) seed formally, under contract with SEFO. On the Altiplano, in the forage MIPITA, 62 farm families were benefited with certified barley seed and 67 families with oat seed, both from the SEFO seed company. On average, each household acquired 16.6 kg of barley seed and 19.8 kg of oat seed.

Adoption of forage seed in Mipita in four communities in Umala, Altiplano, 2004 - 2005

100 direct beneficiaries and 140 indirect ones		
Technology	**Adoption**	**Note**
Barley (variety IBTA 80)	Farmers bought 1,891 kg of seed to plant 27 ha.	Seed was sold by SEFO at half price.
Barley (variety Gaviota)	Farmers bought 2,464 kg of seed to plant 31 ha.	
Intercropping cereals and legumes	Each community planted a hectare of barley-&-vetch and of oats-&vetch	The farmers wanted to do large-scale tests.
Self-provisioning of seed	Seed production on ½ ha per community of barley IBTA 80 with vetch and of Gaviota oats planted alone	The farmers decided to do these tests.

In the high valleys, in the forage MIPITA, beneficiaries bought certified seed at a 50% discount: 98 families with 20 kg bags of oats (variety Gaviota, 11 families with 1 kg bags of *Vicia dasycarpa* and 11 families with 30 kg each of barley (variety IBTA-80), 52 families with purple clover (variety Kenland) and 30 families with alfalfa (variety Bolivia 2000) for a total of 202 families who bought species adapted to the highlands. There was a shortage of vetch seed to buy.

Adoption of forage grains in Mipita in Tiraque, high valleys 2004 - 2005

GETs in Qolqe Qhoya, Sank'ayani, Qhochimit'a and K'aspi Kancha, and the *sindicato* of K'aspi Kancha and Alturas		
Technology	**Adoption**	**Note**
Growing certified barley seed	8 farmers signed contracts with SEFO to grow barley seed on 2.5 ha.	This is their first experience producing certified seed
Growing common seed	2.5 ha planted in oats and barley in 4 communities, for common seed.	The seed will be sold in the weekly farm fair in Tiraque
New varieties of forage grains	98 farmers produce Gaviota oats on a total of 26.5 ha. 10 farmers produce barley (IBTA 80, Ivit and Ivon) on a total of 3.75 ha.	

(For more information see Annexes 3.2a, 3.2b, 3.2c; 3.2d)

Activity 3.3. Generate and Validate Knowledge and Component Technologies for the Integrated Management of *Nacobbus aberrans*

Various studies in Bolivia and elsewhere on *Nacobbus aberrans* provided valuable information on its biology, distribution, parasite-host relationship etc., as well as tactics or components for integrated management. These studies have identified *Nacobbus aberrans* as one of the plant-parasitic nematodes which causes the most economic damage in potato cultivation in the Bolivian Andes and valleys. *N. aberrans*, also known as "potato rosary" nematode, causes quantitative damage, from yield loss, and qualitative damage to the quality of ware and seed potatoes.

N. aberrans causes losses of about $53 million per year in the high Andean potato-growing region of Bolivia. Yield losses reach 61.5%. It also leads to additional expenses for its control and diagnoses. It also causes some fields planted for formal seed production to be disqualified.

But much of the useful information about *N. aberrans* is scattered and difficult for researchers, educators, farmers or others to find. Because INNOVA prioritised the collection, compilation and systematisation of available information on *N. aberrans,* in Bolivia or other countries, to write a technical report on *N. aberrans* and disseminate it to interested institutions. First, information in PROINPA and related institutions such as universities, research centres and agricultural libraries was collected, systematised and pre-classified. Reports, scientific articles, theses, working documents, bulletins etc. were photocopied and classified by type of document and by topic. A technical report or file was prepared and transferred to Working Group 1 of INNOVA. Because of the amount of information, it should be made it available to users through the INNOVA web page or on a CD.

INNOVA now has the most complete set of information about *N. aberrans* in Bolivia as a file of printed documents and in electronic form, for all people or institutions which need national or international information. It consists of:

Scientific articles (12), books (2), theses (31), student papers (*tesinas*) (4) and other sources. Topics include: green manures, organic soil amendments, biological control, cultural control, escape (changes in planting dates), physical control, chemical control with natural products in greenhouses and open fields, dissemination, distribution and host plants, diagnosis and basic studies, mineral fertilisation, integrated management, resistance, races, Andean crops, behaviour, physiological response and yield losses, crop rotation, treatment of tubers, extension and training.

(For more information see Annexes: 3.3a, 3.3b)

Activity 3.4. Validate and Promote Integrated Management Practices for the Control of Insect Pests, Soil and Foliar Diseases of Potato in the Low Valleys

Potato production is affected by problems like frost, drought, poor quality seed, low soil fertility, pests and diseases, which lower yields to an average of 5 t/ha, even though the potential can be as high as 40 t/ha. The most frequently emphasised limitations on potato production are low fertility, diseases and pests. Disease losses are qualitative and quantitative, causing direct losses and inducing farmers to spend money to protect their crops. Low soil fertility is closely related to potato diseases and pests. A plant without the necessary nutrients for normal development will be more susceptible to insect pests and to pathogens. To validate and promote various previously researched practices for the integrated management of pests and diseases of potato in the low valleys, various activities were evaluated with the participation of local farmers, as described below.

a) Validation of chemical control of leaf spots on potato in Caballero province

In Chilón, in the municipality of Saipina, province M. M. Caballero, the strategy was evaluated with the potato variety Desiree. The control strategy included the preventative spray of contact fungicides at 80% emergence (Mancozeb and Chlorotalonil) and systemic fungicides 10 days after the first application (Tebuconazole, Dimetomorf + Mancoceb and Azoxystrobin). Fungicides were applied every seven to 14 days, according to whether or not the weather was favourable to the disease. Systemic and contact fungicides were alternated and systemic ones were not used more than three times. The experimental design was randomised complete blocks with three replications. The treatments were:

T1 = Bravo (C) + Acrobat (S)	T4 = Althane (C) + Acrobat (S)
T2 = Bravo (C) + Folicur (S)	T5 = Althane (C) + Folicur (S)
T3 = Bravo (C) + Priori (S)	T6 = Althane (C) + Priori (S)
T7 = control group with no application	

C = contact; S = systemic

The treatments which achieved the best control were T5 and T6, with 20% and 25% damage, respectively. T5 was the treatment with the highest and the most statistically different yield (p. 05) (30.6 t/ha**).** Farmers who had doubted the effectiveness of the technique agreed that it allowed for fewer applications, lower costs, better control, and higher income.

Some farmers controlled foliar diseases with alternating applications of fungicides, achieving better control than those who did not use it. Some farmers used the technology without having participated directly in the field trials, apparently having learned about it at the technology fairs or from neighbours. Farmer participatory methods with demonstration plots helped encourage adoption, and collaborating farmers will further disseminate the technique.

b) Validation of integrated control of vectors of virus and phytoplasma in potato in Caballero province

This study used certified seed of the potato variety Waych'a. A plough was used to perform high tillage (*aporque alto* —in which the furrows are dug deep and the soil is heaped high upon the young plants). The trial was designed in randomised complete blocks with five treatments and three repetitions. Treatments were:

T1 = Two applications of insecticides	T3 = Six applications of insecticides
T2 = Four applications of insecticides	T4 = Eight applications of insecticides
T0 = The control strategy commonly used by farmers	

Systemic and contact Insecticides were alternated, with applications once every week or every two, depending on the pressure of the insect vector. All treatments used healthy seed, wheat as a barrier crop and to separate the treatments, yellow traps to monitor the insect vectors. The diseases were analysed with DAS–ELISA. Symptoms of big bud (*brotes grandes*) and witch's broom were detected by simple observation.

Above, left. Innova experiment to control insect vectors of disease in potatoes. Note the yellow traps in the background and the line of wheat (centre) as a barrier between experimental treatments.

Above, right. Symptoms of *brotes grandes*, or "big bud" on potato. The purple tubers emerging from the soil are damaged by phytoplasma.

The virus PLRV and APMV were detected in the laboratory. The treatment with four applications of insecticide (T2), obtained the best yield, with 17.08 t/ha. Six applications of insecticide (T6) was not significantly different, but there were statistically significant differences with the other treatments. T1 (two applications of insecticide), with 8.25 t/ha, had the lowest yield, but the difference was not significantly different statistically from the control (T0, farmer control) with 8.62 t/ha. Treatment T4 (eight applications of insecticide), with 12.56 t/ha, was significantly different from all other treatments.

The highest cash expenses were for T4 (with eight applications of insecticide), as the following table shows.

Treatment	***Number of insecticide applications***	***Cash expenses in Bolivianos***	***Cash expenses in US dollars***
T4	8	11,177 Bs	$1397
T3	6	10,917 Bs	$1365
T2	4	10,730 Bs.	$1341
T1	2	10,490 Bs,	$1311
T0	0	10,270 Bs	$1284

The treatments with the highest net benefit were T2 with 16,936 Bs. ($2117) and T3 with 13,286 Bs. ($1661).

To control deformations caused by phytoplasma, aerial tubers and witch's broom, chemical control to eliminate the disease vectors should be used. It is also important to control weeds on field edges, to prevent them from being used as host plants and a source of the diseases.

c) Validation of an integrated management strategy for *Rhizoctonia solani* in Caballero province

This activity was conducted in Verdecillos, Manuel María Caballero province (1900 masl). The potato variety was Desiree and all the agricultural practices necessary for good crop development were used. The necessary fungicides and insecticides were applied. Fungicides used as seed dressing were: Pencycuron (Monceren) and Clorotalonil (Clortosip) mixed and used alone; a control group used neither fungicide. The trial was designed as randomised complete blocks with four treatments and five repetitions.

Left. Researcher Pablo Franco holds a potato plant with severe symptoms of Rhizoctonia

The treatment most affected by sclerotia, evaluated at harvest, was T0 (control group) with 20.8% of the tubers affected, which had no protection from the fungus. The least effected was treatment T3 with 6.69%, in response to the mix and recommended application at commercial doses of both products (Pencycuron + Clorotalonil), which prohibited the development of sclerotia, preventing yield losses. Applying mixes of products of different chemical groups is an effective control of this soil-borne disease.

Treatment T3 (Pencycuron + Clorotalonil), had the highest yield (14.53 t/ha) which was not a statistically significant difference from treatments T2 (11.83 t/ha) and T1 (12.95 t/ha). The lowest yield was with T0, with 9.95 t/ha.

d) Diffusion of integrated management strategies for broad bean (aphids, chocolate spot: *Botrytis fabae*) and others

The IPM validation was conducted at two plots of broad beans in Qolqe Qhoya, province of Tiraque, department of Cochabamba, with two treatments: 1 = integrated pest management (aphids and chocolate spot) and 2 = management by the farmer. Integrated aphid management started with the application of a systemic insecticide Tiametoxam (Actara) when the first insects appeared, alternated with a contact insecticide Cipermetrina (Arrivo), for a total of six applications, two of systemic insecticides and four of contact, resulting in a good control of the aphids.

For chocolate spot, the applications also started at the first sign of disease symptoms (start of the rainy season) with alternating applications of systemic—Azoxystrobin (Priori)—and contact fungicides: Clorotalonil (Bravo 500) and Mancozeb (Dithane). The applications were alternated every seven to 21 days, depending on favourable conditions for the insects and for the diseases. IPM in farmers' fields was accompanied by training sessions in: integrated pest management, aphid IPM, chocolate spot IPM and safe use of pesticides, focusing on prevention, frequency of application and alternating the active ingredients.

Five varieties were compared, in strips: Pairumani 1, Pairumani 5, Ecotype-Colomi, Toralapa and the local varieties, provided by the Pairumani and PROINPA Foundations. Farmers ranked the varieties in participatory evaluations at the start of flowering, pod formation, harvest and tasting.

Farmers said that IPM controlled the aphids well, especially at pod formation. There was little difference between treatments later, because rain controlled the aphids. Farmers said that IPM managed chocolate spot better, with damage on less than 25% of the leaf area. They also said there were higher yields in the IPM plot, because aphids were controlled from the start of flowering so fewer flowers were damaged and more pods formed. The farmers generally use the same products to control broad bean pests as for potato, mainly because of a lack of money.

Left. Broad beans in flower and covered with aphids. The Quechua name *q'epicha* means "it makes a bundle," referring to the folding of the leaves and flowers because of dense aphid populations.

Farmers evaluated varieties at the start of flowering and at flower formation, with statistically significant differences. At harvest there were highly significant differences between varieties, where Toralapa was preferred, followed by the farmers' varieties, Colomi and Pairumani 5. Farmers said that Pairumani 1 was "very good", especially because it is fast-maturing and is sold at a high price. However, it requires irrigation and more attention because birds and mice, which can destroy more than half of the harvest, easily attack it. During the taste test, farmers did not show any significant preference for one variety over the others.

e) Validation of botanical insecticides and detergents for the control of whitefly

Treatments for whitefly control were tested at San Isidro, in randomised complete blocks with five repetitions. The treatments were:

T1 = Water	T5 = Detergent, sodium hypochlorite 8%, Lavandina® bleach (100 ml / 20 l)
T2 = Extract of *Melia azederach*, Chinaberry (0.5 l extract and 10 g soap / 20 litres)	T6= Extract of the plant *chulo chulo* (0.5 l extract and 10 g soap / backpack sprayer of 20 l)
T3 = Soap (10 g /backpack sprayer of 20 l)	T7= Imidacloprid, Gaucho (3 g / backpack sprayer of 20 l)
T4 = Ace® Detergent (30 g /backpack sprayer of 20 l)	T8= Farmer's technology (control group)

To prepare the botanical insecticides, a kilogram of fresh leaves of each species is collected. These are ground, crushed and mixed with enough water to make two litres of solution. This is allowed to stand for about 16 hours. Insect populations are read at 0, 1, 2, 4, 3, 6, & 8 days after application, on 10 plants chosen at random in each experimental unit. The variables to measure were: number of adults per leaflet, nymphs and eggs per cm^2, on the terminal leaflet of the plant. For the populations of adult whiteflies there are only preliminary results from the evaluations, because the plots had low populations of the insect (initial infestation).

In general the populations of adult whiteflies were notably reduced the first day after application, in all of the treatments, and there were no statistical differences in the data, suggesting that even by applying water alone, populations of adult whitefly can be reduced by about 45%. By the second day, there were no significant increases in the population, which indicates that the populations remain stable until the eighth day. There were also slight population differences between treatments at the 2^{nd}, 3^{rd}, and 4^{th} day, which were maintained until the 6th day, which suggest that whitefly populations tend to blend within the experimental units after the 5th day.

f) IPM diffusion plots—tuber moth in field

Diffusion of IPM components was conducted in three farmers' plots, in the communities of Los Pinos and Verdecillos, in the municipality of Comarapa, department of Santa Cruz, in which the following two treatments were applied: 1 = integrated management of the tuber moth, and 2 = the farmers' own practices (control group). The IPM treatment included: pest-free seed, high tillage (*aporque alto*), timely irrigation, pheromone traps to monitor insect populations, adequate applications of insecticides, collection of ground-level tubers before harvest, and timely harvest. The second treatment used the practices normally conducted by local farmers. These included three applications during hilling up (*aporque*), at flowering and at the end of vegetative growth.

Above. *Aporque alto*, or high hilling up in a potato field on the Altiplano. Soil from the furrow is heaped onto the potato plants, which helps protect them from Andean potato weevil, late blight and other problems.

Before applying the components, training sessions were used to teach biology, behaviour and principles of integrated management. The final evaluation was done with harvested tubers. The participatory evaluations showed that the average level of damage by the moth in harvested tubers was less in the IPM plot of the pest (3.0 %) than in the control group (10.6 %).

After seeing the results, the farmers said that the differences between both treatments were slight, and do not effect yields, especially for a cash crop, since damage does not influence the sale price much. However, they also said that it is good to use the control practices, especially when one has certified seed and when growing potato seed.

Farmers also concluded that the application of tuber moth IPM shows good results by capturing many moths and that better results would be obtained if the whole community adopted them. High tillage (*aporque alto*), pheromone traps, timely applications of chemicals and adequate tuber selection are the most important components cited by farmers, and the application of tuber moth IPM is more closely related to seed multiplication. The farmers placed a positive value on tuber moth IPM, and diffusion should be continued to other farmers and other communities in INNOVA's area of influence, where it will be possible to count on the support of farmers who validated the IPM practices.

g) Diffusion of chicken manure to reduce the effect of nematodes in potatoes

The effect of chicken manure on the incidence and severity of nematodes in potato yield was determined in demonstration plots in Qolqe Qhoya in the province of Tiraque, department of Cochabamba, without a formal experimental design, in an area of rain-fed agriculture, in steep, erosion-prone fields. The treatments evaluated were: T1 = 10 t/ha of fresh chicken manure, applied a month before planting; T2 = 10 t/ha of dry chicken manure, applied at planting (a common local practice). Both treatments used certified seed of the variety Waych'a. For the chemical control of pests and diseases, eight applications of insecticide were applied, according to the method conventionally used by farmers, at: 5, 15, 35, 55, 65, 90,100 & 120 days after germination. The products used were: Success, Marshall, Gaucho, Thiosulfan.

Open evaluations were conducted with the cooperating farmer, during cultivation/hilling up (*aporque*), weed control, input management, yellow traps, taking samples evaluation of the incidence of nematodes at flowering and harvest. The open evaluation method was used with the GET, to learn their opinions. According to the participatory evaluation, fresh manure a month before planting helps reduce the incidence of nematodes (*Nacobbus aberrans*), besides contributing to soil fertility. Incorporating chicken manure, especially in seed potato producing areas, increases the yield of size 3 potatoes, which are the ideal size for seed.

Potato IPM, in Mipita in the low valleys, province of Caballero, Santa Cruz, 2004 - 2005

GETS, CIALs and Mipita in Comarapa and Saipina		
Technology	**Adoption**	**Note**
Integrated potato management (*aporque alto*, fresh chicken manure, IPM)	Farmers planted 9 plots for seed production, with 15 tons of certified seed.	Farmers took a loan from a cooperative to buy the seed.
	They planted 58 plots with the technology to produce quality potatoes on 70 ha.	Agreements signed with supermarkets and food processors in Santa Cruz

(For more information see Annexes: 34a, 3.4b, 3.4c, 3.4d, 3.4e)

Activity 3.6. Validate and Promote Improved Tillage Methods for Soil and Water Conservation, Nematode and Weed Control, and for Stabilised/Increased Crop Yield)

Contemporary smallholder farming systems in the low and high valleys and the Altiplano are based on animal energy with the wooden plough for soil preparation (ploughing, harrowing), agricultural tasks (weeding and hilling up—*aporque*), harvesting potatoes and some other activities, complemented with hand labour. But work with a wooden plough is of low quality, and the low labour yield of this plough leads farmers to waste time and effort.

For several years, two UMSS projects, Cifema and recently Prometa (an Innova partner) have developed and diffused different models of improved steel ploughs, with greater efficiency and quality of work. But until recently there was no study of the impact of these ploughs on potato cultivation as the first crop in a rotation or on a three-year rotation (potatoes—broad beans—cereals) or on pests, weeds and the production costs of ploughing. Therefore, Innova studied the effect of tillage on potato agronomy, pests and production costs.

Innova studied the effect of tillage methods (quality of labour of the first and second ploughing, and cultivation tasks) on potatoes, broad beans, cereals and the effect of tillage methods on the population of weeds, nematodes, insects and other pests in the low valleys of Santa Cruz (Comarapa and Saipina), the high valleys of Cochabamba (Tiraque and Colomi), and the Bolivian Altiplano (Ayo Ayo and Umala). The study compared traditional and improved technology in each phase of the crop to determine the influence of improved tillage on the agronomy and economy of the crops.

Left. Improved plough, used for high tillage (aporque alto). This is one of several animal-drawn implements designed and produced by Innova partners (Prometa and Cifema)

The trials were planted in fields of collaborating farmers. Unfortunately, the design in randomised blocks and the size of the experimental units led the farmers on the Altiplano to abandon the study. For logistical reasons, it was impossible to continue the study in the low valleys. So the study was only conducted in the high valleys of Cochabamba (communities of Canco, Chimparancho and Sank'ayani). The experimental design was randomised complete blocks and the main variables evaluated were: yield, incidence of pests and diseases, economic analysis and participative evaluations.

The results are for potato as the first crop in the rotation (2002-2003), later including broad beans in the following season. The improved implements increased the yield of potatoes, at a statistically significant level. Yield increases were due mainly to the higher quality of the work of the improved implements compared with the wooden plough, which permitted deeper ploughing, finer harrowing, higher and wider cultivation (*aporque*), which created more favourable conditions for the crop. There were no statistically significant differences between treatments for pests, diseases or weeds.

According to the participatory evaluations, the implements have a great potential to be adopted by farmers, although they frequently mentioned the high cost of the steel implements. According to results in the 2002-2003 and 2003-2004 seasons, improved tillage with steel implements increased potato yields, although not broad bean yields, because of bad weather.

(For more information see Annexes: 3.6a, 3.6b, 3.6c)

Activity 3.7. Promote Adoption by Farmers of Equipment and Tillage Implements for Use in Potato-Based Cropping Systems

Potato production with the wooden plough and ox team has certain limitations, due to the low effective capacity of this implement, compared with the improved ones, and the low yield of the crop in the existing system. Therefore INNOVA suggested the CIP technique of pre-emergent high tillage (*aporque alto pre-emergente*) for potato, introduced to Bolivia by CIAT of Santa Cruz, where it was studied and validated with excellent results. High tillage is a tedious task which requires much effort, hand labour and more investment by farmers. To make this task easier, PROMETA (Animal Traction Improvement Project), an INNOVA partner, introduced this technique to the high valleys of Cochabamba and (with the support of CIAT) to the low valleys of Santa Cruz. The technique was also introduced to the Altiplano of La Paz, where the search for alternatives to make the task easier led to the development of appropriate wings on the combined plough, which makes it possible to move the right amount of earth to the crest of the furrows, thus increasing the yield of potatoes, and bringing other benefits.

Left. Innova researcher Leonardo Zambrana shows animal-drawn implements to farmers on the Altiplano

To improve potato yields, INNOVA validated pre-emergent high tillage participatively in demonstration plots, with animal-drawn implements. The effect of the technology on the incidence of pests, diseases and weeds was also evaluated.

The improved multiple plough (*arado múltiple mejorado*) has parts to adjust the plough for deeper or shallower work, according to the soil conditions and the traction requirements. It works in difficult conditions, clayey, dry, or rocky soil, or weedy surfaces. Because it is symmetrical, it works in flat fields and on slopes of up to 20% or on erosion-prone soil. The multiple plough has a smaller body than the wooden one, so it moves though the soil with much less resistance.

Potatoes of the variety *Waych'a* (*S. tuberosum andigena*) were planted in test plots in Qolqe Qhoya, in Qori Sonqo in Canco, and in five communities on the Altiplano. The treatments were the wooden plough (T1), the combination plough (*arado combinado*) (T2), and the cultivator for high tillage (*aporcadora de aporque alto*) (T3).

The improved tillage merely used the improved tillage implement to perform a better hilling up, so only two treatments were taken into account. Each was cultivated (hilled up) once. The treatments were: hilling up (*aporque*) with a wooden plough (T1 = conventional, farmer technology) and improved hilling up (*aporque*) with a multiple cultivator (T2). The high tillage trial used randomised complete blocks with three treatments and five repetitions. Participatory evaluations were used to judge the acceptance or rejection of the technologies, using order of preferences and open questions to judge the most accepted technology.

Due to the interest shown by farmers, the technology was disseminated in the second year, including both the technique of high tillage (*aporque alto*) and the tiller (aporcadora) by using demonstration plots. There were three demo plots in Sank'ayani, two in Qolqe Qhoya, three in Chimparancho and four in Canco, i.e. 12 plots. The demonstrations compared farmers' contemporary tillage with high tillage.

The improved tiller, that is, the multiple plough (*arado múltiple*) was compared with the wooden plough in tests in Pomposillo and Tolerani, in the municipality of Umala and in Vitu Calacachi, Mamaniri and Salviani of the municipality of Ayo Ayo. Umala and Ayo Ayo are at 3900 masl, with low temperatures. The annual potato crop per household varies from 0.5 to 1.5 hectares. The average yield of potatoes is 3.5 t/ha.

The first year, the work quality of the multiple plough was better than that of the wooden plough. The multiple plough formed wider, higher ridges, which favoured the growth of stolons, and increased yields. The yield increase is less when the soil is dry (if rains are below normal) or if the tillage (*aporque*) is not performed on time.

The participatory and technical evaluations of improved tillage with animal traction (2002-2003) on the central Altiplano suggest that this implement is adapted to the area, a conclusion supported by the technology fairs in Pomposillo (2003) and Kellhuiri (2005). Because of these results, and the retro-informations held in Pomposillo and Mamaniri in Pomazara, INNOVA implemented validation-diffusion plots to reach more farmers, and determine the effect of the improved tillage on the potato crop, on pests and diseases, and to do a participatory evaluation of the improved cultivator (*aporcadora mejorada*) with the GETs.

The development of the plough wings, and the high tillage technique itself, started at the end of 2002 in two of the three regions. The improved tillage (*aporque mejorado*) created expectations among the farmers on the Altiplano, especially during the second year, when they demanded its application and adoption. The participatory evaluations with the back-&-forth method favoured the rapid development of the plough wings for high tillage, because of adjustments made at the suggestion of the farmers. Currently, high tillage is being diffused. Collaboration between INNOVA partners, CIAT of Santa Cruz, PROINPA in La Paz and PROMMASEL in Cochabamba, allowed the plough wings to be validated in less time than it would have taken PROMETA working alone. Currently leaders (*dirigentes*) of communities outside of the pilot areas are demanding this technique.

Adoption of animal traction implements

Implement	2001 - 2002		2002 - 2003		2003 - 2004	
	Made	Sold	Made	Sold	Made	Sold
Combination plough	168	151	271	269	563	499
Reversible shock absorber plough	528	505	699	652	476	457
Plate harrow	45	42	97	93	94	92
Reversible mountain plough			40	35	15	14
Multiple mountain plough			45	43	55	53
Disc harrow			11	11	3	3
Cart			10	10	8	7
Wings for high tillage			11	10	20	16
Small reversible shock absorber plough					119	119
Sprayer					5	3
Potato digger					146	96
Horse harness			20	17	35	30

(For more information see Annexes: 3.7a, 3.7b, 3.7c)

Activity 3.8. Validate and Promote Practices for Improved Management of Draught Animals

Like the previous activity, and also to improve potato yields, INNOVA validated and diffused agricultural implements (disc harrow, reversible slitted plough, reversible PROMETA plough, combination plough, multiple mountain implement, disked grain planter, weeder, rake harrow, oxen or horse-drawn cart etc.) designed and manufactured by PROMETA-CIFEMA, with the support of other INNOVA partners during the 2002-2003, 2003-2004 and 2004-2005 seasons. Equines (horses and donkeys) were also promoted as draught animals for light tasks, such as planting, hilling up (*aporque*), weeding, transport and carrying, and others.

Above. Ox-drawn disc harrow

To complement the use of animals for traction, farmers were trained as para-veterinarians on the Altiplano and in the high valleys, using botanical anti-parasite remedies, in practical courses. In the last phase of the project there were also courses on the management, conservation and storage of cultivated forages. Skills were developed in the management of implements, in animal health care, and diversifying the use of animals, especially equines, through courses and other methods, as described next.

Working with other INNOVA partners allowed PROMETA to reach new areas, such as Comarapa and Saipina in the low valleys of Santa Cruz, where diffusion was extended in the last two years, at the demand of municipal authorities, NGOs, the Departmental Agricultural and Livestock Service (SEDAG) and others, to the municipalities of Vallegrande, Mairana, Moro Moro and Pampa Grande, and to the municipalities of Umala and Ayo Ayo on the Altiplano of La Paz. These communities are different climatically, topographically, edaphically and socio-culturally from those of the high valleys of Cochabamba, where PROMETA worked during the last four years in Morochata, Capinota and Tiraque, widening its reach with INNOVA, to Colomi.

The back-&-forth method was used to validate the animal traction implements. This iterative method permits changes and adjustments to be made in the implements while developing and validating them, involving farmer leaders, other interested people, institutions, farmers' unions (*sindicatos agrarios*) cooperatives and others. The diffusion of the technology used methods like demonstrations, field days and technology fairs, where organised farmer groups (*sindicatos*, CIALs, FFSs and others) participated.

During the event, implements were shown to farmers, explaining the advantages and uses of each one, besides the care needed to operate or manage them, and how to regulate them while working. Then a demonstration was held with the farmers, who gave their opinion on the implement, and their comments were gathered (open evaluation) where they expressed their ideas, and suggested improvements, after having tried the implement. To allow the implements to be tested freely by the farmers in the three agro-eco-regions—without a *técnico* looking over their shoulder—two sets of equipment were loaned to organised groups, FFSs, CIALs, *sindicatos*, or NGOs. In this stage, called follow-up, suggestions for change were also gathered for the adaptation, acceptance or purchase.

At the request of several municipalities in the low valleys of Santa Cruz and the Altiplano, training courses were held for the management and regulation of the implements. There were also courses for training donkeys and horses in Santa Cruz and Cochabamba. The courses on animals included the use of botanical anti-parasite remedies, developing knowledge on the identification and damage that parasites cause in animals and the appropriate treatments. The course included the identification and collection of plants, and how to conserve them. Extracts were prepared, and given to animals, and the effects were monitored. The plants used for the practical courses on parasite remedies were *payqo* (*Chenopodium ambrosioides*) and *suyku* (*Tagetes* sp.) which are found in the high valleys and on the Altiplano. To conclude this stage, there was a review session; the animals were monitored to see the effects of the botanical anti-parasite remedies.

The course on equine training and management included several sessions. The first one taught the advantages and behaviour of these animals, and how to adjust the high lift harnesses to different sized animals. The second session taught working with the implements in farm tasks. Monitoring assured the proper use of the equipment. The different climates of each region affected the strength of the animals, due to the conditions of weather, soil, altitude and feeding, so the implements and their use were often modified considerably.

During tests on the Altiplano of the reversible mountain plough and the multiple mountain implement, neither of them were adapted to the area, because the animals had limited traction strength, and it was decided to modify the tillage implements, cropping tasks, harvest and post-harvest. The draught animals were small, of low weight, and without enough strength to perform the agricultural tasks. Nevertheless, by demand of the farmers, a course was taught on animal-drawn implements (a resource which all of the farmers have) before hiring a tractor, which is expensive and inappropriate for the region.

However, in the low valleys of Santa Cruz, much of the technology was adapted, accepted and adopted (disc harrow, reversible slitted plough, reversible PROMETA plough, combination plough, multiple mountain implement, disked grain planter weeder, rake harrow, oxen or horse-drawn cart etc.) This was because of the area's optimal conditions: availability of draught power, because the animals are larger and heavier than in the high valleys, and much more so than those on the Altiplano. The intensive agriculture of this region also provides favourable conditions to develop other farm equipment such as the sprayer, for applying pesticides, and pulled by a person or a donkey. The implement was well-received and many were sold.

The goals originally set for these activities were satisfactorily met, thanks to the combined effort of the INNOVA partners; new implements were developed and validated, which reached the diffusion stage: reversible mountain plough, reversible shock absorber plough (*reversible arado de flejes*) reversible PROMETA plough, potato digger, disc harrow, high tillage plough (*aporcadora de aporque alto*) and the cart. Others, like the sprayer, the multiple mountain implement, and the potato sorter, are in their final phase of validation. Implements diffused unchanged were the: combined plough, plate harrow (*rastra de aletas*), large reversible shock absorber plough (*arado reversible de flejes grande*) and the high lift harnesses.

The biggest impact in the high and low valleys was with the potato digger. The design was modified during INNOVA's three years. A greater adoption is expected in the low valleys of Santa Cruz, because field sizes are larger, where adoption is easier. Tests with the implement showed significant economic savings.

The equines were used for light tasks, saving time and money for the poor households of the high and low valleys, although they were not appropriate for the Altiplano. The botanical anti-parasite remedies were an easily adopted alternative for some farmers in the high valleys and the Altiplano, because of their efficiency and low cost.

The improved management of forages also diffused to the farmers, to improve the quality and quantity of fodder, using simple practices, such as timely harvest, drying and storage under a roof. The wide use of the implements in many crops has allowed their incorporation into the potato MIPITA in the low valleys and the forage MIPITAs in the high valleys and the Altiplano. The wide use of these implements means adequate soil preparation, with emphasis on soil conservation, and the ease of performing timely tillage and harvest tasks.

(For more information see Annexes: 3.8a, 3.8b)

Activity 3.9. Identify and Make Available Legume (or Other) Species for Use at Altitude for Fodder Production and Soil Conservation

Cultivated forage is an important crop in INNOVA's area of action. In the high valleys of Cochabamba, the main causes of low yields and scarcity in the dry season are weeds, reliance on a few cultivated species, and unawareness of alternative technologies, such as grains intercropped with forage crops, and new forage varieties. The Altiplano has even greater limitations because of the weather (drought, frost) and the scant possibilities of adapting forage species to the high plains. The smallholders in the higher parts of the low valleys of Santa Cruz do not have a permanent supply of forage, and have a shortfall in the dry season.

Left. Don Ovidio and don Julio, farmers in Verdecillos, Comarapa, Santa Cruz, discuss a recently planted pasture garden in the low valleys.

The main objective of this study was to identify plant species for forage and/or to control erosion in INNOVA's three pilot areas, with farmer participation in local trials to evaluate technical proposals and the technical support to provide new forage species for demonstration trials. The method for selecting promising forage species was to establish small plots called "pasture gardens" in each area. They were planted with various species and varieties of legumes and grasses, including annuals and perennials, planted alone and intercropped. The area planted to each species or variety varied from 6 to 10 m^2, placed next to each other, grouping similar species to facilitate the participatory evaluations of the plots.

The pasture gardens were planted and evaluated during the first year. Then in some communities where they did not thrive they were replicated the second year, and the third year the gardens were included in the new communities of the MIPITAS in the high valleys and the Altiplano. The species selected the first year went through validation trials.

The pasture gardens were tended and evaluated by farmers in the GETs and CIALs. The participatory evaluations used the open evaluation, which elicits and captures comments by farmers, from their point of view, about the most important characteristics of a new technology. The evaluations also included order of preferences. The farmers order various alternatives by preferences, specifying their reasons for doing so. In the validation trials and in the agronomic evaluations of them, experimental designs with statistical analyses were used, especially in the Altiplano. These complemented the participatory evaluations with data on yields and seed production in some areas.

All of the actions were led by PROMMASEL in coordination with the PROINPA Foundation in the Altiplano of La Paz and in the low valleys with CIAT of Santa Cruz. The diverse conditions where the pasture gardens and the trials were planted prohibit a detailed analysis of the particularities of each area, and of the yearly climatic differences. Nevertheless, a general summary is presented for each pilot area.

Altiplano
The first year 14 forage species were planted, including legumes and grasses. The first year, the GETs prioritised the evaluation of annual forages like triticale (variety Renacer), barley (varieties Gloria and Capuchona). Perennial species like alfalfa were not evaluated, because local criteria indicated better performance after the second year. Farmers preferred triticale, followed by oats and barley, taking into account high growth, abundant foliage and good fodder.

The second year, triticale (Renacer) and barley (Capuchona), planted alone and intercropped with vetch (*Vicia dasycarpa*) were validated in a test plot. The results did not show statistical differences for yield, location (three communities) and treatments (including local barley). The results showed that the introduced species were not better than the local ones, but intercropping is an alternative that provides higher quality fodder.

The participatory evaluations showed that farmers in the different communities (Mamaniri, Salviani and Vitu Calacachi) express different preferences for the treatments, even when in some cases the highest yielding one is local barley planted with vetch. The second year, the participatory evaluations for perennial species are not conclusive, so the agronomic evaluations of harvest, degree of re-growth and participatory evaluation are included in the forage MIPITA.

Three plant species were identified, triticale and Capuchona barley (both grasses), planted alone and intercropped with *Vicia dasycarpa* (legume) to be planted for fodder production and soil conservation. Access to them was assured through purchase or growing seed locally (for the grains) and purchase of the legume in places known to the farmers. Perennial species for the Altiplano were not conclusively identified, because farmers suggested that they needed more time to get to know and adopt them, but alfalfa, variety Valador, seemed promising.

High valleys
In the pasture gardens in Sank'ayani (Tiraque) and Chimparancho (Colomi), the legume plots and the intercropped ones were planted separately. In both communities, the participatory evaluations by gender show no important differences regarding preference of perennial species (alfalfa, vetch and clover) and mixes of barley, oats and triticale with *Vicia dasycarpa* and big northern pea (*arvejón del norte*) for the intercropped annual grasses. The evaluations determined that farmers preferred more growth, uniform size, and the ability to grow their own seed. Barley was the most preferred annual grain, especially Capuchona, because it is easy to produce and use as forage.

In Chimparancho the farmers preferred grains that could be intercropped. The second year they planted pasture gardens with new varieties of barley (Ivon, Ibit) alone and intercropped with *Vicia dasycarpa*. The farmers strongly preferred the mixes. The species selected in the pasture garden (first year) were the same as the species tested in activity 3.2. to validate those species and identify the best planting dates to produce seed of *Vicia dasycarpa* planted with oats and barley.

The preference for capuchona barley (first year), motivated the farmers (a group of six families) to plant seed plots (to multiply basic seed), guaranteeing sale of the seed by contract with the seed company SEFO. This activity was expanded in the MIPITA. The results of the pasture gardens (especially the participatory evaluations in year 1) motivated many farmers to buy different species and varieties of forage. In the high valleys 40 farmers bough 25 kg of alfalfa (variety Bolivia 2000), 20 kg of *Vicia dasycarpa* and 30 kg of purple clover in Sank'ayani and Qolqe Qhoya.

Barley (Capuchona) and *Vicia dasycarpa* were identified for forage production and soil conservation in the high valleys. Access to the seed is guaranteed by local production (a group of farmer producing seed) and the possibility of buying it in places familiar to the farmers.

Identifying a potential permanent species did not end with the choice of a variety according to farmers' criteria; they requested more time to get to know and adopt the forages. The farmers' observations are similar to the technical criteria for the adaptation of new species. The most promising forages are alfalfa (Bolivia 2000) and purple clover.

Low valleys
In these valleys there is little interest in cultivating forage, because the main source of forage is natural, free-range pasture. But a pasture garden was planted with the CIALs in Verdecillos and in Los Pinos. The farmers in the CIALs evaluated the forages and expressed a preference for oats, *Vicia dasycarpa*, forage peas and purple clover. In evaluations with animals in Verdecillos, the varieties most accepted and preferred by the animals, were oats (Gaviota) and alfalfa (Bolivia 2000). Also, *Vicia dasycarpa* is being used as a cover crop in peach orchards, to control weeds. But there is little access to the seed, which is quite difficult to buy locally.

(For more information see Annexes: 3.9a, 3.9b, 3.9c)

Activity 3.10. Promote Live Barriers for Erosion Control in Three Agro-Ecological Zones

Irreversible erosion caused by farming steep slopes is characteristic of smallholder farming systems in the highlands of Bolivia. The absence of appropriate soil and water conservation practices for hillsides in rural Bolivia has been a cause of increases soil erosion and damage to the land. The loss of arable soil to sheet erosion, in general imperceptible to farmers, along with pressure on the land, has increased erosion. Therefore, INNOVA promoted the technology of live barriers of Phalaris grass, generated by the Hillsides Project of the UMSS (1996-1999) in three pilot zones of the project.

In INNOVA's three pilot areas in La Paz, Cochabamba and Santa Cruz, the technology was validated with activities such as demonstration plots, training talks, multiplication plots of Phalaris grass and providing plants of the grass in each community. Technical follow up and participatory evaluations promoted the technology and gave farmers had the opportunity to observe the benefits of Phalaris. The participatory evaluations in the Altiplano, high and low valleys used the open evaluation. To study adoption, participatory methods were used: the innovation tree, regenerative cycles and interviews with farmers, besides participatory evaluations on soil conservation.

Left. A large bank of Phalaris grass (centre of photo) in Qhochimit'a, Tiraque, Cochabamba

Establishing live barriers of Phalaris grass

The demonstration plots of live barriers of Phalaris were established jointly with farmers who participated in designing the plot, setting the contour lines, preparing the plants, planting, and in the technical and participatory evaluations. Two to three demonstration plots were planted in each pilot area, except for Los Pinos (low valleys) where live barriers of Phalaris had already been widely disseminated by the farmers themselves. The demo plots planted the first and second year were maintained during the second and third years, for follow up and for technical and participatory evaluations.

Follow up and technical evaluations

After establishing the plots in each community, technical evaluations were carried out on the adaptation of Phalaris grass, on the formation of live barriers, erosion control and fodder production. The main evaluation criteria were: percentage of Phalaris to take root, replanting of dead plants, degree of closure between plants, yield of grass as fodder, number of harvests of grass per year and erosion control and sedimentation as effects of the live barrier.

Technical evaluations confirmed that Phalaris grass is adapted to all of the areas. The effectiveness of the live barriers for erosion control was fair (on the Altiplano because of the reduced development of plants and slight movement of soil in the plots) to more efficient (in Verdecillos obvious terraces formed behind the barriers, which kept soil from running down slope). The technical evaluations were joined by farmers from the CIALs or GETs who were trained to use simple tools to identify the effects of erosion control and the production of forage by live barriers of Phalaris grass.

Participatory evaluation
Participatory evaluations identified farmers' criteria for using live barriers. On the Altiplano one of the most important was the use of the grass as a barrier against the Andean potato weevil, leading to good adaptation in the area. The results in the high valleys, in Tiraque and Colomi were similar to the Altiplano, emphasising forage production and the animals' preference for the grass. During the evaluations, especially in Chimparancho, farmers mentioned the advantages of growing the grass in flat areas as forage.

Training talks
The training talks on soil conservation and live barriers were supported with audiovisual aids and live demonstrations in each pilot area. The workshop was open to the whole community. The talks were held at a time convenient for women and men. The talk included the following topics: basic concepts of erosion, types of erosion, erosion control, mechanical and biological practices of soil conservation, and live barriers of Phalaris. Support material given to community members included pamphlets on how to multiply Phalaris in family nurseries and live barriers, and a poster on sustainable hillside agriculture. The talk was supported with a video on live barriers.

Household plots to multiply Phalaris grass
The first year, communities in the Altiplano pilot area received about 1,050 Phalaris plants, in Pomasara and Pomposillo. In the second year, 66 families in six communities (Pomposillo, Copani, Huaylloroco, Mamaniri, Vitu Calacachi and Salviani) bought a total of 10,300 Phalaris plants. In the forage MIPITA (January, 2005), 71 families in four communities (Iñacamaya, Kellhuiri, Huayllani and Sirugiri) bought 18,500 Phalaris plants to establish fodder plots, and not as live barriers, since the farmland in these community is flat.

In the high valleys, in the first year about 950 Phalaris plants were distributed in Chimparancho to 12 families and in Sank'ayani to 18 families. Later, no more multiplication plots were planted because the farmers had other, more attractive alternatives to produce forage.

In the low valleys, the CIAL of Verdecillos maintains a multiplication plot which supplies Phalaris plants to the community, and which is also supported by another environmental services project, conducted by CIAT. The community of Los Pinos is the exception, and has managed to include Phalaris grass and its multiplication as a common activity in the local agricultural calendar.

Adoption of Live barriers of Phalaris grass

Pilot area	2002 - 2003	2003 – 2004	2004 - 2005
Altiplano	3 demo plots	Follow-up and evaluation	71 families in the Mipita in 4 communities in Umala, buy 18,500 Phalaris plants to produce fodder.
	1050 plants distributed to 35 families	66 families bought 10,300 plants.	
High valleys	3 demo plots	Families are maintaining Phalaris planted earlier.	
	950 plants distributed to 30 families		

(For more information see Annexes: 3.10a, 3.10b)

Output 4

Technological information covers more efficiently the needs of the poorest farmers through institutional mechanisms that are developed, tested and disseminated to link the demand for technology Innovation among the potato supply chain with the supply of technology

Rapid changes have taken place in global food markets in recent years. Evolution in consumer demand (higher quality, more variety, falling prices), food safety concern, agriculture health standards and modern retailing systems are driving these changes. Food industries and supermarkets compete for market shares by trying to meet consumers' preferences. They have become important buyers in global markets. This tendency is also observed in the urban markets of developing countries. Globalisation increasingly requires that developing countries modernise and strengthen their agro-food systems to remain competitive in the world market. The potato market is also changing in Bolivia, along with new consumption habits, a growing urban population and new products (Guidi and Mamani 2000).

This new context means that farmer-market linkage must be improved and farmers have to respond to market requirements with better quality products. Innovative practices that enhance linkages between farm and markets can help alleviate poverty by fostering economic growth. Agricultural research and development also needs to adapt. To respond to this challenge, INNOVA, through Working Group (WG) 4, defined the following activities:

4.1 Identification of potato based products with a commercial potential
4.2 Test and promote mechanisms for capturing demand for innovative technologies among market chain actors and research partners
4.3 Identify researchable interventions based on potato market chain analysis
4.4 A strategy developed with FDTA Altiplano for resource capture, to finance a call for proposals addressing issues identified from the marketing chain analysis
4.5 Document methodologies to link supply and demand for technology innovation in market chains for dissemination and uptake by SIBTA and DFID.

During the project implementation, it was decided to merge activities 4.1, 4.2 and 4.3.

Activities 4.1, 4.2. and 4.3. Development of mechanisms to capture demand for innovation and implement interventions among market chain actors to make use of new market opportunities

Since 2003, WG4 with the support of CIP/Papa Andina has promoted approaches to link technology supply with farmers' needs based on market opportunities within a market chain framework. INNOVA used ideas from innovation systems thinking to bring together technology producers (researchers) and users to learn by doing. This allowed participation of various stakeholders in the generation, adaptation and diffusion of knowledge, contributing to new R&D approaches and to technology development. INNOVA applied the Participatory Market Chain Approach (PMCA) to promote market led innovation with its partners, taking advantage of potato biodiversity to improve the livelihoods of poor farmers. Innovative niche market products or services have been developed to add value to farm produce (Bernet et al., 2005).

The Participatory Market Chain Approach

PMCA promotes farmers' interaction with other actors of the potato chain to generate demand led innovations. It is research-action that starts with a qualitative exploration of the current conditions and market chain perspectives and ends with the launching and introduction of new products to the market.

PMCA discussion and creativity for generating innovations that will benefit each of the participants. This approach seeks to generate trust and collaboration. All innovations must be demand led, emphasizing the wants and needs of consumers. Once commercial innovations have been identified, changes are made through "backward linkages", towards the other actors of the market chain: retailers, wholesalers, processors and farmers.

The approach has three phases: I) diagnosis, II) analysis and III) implementation:

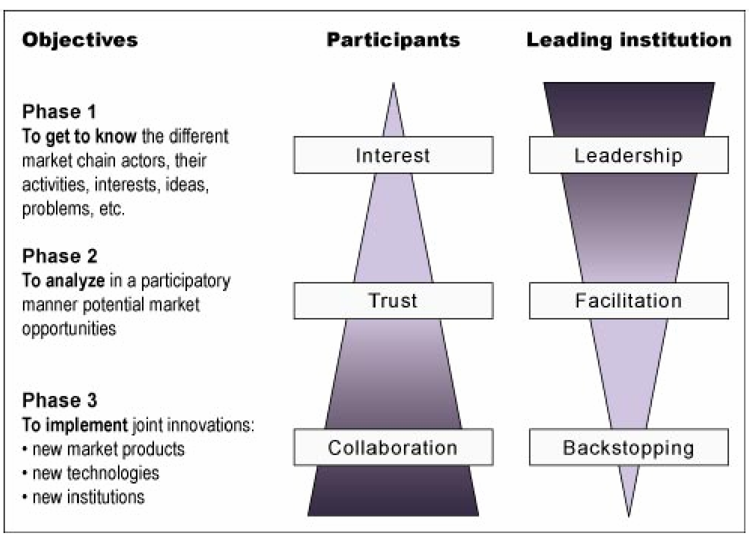


Figure 1. Objectives and phases of the Participatory Market Chain Approach

I. Diagnosis: Qualitative interviews with representatives of each link of the chain make it possible to determine problems, identify business opportunities and have an initial interaction with market actors. This research may take up to thirty days and involve 20 to 40 in-depth interviews. Findings from the interviews are presented in a *First Event*, where all interviewees, other market chain actors and research and government representatives are invited.

First Event: Findings from the interviews are presented.

During this event, small working groups are formed according to ideas or projects that the market chain actors propose to improve production and marketing. This phase tries to motivate the different actors, and encourage them to get involved, and interact with each other.

II) Analysis: The working groups meet every week or two to discuss the technical viability of the market opportunities identified during phase one. At this stage market, economic and technical studies are carried out, with the participation of the market chain members who contribute their knowledge and learn from each other.

This phase lasts six months on average, after which the outputs are presented in a *Second Event*, where new actors could be involved (if necessary) to complement the group with new initiatives, capacities or business implementations. The main principle of this phase is to build trust amongst actors.

III) Implementation: Commercial options generated by the groups are implemented. Manufacturing options and market strategies are developed. Commercial agreements and commitments are made among actors, and business plans are formed so that the new products or services are placed in the market. This phase should last four to five months and end with a *Third and final Event* where the groups present the new products or services that are to be launched. Media and partner organisations are invited to this event as well as the private sector, distributors, and other key market actors.

PMCA was tested and adjusted with actors from three potato market chain segments:

- Chuño and tunta products (dehydrated potato processed traditionally) in La Paz
- Native coloured potato chips in Cochabamba
- Fresh native potatoes bagged for supermarkets in Santa Cruz

Activity 4.4 A strategy developed with FDTA Altiplano for resource capture, to finance a call for proposals addressing issues identified from the marketing chain analysis

This activity was conceived to support SIBTA design and implement a strategy to capture funds for addressing issues related to the potato market chain. It was necessary to redesign this activity when INNOVA started its implementation:

- The potato market chain was not included as a priority commodity within the Bolivian government's development strategy. This was important since all resources distributed by SIBTA for innovation had to be aligned with the national strategic goals and policies.
- SIBTA's Altiplano Foundation, which should interact closely with INNOVA and provide resources, was restructuring and lacked decision-making staff.

It became necessary to generate and provide enough information for the policy makers to give the potato market chain the priority it deserved.

The strategy to achieve this goal covered:

- First phase: assess the potato chain's macro indicators. INNOVA hired the consulting firm AgroData.
- Second phase: the results from the first phase influenced policy makers from the Ministry of Agriculture to request a study of Identification, Mapping and Competitive Analysis of potato in Bolivia. INNOVA hired AgroData and Altiplano Foundation contracted the consulting firm Fundes to do the study.

When the studies were finished, the competitiveness analysis was conducted following a conceptual model called "Porter's Diamond" which considers conditions such as production, demand, strategy, structure and rivalry between competitors and the state.

Activity 4.5 Documentation of methodologies to link supply and demand for technology innovation in market chains for dissemination and uptake by SIBTA and DFID

As mentioned above INNOVA and Papa Andina tested and adjusted the PMCA to link supply and demand for innovation in three potato market chain segments. At the end of 2004, INNOVA started systematise the experiences with:

- INNOVA's partners and technical people
- The SIBTA foundations
- Other R&D organisations and service providers in Bolivia
- Papa Andina's partners in Ecuador and Peru
- DFID and its partners

Outputs of Working Group 4

Activities 4.1, 4.2. and 4.3. Development of mechanisms to capture demand for innovation and implement interventions among market chain actors to make use of new market opportunities

Implementation of PMCA in three segments of the potato productive chain

I) Diagnosis

For the three market chain segments studied: chuño and tunta products, native coloured potato chips and fresh, bagged native potatoes, the diagnosis consisted of:

- Elaboration and validation of the interview questionnaire for market chain actors
- Identification of key actors to be interviewed
- Interviews
- Information analysis and synthesis
- First public Event

Interviewees included farmers, retailers, wholesalers, small and mid-scale processors, key supporting and service providing institutions.

Key subjects for interviews

The following key subjects were to guide the interviews:

- Interviewee's general business information
- Current market constraints
- Causes and consequences of the constraints
- Relationships and trust levels with other actors
- Individual interests
- Collective interests
- Individual ideas or projects
- Collective ideas or projects
- Suggestions to improve business performance

40 interviews were conducted for chuño and tunta, and 50 for the two other segments of the potato sector. During the diagnosis the potato sectors in the high and low valleys were analysed jointly. A First Public Event took place for the each segment once the information had been analysed.

All events followed this basic program:

- Presentation of participants
- Presentation of meeting's objectives
- Brief explanation of PMCA through multiple dynamics that show the importance of using a market led focus and a market chain approach: "The Square Potato Sketch"
- Presentation of results obtained from the interviews

Working group formation based on market opportunities:

Groups formed at the First Public Event	
Chuño and tunta segments	**Potato segment in Cochabamba and Santa Cruz**
1. Tunta for foreign markets 2. New processed tunta and chuño products Selected quality tunta	1. Native potatoes 2. Quality potato for market and industry 3. Quality potato seed

From this point on, actors working on the potato segment in Cochabamba and Santa Cruz decided to deal separately with the high and low valley sectors. The “Native Potato” and “Quality Potato Seed” groups functioned in Cochabamba and the “Quality Potatoes for Industry and Market” group in Santa Cruz. There was a logical link between the Cochabamba and Santa Cruz groups because of seed flows from one area to the other.

II: Analysis

Chuño and Tunta

Participants identified the need to define quality standards for tunta and chuño before starting marketing. According to the market chain actors, the lack of such standards complicated marketing and communication among growers, sellers, processors, and exporters, causing conflicts. It was decided to create the Bolivian Quality Norms for Tunta and Chuño to define quality standards and generate trust in the commercialization of these products.

The Bolivian Institute for Quality Standards (IBNORCA) was asked to assess the creation of the norms, and for guidance on the steps to take. A first meeting of the working group was held in March, 2004. Different market chain actors and support institutions took part; a Standards Committee was established, and a president and a secretary were elected. A work schedule was later agreed on. Meetings were held every two weeks at the IBNORCA offices. Representatives from the following sectors took part in these meetings:

- Chuño and tunta producers from the Collana, Peñas and Tiwanaku.
- Retail and wholesale
- Processing (Chapaquita brand)
- Export (DEZE, IMEXBOL, AGRONAT)
- Support institutions (PROINPPA, PROSUKO, AGRONAT)
- Ministry of Agriculture
- Ministry of Health
- Food quality analysis laboratories

The norms were created in meetings, using other dehidrated products’ quality norms as a reference. This task considered the study of production, product definition, clasification by size, rehidration tests, chemical and microbiological analysis.

During this phase INNOVA did the market study for chuño and tunta in La Paz, Cochabamba and Santa Cruz. In September 2004, a first draft of quality norms was presented, then submitted to a 60 day public consultation formalise its publication.

The Second Public Event took place in January of 2005. The efforts to create Bolivian norms for chuño and tunta were presented, as were the market studies for chuño and tunta in La Paz, Cochabamba and Santa Cruz. Different actors expressed their intentions to take advantage of potential market opportunities:

- IMEXBOL, a company that exports to Argentina, Spain, the UK and other European countries, requested chuño samples from the SARTAWI of Tiawanaku Farmers' Association and suggested ways to improve the product's presentation for the European market.
- Cooking and hotel management schools showed great interest promoting chuño and tunta through new cooking styles and a new market sector.

While writing this report, a qualitative study was being conducted to identify new ideas and projects to present to actors and support institutions.

Native potatoes
The Andean Tuber Farmers' Association of Candelaria (APROTAC), the Lucana private company, two supermarkets (Slam and Hipermaxi) and an organic food store (Econatural) formed this group. Lucana was responsible for enhancing the native potato chip industry; supermarkets and other stores would do the same for "chipas" (bagged, cleaned, fresh native potatoes for supermarkets and specialty stores). Potato producers were interested in finding new options for selling their products; processors were looking to produce native potato chips with a steady supply of raw material. Supermarkets were interested in improving their sales of potato and related products.

Quality Potato seed
This line of business was organized around two potato seed farmers' associations: the Organisation of Agrarian Producers from Candelaria (ORPACA) and the Farmers' Association of El Puente (APP). ORPACA was to produce seed in the highlands of Cochabamba; APP was to multiply this seed to provide it to a third actor in the low valleys of Santa Cruz. This third actor was an organisation formed around a Local Agricultural Research Committee (CIAL).

The Regional Seed Office (ORS) also played a supporting role certifying and disseminating the use of high quality seed. Seed producing companies were to act as the initial providers in the market chain. These actors, especially the growers and the ORS, were particularly interested in starting a profitable business that would provide the low valleys in Santa Cruz with high quality seed.

After five meetings, the seed group confirmed the idea of a potential market for high quality seed instead of the informal seed used by farmers. Training in production, post harvest and marketing, as well as organisational strengthening with a business vision were recommended.

The PROINPA Foundation and farmers wrote a project to access competitive funds from SIBTA through the Altiplano Foundation. The Applied Technological Innovation Project

(PITA) named "Strengthening the Competitiveness of Potato Producers from Pocona and Morochata Linked to the Market" was developed and approved by SIBTA.

This project started in October 2004 and will continue for two years. It aims to improve competitiveness in two potato farmers' associations (ORPACA and APP El Puente) through participatory strategies to enhance seed production quality and quantity. It will also reduce post harvest losses, improve farmers' business skills and facilitate fairer relationships with other market chain actors.

The Second Public Event corresponding to this phase could not be implemented, according to the PMCA guidelines, because of Bolivia's "gas war", when the president was deposed. Marketing and technical outputs generated during this phase were not publicly presented.

Quality Potato for industries and markets
Three meetings were held in the city of Santa Cruz for this phase of PMCA. Business opportunities were analysed. Trust and commercial relationships between participating actors were established. Informal meetings between specific actors complemented the formal ones. Potato producers from the low valleys, the potato chip industry and supermarkets discussed quality and prices. Different quality criteria between actors showed the need to agree on and publish a graphic chart that would illustrate the characteristics for potatoes of first, second and third quality levels.

Potato prices were a polemic subject. Farmers demanded to know how much supermarkets and industries were willing to pay, while supermarkets and industries demanded a price based on farmers' production costs. Supporting entities like PROINPA and CIAT-Santa Cruz were requested to assist farmers formulate a cost analysis for the presentation of a price proposal. The group did not come to any concrete agreements on prices, and more serious issues arose when volumes, periodicity and supply were discussed. At this point, entrepreneurs suggested suspending the meetings until producers organised themselves. Responding to this new challenge, PMCA was put on hold and WGs 3 and 4 worked together to help farmers get organised in agro-businesses. Farmers in Comarapa were trained in technical and marketing topics. This working group did not reach the 3rd phase of the PMCA methodology.

In August of 2004, to close this first cycle of PMCA, participants, other institutions and related companies were invited to the presentation of the results of a study carried out by INNOVA to determine the "potato consumer's profile in Cochabamba, La Paz and Santa Cruz". In this meeting, a work plan for the organisation and training of potato producers from the low valleys was presented.

III: Implementation
Two products reached this phase: native Potato chips and selected bagged fresh native potatoes.

The involved actors coordinated the following tasks:

- Frying tests for potato chips to identify appropriate frying properties. Two native potato varieties were selected: Candelero and Pinta Boca.

- Marketing pilots in fairs, for chips and fresh potatoes. Fresh potato sales were also tested in Santa Cruz.
- Package design for the chips and label design for the bagged fresh potatoes.
- Printing of packages and labels.
- Raw material supply organization, for chips as well as for fresh potatoes.
- Design of contract and agreement models to be used between producers and the industry, especially for chips. Contracts stipulated volumes, prices, transportation, quality, supply continuity, varieties, etc.
- The Lucana Company prepared a batch of native potato chips for a supermarket in Cochabamba, introducing a new product for consumers.
- The *Final Public Event* took place in July 2004 at the Chamber of Industry in Cochabamba. All participants attended, new companies were invited, as well as the media, official institutions, hotels and restaurants among others. This event was the opportunity to officially launch the coloured potato chips and bagged native potatoes. PROINPA provided support for the chips' advertising in mass media on TV and in print. A logo for the native potatoes was officially presented to the public: El Nativito.

Logo for native potatoes: El Nativito (the little native man)

The native potato chip industry is evolving; volumes sold to Lucana rose to 3 metric tons between February and June 2004. Lucana stored part of its raw material to stabilise their production in July and August. September, October and November are still considered critical months because of the seasonality of native potato production. The relationship between APROTAC and Lucana has also evolved and APROTAC was able to negotiate better contract terms.

Lucana: natural colored native potato chips

When the bagged native potato business first started only 500 kg per month were sold to one supermarket in Santa Cruz. Sales have risen to 1200 kg per month and they now deal with five supermarkets and an organic food store.

Chipas: Bagged fresh native potatoes.

These new niche markets promoting native potatoes, with the participation of smallholder farmers in organised market chain segments are building up. As they develop INNOVA will collect information to analyse the additional benefits farmers obtain from these markets as compared to the traditional ways of selling to middlemen. But small-scale farmers need support to overcome weaknesses such as: lack of technical and commercial knowledge, lack of organisation and of capital. Alliances with local government, development organisations and market chain actors are needed to organise the support.

Synthesis of results achieved though the implementation of PMCA

The PMCA promoted market-led innovation to increase farmers' income. The commercial innovation gained through PMCA drives other innovations, including: potato variety selection for processing, production, storage and post harvest techniques for farmers, and information systems. See the tables below. PMCA helped generate market chain innovations and make market chain actors' demands, including farmers, more explicit to R&D organizations.

Three types of innovations were achieved:

- **Marketing innovation** that develops new value added products or services.
- **Technical innovation** that helps smallholders and other actors respond better to market demands
- **Institutional innovation** that strengthens the relationship between stakeholders.

The following tables below summarise the innovations promoted by INNOVA through PMCA:

Market chain segments	Institutional Innovation	
Chuño and tunta	Quality standards for chuño and tunta*	Identification of new allies and partners**
Native potato chips and bagged fresh potatoes	Promote entrepreneurial development of APROTAC	Establish formal relationships between APROTAC, the Lucana company and supermarkets
Quality potato seed and quality potato for industries and markets	Strengthen business skills of the ORPACA and APP farmers' associations	Develop alliances among farmers and R&D organizations.

Market chain segments	Technological Innovation	
Chuño and tunta	Integrated control of Andean potato weevil for improving potato quality	
Native potato chips and bagged potatoes	Selection of potato varieties for potato chips and "chipas" production	Promote seed supply of varieties selected for the market products
Quality potato seed and quality potato for industries and markets	Promote certified seed Integrated control of pests and diseases	Promote production, harvest and post harvest technologies to increase yields and quality.

Market chain segments	Commercial Innovation	
Chuño and tunta	The First Hotel Management School of La Paz promotes new dishes made from chuño and tunta	
Native potato chips and bagged potatoes	Development of coloured potato chips and bags of native potatoes.	Small and medium scale companies participated in commercial fairs such as: Ecoferia, Naturex and Feria a la Inversa
Quality potato seed and quality potato for industries and markets	Introduce new marketing strategies for seed business.	Technological fairs where suppliers and potential buyers meet in business roundtables

Effort was made to make the information related to the potato market chain, and the market studies available to all actors. PMCA was a powerful tool for stimulating innovations of different types: commercial, technological and institutional as illustrated in figure 2.

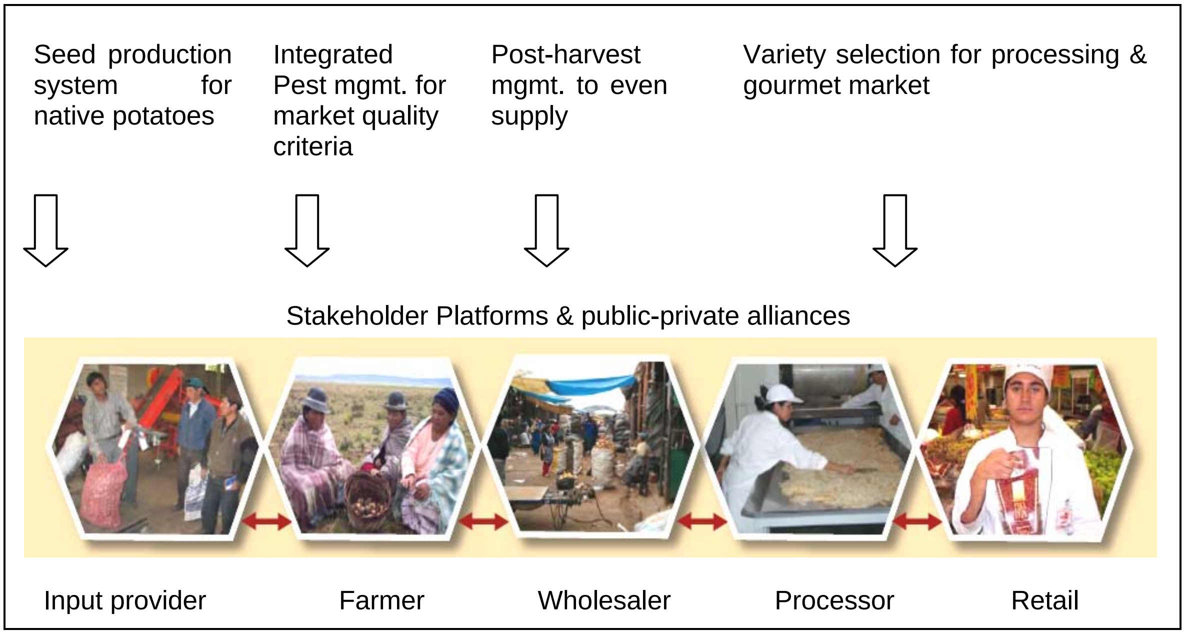


Figure 2: Innovations along the market chain driven by the commercial innovations

The PMCA is a powerfull vehicle to develop innovative niche market products that link smallholders to new market opportunities. But PMCA on its own does not guarantee pro-poor impacts; additional targeting mechanisms need to be implemented with a pro-.poor filter (selecting interventions where the poor have a comparative advantage and are likely to maintain a solid presence in the new developed markets). The market products identified through PMCA, which promoted the use of native potato varieties, grown mainly by small-scale farmers, were selected with the intention to ensure a pro-poor enhancement focus. To ensure that family farmers benefit, stakeholder platforms at the farm level help farmers organise and access services needed to engage in new business opportunities that increase their incomes.

Activity 4.4 A strategy developed with FDTA Altiplano for resource capture, to finance a call for proposals addressing issues identified from the marketing chain analysis

The progress made during the first phase of this activity is presented in the document "Characteristics of the Potato Sub Sector in Bolivia" (Crespo, 2003). This document provides enough information to justify the need for and relevance of including the potato market chain within the Bolivian System of Productivity and Competitiveness.

The information emphasizes this market chain's strategic relevance to the national economy; incomes, job and food generation; number of families involved (production, processing and marketing); service providers; capital invested and human resources; and above all its importance in food security among the poorest families in Bolivia. This report was presented to representatives from the Ministry of Agriculture. As a follow up to this study, a Mapping and Competitive Analysis of the potato in Bolivia was requested and implemented with INNOVA support (Crespo and Bellot, 2005).

A summary of these studies can be found in Annex 4, the main conclusions of the second one are presented below:

1. Almost all macro sector and food security indicators show the importance of this chain in the generation of income for small farmers, its significant contribution towards job generation and the fact that it constitutes one of the main sources of food among the poorest Bolivian sectors.

2. There is a lack of a developed agro-industrial sector to motivate farmers to change their production patterns according to market demand and opportunities. The cost reduction strategies from processing companies and the lack of product differentiation by quality thwart the development of an agro-industrial sub-sector.

3. Public and private support services to the agricultural sector, especially in potato, are biased in favour of commercial farmer. This is particularly critical since two hundred thousand farm families still need technical assistance to improve production, marketing, and eventually processing.

4. The absence of specific potato market studies in Bolivia contributes to the lack of initiative from institutions to support production, marketing and processing of potatoes to market requirements.

5. Partial and lack of knowledge of the problems and limitations within the potato market chain in Bolivia explains why policy makers do not support this sector. On the other hand, farmers are requiring more support, since the sector generates income, jobs and provide food security.

Activity 4.5 Documentation of methodologies to link the demand for technology Innovation among the potato supply chain with the supply of technology for diffusion and implementation by SIBTA and DFID.

INNOVA's systematisation of PMCA is now under way, organised around the following steps:

1. Define the objectives of the systematisation

To gather and analyze experiences from implementing the PMCA in Bolivia.

2. Identify the context where the experience was registered

PMCA was implemented within specific segments of the potato market chain:

- Chuño and tunta in La Paz
- Chips and bagged potatoes produced in Cochabamba, sold in Santa Cruz
- Potato seed produced in the Cochabamba highlands, sold in the low valleys of Santa Cruz

- Quality potato produced in the Santa Cruz valleys, sold in Santa Cruz (for processing and supermarkets)

Identify actors

Actors that were part of this experience come from private and public sectors, development institutions and farmers' associations.

Types of innovations promoted through the implementation of PMCA:

The systematisation described the three different types of innovations: technological, commercial and institutional innovations

The systematisation will be completed and published by the end of 2005

References

Bernet, T., A. Devaux, O. Ortiz And G. Thiele. 2005. Participatory Market Chain Approach. LBL BeraterInnen News 1/2005, p.8-13.

Crespo, F. 2003. Características del Sub Sector Papero en Bolivia. Working document, INNOVA, Cochabamba, Bolivia. 64p.

Crespo, F and S. Bellot. 2005, Servicios de Apoyo y Estructura, Estrategia y Rivalidad de las Empresas del Subsector de la Papa en Bolivia. Working document, INNOVA, Cochabamba, Bolivia. 25p.

Guidi A. and P. Mamani. 2000. Características de la cadena agroalimentaria de la papa y su industrialización en Bolivia. Documento de trabajo, Fundación PROINPA, Cochabamba, Bolivia.

Contribution of Outputs to developmental impact

In this section we identify six key contributions INNOVA made to achieving impact and indicate what remains to be done to capitalise on each one. Many of the contributions depend on several outputs together and so this section brings together the findings of the different working groups and highlights some important changes that occurred during the project.

INNOVA began as a curious mix. It was to be a vehicle for taking forward prior RNRRS work in Bolivia and developing a framework for expressing demand for new technology. This mix was the subject of criticism initially but was transformed during implementation into one of INNOVA's greatest strengths. Half ready, or half baked, RNRRS technology was a good laboratory to test out ideas about bringing demand and supply closer together.

Unlike many countries, Bolivia does not have a national agricultural research institute. INNOVA brought together three of the leading research agencies in Bolivia (Proinpa, CIAT and the San Simón University). Working together on INNOVA built capacities as the three institutions learned new methods and technologies from each other and from CIP.

INNOVA had as a constant backdrop the development of the competitively funded SIBTA system. SIBTA radically changed R & D in Bolivia. SIBTA advanced in implementing down stream development projects using existing technology in a market framework with a pro-poor focus. SIBTA made less advance in more upstream research, and has only implemented a few strategic research projects, none with potatoes. When we designed INNOVA we foresaw a greater role for municipal governments in institutionalising approaches developed by the project. So far SIBTA has not engaged municipal governments and this has made it hard to involve them as users of our methods, although we have not given up trying.

In terms of the international development community there is a renewed recognition of the importance of agricultural technology in agricultural development and of the need to reach the poor e.g. by meeting Millennium Development Goals. For example, green revolution technologies like seeds and chemical fertilisers were not especially invented for smallholders, but were "scale-neutral" enough that smallholders could adopt them, and benefit from them (Jirström 1996). Increasingly the approach being taken is one of national innovation systems. INNOVA made a serious attempt to develop methods to provide technology for the poor, (including the demand assessment methods and Participatory Market Chain Approach). While INNOVA was conceived to fit the Bolivian context, valuable lessons and outputs could be applied elsewhere (e.g. Uganda) and CIP will continue to look for funding to continue INNOVA's work, so INNOVA will no doubt make contributions in the future, and beyond Bolivia.

A short-duration project, with a time frame of 2 – 3 years, can make a good start developing methods, but it cannot ensure the institutional mechanisms and organisational capacities needed to link technology supplies and demands over time within national institutions. This requires a longer intervention (Horton and Siderman-Wolter, 2004).

1. INNOVA is contributing to improving the livelihoods of poor farmers in the valleys and highlands of Bolivia

The project activities were carried out in three pilot areas, in three agro-ecological zones (low valleys, high valleys and Altiplano) and lasted three years (2002-2005). They have focused on potato based cropping systems, which are critical to the livelihoods of the poor. Participatory research methods were used to validate, adjust and disseminate technologies involving improved fallow, intercropped forages, tillage methods and the effects of rotations and other agricultural practices on the incidence of pests.

SIBTA is organised by agro-ecological zones. INNOVA played an important role in testing and disseminating technology across agro-ecological zones. Perhaps the clearest example is animal drawn tillage equipment, which was tested in the Altiplano and is now being widely used, thanks to INNOVA support.

There is strong farmer interest in many of the technologies promoted by INNOVA and evidence of initial adoption. All of the technologies are low cost and risk reducing. As adoption occurs positive impacts on farmer livelihoods can be expected. Improved access to markets, through INNOVA, will also help improve the incomes of smallholder families.

Adoption studies are planned during the latter half of 2006 and these will be written up in the final report of the INNOVA Extension. These will provide evidence to assess livelihood impacts.

The strategy to take forward INNOVA-supported technologies has been to include them in SIBTA projects. For example, a PITA on potato seed production will include several of the technologies and there are opportunities for tillage equipment. Options for taking technology forward have been limited because the Valley Foundation has not prioritised potato despite its great importance for smallholders.

2. INNOVA developed a comprehensive approach for bringing supply and demand for technology together which is of wider relevance

INNOVA developed a menu of methods for joining supply and demand for research. This includes the demand sondeo, the technology fair, feedback sessions and the municipal evaluation committee. Many of the methods already existed but INNOVA adapted them to serve a new function. Furthermore, as the mid-term evaluation pointed out, the real value was not in each individually, but in bringing together and integrating an array of methods. SIBTA conceived of capturing demand as a single event, typically through a visit to a village and a community interview. INNOVA has shown that capturing demand is a process linked to the supply of technology.

While it may seem counter-intuitive to look for demand for technologies already being developed, this is actually how commercial products are designed. For example, an industrial designer gets an idea for a line of pre-packaged Mexican food that the consumer can finish cooking at home. The company sends a team to interview potential customers at home. They talk about what the consumer cooks and eats. The team may share a meal with the interviewee before asking if he or she would honestly try the product. They may even discuss packaging details (e.g. should the instructions be only in English or in Spanish as well) (Sunderland *et al*. 2004). INNOVA has learned that it is not so counter-intuitive after all to gauge demand for technologies already underway. In fact, it is a good way to design the technologies that farmers really want.

INNOVA coined the idea explicit and implicit demand. *Explicit demands* are ones that the people themselves are aware of and can articulate (e.g. “We have lost potato varieties we would like to recover. We need feed for our sheep in the dry season.”) *Implicit demands* are for problems people do not recognise (e.g. they do not demand control of virus in potato, because they do not know the virus exists). Implicit demands are also for solutions people have not imagined (e.g. we found that people did not demand metal ploughs until they saw them). The big demands are the easiest to express. Farmers quickly told INNOVA they needed forage, and late blight control, and these were true, explicit demands. Demands became more specific and more sophisticated as farmers learned more about the technology. For example, after researchers responded to demand, with a new forage crop, farmer said the seed was too expensive, or that they wanted to grow seed themselves, or they responded by planting the forage as a perennial meadow. Demand must continue to be fine-tuned over the life of a project.

INNOVA has shown that it is relatively easy but not sufficient to collect explicit demand. Gathering implicit demand is not so straightforward. There may be implicit demand for technologies, and researchers need better methods for finding them. One method might be a brainstorming session at the end of a sondeo, in which researchers each propose one or more possible implicit demands. The team debates them and refines them, discarding some. The ideas are presented to the community members, who reject some implicit demands, and refine others.

INNOVA has actually rejected some technology, e.g. sticky yellow traps for whitefly, a wagon that was too expensive, and various others. Rejecting lines of research shows that INNOVA was honest about responding to demand.

Researchers do not know the specifications for a technology until they take it to the field. In a workshop people can explain the broad outlines of an explicit demand, but not the implicit demands and not even all of the specifications of the explicit ones. For example, farmers did not tell us that they wanted to produce their own forage seed until they had grown forage crops with INNOVA. People on the Altiplano could not say that they wanted smaller ploughs until they had ploughed with the new metal ones. These details are worked out only after researchers have taken something to the community for the people to comment on. The proto-technologies become conversation pieces for eliciting the specifications of the technology.

While INNOVA was being planned, some critics within DFID suggested that INNOVA was ‘researcher-driven’, and that its partly-finished technology supply did not respond to demand. They said that the technologies should be abandoned, and that the project should start over collecting demand from farmers. However, as we have shown in Output 3, there was strong interest in most, but not all, INNOVA technologies, and there is evidence of adoption of several. Had we simply discarded all prior technologies we would have wasted a substantial prior research investment. In retrospect, most INNOVA researchers are local people, who speak the local languages, live among or near the farmers and had been responding to real farmers demand most of the time.

SIBTA'S FOUNDATIONS ARE NOW USING INNOVA METHODS. An alliance with the DFID funded FOCAM project and FIT 9 (Horizontal Learning) is facilitating the use of INNOVA's menu in the SIBTA foundations. But because the foundations work with finished technologies they have been more interested in the participatory project development methods than the demand assessment methods. Until SIBTA addresses systematically more strategic research, the demand assessment methods may not find a clear user. Policy changes are needed to provide a more favourable environment and we are contributing to dialogue here (see contributions 4 and 5).

We are currently finishing a document describing the INNOVA methods menu. This will be presented to potential users in SIBTA and widely distributed. We are writing an article for the international development community on the broader lessons learned from bringing supply and demand together (building on Bentley *et al*. 2004)

3. INNOVA contributed to adapting and applying the Participatory Market Chain Approach and Multi-stakeholder Platforms in Bolivia

SIBTA was committed to working with the market chain, but lacked tools to do so. Building on earlier work by CIP (Bernet *et al*. 2004) INNOVA has applied the Participatory Market Chain Approach (PMCA) to promote market led innovation with its partners taking advantage of potato biodiversity to improve the livelihoods of poor farmers. Innovative niche market products or services have been developed to add value to farmer production. This rapidly enhanced trust between market chain actors stimulated commercially oriented innovation and led to benefits for small farmers who grow native potatoes. Through the food chain focus, the demands of farmers were complemented with those of the market by interacting with other actors on the chain. It is important to mention that the commercial innovation obtained through PMCA became the driver for other innovations along the market chain that were required for developing the newly identified products and for improving relationships between market chain actors. For example, these innovations included: potato variety selection for processing, productions, storage and post harvest techniques for farmers and information systems. PMCA can be used as a mechanism not only to generate market products but also to make market chain actors' demands, including farmers, more explicit to R&D organizations.

PMCA on its own does not guarantee pro-poor impacts; additional targeting mechanisms need to be implemented with a pro-.poor filter (selecting interventions where the poor have a comparative advantage and are likely to maintain a solid presence in the new developed markets). The market products identified through PMCA, which promoted the use of native potato varieties, grown mainly by small-scale farmers, were selected with the intention to ensure a pro-poor enhancement focus.

There is a clear awareness that PMCA needs to be complemented with multi-stakeholder platforms for service provision and agribusiness development at farmer level because small-scale farmers need support to participate in market chain for new market products. In the future, alliances with local government, development organizations and market chain actors must be strengthened to better help small holders to get organized and to access critical services for engaging in new business opportunities.

We are currently writing up a practitioner's guide to PMCA and multi-stakeholder platforms and plan further training in Bolivia. The PMCA has been incorporated in several SIBTA projects and could be used much more widely. A project proposal currently being considered with New Zealand will build on these ideas.

There is wide interest in the PMCA outside of Bolivia. Partners with CIP are involved in promoting and adapting the approach in Uganda with CPHP funding.

4. INNOVA contributed to shifting priorities and changing policy for agricultural R & D in Bolivia

SIBTA began with an emphasis on cash and export crops. Potato was not seen as a priority crop despite its importance in smallholder cropping systems. Previous research showed that research investment in potato had more favourable impacts on the economy than that in other crops, including soybeans and maize (De Franco and Godoy 1993). INNOVA commissioned studies of competitiveness of the potato sector documenting the value added and employment generated by the crop (Crespo, 2003 & Crespo and Bellot, 2005). This is being used in a dialogue with the Ministry of Agriculture to reassess the potato and have it designated as a priority crop for R&D investment.

The competitiveness study also identified a potato cluster of R & D organisations, and seed and ware producers in the valleys of Cochabamba and Santa Cruz. DFID's FIT 9 project on "Programmes for technology innovation" will include this potato cluster as one of its case studies. This should lead to developing a more integrated approach to planning R&D with SIBTA than is currently possible with the PITAs. Policy change here will favour the adoption of INNOVA technologies as discussed earlier.

5. INNOVA helped develop an alliance amongst strategic research providers and linkages with SIBTA's foundations

SIBTA's competitive funding mechanisms promote competition between technology service providers. It has not provided a favourable environment for learning across technology service providers or for building alliances. INNOVA brought together the PROINPA Foundation, the University of San Simón and CIAT of Santa Cruz in a strategic alliance. Working together was a capacity building experience. INNOVA did not have a full-time staff, but supported technical people in three existing institutions, and gave them opportunities to work with colleagues in the other institutes. So the *técnicos* learned from colleagues in other institutions for example, about participatory research, demand assessment methods, and about the technologies themselves. Improving relations between colleagues helped promote technology across agro-ecological zones as partners shared research infrastructure and personal, as described in contribution 1.

INNOVA proposed developing a consortium of its three principal partners, which could have a life beyond DFID funding. This may not occur, because SIBTA currently offers no funding for a consortium of this nature, despite the potential benefits. We are currently widening the consortium to form a working group of strategic research providers. This can provide a space for learning and policy dialogue. INNOVA commissioned a study on the state of long-term research in Bolivia (Ampuero 2004). This has shown that long-term research is declining and that SIBTA is undermining the capacity of existing strategic research providers to continue functioning. Support to the working group will continue under the extension phase of INNOVA. This initiative is linking with FIT 9

Horizontal Learning, which is implemented by CIP and the PROINPA Foundation in its participatory assessment of SIBTA.

6. INNOVA provided a dynamic model for information management that can be used by national and regional researchers, development institutions, policy makers, donors and others

Information management is a critical component of a national innovation system. INNOVA provided a coherent model for information management based on a communications strategy that could be used by others.

The information produced by INNOVA's partners prior to and during the project about technologies, methods and approaches is available to the different target groups considered in the communications strategy.

The database and website model, as well as the system designed to collect, prioritise and disseminate information, can be used by INNOVA's partners, other projects and development institutions, as guides to strengthen their own communications and information strategies.

The steps taken towards implementing the information strategy designed for farmers has become a model for technology supply and transfer organisations which are now more likely to provide timely and pertinent information to their stakeholders.

The INNOVA partners are working with CIP to develop new technology communication approaches to meet the needs of the poor for particular market chains and opportunities. A project proposal has been submitted to New Zealand to continue this work.

References

Bentley, Jeffery W., Graham Thiele, Rolando Oros & Claudio Velasco 2004 "Cinderella's Slipper: Sondeo Surveys and Technology Fairs for Gauging Demand." London: ODI Agricultural Research & Extension Network (AgREN). Network Paper No.138.

Bernet, T., A. Devaux, O. Ortiz And G. Thiele. 2005. Participatory Market Chain Approach. LBL BeraterInnen News 1/2005, p.8-13.

Crespo, F. 2003. Características del Sub Sector Papero en Bolivia. Working document, INNOVA, Cochabamba, Bolivia. 64p.

Crespo, F and S. Bellot. 2005, Servicios de Apoyo y Estructura, Estrategia y Rivalidad de las Empresas del Subsector de la Papa en Bolivia. Working document, INNOVA, Cochabamba, Bolivia. 25p.

De Franco, M. and R. Godoy 1993 "Potato-Led Growth: The Macroeconomic Effects of Technological Innovation in Bolivian Agriculture." *The Journal of Development Studies* 29(3):561-587.

Horton D. and B. Siderman-Wolter. 2004. Mid-Term Review of INNOVA, "Strengthening Technology Innovation Systems within Potato-Based Agriculture in Bolivia", report of the Review Commissioned by the INNOVA Coordinating Committee, INNOVA, Cochabamba, Bolivia. 28p.

Jirström, Magnus 1996 *In the Wake of the Green Revolution: Environmental and Socio-Economic Consequences of Intensive Rice Agriculture—The Problems of Weeds in Muda, Malaysia*. Lund, Sweden: Lund University Press.

Sunderland, Patricia L., Elizabeth Gigi Taylor & Rita M. Denny 2004 "Being Mexican *and* American: Negotiating Ethnicity in the Practice of Market Research." *Human Organization* 63(3):373-380.

Annex List

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Annex 2.3: Sondeo Estratificado Los Pinos
Annex 2.4: Technology Fair in Kellhuiri
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Annex 5: Equipment Inventory