Project: Integrating and Scaling-up Technologies for Resource-Poor Potato Growers (TAG 652– CIP)

2004-2007 Final Report

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1. BACKGROUND

The International Potato Center (CIP) and partner institutions (see Table 1.1) have concluded the implementation of the project entitled "Integrating and scaling-up and replicating technologies for resource-poor potato growers" identified at IFAD as TAG 652-CIP. The project was formally approved by IFAD in 2003 and the official starting date of the project was set as 21 January 2004 and the programme completion date was 30 September 2007, where country reports were sent to the coordination unit. This report describes the main results achieved according to the project objectives.

Country	**Institution**	**Main orientation**	**Role in the project**
Ethiopia	Ethiopian Agricultural Research Organization (EARO)	Research	Backstopping technical aspects, implementing and monitoring PR cases and trials
	Self Help Development International (SHDI)	Development	Backstopping and monitoring PR cases and trials
Uganda	National Agricultural Research Organization (NARO)	Research	Backstopping technical aspects, implementing and monitoring PR cases and trials
	AFRICARE	Development	Implementing and monitoring PR cases and trials
Bolivia	PROINPA foundation	Research	Backstopping technical aspects, implementing and monitoring PR cases and trials
	ASAR	Development	Implementing and monitoring PR cases and trials
Peru	CIP	Research	General coordination, training, implementing and monitoring PR cases and trials
	CARE Peru	Development	Implementing and monitoring PR cases and trials
	Local partners	Development	Local Municipality of Baños del Inca District

Table 1.1. Institutions participating in the project

2. OBJECTIVES OF THE PROJECT

The proposal that was approved by IFAD stated the general objectives of the project, which were used to define specific objectives in each of the work plans at country level. Work plans were endorsed by the Steering Committee of the project and submitted to IFAD on a yearly basis. The general objectives of the project were to:

1. Describe components, interactions and strategies of existing research and extension systems related to the potato crop using an agricultural knowledge and information systems (AKIS) approach, also called potato innovation system approach.

2. Determine factors that facilitate or limit innovation for using and scaling-up technologies and participatory research methodologies.

3. Fill technology and knowledge gaps related to potato production in each site using basic and participatory research.

4. Assess which participatory approaches could be more effective for each type of technology within the context of the intervention area taking into consideration the potential for scaling up.

3. MAIN RESULTS ACCORDING TO PROJECT OBJECTIVES

3.1. Objective 1: Characterization of potato innovation systems in Bolivia, Ethiopia, Peru and Uganda

The first objective of the IFAD grant was to characterize the potato research and extension systems at the pilot sites using the agricultural knowledge and information systems (AKIS)[1] and the innovation system approach[2]. In this section, the main characteristics of the potato innovation systems are described, which is the result of several participatory workshops and surveys run at each pilot site, aiming at identifying the main components of the system, their interactions and limitations.

A total of 10 participatory workshops were run during 2004 and 2005 with the participation of potato-related stakeholders at the pilot sites in each country. With some variations the workshops responded to the following questions:

- Who are the components (organizations or individuals) that form part of the potato innovation system (are related to some part of the production, commercialization, research or extension process) of potatoes and what is their main role?
- What types of potato-related interactions occur among components?
- Which are the main problems of the potato innovation system?

In addition, surveys were applied to farmers in the four countries for identifying information sources and knowledge management about the potato crop.

[1] Engel, P. 1997. The Social Organization of Innovation: A Focus on Stakeholder Interaction. The Netherlands: Royal Tropical Institute.
[2] Lundvall, B., B. Johnson, E. S. Andersen and B. Dalum. 2002. National systems of production, innovation and competence building. Research Policy 31, 213-231.

Photograph 3.1.1. Potato innovation system workshop in Sanchez Carrión Province, Peru, 2004.

Photograph 3.1.2. Potato innovation system workshop in Kabale, Uganda, 2004.

In this section, the main results of the characterization of the potato innovation systems are presented.

3.1.1. Bolivia

The potato innovation system in Bolivia and the potato knowledge and information system have evolved through the time due to changes in both social and agro-ecological contents. On one hand, public investment in research and extension services has been reduced to a minimum since mid nineties. In the 1990's a number of organizations, mainly NGOs started their operations at the pilot site of Cochabamba, providing research and extension services to farmers, trying to replace the lack of government interventions. In addition, farmer organizations have become important stakeholders in many agriculture-related interventions.

In the 1970's, the national research institute IBTA introduced the potato variety Waych'a, now the most popular potato variety in Bolivia but susceptible to late blight, and farmers started to use chemical fertilizers and pesticides. However, biotic problems including more virulent strains of potato diseases, such as late blight, have increased in the last 30 years, generating the need of new knowledge on how to control it.

Participatory methods have been part of the institutional interventions. For example, local agricultural research committees (CIALs) and farmer field schools (FFS) have been promoted in the last decade by institutions such as PROINPA, ASAR and Senda. Later PROINPA developed a participatory methodology called "participatory plant breeders" or PPB[3], which aimed at involving farmers in selecting parental lines, crossess and subsequent selection of progenies, until new varieties were identified.

In summary, the potato innovation system in Bolivia changed from a government-centered service to a more complex system with the participation of several private, public and farmer organizations in the last three decades.

[3].Gabriel, J., J. Hebas, M. Salazar, J. Ruiz, J. Lopez, J. Villaroel and D. Cossio. 2004. Participatory plant breeding: A new challenge in the generation and appropriation of potato varieties by farmers in Bolivia. . Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (PRGA); Consultative Group on International Agricultural Research (CGIAR); Fundación PROINPA. Working Document No 22. Cali, Colombia

3.1.1.1. Identification of components in the Bolivian potato innovation system

a. Farmer organizations

The farmers' organizations in Bolivia are important components of the Potato innovation system. There are two types of organizations. Some of them specifically related to agriculture, and others are more politically oriented. However, both influence to each other. For example, most of the formal, small-scale seed potato producers in Bolivia are organized into "small seed firms" (PESEMs). APROSEPA (Association of Potato Seed Producers) is an association of four PESEMs and several individuals, with 67 members. There was also an independent union of seed producers called ARADO. In addition, ORPACA is the Agricultural Producer Organization of Calientes, Morochata and was created in 1999 aiming at producing high quality seed. Other farmers' associations are APP "El Puente" and ASEP. Besides, there are community organizations called unions ("sindicatos") that group men and women, which are not specifically related to agriculture, but have influence on agricultural projects.

b. Non-governmental organizations (NGOs)

Participatory workshops and surveys revealed that the components of the Potato innovation system in Cochabamba include some NGOs, namely PROINPA, ASAR and CIFEMA, working in potato. PROINPA (a private research foundation which was originally a special project of the Bolivian government research system) has the objective of developing, promoting and disseminating technological innovations to improve food security of Bolivian rural families and improve the competitiveness of value chains of Andean crops such as potato, quinoa, capsicum, bean, olluco, isaño and others. PROINPA works in Morochata and Pocona districts of Cochabamba, and in other sites of Bolivia.

ASAR (Asociación de Servicios Artesanales y Rurales) works in Cochabamba (in the Provinces of Arque, Tapacarí, Bolívar and Ayopaya) and provides training and technical assistance (particularly about potato seed production), credits, and supports the formation of farmer "promoters" related not only to potato but also to livestock and handicraft production.

The Research, training and extension center on Agricultural Mechanization (CIFEMA) aims at building, validating and diffusing good quality agricultural tools, implements and equipment that are adapted to the production process in the Andean conditions. Their main targets are small and medium scale farmers.

c. Governmental organizations (NGOs)

The Regional Seed Office is one of the few national government organizations that work with potatoes in Cochabamba. It works on the certification and control of seed production and trading, and is part of the National Seed Program (PNS), which belongs to Ministry of Peasant and Agricultural Affairs (MACA). This organization interacts with the seed producing farmer organizations.

The municipality of Morochata is a local government institution which has agricultural extension units or departments in charge of promoting agriculture and rural development.

d. Private sector

A number of private companies were identified as part of the potato innovation system. The private sector participation is in different sectors of the potato value chain such as seed production (farmer organizations were private seed producers), provision of agricultural tools, agrochemicals and credit.

The seed potato company "UPS/SEPA - S.A.M." (Unidad de Producción de Semilla de Papa - Sociedad Anónima Mixta), abbreviated SEPA, has developed seed production systems based on in-vitro multiplication of healthy material, tuberlet production in screenhouses and subsequent field multiplication in farmers' plots.

Caja Los Andes, a credit institution, was started in 1995 as one of the first Financial Private Fund to work in Pocona under the base of the NGO Procréditos.

The agrochemical companies, Novartis and Agripac, provide training courses and information about fertilization and strategies for chemical pest control, have demonstrative plots, and sell agro-chemical inputs to farmers.

e. Media (Radio stations)

The radios (Morochata, Esperanza and Mosoj Chaski) also form part of the innovation system, and they are vehicles for information dissemination. Radio stations in

rural Cochabamba are involved in process of popular education in Quechua (native language) and Spanish. Radio stations Mosoj Chasqui, Radio Esperanza, and Radio Morochata are also oriented to promote religious believes, but give service for diffusion and indirect support to rural development projects and technical issues to farmers.

f. <u>International organizations</u>

CIP is an international research organization that had interactions with PROINPA and ASAR on technological and methodological aspects related to potato production. The interaction included aspects related to breeding, natural resources management, integrated crop management and participatory methods. The latter supported by the IFAD grant.

3.1.1.2. Interaction of components in the Bolivian system

After identifying the components of the potato innovation system in the participatory workshop, specific questions were asked about the types of interactions among components using a matrix. The graphic representation of components and interactions is shown in Figure 3.1.1.

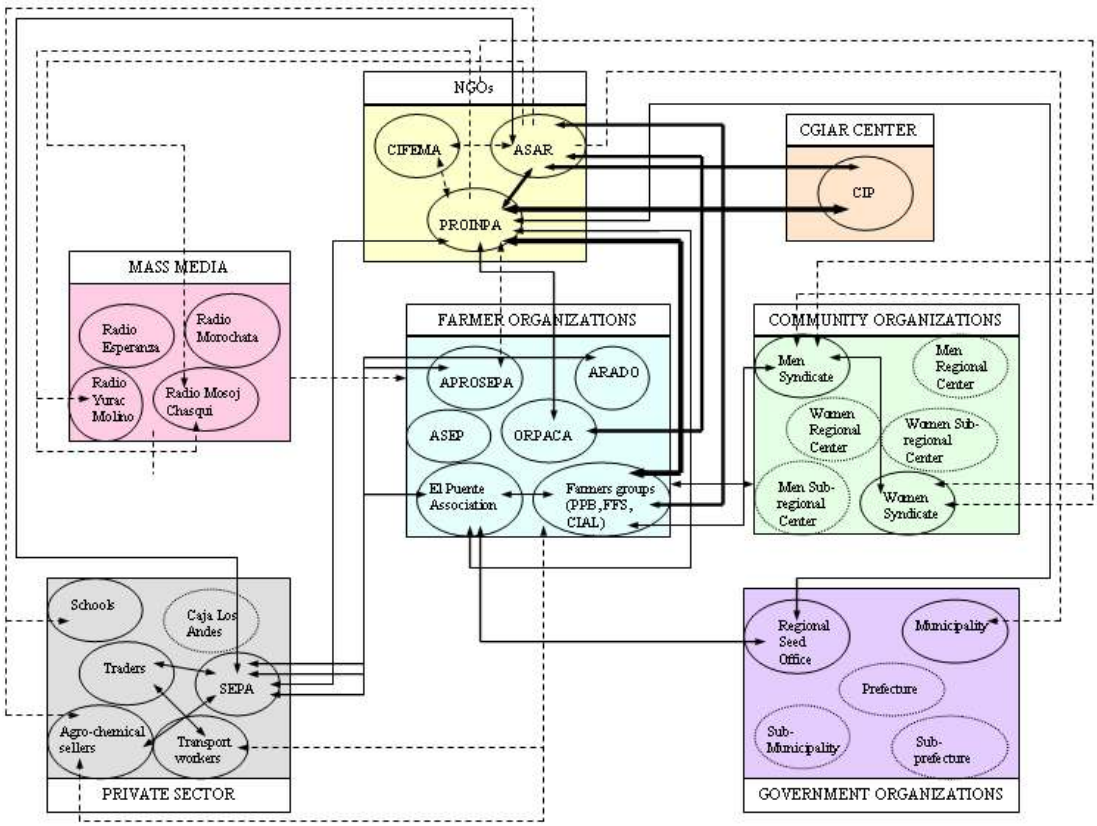

Figure 3.1.1. Potato innovation system components and interactions in Cochabamba, Bolivia in 2004. Data from Morochata and Pocona Districts.

Note: The thickness of the arrows indicates the strength of the linkages and information exchange.
CIFEMA = Research, Training and Extension Center on Agricultural Mechanization, ASAR = Handicraft and Rural Service Association, PROINPA = Promotion and Research of Andean Products, SEPA = Seed Potato Production Unit, CIP = International Potato Center, APROSEPA = Association of Potato Seed Producers, ARADO = Independent union of seed producers, ORPACA = Agricultural Producer Organization of Calientes, ASEP = Seed producer association, CAJA LOS ANDES = Credit Institution, PPB = Participatory Plant Breeders, FFS = Farmer Field Schools, CIAL = Local Agricultural Research Committees.

Figure 3.1.1 shows the complex innovation system in two Districts of Cochabamba, Bolivia, and shows that more frequent and strong interactions occurred between farmer organizations related to agriculture with NGOs and the private sector, whereas the interactions with the government sector was less relevant. An important feature of the system in Bolivia is the relatively strong presence and action of farmer and community organizations, which was not observed in the other countries included in the diagnosis study supported by the IFAD grant.

In an ideal innovation system, all components would interact with each other in some way. Therefore, taking into consideration the total number of components in the case of Morochata, there would be a total of 351 possible interactions and 276 in Pocona, which would be 100% of interactions. However, results from the analysis of interactions

indicated that interactions among components were limited. In relation to seed management, there were 41 interaction (11.7% of the potential interactions) in Morochata and 33 (12.0% of the potential interactions) in Pocona; while in commercialization, there were 20 interactions (5.7%) in Morochata and 17 (6.2% of the potential interactions) in Pocona. Therefore, less than 20% of potential interactions occurred at the moment of the study. It is also interesting to see that most of the interactions corresponded to 4 organizations in Pocona and in Morochata. In Morochata, ASAR and PROINPA were included in about 60% of the existing interactions related to potato seed, and in 30% in those related to potato trade. The other component that highly influenced the potato innovation system was the men syndicate, which participated in about 22% of the existing interactions related to potato seed and in 20% of interactions related to commercialization.

The role of farmers' organizations (especially the farmer unions called "sindicatos") was important in the Bolivian system. They work together with NGOs and PROINPA, and also interact with seed producers associations, such as SEPA and APROSEPA in Morochata and ARADO and APP "El Puente" in Pocona.

The private financial organization "Caja Los Andes" works with these unions to provide credit to them in potato production activities.

The seed producer associations mentioned above have links, mainly with PROINPA, the Regional Seed Office (ORS), agrochemical companies (Agripac), and with individual potato producers, and farmer's organizations which were their clients. Those seed organizations use also the radio for information dissemination and marketing.

The NGOs with more active interactions in the system were PROINPA and ASAR. Both were involved in collaboration agreements where PROINPA taked the responsibility for research activities and provision of new potato varieties coming from breeding, and ASAR was responsible for the multiplication of seed of resistant cultivars and the replication of the experience in other places. Both, PROINPA and ASAR, interacted with CIP for participatory research and training about potato-related technologies. Both institutions also interacted with farmer unions, an agrochemical company (Agripac), and farmers associations like ORPACA. Also, PROINPA interacted with seed related organizations such as APROSEPA, ASEP and the Regional Seed Office (ORS). ASAR interacted with CIFEMA regarding technology transfer. In addition,

ASAR and PROINPA used the radio to diffuse their activities and other events. For example, PROINPA interacted with Radio Morochata and Radio Mosoj Chasqui, while ASAR only interacted with Radio Mosoj Chasqui, but interactions through radio were limited.

The local government and other governmental institutions did not provide significant technical support to farmers, and in the workshop the interaction with governmental institutions was not relevant for farmers who regarded it as having limited contribution for their interests.

Stakeholders also reported interactions with other components for specific purposes. For example, farmers with traders and transporters for potato marketing, and farmers with rural schools, which were not specifically related to the potato innovation system.

3.1.1.3. Sources and types of information managed by farmers about potatoes

Information is one of the main inputs that were exchanged through interactions among components in the system. A survey to determine information sources in the innovation system was conducted in two districts with the participation of 147 farmers (79 in Morochata, and 68 in Pocona). Table 3.1.2 shows the detail relative importance of sources of information for the different types of information received.

Table 3.1.1. Average use of the main information sources for potato crop in two study sites in Bolivia, 2005 (% of the total number of answers that mention the source related to agronomic practices in general). N=147

Info source / Study site	Own experience	Family members	Neighbors and friends from the community	Extensionists, technicians or researchers	Media
Pocona	18%	50%	9%	7%	2%
Morochata	17%	50%	7%	25%	1%

Table 3.1.2. Main sources of information for potato management in Pocona (Poc.) and Morochata (Mor.), Cochabamba, 2004. N=147.

Activities/topics	Internal sources						External sources					
	Own experience %		Family members %		Friend/ neighbor %		Engineer and/or technician %		Agro-chemical dealer %		Radio %	
	Poc.	Mor.	Poc.	Mor.	Poc.	Mor.	Poc.	Mor.	Poc.	Mor.	Poc.	Mor.
Soil management												
Soil and plot quality	30	57	52	38	0	0	7	5	0	0	9	0
Land preparation	21	32	66	65	1	1	10	1	0	0	1	0
Fertilizers												
Organic fertilizer	22	24	43	46	3	0	26	30	0	0	3	0
Chemical fertilizers	15	7	35	41	4	24	29	27	1	0	13	0
Varieties	0	35	60	42	10	0	30	22	0	0	0	0
Seed management	30	11	35	30	0	14	30	35	0	0	5	10
Agronomic practices												
Hilling up	0	22	62	67	0	0	0	11	0	0	0	0
Weeding	25	19	55	54	0	1	0	26	0	0	0	0
Disease and insect management												
Diseases	0	0	44	24	38	3	0	62	0	0	0	3
Insects	30	0	40	28	30	21	0	49	0	2	0	0
Harvest												
How to harvest	5	43	72	57	13	0	10	0	0	0	0	0
When to harvest	20	16	66	38	9	19	5	27	0	0	0	0
Selection of potatoes	24	14	60	73	0	13	0	0	0	0	0	0
How to store	18	11	57	35	0	22	0	32	0	0	0	0
Commercialization of potato	30	0	45	97	10	0	5	3	0	0	0	0

External sources, such as technical assistance in Pocona, were found to be especially important to contribute with information about the use of organic and inorganic fertilizers, information about new potato varieties and potato seed management. Topics like pest and disease management, harvest, storage and "ways of selling potatoes" came from internal sources also, mainly from family members. On the other hand, in Morochata, around 50% of the information about pest and disease management, and 30% of the information about weeding, "when to harvest" and storage come from external sources. These results indicated that farmers in Morochata have more access to technical support than farmers in Pocona, but none of them received information on how to market their products, which had effects such as low potato prices paid by intermediaries.

3.1.1.4. Conclusions about potato innovation systems in Bolivia

The main feature of the Bolivian innovation system was the weakness of the national government components, participating only with a regulatory role (case of seed production). In addition, local municipalities, although showed interest in promoting agricultural development, but it would be unlikely that they would strengthen their capacities for this type of services because of the lack of national government initiatives to promote and regulate extension activities at a municipalityn level.

The most important source of information about potato management was the family, community and farmers' own experience. In Morochata and Calientes there was a local system for community labor called "Ayni" through which farmers shared labor but also information. Probably, the information disseminated by the institutions presented in Potato innovation system in Cochabamba was partially diffused by these mean from people who participate to the training to other farmers without being recognized that the information comes from external sources once passes from farmer to farmer However, the role of indigenous or local information systems is undoubtedly important, but requires interacting more with unbiased external sources of information, so that farmers know more about new threatens such as more virulent diseases, market opportunities and risks of toxic pesticides.

The participation of farmers' organizations in the system was strong and relatively higher than in the cases of Peru, Uganda and Ethiopia. Farmers tended to be more organized and interacted more with service and input suppliers to improve potato production and marketing. Farmer organizations would be even more important under the current government that is promoting grass root participation in productive and political activities.

Stakeholders identified some potential activities for improving the potato innovation systems. For example, the government should support the municipalities in their efforts to promote agricultural development. Organizations should share their valuable experiences,for example, by NGOs about the use of participatory research and training and strengthening farmers' associations, which should be replicated in the system through better interactions. There were limited sources of technical information coming

from research (not necessarily conducted by research institutions) in the system, which also needs to be reinforced.

3.1.2. Ethiopia

3.1.2.1. Identification of components in the Ethiopian potato innovation system

The agricultural innovation system in Ethiopia still maintains a strong role from the national government system, particularly through the Ethiopian Institute of Agricultural Research (EIAR) as the research component, and governmental extension services in most of the districts, although in limited number. NGOs have started to play an important role but still in relatively lower number compared to the other countries. However, the role of the private sector, such as input dealers, is relatively weak in the Ethiopian case, with very few input dealers located outside of big cities.

In the stakeholder workshop in Ethiopia, 14 components were identified: Researchers, farmers, potato traders, consumers, district bureau of agriculture, transporters, daily laborers, NGOs, farmer cooperatives, brokers, store owners, media, agro-input suppliers and supermarkets.

The components identified in Ethiopia include:

a. <u>Farmers and farmer cooperatives</u>

Farmers play the central role in the innovation system, being in charge of producing potatoes for home consumption and for the market. Some of them have started to multiply seed on their farms and sell seed to the neighboring farmers. They receive advice from researchers and extension workers and adopt the technology when feasible. Farmer organizations are relatively weak, and some unions are in the process of formation and help with the provision of different agricultural inputs, also collect and sell the produce of the farmers, and in some cases provide loan services.

b. Governmental agricultural institutions.

This component include researchers from the potato program of EIAR who participate in the system and were in charge of testing and providing improved potato varieties to farmers, conduct research about ways to control potato late blight using resistant varieties, recommend fertilizer rates. In general, they were perceived as being in charge of identifying problems and searching for solutions from the scientific point of view. In addition, the District Bureau of Agriculture was in charge also of identifying farmer problems, introducing new technologies, facilitating input provision for agriculture, providing general advice to farmers, and bringing feed back to researchers. However, their interactions with both farmers and researchers were regarded as weak.

c. NGOs

NGO staff members were perceived as being in charge of technology dissemination and providing training to farmers. They also worked on facilitating their access to market opportunities in order to enhance potato prices and farmer income. NGOs also facilitated the establishment of farmers Cooperatives and Unions.

d. International organizations

The International Potato Center (CIP) was also part of the potato innovation system, interacting with the Ethiopian Institute for Agricultural Research and the NGO Self Help Development International. CIP provided technical (i.e. new varieties and methods to control diseases) and methodological (i.e. about participatory research and training) support.

e. Potato traders

Potato traders usually buy potato from producers and take the product to the market usually to Addis Ababa where they sell it to consumers either as a whole or in retail.

f. Brokers

Workshop participants identified an important role for brokes who connected producers and sellers. They were perceived as having knowledge about market connections and prices.

g. Store owners and retailers

This stakeholders were also identified as part of the potato innovation system in charge of renting stores for the purpose of storing fertilizers and other agricultural inputs until they are distributed to the farmers. Retailers played the role of selling processed potato products.

h. Media

Although media was identified as part of the system, it was regarded as playing a limited role of providing or advertising new technologies.

i. Agricultural input suppliers

These were also identified as important components of the innovation system in charge of selling fertilizers, different agro- chemicals and farm tools, although their presence was limited in the rural areas according to the workshop participants.

j. Transport dealers

These components were identified as being in charge of transporting potato from farms to the market, usually located in Addis Ababa, and also communicating information about market prices. They also transport agrochemicals and fertilizers and other inputs from urban to rural areas.

3.1.2.2. Interaction of components in the Ethiopian system.

Figure 3.1.2 shows the main interactions among components observed in the Ethiopian case.

The marketing was identified as the activity through which most interactions occurred between farmers and the private sector. Research and extension organizations, as well as suppliers of agricultural inputs had interactions to provide information to farmers, although in a limited way. There were interactions between research institutions (EIAR) and development institutions (SHDI) for exchanging information, technologies and coordinating actions, and between EIAR and district of agricultural officers. In

general, the Ethiopian potato innovation system is relatively less complex than the systems in the other countries in term of interactions.

The analysis of constraints to interactions showed that researchers were particularly disappointed with the results of technology dissemination, because of the lack of uptake of technologies by farmers, in spite of efforts oriented to make farmers participate in technology development. Also the flow of technology from trained farmers to other members of the community is said to be limited. Collaboration between researchers with the public extension workers form the district bureau of agriculture was difficult because it has limited human resources and not enough time to collaborate.

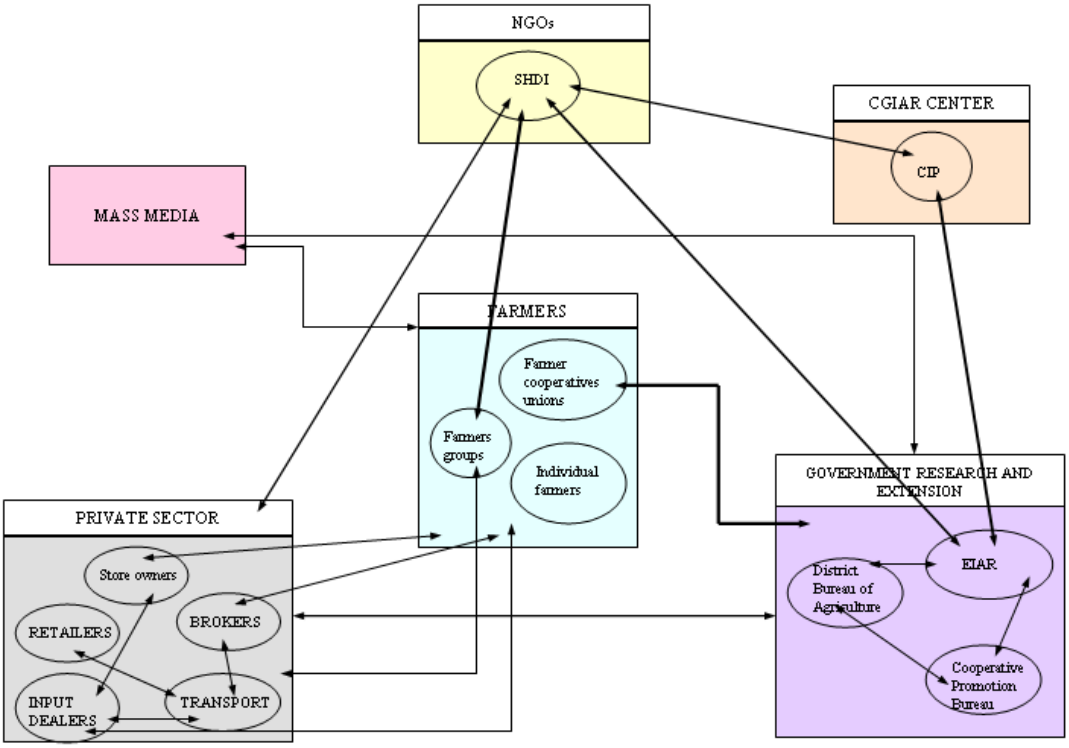

Figure 3.1.2. Potato innovation system components and interactions in Oromia, Ethiopia in 2004.

Note: The thickness of the arrows indicates the strength of the linkages and information exchange.
EIAR = Ethiopian Institute of Agricultural Research SHDI = Self-Help Development International CIP = International Potato Center.

Farmers indicated that they interacted with input sellers for buying inputs but the low quality of agricultural inputs was a constraint. In the interactions with the market, they further identified low potato prices and dishonest brokers as problematic. In the interaction with extension staff they noticed low commitment of them contributing to solve farmers' problems.

Staff from the public extension service indicated that there was not a good interaction with researchers. They also indicated that farmers ignored their advice, in spite of training, and tended not to adopt newly introduced technologies. The government extension service acknowledged a limited interaction with NGOs.

NGOs indicate a slow response from the side of research to requests coming from practice; for example, how to control diseases or solve storage problems.

The traders indicated that they interacted with farmers for buying potatoes, but they usually got low quality produce at farm gate, and identified this as the reason for the low prices offered to farmers.

Table 3.1.3 sums up the most important constraints identified by the stakeholders of the potato innovation system and the solutions proposed. In general, stakeholders indicated that linkages among many of them in the potato production and marketing system were weak. The lack of mechanisms, for example platforms, for promoting interactions among all stakeholders was noted. Such a platform could be an instrument to improve linkages between stakeholders and could help in improving the flow of information through the system. This would assist in increasing production and improving the marketing chain of potatoes in Ethiopia. The strengthening of farmer organizations was widely recognized as imperative for improving linkages with farmers for technology dissemination, as well as for improving input supply and output marketing. The lack of quality seed potatoes featured prominently in the discussion as an important constraint that affected the system. As a solution the training of specialized seed producers and their promotion was suggested.

Table 3.1.3. Main constraints within the potato innovation system in Ethiopia and suggested solutions.2004.

Constraint	**Suggested solutions**
Limited interaction between research, extension, NGOs and farmers	▪ Researchers should transfer information faster. ▪ Existing stakeholder forum should be strengthened and new forums initiated. ▪ Improve training to transfer more information to farmers. ▪ Create a desk at the agricultural office for exchange between research and extension. ▪ Leaflets, manuals and other training materials should be made available to development agents and farmers. ▪ Development organizations need to cultivate a culture of collaboration.

Low prices for ware potatoes at farm gate	▪ Strengthen farmer organizations. ▪ Market potatoes through farmer organizations. ▪ Improve exchange of price information. ▪ Encourage farmers to construct improved ware potato stores.
Bad roads	▪ District and zonal councils must repair them.
Unavailability of inputs	▪ More input shops should be opened in rural areas. ▪ Farmer unions should play a role in the supply of agro-chemicals and quality control. ▪ Training on alternative low-input management strategies.
Low quality products	▪ Federal control of the quality of agrochemicals.
Limited adoption and further dissemination of technology by farmers	▪ Improve training methods. ▪ Select early adopters among farmers to assist in facilitating innovation. ▪ Develop demonstration sites. ▪ Improve collaboration between researchers and extension staff in training farmers. ▪ Research should develop cost effective innovations.
Limited skills extension staff	▪ Extension staffs need to receive continuous training on technical and methodological aspects, and their number should increase.
Low quality of potatoes	▪ Farmers need training to become aware of how to improve potato quality, including harvest and post harvest management. ▪ Quality standards should be set for potatoes.
Weak credit schemes	▪ Raise awareness about credit and pay-back mechanisms. ▪ Extending the number and duration of payment periods of loans.
Lack of quality seed potatoes	▪ Reliable seed potato producers should be trained and identified within the system.

3.1.2.3. Sources and type of knowledge managed by farmers about potatoes

From a sample of 646 farmers, 34% of them were literate and had taken formal education, 19 % learnt to read and write through informal means of education, whereas 47% were illiterate. The relatively high rate of illiteracy characterizes the farmers in Ethiopia and possible limits a more active role within the innovation system.

Farmers manage information about different potato varieties and reasons to select potato cultivars. For example, the lack of alternative varieties was mentioned as a reason for selecting 'Roge' variety (9%), acceptable taste was mentioned as selection criteria for Dire Dawa Variety (14%) in West Shewa Zone. Tolcha and Shashamane varieties were

selected due to its higher yield per unit area (6%), and the former due to its higher disease resistence (2%). In Alemaya area, Chiro, Genet and Bete varieties were also selected for their higher yield per unit area (12%, 7%, and 5%, respectively). With respect to information sources regarding varieties, neighboring farmers were found to be the major sources at the pilot sites, followed by family members.

Regarding information related to potato seed, the size of the tubers was identified as a criterion for seed tuber selection (34%), followed by tuber health (14%). Most farmers mentioned to use small sized seed tubers because in this way they covered wider area with smaller amounts of seed (14%). In addition farmers considered the health of seed tubers and tried not to use tubers showing symptoms of diseases to be utilized as planting material (19%). Local markets and neighboring farmers were found to be major sources for the acquisition of, and information about planting materials. Self-experience and family members were identified as important sources of information (17% and 12 %, respectively). Farmers were able to mainly acquire information regarding using tuber size and tuber health for seed tuber selection through their own experience (22% and 16%, respectively).

Information about potato late blight, which was found to be a major constraint to potato production at the pilot areas, mainly East Hararghe and West Shewa Zones (mentioned by 84% of the interviewed farmers) was exchanged. Farmers mentioned different methods to control late blight. Most of them mentioned chemical control measures (fungicides) as a control mechanism. Regarding information sources, neighboring farmers have contributed a lot in rendering information regarding late blight control (31% of cases) and also farmers have used their own indigenous knowledge as a source of info for late blight control (18%). Farmers have managed to acquire information on late blight control from their own experience (37%), and others acquired it through observation (27%) in other fields. The information regarding late blight has been mainly transferred to own family members (26%) followed by neighboring farmers (18%).

Farmers identified local markets as the major potato marketing places (65%) at all pilot sites. Farmers sold their tubers in the local markets since it was near to their homes and some others did so due to lack of alternatives. Only 3% of the respondents mentioned selling potatoes in the central market of Addis Ababa. Another 3% of the farmers

mentioned selling their tubers on the farm with farm gate price. Most of the farmers in the districts have learned where to sell their tubers from their own experience (42%) and from family members (13%), and information about market experiences is communicated to family members and neighbors.

3.1.2.4. Conclusions about potato innovation systems in Ethiopia

Improving the potato innovation system in Ethiopia require different types of interventions. One of the most important options would be finding creative ways to improve the interaction among the different components, particularly farmers, extension providers and researchers for the exchange of information and trade of other farming inputs. Innovations oriented to strengthen farmer organizations would also be crucial if the system is expected to enhance as a whole.

Generally there was a significant difference across the three zones studied in Ethiopia in terms of identifying constraints for information flow. For example, the lack of trained personnel in research and extension institutions was mentioned by 44 % of farmers. This indicates that farmers were paying attention to, and requesting the contribution from, trained personnel, and they were eager to access the knowledge from these personnel. On the other hand, 33 % and 26 % of the farmers in West Shewa and in East Hararghe zones respectively, described lack of quality planting material as a constraint. However, no farmer in North Shewa zone described lack of quality planting material as a barrier. This is more probably due to the fact that the farmers in North Shewa zone have started potato production recently because of Holeta Agricultural Research Center intervention in the zone, as a key actor focusing on potato. Forty-six of the farmers in East Hararghe said that lack of market is their major problem. On the other hand, only 11 % and 1.5% of the farmers in West Shewa and North Shewa zones respectively described lack of market as a barrier.

During the interaction between farmers and researchers, insufficient exchange of information was identified to be a problem. It was suggested that research centers should strengthen information transfer mechanisms using different options, such as leaflets, manuals and other materials. Existing platforms should be strengthened and other stakeholders should be given opportunities to participate in such a forum. Appropriate

platforms should also be established to create enabling environment for frequent discussions with the stakeholders to facilitate information and knowledge transfer among them. To improve skills and knowledge of farmers and development agents, and facilitate information exchange, training programs need to be strengthened. Farmers should also be encouraged to transfer their knowledge and skills to neighboring and other farmers in their village.

The most important and key option to overcome most of the problems faced during stakeholder interactions was the establishment of Farmers' Cooperatives and Unions. Voluntary farmers could form cooperatives and unions to help them solve problems related to potato production and marketing. The unions could purchase inputs from notified dealers. Moreover, unions could have stronger bargaining power when they purchase inputs and sell their products. Problems related to transportation, low prices of potato and technologies could be overcome by establishing farmers' unions also. Above all, information and knowledge transfer could be facilitated within members of the unions and outside the unions. Establishment of farmers' unions could also help strengthen the sense of working together and solving problems commonly. The members of the unions could have stronger social capital, and the sense of working together could scale up from potato alone to other enterprises. One of the expected problems that would be arising in an attempt to establish farmers' cooperatives would be hesitation from some farmers due to bad previous experiences. In Ethiopia, there used to be producers' cooperatives during the Socialist Regime, and the principle of these cooperatives was that the members used to pool all their resources, work together and share products and benefits according to their contribution. Even though this was a principle, it had several problems when it was implemented on the ground. As a result, it ended with complete failure. Currently, when the farmers hear of any word about cooperatives, they feel suspicious. Therefore, institutions promoting farmer organizations would have to be transparent to the farmers and explain clearly about the differences between previous and current cooperative societies. The farmers should also be free to decide on their own about membership. The farmers will need to be assisted technically and with other aspects by different governmental and non-governmental organizations until their organizations are strengthened.

Some of the lessons identified during the characterization of the potato innovation system and which could help for further scaling up process are:

a. There is a need for linkage of interactions among different stakeholders.
b. There is a need to give emphasis for the potato sector by all the stakeholders.
c. The existing extension system seems not well ready to push potato technology to the community.
d. There is a serious gap between technology generation and transfer as well as marketing in the potato sector.
e. There is a potential for potato production, marketing and consumption in the sector and this potential could be taped if there is a serious commitment from all stakeholders.
f. The government needs to put more emphasis on potato sector in input supply and media coverage.
g. There is absence of credit giving institutions for the potato sector.
h. The consumption culture of the country seems encouraging for potato production and marketing.
i. By most of the farmers, potato is viewed as one of the five most ranked crops in the cropping system and there is a good opportunity to be tapped.
j. The majority of the stakeholders have a positive attitude towards the potato sector.
k. Ex post and ex ante study have revealed that farmers who have participated in the potato project have shown a positive attitudinal development. The study has shown the importance of participation and group approach for behavioral change. Farmers have appreciated the importance of group approach to bring desired change.
l. Neighboring farmers have been motivated to adopt technologies by seeing from participant farmers; however the serious challenge that faces these motivated farmers is the lack of improved seed.
m. There is a serious gap of information flow in the potato sector among different stakeholders.
n. There is no specialized institutions that can facilitate the potato input supply, marketing facilitation and production enhancement.

o. Farmers exchange information among themselves and the flow of information is from farmers to farmers better that from other institutions to farmers. However, the information exchange among farmers about potato is not a reliable means as the exchange is limited only to kinship circles.
p. Potato pest and disease management needs to be improved in order to contribute to successful potato production and marketing; farmers lack the required knowledge in this regard.
q. Even there are different varieties in the potato sector, their presence and farmers' preference towards them varies from zone to zone, and it seems that the distribution of the varieties across all the zones is a concern for future.

Therefore, before intervening in potato technology scaling up there is a need have awareness about the fostering and hindering factors so that utilizing the former and addressing the shortcomings for successful scaling up process could be a crucial move.

3.1.3. Peru

3.1.3.1. Identification of components in the Peruvian system

a. <u>Farmer organizations</u>

Farmers were the central component of the potato innovation system and they participated actively in the workshops (Photograph 3.1.3). They were organized into community-based organizations (CBO) to support agricultural activities, but just some of these organizations were involved in potato production. Most of these CBOs working on potato were found in Sanchez Carrión province where potato is an important activity for farmer livelihood systems, while in the other places livestock production becomes more important (San Miguel province) and organizations focused their attention in milk production activities. In Sanchez Carrión, there were farmer groups formed to work with a soil conservation project called CODECOS, and other farmer organization called CEPASAC had been initiated through a program sponsored by the Provincial municipality, which were working on agricultural activities to improve management, organization and coordination in the community, and also to facilitate the interactions with NGOs and government organizations for potato-related activities.

Photograph 3.1.3. Farmer explaining the organizational diagram of farmers and institutions in Sanchez Carrión, Peru, 2004.

In the case of San Miguel, the FFS Association was formed by farmer facilitators in order to support the activities of the communities. The Association goal was to support potato-related activities, such as seed production and also provide training to other farmers about integrated crop management and experimentation in potato farming. The individual farmers mentioned that they cultivated potatoes as part of many other income-generating activities, among which dairy cattle production was important, and they were part of local groups, communities and organizations.

b. <u>Non-governmental organizations (NGOs)</u>

There were 10 NGOs in the innovation system in the four provinces studied in Cajamarca and La Libertad (Northern Peruvian Highlands), which was a relatively larger number compared to the other countries. There were NGOs with national coverage and also local NGO. The NGOs with national coverage, such as CARE-Peru, ADRA, and CEDEPAS were working to support farmer organization and provided technical assistance on agricultural production and management. They included training to farmers in the production of potatoes, some of them with the use of participatory training. Local

NGOs, such as IDER-CV, ADIAR, EDAC, PRISMA, and Agroservis, also worked providing technical assistance, for example, specifically about potato seed improvement, but also to strengthen local organizations.

c. <u>Governmental organizations (GOs)</u>

Stakeholders participating in the workshops identified different government organizations working on potato-related aspects such as research, information provision and sanitary control albeit in a limited way. The national institute for agricultural research (INIA), a public institution was in charge of research, promotion and technological transfer of crops with national importance, and particularly of developing new potato varieties with resistance biotic or abiotic constraints. However, INIA was not present with staff or activities in the local innovation systems in the four sites studied but its importance was mentioned by local stakeholders. The Agrarian Agency, under mandate of the Ministry of Agriculture, was in charge of agricultural development by giving information about the areas of crops planted and harvested, market prices, and promotes linkages among organizations. Pronamachcs, a public special project of the Ministry of Agriculture, was in charge of watershed management and soil conservation, but it also worked on technology transfer for potato production. Finally, SENASA had responsibilities for controlling plant and animal pest and diseases and, as part of the potato innovation system, it contributed to training seed potato growers, potato seed certification, and selling basic seed potatoes.

There were also local government organizations as part of the potato innovation system, with different levels of commitment regarding agricultural development and specifically to potato production in the different provinces. Some municipalities, such as those in Baños del Inca and Sanchez Carrión, showed substantial commitment to agricultural development and included specific rural development offices. They had technical staff in charge of providing information to farmers and were interested in participatory methods. However, this characteristic was not common and other municipalities such as in San Miguel and Cajabamba provinces where the support to potato-related activities was limited to sporadic logistic support.

Educational institutions were also mentioned as being present in the study area. However, the universities were indicated as having little interest in disseminating

information about potato at least within the areas where this study was conducted. The University of Cajamarca and the University of Trujillo, with faculties of Agronomy were students are trained in potato management issues, were specifically identified as contributing to the system but being far from the communities. Agricultural schools called CEFOP or Center for professional formation that were financed by Dutch cooperation provided training on agricultural management to farmers, but stakeholders indicated that information about potato was limited.

d. International organizations

An international organization (CIP) was present in the potato innovation system in Cajamarca. It was in charge of conducting research on potato production constraints aiming at improving seed systems, providing new varieties, developing crop management technologies and evaluating participatory methods. The German cooperation agency or GTZ was also an international organization which provided funds to development projects.

e. Private sector

Other components found in the potato innovation system belonged to the private sector, such as agrochemical companies, and potato traders, which played a more active role compared to the systems in Ethiopia and Uganda. Agrochemical sellers were in charge of supplying farming inputs and also providing advice for controlling pest and diseases. Some of the pesticide dealers run demonstration plots about their products and also organized workshops to diffuse those technologies. Potato traders usually participated in the system by trading potatoes from farmers to larger markets, and provided information about market prices. They were also in charge of transporting the produce. Most of the information that came from this source was usually biased, and farmers indicated that they provided unfair prices to potato. They played a small but important role in providing information concerning potato production. The private sector was more active in Sanches Carrion province because of the importance of potatoes in the livelihood systems, compared to the other provinces.

A private educational institution was mentioned by stakeholders in the workshop. It was the case of IINCAP which has the goal to contribute to overcoming poverty and

building sustainable human development, and the primary role within the potato innovation system was the evaluation of agricultural competitiveness including potatoes

There were two radios (Radio Campesino and Radio Los Andes), which played the role of information dissemination and promoting agricultural activities of NGOs and GOs in the system, but their role was identified as being limited.

3.1.3.2. Interaction of components in the Peruvian system

In San Miguel province, the majority of the links were passive (meaning ad hoc and based on casual or personal relationships), and the coordination was only at local level. There were a total of 16 components in this province. However, the interactions were limited and only 23% of the potential interactions occurred (100% of interactions would occur if all components interacted to each other which could be unrealistic but gives a relative point for comparison). In the Cajabamba province, there were also several actors from a diversity of sectors, including farmers, government and non-government organizations, etc. However, not all of them worked specifically on potatoes. The total number of potato innovation systems components identified in Cajabamba was 20, but the interaction rate was 16%. However, there were more "active" interactions in Cajabamba, and there were mostly formal arrangements among organizations to support potato cultivation. Some informal linkages among some of the actors were also identified in this province.

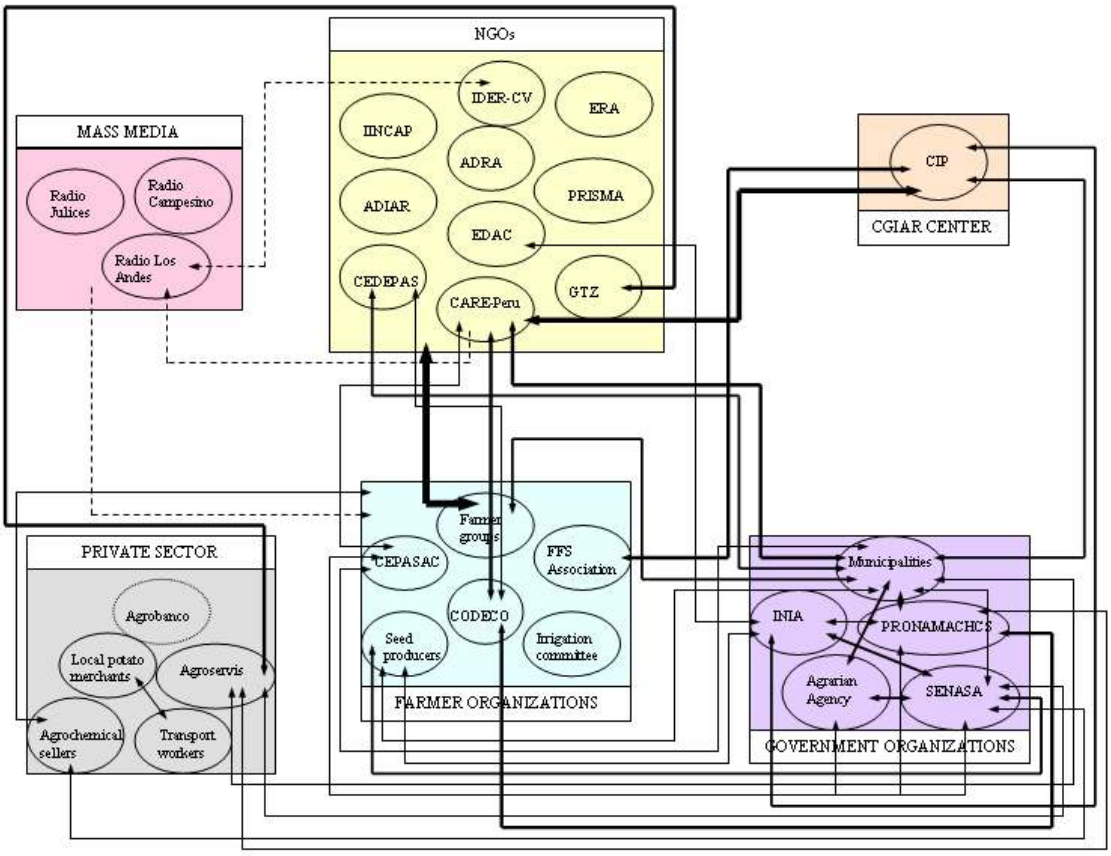

Figure 3.1.3. Potato innovation system components and interactions in four provinces of Cajamarca, Peru in 2004.

Note: The thickness of the arrows indicates the strength of the linkages and information exchange.
IDER-CV = Institute of Regional Development "Cesar Vallejo" ADRA = Adventist Agency for Development and Assistance Resources ERA = Andean Rural School PRISMA = Projects in Informatics, Health, Medicine and Agriculture EDAC = Team of Agricultural Development Cajamarca ADIAR = Association for the Regional Alternative International Development IINCAP = Research and Professional Training Institute – "Jorge Basadre" CEDEPAS = Ecumenical Center of Promotion and Social Action GTZ = German Cooperation Agency CIP = International Potato Center CODECO = Community Development Committee CEPASAC = Consortium of Agricultural Producers from the Province of Sanchez Carrión INIA = National Institute for Agricultural Research SENASA = National Service of Agricultural Health PRONAMACHCS = Special National Project for Watershed Management and Soil Conservation

In Baños del Inca Province, 18 components were identified in the potato innovation system with 17% interactions occurring. Links were primarily informal, although there were some formal agreements between research and extension agencies, and between governmental organizations with NGO's and research institutions (such as CIP). Baños del Inca had the advantage to be near to the capital city of the Department, providing better access to government institutions, other information sources and markets. Nevertheless, information exchange was regarded as being based on informal interactions with individual farmers and institutions, limited by scarce financial and human resources, which in turn limited its sustainability. Another problem found is that information

reached a limited number of people. Farmers were the target population, but only a small proportion, particularly specialized farmers (e.g. seed producers), worked directly with extension workers from GO or NGOs.

Sanchez Carrión Province had a larger network of interactions with national connections. A total of 21 components was identified in the Potato innovation system workshop, the highest of the four districts sampled. About 19% of potential interactions occurred but based on more formal mechanisms among organizations. An important factor that facilitated the interactions was the presence of farmer committees and the presence of local municipalities interested in agricultural development, which facilitated coordination. Another important factor was the presence of international NGO's in the district, working on capacity building and empowerment such as CARE-Peru and CEDEPAS, who were very active in promoting capacity building of local organizations.

Individual farmers, farmers' organizations and communities were the center of the interactions in the system. Individual farmers had more active interactions with certain organizations such as the government organizations, and NGOs working in the area. At the community level, farmers had "active" interaction with the Municipality which supported them with coordination of agricultural fairs. "Passive" interactions also occurred in which farmers had an informal agreement with PRONAMACHCS. This project installed demonstration plots and provided training to farmer groups in the past. There was also "passive" interaction between farmers and SENASA, which tried to provide key information and technical assistance to farmers in the district but in a limited way.

Government institutions had "active" interactions (institutional agreements) amongst each other, such as SENASA, PRONAMACHCS, Agricultural Agency and the Municipality. PRONAMACHCS provided technical support to farmer groups, while SENASA coordinated with PRONAMACHCS in areas where their mandates overlapped about agricultural sanitation. Although the budget and staff were identified as a factor that limited the interactions, they continued offering workshops together on different plant health issues including the management of potato pests. The Agriculture Agency coordinated staff and economic resources with PRONAMACHCS, who collected data from the field for the Agency. The Agriculture Agency collaborated closely with SENASA on the monitoring of pests in zones where potatoes were cultivated. The

Agriculture Agency had "passive" interactions with farmers, providing information occasionally about the occurrence of potato diseases. Interactions that involved INIA were mentioned, specifically for training provision to farmers and seed producers but only reached a limited number of people. INIA's interactions facilitated the diffusion of new potato varieties of potatoes in the areas of intervention. However, the collaboration between INIA and seed potato producers remained informal and inconsistent. The seed producers had an official agreement with the Agriculture Agency and SENASA for seed certification but there was lack of significant support for the commercialization of seed potato.

NGOs were present in all study sites except in San Miguel Province. The NGOs that were seen as highly influential by the participants. were CARE, CEDEPAS, and ADRA. Local NGO's were also mentioned; however, because of limited resources they were not seen as important sources of information. They worked on potatoes as part of interventions that involved the whole household production system. Those NGO's had very limited interaction with other actors except their targeted group: the farmers. In Sanchez Carrión, NGOs were better articulated to the whole system than in other sites, and they were coordinating a program to produce potato seed. CARE and the Municipality of Curgos (local district) collaborated and an agronomist was hired by the Municipality to support the soil conservation committees, but the district was large and the agronomist was unable to fulfill all the requests for technical assistance. The strongest link of CARE was directly with the farmer Conservation Committees, who were assisted with training on leadership, commercialization, and sustainable natural resource management, but the Conservation Committees lacked access to information about market relationships. CARE coordinated with the Agriculture Agency and PRONAMACHCS to train technicians, extension officers, farmers and for organizing study tours. CEDEPAS was another NGO with strong presence in Sanchez Carrion. CEDEPAS and UMDE (Municipal Unit of Economic Development) organized training oriented to improve seed production, fertilization and provide agricultural inputs. UMDE had strengthened CODECOs (Communal Development Committees), a type of collective community development organization, to manage projects and technical assistance, but there were scarce financial and human resources to enlarge the coverage.

Another important actor in the Potato innovation system in San Miguel, Sanchez Carrion and Baños del Inca was the International Potato Center (CIP), which had active and formal interactions with CARE and the local municipality, but also directly with farmer FFS participants, ex-FFS participants and the Association of FFS facilitators. Farmers were organized into groups to facilitate their involvement in participatory methods. CIP and Agrarian Agency had "passive" and local interactions through inter-institutional support, but limited resources were shared.

The local government (municipality) was also an important member of the Potato innovation system, even though in San Miguel, the role of the local municipality was limited. However, the Municipality of Cajabamba had formal collaboration with the Agriculture Agency. The local government also licensed the agrochemicals sellers to operate, and they were interested in coordinating with SENASA to verify the quality of the products that were being sold. They had a relationship with some of the farmers, but they would like to extend it to a larger group. In Baños del Inca and Sanchez Carrión Provinces, the local governments were considered being closer to farming communities and had an "active" interaction with farmers, being more involved in potato production than the local governments in other districts studied in Cajamarca. The Municipality of Baños del Inca had initiated potato projects and it hiredagricultural technicians. It also had an "active" and formal interaction with CIP oriented to evaluate participatory methods for the potato crop, which involved sharing logistic support, funds, provision of genetic material, training for facilitators, technical and methodological backstopping. The Municipalities of Baños del Inca and Sanchez Carrión had a formal agreement with the Agrarian Agency to offer workshops on agricultural production and partnership coordination, but resources were scarce and the coordination was sporadic and weak.

Private companies were also identified to be highly influential in the Potato innovation system. The agrochemical companies were sources of information for farmers regarding the use of chemicals and disease management. Agrochemical products were monitored by SENASA, which provided technical information to farmers regarding the use of pesticides.

The local radio station called Radio Campesino transmitted some events from government institutions and NGOs but the interactions were sporadic and weak. Radio Los Andes had passive interactions with several NGOs, farmer organizations and

government institutions; the collaboration included the diffusion of informational materials to farmers and offered private and public informational workshops. The Radio advertised activities, actions, campaigns and norms, among other things, but they lacked institutional coordination. Adding market prices to their daily broadcasts would be useful.

3.1.3.3. Sources and type of knowledge acquired by farmers about potatoes

Farmers had limited access to formal education, and even though there was just 9% of illiteracy, 84% of them only had primary education, but schools were not regarded as important sources of information for agriculture. This represents a difference regarding human capital compared to farmers in Ethiopia. Their education on potato farming was conducted mostly at home with the influence of parents and neighbors. The main activity found in the study area was agriculture, and 73% of surveyed farmers mentioned that potato was the most important crop for their livelihood system.

The result of the survey showed how information sources varied according to zones (Table 3.1.4). The table shows the average participation of the different sources of information according to different types of agricultural knowledge.

Table 3.1.4. Main information sources for farmers on potato management and marketing in the four study sites in Cajamarca, Peru (% de total number of farmers that uses the source per agronomic practice). N=218

Information sources: / Locations:	Own experience	Family members	Neighbors or friends	Extensionists, Technicians or researchers	Agro-chemical seller
San Miguel (N=98)	20%	45%	16%	17%	1%
Baños del Inca (N=40)	25%	40%	19%	11%	1%
Cajabamba (N=20)	7%	47%	28%	10%	5%
Sanchez Carrión (N=60)	8%	44%	29%	9%	7%

The most important source of information for farmers was their own family, which was identified as being a way of transmitting information from generation to generation. This was especially important when potato production is more for home consumption like in San Miguel. However, when production is more commercially oriented (e.g. Sanchez Carrión and Cajabamba), farmers reported accessing more information from external

sources such as agrochemical sellers. Mostly this information was related to pest management and soil fertility aspects.

It was expected more participation of the media as source of information, especially the radio, but although farmers had access to radios, they did not consider this source as important for learning new technologies or methodologies in order to improve their potato production.

The primary external sources of information were the different extension organizations (CARE, CEDEPAS, local NGOs, SENASA, PRONAMACHCS, and German Cooperation Agency or GTZ) and the agro-chemical sellers. The type of information received by farmers was mostly about pest and disease management, which is consistent with farmers' opinion regarding the importance of these constraints in the region. However, the lack of interaction among organizations working in these issues was identified as a problem to be solved.

The other two problems were low seed quality and low potato prices. Organizations recognized that seed management and commercialization were not included in the list of priorities. To some extent, SENASA and some NGOs were working in seed management, but they highlighted the limited coverage in term of number of farmers attended. Lack of information and knowledge about commercialization and market was identified as a constraint in the system.

3.1.3.4. Conclusions about potato innovation systems in Peru

During workshops and interviews, stakeholders identified some constraints to more efficient interactions. The problems are summarized below:

a. Limited human resources and operational funds: The coverage of the national government organizations was considered limited because of a lack of human and financial resources. Therefore, each institution was only capable of reaching a limited number of people or interacting only with a limited number of other organizations.

b. Limited and biased information: The participants were worried about the kind of information that the private companies provided to farmers, which tended to be biased towards agro-chemical use.
c. Another point of concern was the lack of an entity to regulate input trade, resulting in traders selling low quality chemicals or low quality seeds.
d. Limited farmer organization. Farmers were not well organized which is a reason why farmers cannot demand or access support from NGOs or GOs, or cannot negotiate with the private sector.
e. Limited interactions: Because of the reasons expressed above, institutions complained about lack of inter-institutional coordination and difficulties to establish relationships with farmers and among organizations. A central platform to coordinate activities would be beneficial. There was lack of coordination between institutions to assist in seed production and to give technical assistance in general, and limited coordination between NGO's and local governments. As a result, some institutions were not up to date about new technologies for potato production, or information was not provided on a timely bases.

The Potato innovation system in the four study sites in Cajamarca included 10 NGO's working in potato production, 4 government organizations, 4 municipalities, 2 universities, 3 farmers organizations, 7 types of private sector components, seed producers and independent farmers. The evidence shows a highly complex innovation system with multiple organizational components. NGOs counted for the larger, varied and more active institutional components in the innovation system.

The dynamism of the potato innovation system depends on the importance of the potato production. For example, in San Miguel, Cajamarca, potato was less important than dairy cattle production, and the system had fewer components with less active interactions.

Farmer organizations were also stronger in locations where potato was more important for the livelihood systems and therefore they were more active components of the innovation system. This was also reflected in the interest of local governments, such as the municipality, to support agricultural development. However, the role of national and local government institutions is limited by the lack of human and financial resources.

The sites with a dynamic potato innovation system had common characteristics, such as a higher number of actors in the system, more involvement of government institutions and local government, and more NGOs. But the most important factor was the higher importance of the potato crop to farmers for either subsistence or as a cash crop. Some of the strongest links in the network were among organizations that were using participatory methodologies. They contributed in different ways, from involving farmers in the planning of projects to facilitating organization and access to market, and teaching agronomic management technologies.

Farmers in general were poorly organized which limited a more active role in the potato innovation systems. In places where potatoes were important in the livelihood system and farmers were more organized, there was a more dynamic innovation system.

Even within the same region, the potato innovation system in Peru was different from one district to the other, some having a higher number of actors or components and interactions in those places where potato production was more relevant for the household economy. In general terms, farmers' organizations, which were identified as components of the Potato innovation system, were relatively weak in the study area of Peru.

3.1.4. Uganda

3.1.4.1. Identification of components in the Ugandan system

a. <u>Farmer organizations:</u>

Three farmer's association were identified as part of the potato innovation system: The Uganda National Seed Potato Producers Association (UNSPPA), which was in charge of producing cleaner seed in a farmer-based seed system; the Kabale District Farmers Association (KADFA) which was an umbrella organization of farmers in the district, coordinating activities on different crops including potato. Nyabyumba United Farmers Association was an association of groups of farmers that benefited from the FFS formed under TAG 411. Members were involved in participatory research activities in collaboration with NARO and Africare. Farmer seed producers received quality seed from KAZARDI and grew it on good soil while applying appropriate management practices, and sell the produced "commercial seed" as improved seed to ware potato growers.

Independent farmers in Kabale district were identified as being in charge of growing potatoes to feed their families and generate income for sending their children to school. The main activities of farmers concerning potato production were teaching other farmers about potato production as part of FFS, selling seed potato to other farmers, production of potatoes for both home consumption and sale, provision of employment to other people in potato production activities, and purchasing inputs for potato production from traders, mainly agrochemical dealers.

b. <u>Government organizations:</u>

The government organizations included the National Agricultural Research Organization(NARO), the National Agricultural Advisory Services (NAADS), and Area Based Agricultural Modernization Programme (AAMP). At the pilot area of Kabale, Namulonge Agricultural Research Institute (NAARI) was one of the nine research institutes of NARO with the mandate to generate and disseminate improved technologies of beans, cassava, cereals (maize and rice), sweet potato, potato and animal production. However, the mandate on potato (called "solanum potato" or "Irish potato") was devolved to Kachwekano Agricultural Research and Development Centre (ARDC) after its establishment as a NARO zonal centre in the southwestern highlands agro-ecological zone of Uganda in 2000. At the moment of the workshop, the center was called Kachwekano Zonal Agricultural Research and development Institute (KAZARDI). The station was in charge of carrying out research on potato variety improvement (variety evaluation and on-farm/on-station technology development trials), variety dissemination, training of trainers in potato production, foundation/basic seed production, and networking with other researchers, extension agents and development agencies.

The National Agricultural Advisory Services (NAADS), a program the government of Uganda, was in charge of increasing the efficiency and effectiveness of agricultural extension services. Its development goal was to enhance rural livelihoods by increasing agricultural productivity and profitability in a sustainable manner. The Area Based Agricultural Modernization Programme (AAMP), a six-year IFAD-initiated programme, was designed to increase incomes among poor rural households in southwestern Uganda by stimulating economic activity and contributing to the modernization of smallholder agriculture. Both NAADS and AAMP were identified in the workshop as working on

potato production by hiring private service providers for multiplication of seed potato, on-farm demonstrations, sourcing for foundation seed/technology, institutional capacity building through marketing associations, farmer forum, farmer groups, support to farmers with agro-inputs for commercial potato production, and rural infrastructure development.

c. Non-government organizations (NGO):

There were also a number of NGOs working in Uganda for potato production at the moment of the workshop. For example, Africa 2000 Network-Uganda (A2N) had the mission to alleviate poverty by supporting smallholder farmer groups to undertake initiatives geared towards livelihood improvement and natural resources regeneration and conservation in Uganda. In potato production they worked on farmer trainings (post harvest), provision of starter seed, linking farmers to markets, information dissemination in relation to potato (community libraries), and establish marketing centers (collection centers).

The NGO Africare has worked in Africa for 35 years. It had the Programme "Farmer training and improved potato production" which showed the importance of potato production to achieving their mission of food security for Uganda. The main activities in this area were starter seed provision, technology dissemination, community road construction, post-harvest handling through training and demonstration, enterprise development, linking farmers to markets, natural resource management and soil erosion control.

Nangara Integrated Development Project (Nangara ID), a project from the African Evangelistic Enterprise (AEE), had the purpose of improving the standard of living of 600 households. To achieve its goal, AEE cooperated with the local population, community leaders, and the churches. It worked with potato related projects such as starter seed provision, training farmers by hiring extension services, linking farmers to markets, and with other NGOs.

CARE Uganda emphasized long-term development in projects dealing with agriculture, primary health care, population and small enterprise development. The project "Food security through farmers innovation" used participatory methodologies to characterize and diagnose critical issues in two watersheds in Kabale district. CARE worked in provision of experimental materials, linkages with researchers, seed multipliers

and business people, market linkages, training in potato management and post harvest handling, and soil and water conservation.

World Vision worked in the most impoverished communities of Uganda, providing families with skills and resources they need to improve the quality of life for their children.

d. <u>International agricultural research centers:</u>

International research centers were also identified as components of the Potato innovation system. The International Potato Center (CIP) worked with NARO on potato-related research and also with Africare on participatory research and training. CIAT had helped to organize courses in eastern Africa on agro-enterprise development. In addition, CIAT and CLAYUCA (Latin American Consortium for Cassava Research) have forged a broad agreement with IITA for collaboration with the International Potato Center (CIP) and national partners through the USAID-funded Southern Africa Root Crops Research Network (SARRNET). CIAT worked on potato production in issues related to enterprise development, linking farmers to markets, and networking with other NGOs, researchers, and other stakeholders. The African Highlands Initiative (AHI), a programme coordinated by ICRAF, focused on key natural resource management and agricultural productivity issues in the highlands of East and Central Africa, where potatoes are cultivated.

e. <u>Media:</u>

Media in Uganda was identified as important for information diffusion. Kabale district had four community radio stations at the moment of the workshops called "Voice of Kigezi FM (U) Limited", "The Roots (U) Limited", "Kachwekano Community Mult-media Centre", and one based in Mbarara district mainly "Radio West Limited". Voice of Kigezi worked with NAADS by diffusing a market information service that meets the marketing needs of the farming and trading community at the district level, and also by introducing an educational element that would help farmers to use the information more effectively. Radio provided information about potato such as the collection of information from brokers, traders, farmers, researchers and consumers albeit in a limited number; information dissemination from researchers, extension workers, farmers, traders,

processors and consumers; and the collection and dissemination of marketing information. Radio stations also hold talk shows on potato production.

3.1.4.2. Interaction of components

In Uganda the interactions between stakeholders in the potato knowledge and information system were mapped out (see Figure 3.1.4).

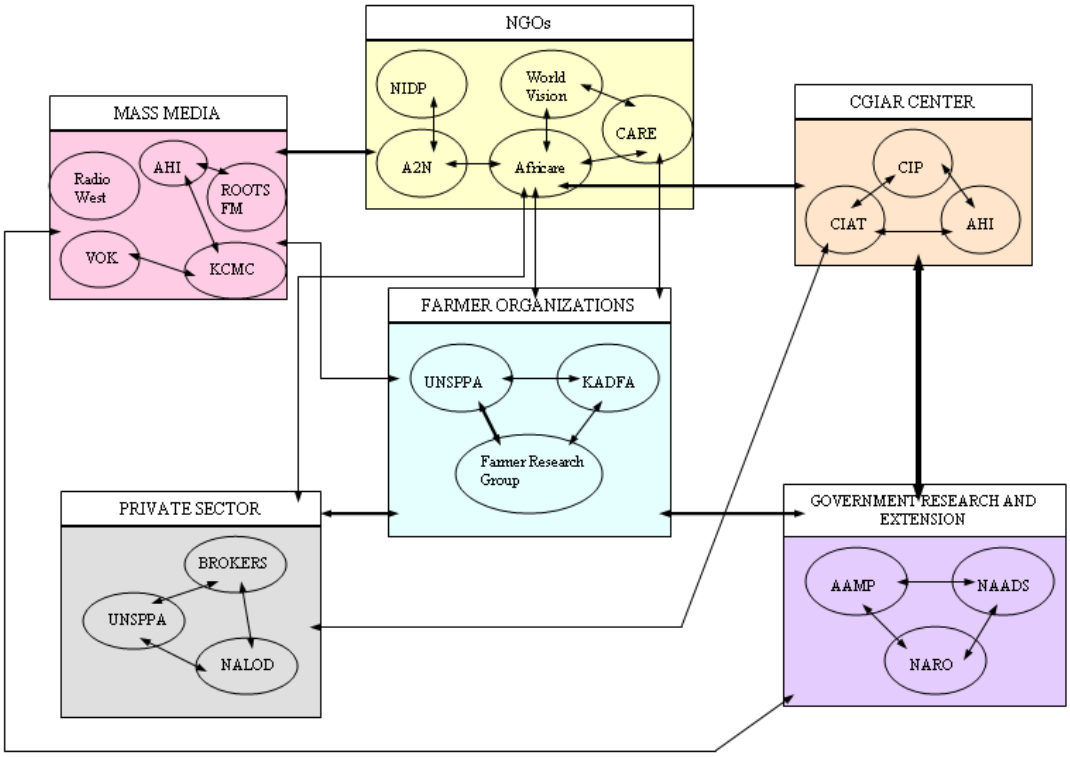

Figure 3.1.4. Potato innovation system components and interactions in Kabale, Uganda in 2004.

Note: The thickness of the arrows indicates the strength of the linkages and information exchange.
AAMP = Area based Agricultural Modernization Programme NAADS = National Agricultural Advisory Services NARO = National Agricultural Research Organization A2N = Africa 2000 Network AHI = African Highlands Initiative CIAT = International Center for Tropical Agriculture CIP = International Potato Center NIDP = Nangara Integrated development Project UNSPPA = Uganda National Seed Potato Producers association NALOD Perfect Consult LTD = KADFA = Kabale District Farmers Association VOK = Voice of Kibwezi KCMC = Kachwekano Community Multi Media Centre.

Twenty-two actors were identified by the AKIS –potato workshop participants. The institution having the largest number of partners was Africare, who related directly to 12 of the partners present in the workshop. The actors in the mass media category seem to be less interactive with other organizations because they were massed together as media.

The government research and extension agent interacted with all the actors though at different degrees. This is because of the new approach in Uganda as a policy

requirement to have greater integration between agricultural research and extension service.

The importance of the different interactions for managing knowledge and information in the potato chain was ranked. The mass media were considered to play the smallest role, while the farmers and the national research and extension institutions were ranked highest.

Even though, there was strong involvement of government through public research (NARO) and local government agricultural extension services (NAADS and AAMP) and the involvement of private sector like UNSPPA in scaling out technologies developed by research organizations, poor linkages among the institutions involved in the potato innovation system were identified as one of the hindrances to information access. Research, agricultural extension service, NGOs, farmers, private sector, mass media were found to have limited common activities and there was little feed back among the partners.

Other problems limiting information access were related to limited availability of logistics and resources. In most cases, information was not accessed due to limited funds for information development and dissemination teams to avail the information to the end-users. Also in some situations, information or technology end-users did not have the capacity to access or utilize the information especially where it involved purchase very expensive input technologies which most of the users in rural poor communities may not afford. Low human resource base also limited access of information to farmers and other components.

Untimely availability of information to the users also limited accessibility and use of information. Information was sometimes delivered to the users too late to be useful.

Poor or lack of infrastructure and communication development (roads, markets, radios and other communication means) hindered information accessibility to the users. Few potato innovation system components had full-time access to the internet and traditional library services were limited in Kabale area zone where potato is important.

The type of innovations needed to improve the potato sector in Uganda should give priority to those oriented to enhance capacity building of different stakeholders in the system and improving interaction mechanisms for a more coordinated work.

3.1.4.3. Sources and type of knowledge acquired by farmers about potatoes

106 farmers from participants and non-participants were interviewed and results are presented in Tables 3.1.5 and 3.1.6.

Table 3.1.5. Main information sources for FFS participants about potato management and marketing in the in Kabale, Uganda (% de total number of farmers that uses the source per information type). N=56

	Information source and %age of respondents N=50										
Information type	Own experience	Neighbours and family	Traditional extension	Trained farmer	Africare	NARO	NAADS	AAMP	FFS	UNSPPA	Demonstration
Agronomic practices											
Site selection	28.6	3.6	1.8	3.6	3.6	12.5	1.8	0	42.9	0	0
Fertilizer use	9.0	0	5.4	3.6	12.5	30.3	1.8	0	41.1	0	0
Improved varieties	0	1.9	7.4	1.9	16.7	22.3	0	0	53.8	0	0
Source of quality seed	14.3	5.4	0	0	0	17.9	0	0	0	25.0	0
Knowledge on seed source	5.4	8.9	0	7.1	10.7	12.5	0	0	42.9	0	17.9
Row planting	0	0	0	1.8	16.4	29.1	0	0	58.2	0	0
Earthing-up	1.9	1.9	0	0	1.9	9.4	1.9	0	47.2	0	35.8
Dehaulming	0	0	1.9	0	1.9	13.4	3.8	0	50.0	0	30.8
Pest & disease management											
Rouging	0	0	2.1	0	4.3	10.6	2.1	0	53.2	0	27.7
Bacterial wilt management	0	3.8	1.9	0	0	11.5	0	0	61.5	0	21.2
Late blight management	0	1.9	1.9	1.9	0	13.2	0	0	56.6	0	24.5
Insect pest management	18.2	7.3	9.1	1.8	0	0	0	0	52.3	0	10.9
Post harvest handling											
Seed selection	3.6	3.6	0	3.6	1.8	5.5	0	0	56.4	0	23.6
Storage of ware potato	8.3	0	0	0	8.3	16.7	0	0	50.0	0	16.7
Seed potato storage	3.2	0	0	0	9.7	16.2	0	0	61.3	0	16.1
Marketing											
Ware potato markets	0	0	0	4.1	0	0	0	0	0	0	0
Seed potato markets	0	0	0	0	0	0	0	0	0	0	0
Market information	0	87.8	0	2.0	4.1	0	0	0	0	4.1	0

Table 3.1.6. Main information sources for Non-FFS participants about potato management and marketing in the in Kabale, Uganda (% de total number of farmers that uses the source per information type). N=50

Information type	Information source and %age of respondents N=50										
	Own experience	Neighbours and family	Traditional extension	Trained farmer	Africare	NARO	NAADS	AAMP	FFS	UNSPPA	Demonstration
Agronomic practices											
Site selection	64	12	0	10	2	6	4	0	2	0	0
Fertilizer use	26	8	18	26	2	8	6	4	0	0	0
Improved varieties	2.5	22.5	15	40	7.5	7.5	2.5	0	2.5	0	0
Source of quality seed	10	12	0	0	0	4	0	0	0	10	0
Knowledge on seed source	16.3	55.1	2	10.2	2	6.1	2	0	2	0	4.1
Row planting	4.2	16.7	8.3	33.3	6.3	12.5	8.3	0	2.1	0	0
Earthing-up	12.8	25.6	5.1	17.9	2.6	7.7	0	0	0	0	28.2
Dehaulming	3	9.1	15.2	33.3	6	6.1	0	3	0	0	27.3
Pest & disease management											
Rouging	9.4	15.6	18.7	31.3	3.1	6.3	0	0	0	0	15.6
Bacterial wilt management	2.4	36.6	4.8	24.4	0	14.6	0	0	0	0	17.1
Late blight management	0	37.5	2.5	25	0	15	0	0	0	0	20
Insect pest management	18.2	36.3	6.8	13.6	0	4.5	2.3	0	0	0	18.2
Post harvest handling											
Seed selection	44.7	23.4	0	10.6	0	8.5	4.2	0	0	0	8.5
Storage of ware potato	42.9	28.6	0	0	0	28.6	0	0	0	0	0
Seed potato storage	11.8	17.6	0	29.4	11.8	23.6	5.9	0	0	0	11.8
Marketing											
Ware potato markets	0	0	0	0	0	0	0	0	0	0	0
Seed potato markets	0	90	0	0	0	0	0	0	0	0	0
Market information	0	89.5	0	0	0	0	0	0	0	0	0

a. Agronomic practices

None of the FFS participants mentioned AAMP as a source of information and just 3% of respondents who are non FFS-participants (Table 3.1.6). Both FFS participants and non-participants obtained only information about improved seed from UNSPPA and not any about any other technology (Tables 3.1.5 and 3.1.6). The main sources of information for agronomic practices, except seed source among FFS participants, were through FFS followed by NARO and Africare. For instance, for site selection, 43% of the

respondents mentioned that their source of information was the FFS, while 12.5 and 3.6% said they obtained information from NARO and Africare, respectively (Table 3.1.5). This contrasted with non-participants of FFS in FFS intervention area who mainly obtained information from own experience, neighbours and/ family member, and fellow trained farmers. It is interesting to note that a 15-30% of the non-FFS participants obtained information on earthing-up, de-haulming, and rouging from demonstrations (Table 3.1.6). This probably indicates that non-participants of FFS may be copying from demonstration laid by other extension agents or experimental sites for FFS or other trained farmers (Table 3.1.6). It is evident from the data that non-participants of FSS, even in FFS intervention areas, had limited assess to information and information service providers (NARO, Africare, public extension service). Generally this category of farmers depended on personal experience, neighbors and fellow trained farmers on general potato agronomic practices, while for FFS participants, their principal sources of information were FFS, NARO and Africare representing 41.1, 30.3, and 12.5 percent of the respondents.

b. <u>Pests and diseases</u>

The main source of information for potato insect pest and disease management among FFS participants in FFS intervention area were the FFS's (Table 3.1.5). This sharply contrasted with non-participants of FFS in the same area where the main sources of information are neighbors, fellow trained farmers and demonstrations, respectively (Table 3.1.6). A number of farmers among FFS participants used their own experience for insect pest management (18.2%) while non-participants obtained their information from neighbors (Tables 3.1.5 and 3.1.6). Although no respondents among FFS participants mentioned NARO as a source of information for insect pests management, 11.5% and 13.2% of the respondents said that they learnt about the management of BW and LB management, respectively from the same organization (Table 3.1.5). Contrastingly, non-participants of FFS cited NARO as a source of information for all the three types of information.

c. Storage and post harvest handling of potato

The leading provider of information about storage of ware and seed potato was reported to be FFS representing 50 and 61.3% of the respondents, respectively (Table 3.1.5). On the other hand, non-participating farmers reported using their own experience in ware potato handling (42.9%) while 23.6% and 29.4% obtained information from NARO and fellow trained farmers, respectively on seed potato storage (Table 3.1.5). Between 8 and 17 % of FFS participants obtained information on general potato storage from NARO, Africare and demonstrations (Table 3.1.5). Interestingly, FFS participants from FFS intervention area did not cite the traditional agricultural extension, neighbors, fellow trained farmers, UNSPPA, and NAADS and AAMP, that replaced the old extension service, as information sources for potato storage (Table 3.1.5) while most have been operating in the district for some time. The same trend was observed among non-FFS participants except NAADS that was cited as being a source if information for seed potato storage (Table 3.1.6).

d. Market information

The majority of both FFS participants and non-participants obtained market information from neighbors representing 87.8% and 89.5% of the respondents in the two categories, respectively in the FFS intervention area. Generally, data from the survey indicate that potato farmers in Kabale district had a narrow range of information sources.

Table 3.1.7. Constraints and suggested solutions for potato production and marketing in Uganda.

Constraints	Solutions proposed
Inappropriate packaging of training materials.	▪ Capacity building in creating training materials for research and extension staff.
Limited staff in research organizations and NGOs influence limited coverage to farmers.	▪ Collaborate closer with NAADS service providers and public extension service. ▪ Use radio. ▪ Involve agro-input dealers.
Some incompetent contractors in NAADS.	▪ Collaborate closer with NGOs and research.
Reluctance of farmers to involve in learning new ideas, low group sustainability.	▪ More focus on sustainable farmer group formation.
Adulterated inputs sold.	No solution proposed.
Lack of credit facilities input dealers.	No solution proposed.
Limited funds for radio stations.	▪ Collaborate closer with research, extension and NGOs.

3.1.4.4. Conclusions about potato innovation systems in Uganda

A major problem identified in the Ugandan potato innovation system was the inappropriate packaging of information. Especially the language of materials was identified to be problematic. Moreover materials were mostly inappropriate for illiterate people. A limited flow of information was noticed between wealthy and poor sectors of the community.

Poor linkages between different stakeholders in the potato sector were identified. Especially the mass media (radio) were poorly connected to the information suppliers. Input dealers were not considered as information suppliers by extension and research, while the farmers consider them an important source of information. NGOs and extension did appreciate the research for their participatory research activities, but however consider their reach limited. Also the reach of the NGOs was considered limited. The privatized extension (NAADS) had a wider reach, but had limitations in terms of agricultural extension skills and access to useful information.

Interestingly farmers were said to provide limited feedback to development organizations. The development organizations also complained that farmer group continuity was limited, and farmers showed limited initiative in seeking for information. More attention needs to be given to farmer group formation and cohesiveness.

Suggestions for improving the flow of information included capacity building for research and extension in the development of appropriate training materials. Also improving collaboration between research, NGOs and private service providers is an opportunity to optimize the use the higher skills available in NGOs and research organizations with the larger reach of the NAADS program and the public extension service.

3.1.5. Comparative analysis of potato innovation systems

The results indicated that potato innovation systems vary across countries, but also across pilot sites within a country. The main groups of stakeholders identified in the system included farmer groups and organizations, government institutions, nongovernmental institutions, private sector and media. Table 3.1.8 shows a comparative analysis of the potato innovation systems at the pilot sites in the four countries, which was the result of 10 participatory workshops in the countries with the participation of stakeholders.

Table 3.1.8. Main characteristics of the potato innovation systems in the four countries included in the study.

Main features*	Ethiopia	Uganda	Bolivia	Peru
Number of components**	14	22	31	30
Intensity of interactions	Limited	Limited	Limited	Limited
Role of farmer organizations	Limited	Increasing	Major	Limited
Role of National government	Major	Substantial	Very limited	Limited
Role of local government	Limited	Limited	Increasing	Increasing
Role of the private sector	Very limited	Very limited	Major	Major
Role of international research centers	Limited	Substantial	Limited	Limited
Role of media	Limited	Limited	Limited	Limited
Main sources of potato-related information	Farmers	Farmers	Farmers	Farmers
Receptiveness of the system to PR	Limited	Increasing	Increasing	Limited
Whole innovation system	Less complex and stable	Growing in complexity	Complex and dynamic	Complex and dynamic

* The ranking of the different characteristics in each country is relative and respond to notional indicators coming from the workshops and observations made along the project.

** Include farmer communities, organizations, local and national agricultural institutions, NGOs and private sector, including media, and although in some countries more then one pilot site was included, the number gives a relative indication of component diversity.

- ***Complexity of the system:*** Table 3.1.8 shows that the potato innovation system is less complex and stable in Ethiopia, where government organizations still play a major role, compared to the other countries, where the government sector is limited and there is a major role on the part of NGO and the private sector.
- ***Intensity of interactions:*** Stakeholders at all pilot sites pointed out the existence of limited interactions among the components of the system. For example, in the case studies from Peru, with larger number of components, only between 16% to 23% of the total potential interactions was reported (100% would be if all components interacted to each other) mostly involving farmers, which is an indicator of the lack of coordination and interaction particularly among support organizations both public (GO) and Non-governmental (NGO).
- ***Role of government and non-government organizations:*** The main characteristic of the Ethiopian system is that it still includes a major government presence, in research, agricultural extension and input marketing, in stark contrast to the Bolivian and Peruvian systems where involvement governmental organizations in the innovation system is minimal. However, in the latter systems, local governments such as municipalities are starting to play an increasingly important role. The Bolivian case has also followed a similar trend in terms of the government participation in the sector. Although in recent months the government is trying to design a strategy to reactivate government agricultural services because of the political changes in Bolivia. In Uganda there is an on-going decentralization of responsibilities from national organizations to regional institutions and local government as well as a from of privatization of delivery of agricultural extension services under the NAADS program (Benin et al., 2007)

- ***Role of farmer organizations:*** On the contrary, in Bolivia farmer organizations such as unions play a major role for the coordination of interventions, compared to the other countries, which have relatively weak farmer organizations. At the pilot sites in Peru, there were some farmer organizations with limited representation beyond the community level. Also in Uganda the organization of potato farmers has not extended beyond village level farmer groups initiated for different reasons, but mostly to improve access to services or for traditional collective saving. In Ethiopia efforts are being made by the NGO sector to build farmer associations to improve their access to services and input and output marketing channels. They do however have to deal with the negative image of farmer cooperatives that has developed as a result of forced farmer organization under totalitarian rule.
- ***Role of the private sector:*** The private sector presence and role is more important in the Latin American countries. Most farmers have contacts with agrochemical companies for both buying inputs and receiving information. There is also a stronger role of potato dealers in the innovation system. In Ethiopia the central government controls the trade in agricultural inputs. In Uganda the input trade is fully liberalized, but local availability of inputs, especially fertilizer, within the potato growing areas is limited.
- ***Role of the media:*** In all countries there is a weak role of media for the potato innovation system. In Uganda however, local radio stations in vernacular language exist and are broadly listened to. And these radio stations do have interactions with other actors in the innovation system, although limited.
- ***Role of PR in the system:*** In the four countries analyzed, there was interest on the part of research and development organizations regarding PR. Some of them have had more experience with PR than others, such as in the case of Bolivia. But there was not evidence that PR had been already institutionalized formally within institutions. In all cases, an international research institution (CIP) was promoting PR implementation, assessment and lesson extraction from the experiences.

3.2. Objective 2: Determine factors that facilitate or limit innovation for using and scaling-up participatory research methodologies and technologies, and assessing participatory methods in case studies.

3.2.1. Introduction

The IFAD grant supported the evaluation of participatory methods by key stakeholders namely farmers, field practitioners (facilitators and researchers) and institutions. The objectives 2 and 4 of the initial proposal included the identification of factors that influence scaling-up and out of participatory methods, and also the assessment of methods from the point of view of these stakeholders. The evaluation took place between 2004 and 2007 at the pilot areas in the four countries. The case studies were located in Cajamarca (Peru), Cochabamba (Bolivia), Kabale (Uganda) and Oromia (Ethiopia) (Figure 3.2.1).

Figure 3.2.1. Location of the pilot sites where the project was conducted in the four countries: Peru, Bolivia, Ethiopia and Uganda.
Source: Microsoft Encarta maps

The units of analysis for the case studies included different levels namely 1) farmer groups involved in participatory methods, 2) PR practitioners (extension workers, facilitators and researchers), and 3) organizations. At each level, different tools were used to elicit information from stakeholders (Table 3.2.1).

Table 3.2.1. Case studies, informants and tools for data collection used in the study.

Levels of case studies: informants or unit of observation	Number	Tools for data collection
Farmer groups*	249	Focus groups, non-participant observation.
Individual Farmers	Peru: 159 Uganda: 302 Bolivia: 21 Ethiopia: 112	Questionnaires
PR practitioners (facilitators and researchers)	Peru: 4 Bolivia: 3 Uganda: 7 Ethiopia: 4	Questionnaires, group discussion, participant observation.
Organizations**	10	Semi structured interviews, non-participant observation, participatory workshops

* Farmer groups who have participated in different participatory methods namely: FFS, FRG, groups for seed multiplication.
** Includes: Care-Peru, Municipality of Baños de Inca District, FFS Association of San Miguel, PROINPA Foundation, ASAR, NARO, Africare, EIAR, SHDI and CIP.

3.2.1.1. **Data collection from farmer groups**

Focus groups were conducted with farmers who have participated in the PR cases for the last three cropping seasons. The focus groups were organized to allow farmers to identify aspects that had changed as a result of their participation, and the factors they had taken into consideration when making decisions related to participatory research (PR) activities. The focus group meeting started with a brainstorming about the benefits farmers perceived, and farmer answers were grouped around categories. Farmers were asked to compare the situation before the project with the current situation, using the card method (Ortiz and CIP-CARE, 2002). In this way, it was possible to assess how farmers perceived the changes and the factors involved.

3.2.1.2. **Data collection from individual farmers**

In the case of Peru a questionnaire was applied to 159 farmers who were involved in PR in Peru. The questionnaire was part of a student thesis and was oriented to elicit information about farmer perceptions of the factors that influence, and the benefits generated from, PR. In Bolivia 21 farmers gave their opinions about Farmer Research Groups (FRG) and FFS. In Uganda, AAMP surveyed 74 farmers who participated in grant and monitoring methodology, while NARO and Africare surveyed another 32 participants from the FRG, 119 from the FFS and 77 from the Farmer Run Field School

(FRFS) to give insight about their perceptions of the methodologies farmers have participated. In Ethiopia, 112 farmers from FFS and FRG were assessed about their opinion about the method by using a set of 16 statements and giving those statement a attitude scale ranging from strongly disagree to strongly agree.

3.2.1.3. **Data collection from PR practitioners**

For this purpose, facilitators filled out a questionnaire oriented to help them describing how each participatory method had been implemented with each farmer group. This questionnaire was organized in different sections asking for information about the organization of the group, selection of technologies and topics, group size, level of farmers' involvement, participatory evaluation of groups, objectives and results of the participatory methods and a qualitative characterization of methodologies from the point of view of facilitators. In addition, at least three participatory workshops per year were organized among the participating organizations in each country and continuous meetings to analyze the experience and extract lessons.

3.2.1.4. **Data collection from organizations**

In order to gather information from the organizational point of view, workshops were organized three times a year. In the workshops, PR practitioners and managerial staff of institutions evaluated the interventions from the point of view of organizations, particularly taking into consideration possibilities of scaling-up. In addition, staff from institutions took detailed information about the costs of implementing the methods, which was analyzed during the workshops. Complementary information was generated by a student from the University of Larenstein (Netherlands)4 who interviewed 35 organizations (GO and NGO) regarding the use of participatory methods in Central and Southern Peru in order to identify the factors that influence their involvement in this type of methods.

[4] Kobus, M. 2005. The opportunities, limitations and treats of an effective scaling-up of participatory methods: FFS, PTD, farmer-to-farmer extension, and technical farm-assistance in the potato producing regions Huancayo and Cusco, Peru. BSc. Thesis, Rural Development & Innovation, Larenstein University, The Netherlands. (Fieldwork conducted as part of the IFAD-funded project).

3.2.2. Results of the evaluation of participatory cases:

3.2.2.1. Helping institutions to design their own ways of implementing the methods:

At the beginning of the project, organizations analyzed their previous PR experiences and identified four general participatory methods to be evaluated during three cropping seasons. These methods were: 1) modified versions of farmers field schools (FFS) lead by professionals or by farmers, 2) farmer research groups (FRG), 3) seed multiplication under shared risk, 4) Grant and Monitoring, which was only included in the case of Uganda as an additional method implemented by the government extension service. Although, in theory some institutions implemented the same method, the way in which they implemented was different, being result of several factors, such as institutional objectives, context, situation of the agricultural knowledge and information system (or innovation system) in which they were involved, human resources and capabilities, previous experience of organizations and farmer groups. The methods assessed thanks to the support of the IFAD grant are described below.

a. **Modified versions of Farmer Field Schools (ex-FFS)**.

Farmer groups who evolved from previous FFS experiences (also supported by another IFAD grant between 1999 and 2002) participated in the present study in Bolivia, Ethiopia, Peru and Uganda. In Peru, the FFS method was adapted in San Miguel in 1999 with an emphasis on facilitation by professionals. During four years, farmers participated in the adaptation process, PR and training (Nelson et al, 2001; Ortiz et al, 2004). The same method was also adapted in Ethiopia and Uganda (Olanya, et al., 2000). The FFS method has been evolving in the different countries. In the case of Peru and Uganda, farmers have been trained as facilitators and they supported FFS implementation. In Bolivia and Ethiopia, a professional facilitator conducted FFS. However, in Bolivia, farmer groups who participated in the project in Pocona originally as FFS group, evolved into research groups for evaluating varieties with resistance to late blight coming from conventional breeding as part of integrated management of the disease. In Pocona, there was one farmer group with 20 participants, which were

divided in five sub-groups to conduct an experiment each. One plot was designed for detailed studies ("mother plot") with rigorous scientific evaluation of the experiment, and four plots for participatory evaluation with farmers ("baby plot"). The method of "mother and baby trials" was adapted from Snapp et al. (2002).

In Ethiopia, the potato technologies that were analyzed by the project using FFS approach included integrated disease management of late blight (IDM-LB), integrated nutrient management (INM) and post harvest management of ware potato. These technologies have been selected based on the previous experience of EIAR and SHDI and the existing problems of potato production and marketing prevailing in the project operational districts. During the selection of technologies, special attention was given to the identification of the technological characteristics that may influence the use of specific participatory approaches and vice versa, which in turn could have an effect in the dissemination process.

In Uganda, there were farmer field school (FFS) run by a professional facilitator, and farmer run field school (FRFS). The FFS programs covered disease and pests control, other management practices of potato production, post harvest handling, record keeping and economic analysis of potato production activities.

b. **The Farmer Research Group (FRG)**

The FRG was conceived as a simplified version of FFS and other participatory method such as CIAL and PTD. The objective of the adaptation was to make the method less demanding on time and capabilities on the part of facilitators, but also less demanding of time on the part of farmers. As a consequence, the number of training sessions was reduced. The main characteristic of this method was the lower number of sessions compared to a conventional FFS (between 5 and 8 compared to 13). As indicated before, the implementation was the result of several internal and external factors to organizations; hence, the variations observed are described below:

FRG implemented by CARE-Peru and the FFS Association-CIP were similar and had more orientation to evaluate technologies with farmers in a conventional participatory way. The difference was that CARE had an strategy consisting of two years of participatory trials and move to validation on larger plots in the third year, whereas, CIP did not plan to include the third year of validation, because of the

emphasis to produce research results and not being involved in extension activities. In the case of the local Municipality of Baños del Inca, it was more interested in using participatory methods towards extension and dissemination of technologies. They defined a strategy from the beginning, consisting of starting a PR group with 20 farmers in a community during the first year. This group became a validation and multiplication group during the second year, while at the same time a second PR group with other members of the community started. During the third year, the idea was that the validation group could start planting commercial plots, the group of the second year could become a multiplication group, and a new PR group could start. The idea was to involve as many members of the community in three years, which was a clear strategy for scaling out. However, in this case, the Municipality provided no full-time facilitators and the field staff had other responsibilities, and also had logistic limitations to visit the groups as frequent as in the case of CARE and CIP.

The FRG approach in Bolivia was conducted with groups that previously worked with the Participatory Plant Breeding (PPB) methodology that started in 1999 (Gabriel et al, 2004). The initial objectives of PPB method were mainly to improve farmer research capacity to develop varieties with good resistance to late blight, good yield, and acceptable culinary qualities for household and industrial consumption. The communities were already involved in PR and training with CIAL and FFS at that time, and the PPB approach adapted the contents and procedures using the existing experience. As a result, after crosses and selection, farmers have selected their own potato varieties. PROINPA used the Farmer Research Group approach so that farmers have been able to evaluate the selected clones coming from PPB. The average farmer group size was 8 and the number of training sessions was 7.

The FRG method in Uganda was the result of the adaptation from previous FFS implemented with the support of TAG 411-CIP. The farmers having a research experience from the farmers' field school approached the researchers to help them develop a technology that would increase the proportion of market preferred tubers (appropriate size) destined for chips processing. The salient features of the study were that farmers proposed the research scenario. The farmers proposed to investigate effect seed density at planting by varying the in inter-row and intra-row spacing in addition to varying the fertilizer rates.

The FRG method in Ethiopia was designed to be a participatory approach with lower farmer and facilitator involvement. It included groups of only five participants, with the aim of disseminating research results to other community members in a later stage. In addition, unlike the FFS approach, there were no field sessions in the FRG approach (less emphasis on training). Participant farmers did not influence the treatments in the experiment and the group did not have formal structure necessarily. Participants only met on specific occasions to perform agronomic practices following the phenology of the crop. In this PR approach the facilitator acted as a supervisor and interacted with the farmers less frequently. The objective of the FRG approach was to test and extend technologies with minimum external facilitation but more participation of farmers in order to build their capacity to conduct research on their field. Like the FFS approach, the technologies tested in this approach were IDM, INM, and post harvest handling of ware potato.

c. **Seed growers under share risk**

This method has been used by ASAR for about 30 years. For the project supported by the IFAD grant, they included five farmer groups for the evaluation of this methodology. The main objective was to provide training to farmers to enhance production and productivity of potato at the pilot sites. The NGO established an agreement with a farmer organization called ORPACA to grow potatoes and put emphasis on the multiplication and trade of quality seed. The training sessions were on a monthly basis with more frequent visits of the facilitator. They managed two types of training session: first, around 4 to 8 short courses in the communities, second, training courses with different groups gathered in a facility generally far from their community (3 courses of 5 days each). The share risk implies that both parties (the farmer and the NGO) provide resources for potato cultivation; for example, farmers provide land and labor while the institution provides the rest of the input and training costs, and both shared the benefits and risks. This methodology was adapted to PR, aiming at providing an opportunity for farmers to evaluate the effect of quality seed (usually certified seed) vs. their own seed. The method did not use an experimental design and farmers observed, evaluated and compared commercial plots. There was a variant of the method used in three groups aiming at evaluating strategies for chemical control of late

blight and the use of resistant varieties with a number of participants between 10 and 13 and an average sessions number of 6.

d. **Grant and Monitoring methodology**

This was not a PR method specifically implemented with funds of the IFAD grant. It was used by Area based Agricultural Modernization Program (AAMP), another IFAD funded program in Uganda. This method was also studied by NARO in partnership with AAMP for comparison with other methodologies being used by NARO and Africare. Although, this methodology was not specifically for research, partners in Uganda tried to adapt it for helping farmers to compare technological options. The sub-county AAMP coordinator with the farmer groups identified profitable business opportunities (for example, potato production). Farmer groups prepared and submitted proposals, which stipulated the kind of support they needed. The proposals and budgets were reviewed and accordingly funded through grants provided by the district local government /AAMP project. Potato cultivation, particularly in relation to market chain development, was one of the main activities.

3.2.2.2. Key factors that farmers take into consideration to make decisions to be involved in PR.

Evidence coming from focus groups and interviews gave insight about the factors that farmers take into consideration when making decisions to be involved in PR. The factors are presented in five categories: effects on social capital (organization), access to technology, and effect on human capital (knowledge), contextual and other factors. See description below.

a. ***Strengthening human capital***. Figure 3.2.2 shows that about 63% of answers in Peru indicated that accessing new knowledge and skills for solving the main potato-related problems was an important factors that farmers took into consideration when making decision about PR. In the Uganda case, around 40% of the respondents from FRG identified that accessing research-based advice was important for them, while around 48% from FFS (N=119 for FFS and N=77 for FRFS) indicated that accessing to information and knowledge through the methodology as an advantage from their

involvement in PR. Several studies, such us Zuger (2004) and Godtland et al. (2004), coincide with the results of these case studies, in the sense that accessing to information and knowledge is clearly a benefit for farmers, which compensate the time and resources they invest. This is partially explained because of the lack of information sources in the study sites. Results presented in the chapter about characterization of the potato innovation system confirmed that most of the information farmers manage came from internal sources such as the family members, with limited participation of extension providers. Therefore, having the chance to access external information is a factor taken into consideration by farmers to make decisions about involving themselves in PR. However, if accessing information and knowledge is a strong motivation then probably PR should be complemented with other dissemination methods to reach a larger coverage with the results of PR.

b. ***Accessing to new technology*** was the second factor mentioned by individual farmers as a potential benefit of their involvement in Peru. Farmers from the Grant and Monitoring methodology from AAMP in Uganda preferred the access to improved potato varieties rather than the use of fungicides or fertilizers, being the first one a input that farmers received for "free" and can re-multiply for their fields, but the fungicides and fertilizers are inputs that farmers received just for the experiments but they need to buy in order to use in their own fields. In Uganda, the FFS and FR-FFS participants valued the most the access to improved technology 60% and 65% respectively. In Bolivia, farmers declared that evaluating and distributing potato seed through PR was a good strategy for evaluating the behavior and adaptation of the new varieties to different conditions y permit to cultivate potatoes in areas highly affected by late blight.

Farmers perceived more easily the potential benefits of input-based technologies (i.e. new potato varieties or sources of fertilizer) than from knowledge-intensive technologies (integrated pest or disease control). Expressions such as "we want new seed" (meaning new varieties) were common.

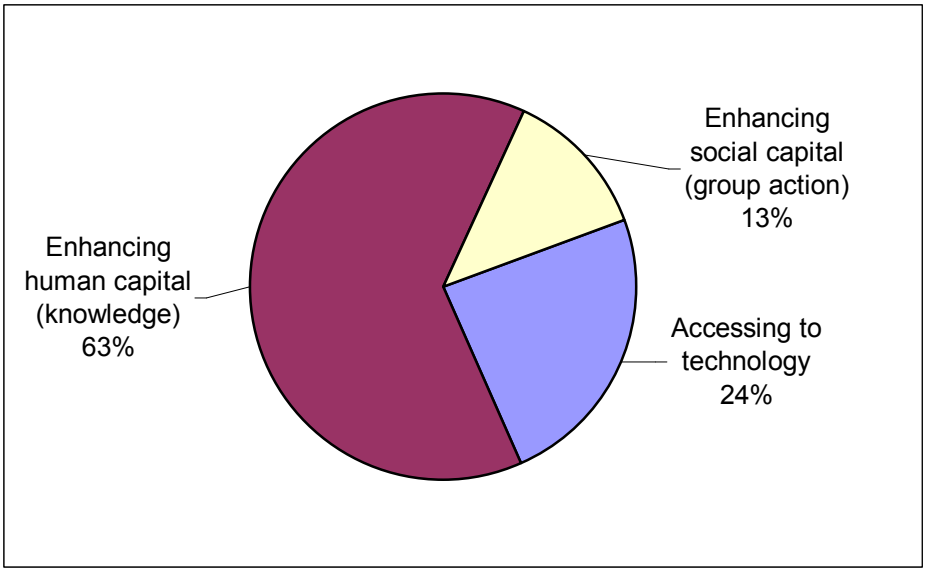

Figure 3.2.2. Percentage of answers indicating the perceived benefits from PR in the study sites of Peru during 2004-2005 cropping season. Results from a questionnaire. N= 125.

In the survey, farmers expressed that accessing to information and technologies were the most important factors to be considered for involving themselves in PR experiences, and results from focus groups confirmed the findings and indicated that the improvement of social capital (Figure 3.2.3) was equally important. These results indicate that accessing technologies through PR is an important motivation for farmers but access to new information and knowledge is equally important, particularly because of the lack of information sources in the system. Therefore, interventions should combine PR with other means of information dissemination such as participatory training (PR), farmer-to-farmer or mass media in order to satisfy farmer demands.

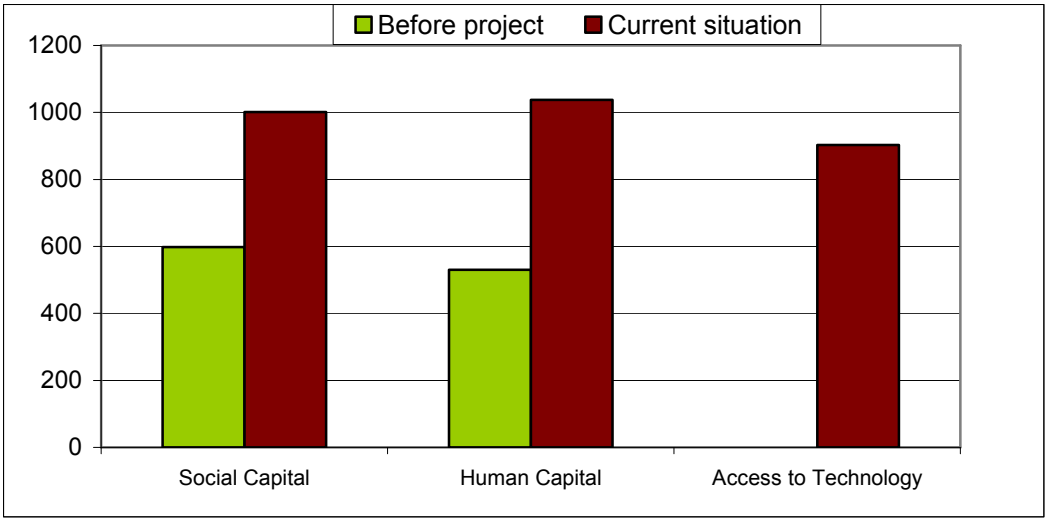

Figure 3.2.3. Index of the importance of perceived benefits identified by farmers through focus groups with PR participants from San Miguel, Cajabamba, Sanchez Carrión (Peru) and Morochata (Bolivia). Results from 18 groups with the participation of 186 farmers. 2006.

c. ***Strengthening social capital.*** In Peru, farmers also took into consideration the potential benefit of strengthening their own organization, group or collective action when making decisions about PR activities. Similar situation was observed in Morochata, Bolivia, where the groups have had already about five years experience with PR. Therefore, although this type of benefit was not easily recognized at the beginning of the project, when the groups had some experience, they realized that the improvement of internal networking and group action was a benefit that they also needed to take into consideration to be involved in PR. In Uganda, around 40% of the farmers interviewed from FRG (N=32) valued capacity building and empowerment as the most important contribution together with knowledge from the participatory process. In Ethiopia farmers indicated that there was a higher degree of experience sharing during PR and training sessions among farmers and the facilitator.

d. ***Contextual factors***. Each farmer group was immersed within a socioeconomic and agro-ecological context, which influenced decision-making about PR. For example, market development played a critical role. When the potato market was not developed in a sufficient way, such as in the case of San Miguel, Peru, farmers' motivation to work on potato-related PR was reduced. A more developed market, such as in

Huamachuco, Peru, or in Kabale, Uganda, where potato was perceived as a cash crop, influenced farmer interest in having access to and evaluating new technologies. In addition, there was an organizational context surrounding farmers, which in some cases presses in opposite directions of what PR was trying to do. For example, testing IPM vs. promoting pesticides. This happened particularly in potato innovation systems with larger number of non-governmental organizations and stronger presence of the private sector.

e. ***Other factors that farmers take into consideration*:** In addition to the four groups of factors described above, there were other factors indicated by farmers that deserve discussion. The first factor is time, which is usually considered a scarce resource. However, although farmers invest time for participating in PR activities, in the case of Peru, there was a number of NGOs and GOs working on potatoes. Hence, in the same way that farmers took into consideration the potential benefits of their involvement in PR, they were engaged in a negotiation process with more than one external organization assessing the potential benefits and making decisions about time allocation. This means in practice a competition among institutions for farmers' time.

In addition to benefits such as access to technologies, the perception of having access to more tangible benefits such as inputs (seed, fertilizer or pesticides) for the experimental or multiplication potato plots was taken into consideration. Farmers were looking for opportunities to access this type of inputs and when there were several potential sources (such as projects from different institutions), they tended to prefer those that could yield the most tangible benefits. For example, accessing to inputs for free. This made it difficult for institutions that aimed at, for example, evaluating technologies or improving farmers' knowledge through training, because accessing technology or information was not easily perceived as a tangible benefit at the beginning.

In summary, farmers take into consideration several factors when making decisions to be involved in PR, which includes the possibility of accessing to technology and knowledge, the possibility of strengthening their own organization,

the importance of potatoes for income generation, time restrictions and the additional benefit of accessing tangible benefits such as agricultural inputs.

3.2.2.3. Key factors that extension workers (facilitators) and researchers take into consideration to be involved in PR.

Even though extension workers or facilitators and researchers did belong to an organization, and therefore were under institutional policies and procedures, results of case studies indicated that there were several factors that they take into consideration as individuals and influence their involvement in PR. Results from 38 questionnaires filled by facilitators used to monitor PR groups indicate that the main factors that influence successful implementation include resource availability, farmer willingness to work, coordination between farmers and organizations, adverse weather conditions that limit accessing the communities, the context and the benefits generated for farmers. It is important to note that whereas for farmers the potential benefits in terms of accessing information, technologies and strengthening social capital were the main factors, for facilitators and researchers, the potential benefits for farmers are less important (Figure 3.2.4). In addition, other factors were identified through participatory workshops, which include for example, time management, perception of additional benefits, required capacities and skills, need to respond to different types of demands (i.e. rigor from experimental designs vs. practicality for farmers), and instability within institutions. Farmer willingness to work was perceived as important for establishing good coordination, good working relationships and carrying out collaborative workplans towards PR. PR practitioners also took into consideration the availability and quality of the logistical support that the institutions could provide for the activities. The situation was easier with NGOs, which had more flexible administrative mechanisms and resources to commit, such as transportation means and could support the timely availability of inputs for the experiments. It was more difficult in government institutions, such as a local municipality, which had limited logistical support for the staff involved in PR and more rigid administrative procedures that limit the timely availability of inputs for the fieldwork.

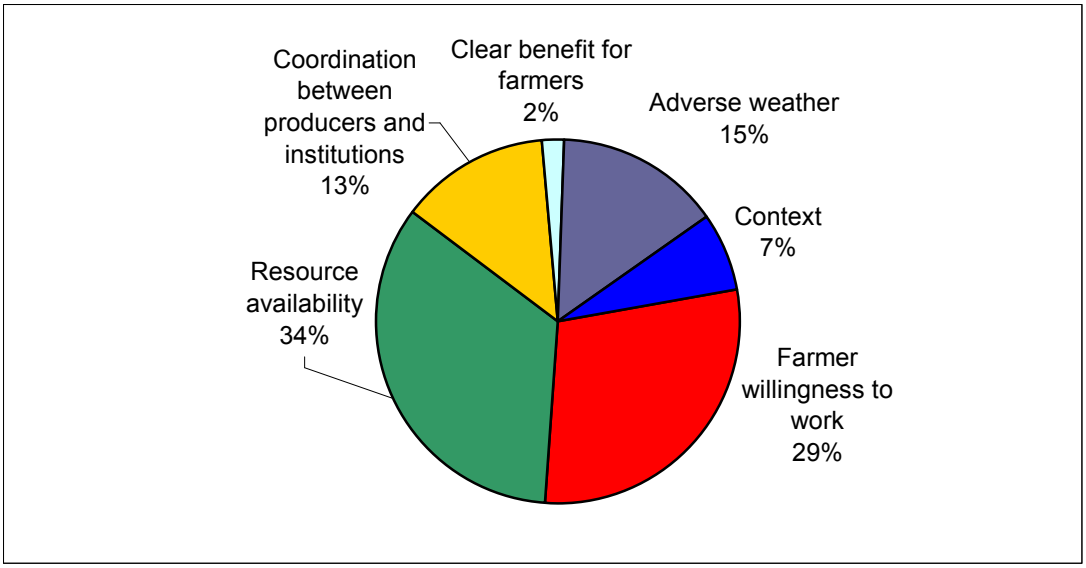

Figure 3.2.4. Factors found by facilitators from Peru and Bolivia that affect scaling-up. 2006. N= 38.

Working with PR methods implies that the extension worker or facilitator and the researchers need additional time for planning and conducting the sessions and experiments; hence time management becomes essential. Because of the frequent field visits, PR practitioners require usually more time than normal extension activities or conventional on-farm research, which also have implications for the cost of the method. Observations made with the staff of the institutions involved in the project indicated that in all cases, field staff took PR as an additional responsibility to what they usually do. As a result, the diversity of duties influences the amount of time they had for PR activities, which in turn influenced the quality of PR because staff could not focus and specialize on PR, but they had to play multiple roles and functions.

In the same way that farmers took into consideration the possibility of accessing tangible benefits through their participation in PR, extension workers and researches also took that factor into consideration. Tangible benefits or incentives were also weighted by facilitators at this level including, for example, accessing a per diem or having the chance to travel and participate in training meetings or for exchanging experiences. This perception influences the interest of the staff in PR.

Capacities and skill of the field staff was another factor that influence decision-making to be involved in PR. Field staff needs sufficient skills about PR method and about the crop or the problems to be dealt with. However, the lack of skills and

capabilities was not listed by facilitators in the factors that influence the success of PR methods, but listed on the factors mentioned at institutional level. Instead of that, facilitators tend to put most of the responsibilities on resource availability and "farmer willingness to work". This is a critical issue because if a person do not perceive a gap or problem, does not look for a solution.

Organizations had multiple objectives and staff had to respond to different demands. For example, in research institutions, staff had to respond to demands for having acceptable results from a scientific point of view vs. the demand of having experimental designs sufficiently simple to be useful for farmers. Nelson et al (2001) also mentioned this challenge in a FFS-related experience in Peru. Most of the institutions involved in the project used randomized block design for PR, whereas some of them, more oriented to extension used multiplication or semi-commercial plots as testing plots. In development-oriented institutions, staff also had to respond to different demands, such as those derived from participating in a PR project and those derived from their conventional development projects.

Instability of staff within institutions was a permanent concern for practitioners. In most cases, staff was working under short-term contracts, which did not ensure a sustainability of activities. Research-oriented institutions and NGOs tended to work with projects that last about three years. In government institutions, such as the local municipality, changes in policies, procedures and funding tended to occur after each election, which did not ensure a continuity of PR activities. For example, with the municipality of Baños del Inca in Peru, it was possible to work only the first and second year of the project. At the end of the second year, the new administration did not prioritize PR and the project activities were stopped. As indicated, institutions tended to hire staff on a short-term basis, which did not motivate staff to be more interested in PR because they were thinking about other potential sources of income or alternatives to work.

3.2.2.4. Key indicators that institutions take into consideration to make decisions about PR methods.

Results from participatory workshops, interviews and observations with managerial staff from the participating institutions indicated that, from an institutional point of view, the main factors taken into consideration to make decisions about innovating on PR methods included: the costs, the complexity and logistic support required for the methods, the additional knowledge and skills required, the quality of the technologies generated or validated, contextual factors related to the characteristics of the potato innovation systems, and the sustainability of financial support for PR activities.

a. **The cost of participatory methods**

For all institutions, one key factor for adopting a PR methodology was the cost involved in its implementation. However, monitoring costs is something that organizations did not prioritize, and because costs were associated to the institutional mechanisms and policies (i.e. staff salaries), they did not know exactly the real cost until they actually implement and evaluate it. The IFAD grant supported this effort, so that institutions had reliable information for decision-making. Institutions participating in the project monitored their costs during three cropping seasons to estimate the investment needed for conducting the different PR cases. The monitoring process included the costs of implementing the participatory trials, of conducting training and supervision, including personnel costs, but also the inputs and time provided by farmers. They used standardized forms to gather information about all variable and fixed costs. The items considered on the cost evaluation were land preparation, management of the experimental plot (including labor), costs of input, small equipment and training materials, costs of personnel, monitoring costs and depreciation. In addition, the total costs of the method were divided in those incurred by the institution and those incurred by the farmer group (i.e. land preparation, labor for managing the crop and some inputs locally available).

Figure 3.2.5 shows that in the case of CARE, the average cost in the 2004-2005 and 2005-2006 season was US$ 820 and US$ 564 respectively. The cost of personnel was the most important item in the cost of the method, but tended to be optimized

when the staff gained experience on Pr. For example, in 2004-2005 cropping season, Care-Peru paid a lot of attention for monitoring (aiming at ensuring a correct implementation of the experiments and strengthening farmer organization) and this increased the cost of the method at the end. The type of technology under evaluation also influenced the costs. For example, up to 13 monitoring visits were needed for the case of evaluating native varieties and seed management through positive selection; whereas up to 29 follow-up visits were needed in the case of evaluating late blight resistant clones, which required close monitoring of the evolution of late blight disease.

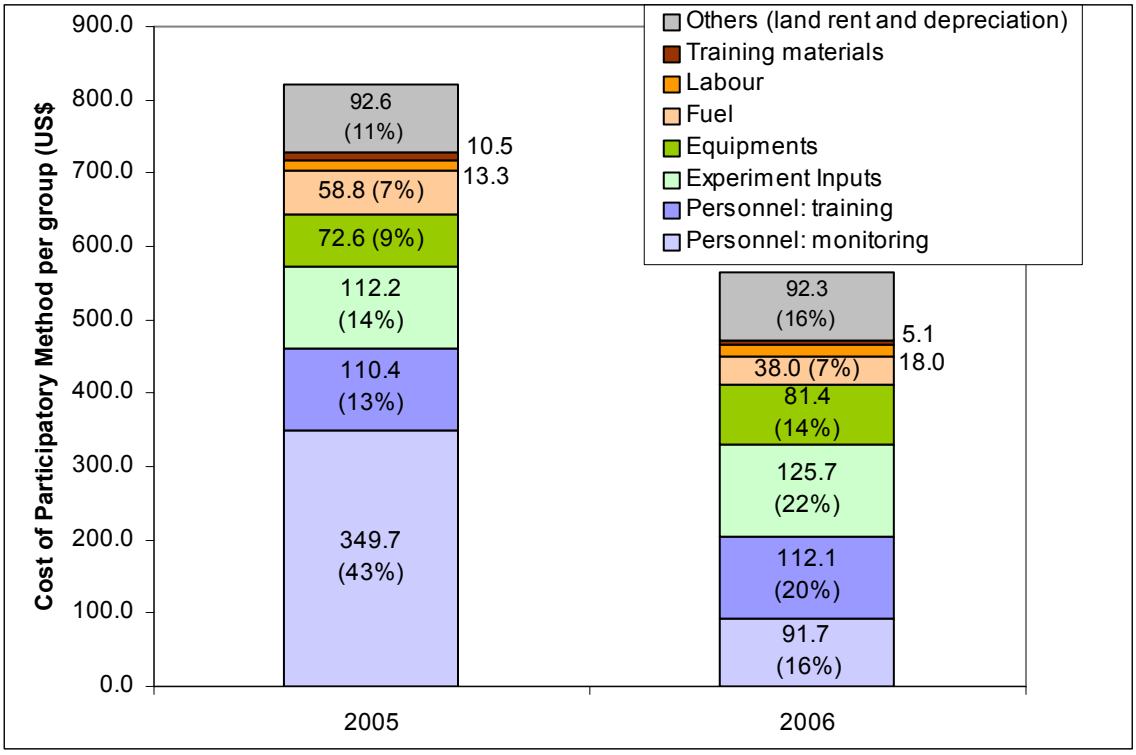

Figure 3.2.5. Average costs of nine FRG implemented by CARE-Peru during 2004-2005 and 2005-2006 cropping seasons in Huamachuco and Cajabamba, Peru.

In 2005-2006 cropping season, the CARE cost of implementing PR in the different groups went down an average of 35% reduction because of lower intensity of monitoring, which would reflect more real cost when the institutions acquire more experience with the methodology. The cost of the method is influenced by the level of salary and per diems that an institution pays, which could range from about US$ 300 to US$ 600 per staff member and month in the case of Peru.

The cost of the different methodologies evaluated in the project, including FFS and variations, FRG, seed multiplication under shared risk, and grant and monitoring approach is shown in Figure 3.2.6.

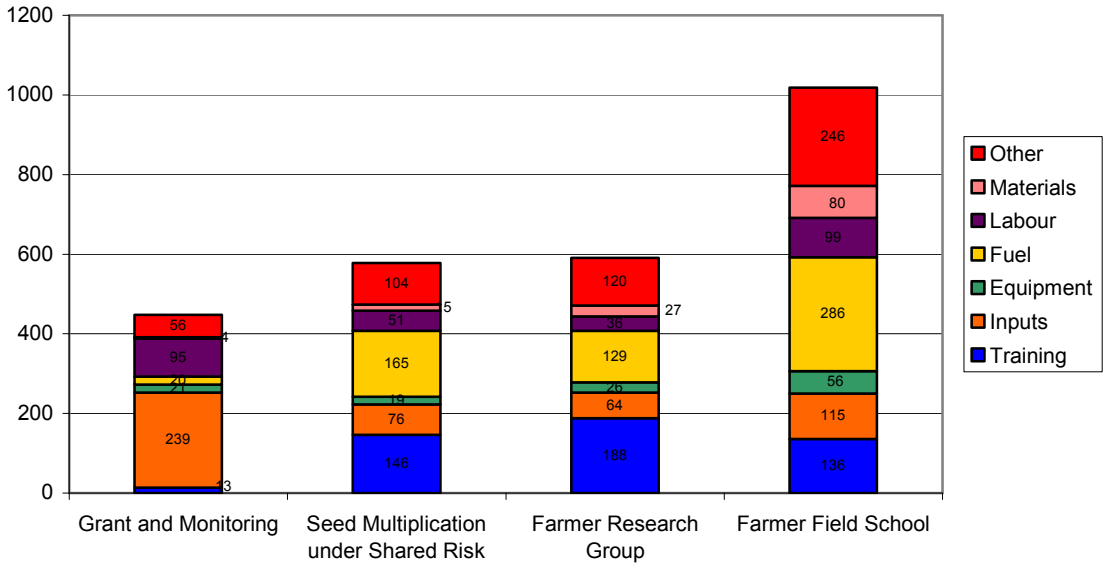

Figure 3.2.6. Average costs of 179 farmer groups from PR methods implemented by CARE-Peru, CIP, Proinpa, ASAR, NARO, AAMP, SHDI, and EIAR during 2004-2005 and 2005-2006 and 2006-2007 cropping seasons in Peru, Bolivia,Ethiopiu and Uganda.

* Others = Land hire + depreciation costs of equipments.

The average costs for both Farmer Research Groups and Farmer Field Schools for each season, were higher than the average costs of CIALS (US$ 325 to US$ 486) and FFS (US$ 532 – US$ 586) reported by Braun et al (2000), probably because of higher importance given to participatory research in FFS, the costs in the countries and organizations involved in the study; but as indicated, the cost of a method was influenced by the cost of staff time. The method of Grant and Monitoring and Shared Risk had lower costs because they involved less number of sessions and visits, and less time of facilitators and farmers. The technology being evaluated has also influenced the cost of the method as shown in Figure 3.2.7. Data indicate that conducting PR with input-based technologies was less expensive than doing PR on knowledge intensive technologies because of higher need for facilitation and training in the latter

case. However, these results were influenced for the lower cost of the Grant and Monitoring method, which emphasized input provision.

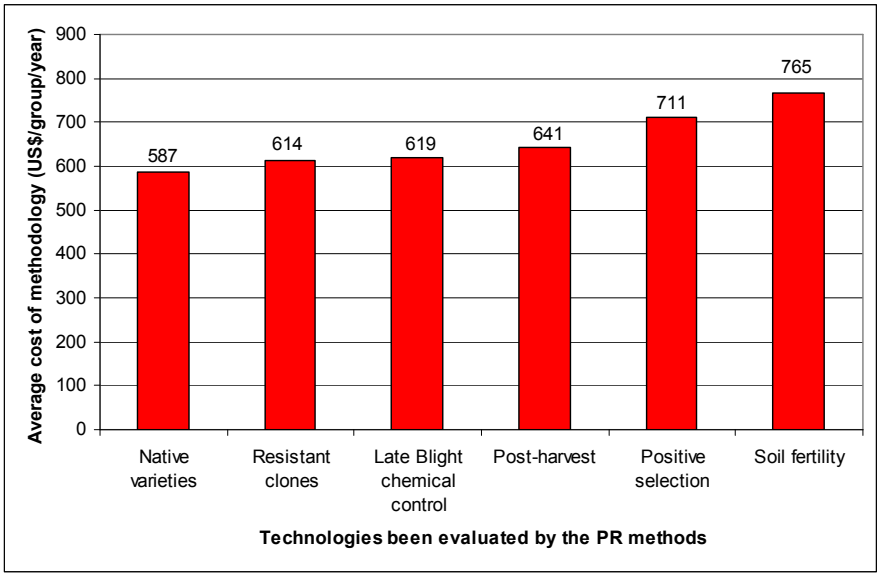

Figure 3.2.7. Average costs of the PR methods used according to the technology evaluated in Peru, Bolivia, Ethiopia and Uganda between 2004 and 2006. N=179 farmers groups (considered 1 farmer group as 1 group participating per season)

In terms of cost per farmer, the main issue to consider for its estimation was the number of farmers that indeed participated per group. There were small groups such as in Bolivia and Ethiopia, and relatively large groups in Peru and Uganda. In general terms, the average cost per farmer in FFS was US$ 55, the FRG had a higher average cost per farmer of US$ 66, mainly due to the lower number of farmers per group in Ethiopia, and the higher cost from FRG in Peru (Care-Peru had high monitoring costs). The lowest cost per farmers belonged to the methods of to Shared risk and Grant and monitoring with US$ 47 and US$ 20 respectively. This was because there was lower emphasis on actually evaluating technologies and providing training and groups were larger. These costs are in the range of costs reported by Quizon et al (2001), who indicate US$ 47.6 in the Philippines and US$ 62 in Indonesia, and criticized them as fiscally unsustainable. Actually, the criticism could be expanded to include any type of intervention system, not just to FFS or PR methods in general.

The Grant and monitoring methodology from AAMP (Uganda) was less costly, in terms of cost per farmer trained compared to other methods; however, little knowledge in potato production and management was provided to farmers during the process, where

the provision of inputs was emphasized. The study showed that farmers in this group lacked enough knowledge and skills especially in disease management. Therefore the method with input based technologies would be suitable to farmers who are already trained and have knowledge in all aspects of potato management.

An example of using this type of information for decision-making can be used here. Taking into consideration the lower cost per farmer of US$ 18 and the higher of US$ 90 in Peru, an investment of between US$ 1 million and US$ 5.4 million would be needed to have PR projects to involve at least 10% of the 600,000 potato growers in Peru, assuming that 10% of potato growers, selected from representative agro-ecological conditions would generate or validate technologies that could be scaled out to other farmers using dissemination means of lower cost. This assumption could work more easily on input-based technologies such as new potato varieties, but not so easily on knowledge-intensive technologies, where technology and training method are linked. However, the threshold of the proportion of farmers who would need to be involved in order to have a sufficient critical mass that could influence the other farmers is not yet known.

Therefore, the challenge of finding sustainable sources of funding for this type of investment remains, as indicated by Quizon et al (2001). In Peru, government income from taxes has been growing substantially in recent years, and it is envisioned that more income will be generated in the near future because of free trade agreements. However, no discussion has been initiated about using part of this income, or generating specific mechanisms to tax agricultural exports in order to generate a sufficiently large research and training fund to support the agricultural sector, which in turn would help farmers to take advantage of emerging market opportunities.

b.**The complexity and logistic support**

The results presented in the previous section not only imply that institutions need to have enough budget for conducting PR activities with the farmer groups, but also need to provide logistical support for the facilitators; for example, vehicles for transportation, offices and logistic systems that ensure timely availability of inputs and communication. The more intense the method the more logistic support is needed. Differences were observed between NGOs such as CARE, ASAR and AFRICARE, or private foundations such as PROINPA, which had structures and enough logistic support in place, compared

to local government institutions such as municipalities which did not specialize in agriculture-related interventions and therefore lacked sufficient logistic support. Scaling-out PR methods would need a complex and sophisticated logistic support, which would be part of the cost of implementation.

c. **Additional capabilities for staff**

To accomplish the objectives of the participatory approach and farmer's expectations, facilitators should have enough knowledge and skill to manage the field activities and session properly. When the method is more complex such as FFS, informants indicated that there would be more need to invest in human resources development, so that staff could have the necessary knowledge and skills to run FFS appropriately. In some cases, individuals within organizations tended to use the methods instrumentally, without enough understanding of PR principles, which affected the quality of the method and the results. Hence, the lack of knowledge represents individual barriers to PR as indicated by Bechstedt (2005). Sources of training about new PR methods were scarce in the potato innovation system, only being CIP in charge of supporting local institutions at the pilot areas. This is a critical factor because the scaling-up and out of PR methods, and the technologies derived from them, would require a well organized training system for interested institutions, which is lacking under the current conditions of the participating countries.

d. **Rate of success of PR and quality of technologies generated**

Research and development oriented institutions aim at providing appropriate technologies to farmers. Therefore, they also assess the efficiency of PR methods to develop or validate suitable technologies for the local conditions and take this as an important factor to be considered (see section 3.3).

e. **Contextual factors related to the characteristics of the potato innovation system**

The characteristics of the potato innovation system (organization and context) in each location also had an influence the way in which a technology and methodologies could be replicated. In the case of the Peruvian pilot sites examined, there were two types of potato innovation systems, one in San Miguel that was less developed, there were fewer

components, market was limited and potatoes were important mostly for home consumption. On the other hand, a dynamic system in Huamachuco with many components taking active roles, coordinating activities between institutions and strengthening capacities of peasant organizations. Across countries, similar differences were observed. For example, the Ugandan system was dynamic because potato was a cash crop and institutions were interested in its promotion, compared to Ethiopia where the potential exists, but still requires inter-institutional work, or compared to Peru and Bolivia, where potato has problems to be profitable in general, but where more varied components exist. The analysis suggests that replication of PR methods and technologies would be easier in dynamic potato innovation system where there is a clear interest in improving the potato system. However, as indicated before, the provision of suitable training for institutional actors would be a critical factor for the replication of PR experiences. In addition, a common characteristic of the potato innovation system in the four countries where the study was conducted was the limited interactions and coordination among organizations. The institutional context of participating institutions in Peru (CARE-Peru), in Uganda (NARO, AAMP and Africare), in Ethiopia (SHDI and EIAR) and Bolivia (PROINPA and ASAR) - institutions with experience and mandate related to promote agricultural development - was different from the institutions such as the Municipality of Baños del Inca, Peru, for which the involvement in potato-related PR was just one additional and relatively less important activity in its portfolio. Therefore, planning the introduction and scaling-up and out of participatory methods should start by understanding the local innovation system.

f. **Sustainability of financial support for PR**

Usually, PR projects last up to three years for the institutions involved, which according to the informant opinions was not enough to consolidate results. For example, the Municipality of Baños del Inca, started to work with PR methods in 2004, but the activities were stopped because of changes in administration as a result of new elections in 2006. In other cases, institutions such as Africare, SHDI, CARE, PROINPA, ASAR and CIP have projects that did not allow for a long-term strategic planning of participatory activities. In the case of CARE and AFRICARE in Peru and Uganda respectively, they were finishing large projects at the pilot areas, which decreased the

chances to sustain the PR interventions. On the other hand, governmental organizations like NARO and EIAR were more sustainable but had limited financial resources to lead the potato innovation system in Uganda and Ethiopia. In general terms, organizations did not institutionalize participatory activities in a way that core funds were allocated to them in a sustainable manner, as a result, PR activities tended to depend mostly on special project funds, which affects their scaling-up and out.

g. **Opportunities for inter-organizational learning**

Because of the lack of enough sources of new information in the potato innovation system, organizations tended to pay attention to opportunities for inter-organizational learning. The inter-institutional interactions among CARE-Peru, Municipality of Baños del Inca in Peru, PROINPA and ASAR in Bolivia, NARO and AFRICARE in Uganda, and EIAR and SHDI in Ethiopia, have been perceived a mechanism for accessing information, knowledge, technologies and methodologies by linking research and development organizations. The relationship between CIP and the organizations indicated above was also regarded as a mechanism to access new information about methods and technologies. Using the term of Lundy et al (2005), it is possible to say that "learning alliances" between national, international and farmer organizations were supported by the IFAD grant.

h. **Competition for farmer time and attention**

The existence of several organizations working in some of the communities involved in the study, particularly in Peru, represented in practice a competition for the time of farmers, and also a competition of working styles for attracting farmer attention. The lack of inter-organizational interaction in the potato innovation system was one of the causes of such competition, which reduced the time available for more efficient PR.

3.2.2.5. Conclusions related to the evaluation of PR methods and the analysis of factors that influence scaling-up and out.

The analysis of results from the case studies supported by the IFAD grant and presented in the document indicate that there are a number of factors that influence

decision-making by individuals and organizations when they assess their involvement in PR. At the level of farmers, the most important factors are the possibility of accessing to new knowledge, technologies, but also equally important is the possibility of strengthening the social capital (local organization), and the context of the agro-ecosystem. This situation indicates that not all farmers are motivated to work on PR, and that scaling-up and –out interventions should combine PR with other means of information and technology dissemination, including, for example, participatory training, farmer-to-farmer, and mass media, which would contribute to reduce the cost per farmer. In addition, time becomes a scarce resource for farmers and they tend to use it as a negotiation factors for selecting organizations to be involved with according to the potential benefits. At the level of PR practitioners, factors such as time management, access to logistic support, perception of farmer willingness to collaborate, perception of additional benefits, existing capabilities and skills, response to different types of demands and instability of institutions are factors that influence their involvement in PR. At the level of organizations, the cost of PR methods is a critical factor for decision-making and, therefore, finding ways to reduce this cost and increase coverage is a research topic that should be addressed. The complexity of the methods and the requirement of logistic support, the need to develop human resources within organizations for the new methods, the quality of technologies generated, the sustainability of financial support and contextual factors related to the AKIS-potato are also taken into consideration by organizations when making decisions to innovate regarding PR.

The influence of the context was highlighted at different levels and deserved a more detailed study, because if it is not enabling for PR, then there is a pressure opposed to innovation, and strategies need to be found to avoid this.

PR activities implemented by organizations are not in isolation; on the contrary, they are part of a larger innovation system. The lessons learned at the level of the organizations involved in this study are the starting point to understand how PR methods and the technologies derived from them could be scaled-up and out. Organizations need to transform their experiences into explicit knowledge, in the form of guidelines, so that other organizations in the system can use the information for improving future interventions. When talking about organizational innovation towards PR there is the need to promote intra and inter-organizational learning so that methods are adapted to the

local institutional and agro-ecological contexts. Organizations do not innovate in methodological terms until they have the chance of evaluating the methods on their own, so that they can make decisions based on their own experience.

3.3. Objective 3: Fill technology and knowledge gaps related to potato production in each site using basic and participatory research.

3.3.1. Introduction

In the previous chapters, the characterization of the potato innovation system and the evaluation of participatory methods have been presented. In addition to that, there was an objective oriented to fill technology and knowledge gaps according to needs identified by stakeholders at the pilot sites. A total of 249 participatory experiments were supported by the IFAD grant and the main results are extracted here. It is expected that a full analysis of results will be carried out by each partner institution and will be reflected in forthcoming scientific publications.

3.3.2. Main results of participatory experiments

3.3.2.1. Participatory experiments conducted during the project

Between 204 and 2007, participatory experiments were carried out using different participatory methodologies as Farmers Field Schools (FFS), Farmer Research Group (FRG), Shared Risk, Grant & Monitoring and Post Harvest and others. Table 3.3.1 describes the technologies evaluated and the participatory methods used. The experiments aimed at improving solutions to the main potato constraints at the pilot sites, which included late blight, low soil fertility, and lack of quality seed. In addition, the low profitability of potatoes was addressed in Peru through the evaluation of native variety cultivars with potential higher value for the market. In the case of Uganda this problem was addressed through trying to harvest a higher proportion of tubers with appropriated size for processing.

Table 3.3.1 Technologies and participatory methods used by organizations between 2004 and 2007.

Country	Technology	FFS	FRG	Other	Nº trials
Bolivia					
PROINPA	Integrated disease management-Late Blight			PPB	15
	Resistant varieties to late blight.			EX-FFS	10
ASAR	Quality seed			Shared risk	15
	Late blight resistant varieties	√			9
Ethiopia					
EIAR / SHDI	Integrated Disease Management-Late Blight	√	√		49
	Integrated Nutrient Management	√	√		28
	Post harvest management of ware potato	√	√		13
Peru					
CARE	Native varieties with market potential		√		7
	New potato clones with resistance to late blight		√		7
	Seed management through Positive selection		√		6
	Liming		√		1
Baños del Inca Municipality	Varieties and clones with resistance to LB		√		15
	Integrated Crop Management (focusing on Andean potato weevil control)		√		15
FFS Association	Integrated Crop Management: focusing on soil fertility management	√	√		15
	New potato clones evaluation with resistance to late blight	√	√		3
	LB control of varieties and clones with resistance.	√	√		9
Uganda					
NARO-AFRICARE	Integrated Disease Management-Late Blight	√	√		16
	Integrated crop management	√	√	G&M	8
	Fertilization	√	√	AAMP	8

3.3.2.2. Analysis of results of participatory experiments.

An analysis of the results of PR trials, indicates that only 2 % (5) of experiments were lost because a bad weather conditions, and 98% (244) were experiments that were harvested. However, there was 4% of experiments, which had results that were not useful either for statistical analysis or for farmers evaluation because of problems with the design. This was the case of evaluating methods for controlling the Andean potato weevil carried out by the Municipality of Baños del Inca in Peru. Therefore, 94% of experiments (234) were evaluated and harvested, and the results were useful in different ways for the different stakeholders, which means a relatively high rate of success in this respect.

In terms of the analysis of results, each organization made its own analysis, using statistical means (56% of cases), and others (44%) were not analyzed statistically or results were still under analysis.

According statistical principles, values of coefficient of variability (CV) should be between 9% to 29 % in controlled experiments; if we use that concept, from a sample of 97 experiments analyzed, 59% were within the range indicated. But from participatory research point of view, we could include values up to 39% of CV, which would means that 68% of experimental results coming from participatory trials could be acceptable results statistically speaking (Figure 3.3.1.), which gives an interesting rate of success for experimental results conducted closely with farmers under risky and difficult-to-control conditions.

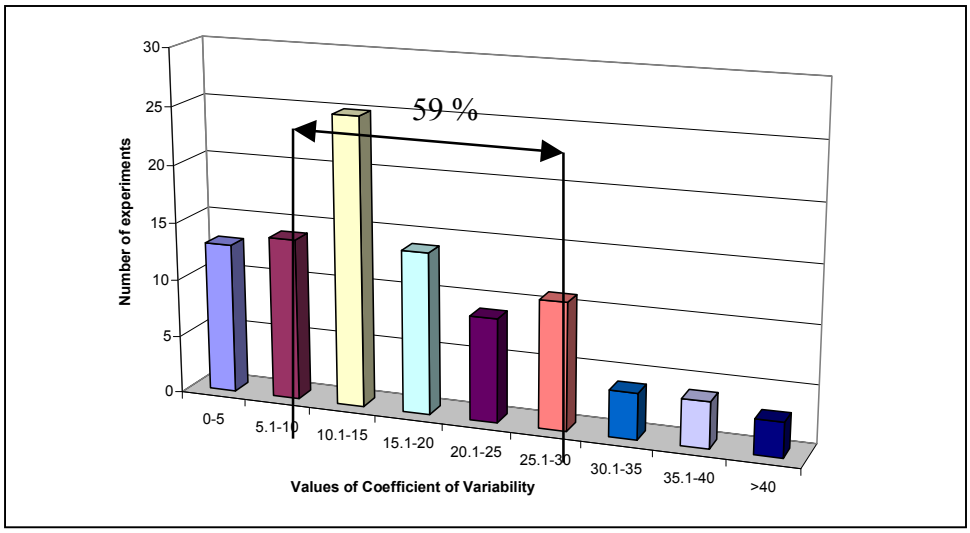

Figure 3.3.1. Values of coefficient of variability of a sample of 97 participatory experiments conducted by farmers and partner institutions in Peru between 2004 to 2007.

3.3.2.3. Main agronomic and economic results

As indicated before, this reports only highlights some of the key technological results generated during the project period. We envision that organizations will continue analyzing the results and scientific papers could be produced with those results. The results are described according to the main technologies evaluated and the analysis also consider differences between input-based and knowledge intensive technologies.

a. Control of late blight using fungicides

Different strategies of chemical control against late blight were evaluated in the four countries. Table 3.3.2 shows the variations in the technologies evaluated across sites. In some cases, organizations and farmers evaluated the alternation of different contact and systemic fungicides according weather conditions, in other cases they tested weakly spray regimes compare with applications based on monitoring. The use of decision support tools, such as the use of rainfall threshold was also evaluated in the case of Peru.

From a total of 33 experiments, 19 (58%) generated useful lessons for farmers, meaning technological results with high potential of being replicated by participants and/or neighbors; and also could be included by organizations in their technological

recommendations. However, in 8 experiments there were not conclusive results but good feedback to researches showing that some technologies still need to be improved. Providing feedback fulfilled one of the objectives of participatory research.

Table 3.3.2. Strategies for late blight control using different fungicides evaluated between 2004 and 2007 in the four countries.

Country	N° Exp.	Technology / treatments	Assessment
Bolivia	9	LB control. • Use of different contact and systemic fungicides.	Results showed that resistant varieties must be sprayed only with contact fungicide.
Peru	4	Evaluation of rainfall threshold • Sprays calendar each 21 days • Spray fungicides every 50 mm of precipitation.	Results were not clear. The technology needed to be adjusted. Feedback provided to researchers
	1	LB control strategic to susceptible native variety. • Alternations of different contact and systemic fungicides • Sprays with contacts fungicides	Late blight pressure too high. Experiment was lost.
	3	Use of Phosphite as alternative fungicides • Potassium phosphite • Spray contact and systemic fungicides • Sprays with contacts fungicides	Results not clear. The technology needed to be adjusted. Feedback provided to researchers
Uganda	8 8	**A**. Monitoring and spray • Weekly spray with contact fungicide • LB disease monitoring and integrating a contact a systemic fungicide • Unsprayed control B. Different fungicide regimes • 14 days interval spray with contact fungicide • Contact + systemic fungicides • Contact + systemic + contact fungicides • No spray	Monitoring and spray with contact + systemic fungicides; contact + systemic + contact fungicides were effective as fixed interval spray to LB control, but generated savings in fungicide use.
TOTAL	33		

As an illustration of results that were perceived as useful by farmers and researchers, in the case of Kabale, Uganda, two kinds of experiments were conducted. The first experiment aimed at testing three LB control strategies to demonstrate the effect of host resistant in combination with different spray regimes including a weekly spray with

Agro-zeb (contact fungicide); LB disease monitoring before spraying and integrating a contact a systemic fungicide, and a control with no spray. Additionally, three varieties with different level of resistant were used. The cultivar Victoria (CIP 381381.20) was used as susceptible variety, NAKPOT 4 (CIP 387121.1) as moderate susceptible and NAPKOT 5 (CIP 381471.18) as resistant to LB.

The second experiment was oriented to test spray regimes including: 14-day interval spray with Agrozeb 80WP, (14-DayM), two sprays -first with Agro-zeb then with Ridomil- at first LB symptom (M+R), three sprays- first with Agrozeb 80WP then with ridomil Gold at first disease symptom then Agrozeb 21 days later (M+R+M), and an unsprayed control (No spray) (Table 3.3.2). Additionally two potato varieties were used, Victoria and NAPKOT 5. These experiments were implemented in six sites conducted by NARO and AFRICARE.

Results of the second experiment indicate that LB severity was significantly ($P<0.05$) affected by trial site, fungicide spray regime and potato variety. All two-way interaction among main effects were highly significant ($P<0.001$). However, the greatest contribution to variability was due to fungicide spray regime and trial site, respectively.

Total tuber yield was significantly ($P<0.05$) influenced by all main effects (site, season, potato variety and spray regime). However, only the second order interaction between site by season, site by spray regime and spray regime by variety were significant ($P<0.05$). The greatest variability in yield was explained by trial site and fungicide spray regime.

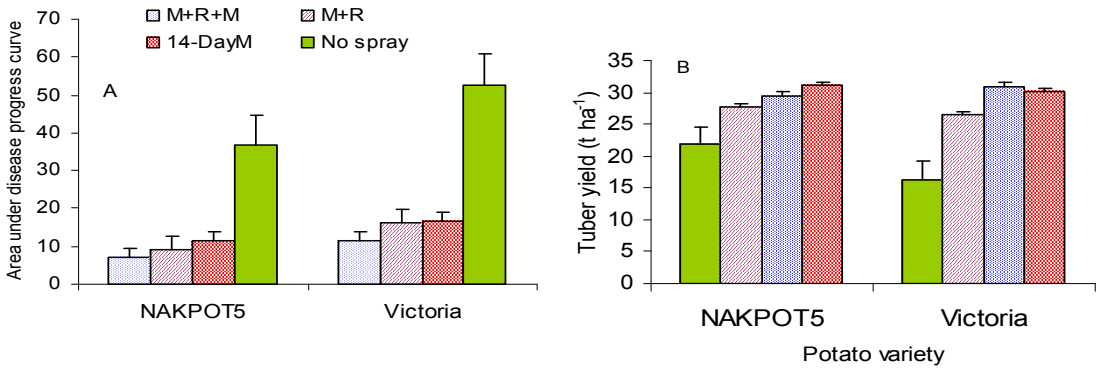

Figure 3.3.2. Effect of fungicide spray regime and potato variety o late blight relative area under disease progress curves (disease severity) and total tuber yield (t/ha.) in Kabale, Uganda in 2006, average results of six sites.

Comparison between varieties indicated that cultivar Victoria had higher rAUDPC than cultivar NAKPOT5 at each level of fungicide spray regime demonstrating the resistance of the latter variety. Spray regimes with a component of a systemic fungicide, i.e. M+R+M and M+R had lower disease severity than 14-day interval spray with a contact fungicide (14-DayM) (Figure 3.3.2). There was no significant difference between 14-DayM and M+R spray regimes for cultivar Victoria. This indicates that frequent sprays with a contact fungicide do not provide better protection than fewer sprays integrating a systemic and a contact fungicide.

Evaluations of yields across varieties and spray regimes indicated that unsprayed potato had lower yields than when fungicides were used. Total tuber yields were comparably similar between NAKPOT5 and Victoria for 14-Day interval contact fungicide spray and M+R+M spray regime (Figure 3.3.2).

In conclusion, the use of resistant cultivars pays off, but also the appropriate fungicide regime. Not using any control measure reduces yields significantly.

There were examples of technologies, which did not have clear results for farmers and researchers. In the case of evaluating rainfall thresholds (Photograph 3.3.3), results were not clear because, on the one hand, according to the scientists, this method works efficiently when the farmers plant commercial varieties with moderate levels of resistance. However, if they use this technology with susceptible varieties, the method does not provide sufficient information to support decision-making about appropriate spray regimes and LB was not properly controlled. On the other hand, there was a lack of farmers' understanding of the method, particularly the fact that they had to wait until the rainfall accumulates (50 mm of precipitation). In most cases, rainfall reached that amount in two or three days, but it was too soon to spray again. The conclusions were that this method requires adjustment to become a real decision support system for farmers.

Photograph 3.3.3. Domestic rain collector made with a plastic bottle.

b. <u>Evaluation of potato clones with resistance to late blight</u>

The research division on crop improvement (breeding) at CIP develops new clones with resistance to LB. These clone were sent to the different countries (except Bolivia) to be tested with farmers in a participatory way. Table 3.3.3 summarizes the number of experiments related to clone evaluations that were conducted between 2004 and 2007. Improved clones or varieties are considered to be input-based technologies.

Table 3.3.3: Participatory experiments conducted to evaluate potato clones with resistance to late blight in Bolivia, Ethiopia and Peru.

Country	N° Exp.	Technology / treatments	Assessment
Bolivia	27	Evaluation of LB resistant varieties using strategies recommended by PROINPA.	Varieties with resistance to LB had better performance.
Ethiopia	49	Evaluation Late blight resistant clones with and without fungicides.	Resistant clones were better, but use of fungicides was feasible with local susceptible varieties also.
Peru	3	Evaluation of LB resistant clones.	Resistant clones were better than resistant commercial varieties.

In La Mishca, Peru, three LB resistant clones were evaluated to observe late blight effects on yield. Farmers belonging to FFS in a previous project selected these clones.

These clones belonged to the "B" population of the breeding program of CIP, which has minor genes, and their advantages include high resistance to LB, high yield, good culinary quality and excellent characteristics for processing. CIP codes of clones evaluated are: 391696.96 (now is a new variety named Serranita in Peru), 392633.54 and 391011.17. The Amarilis variety (resistant) was used as control. The experiment was evaluated using a Randomized block design with 3 replications.

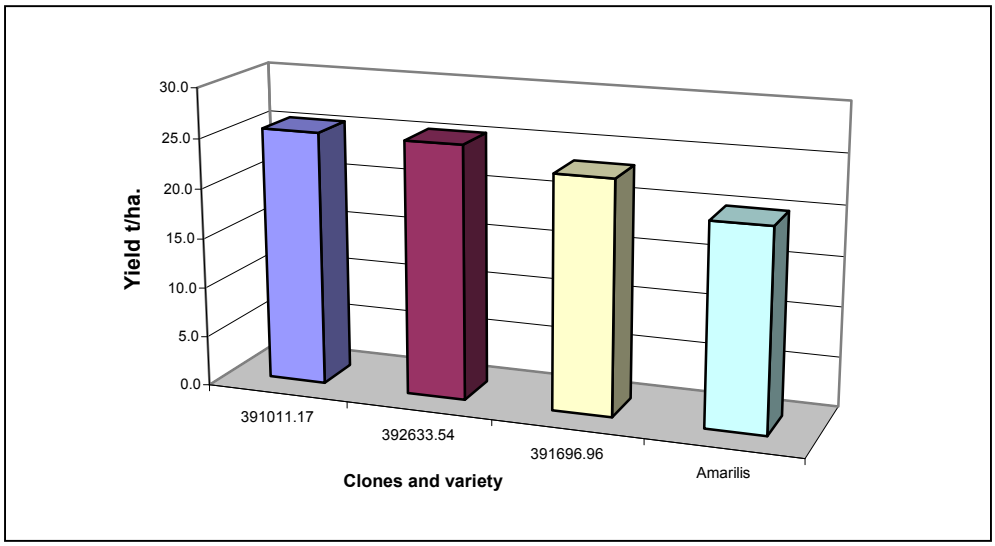

Figure 3.3.3. Total yield of resistant clones evaluated in La Mishca, San Miguel - Peru, 2004-2005.

Results showed that resistant clones had yields slightly higher than the control. Yield of clone 391696.96 (Serranita variety recently released) was the lowest but had 2.3 t/ha. more than Amarilis. Analysis of variance indicates that there were no statistical differences significant among control and clones, which means that the new clones could be used instead of the popular Amarilis variety. In addition, farmers perceived the new clones as having good quality, in addition to using less fungicide, which increases the possibility of adoption.

c. Control methods against the Andean potato weevil control

One of the IPM practices recommended against the Andean potato weevil (APW) is using ditches around the potato field, usually combined with a contact insecticide. The APW usually walks from field to field (this insect cannot fly) and is trapped into the ditches. This is a knowledge intensive technology, which requires that farmers understand the life cycle and behavior of this insect so that they also understand why they should use the ditches. A total of 12 experiments were conducted in Peru in coordination with the local Municipality of Baños del Inca. However, the results did not show visible effects of the ditches because it was difficult to estimate the APW population existing in the fields and the infestation sources. The lesson learned here was for researchers who should think of alternative ways of evaluating this technology to ensure that effects are measurable and visible for farmers.

d. <u>Evaluation of native potato varieties with market potential.</u>

Native potatoes are grown only in the Andes and are usually consumed by highland farmers due the excellent quality. Because of the good quality, those varieties have excellent market opportunities and good and stable prices. Varieties in general are input-based technologies.

At the beginning of the project in Calvario, Cargache and Rumi Rumi communities of the Peruvian Northern highlands, farmers evaluated a set of seven natives varieties. After two seasons of evaluation, only two were selected namely Peruanita and Huagalina, which were recommended to be promoted among farmers and organizations.

In 2006 these varieties were compared with a commercial variety with resistance to Late blight, called Amarilis.

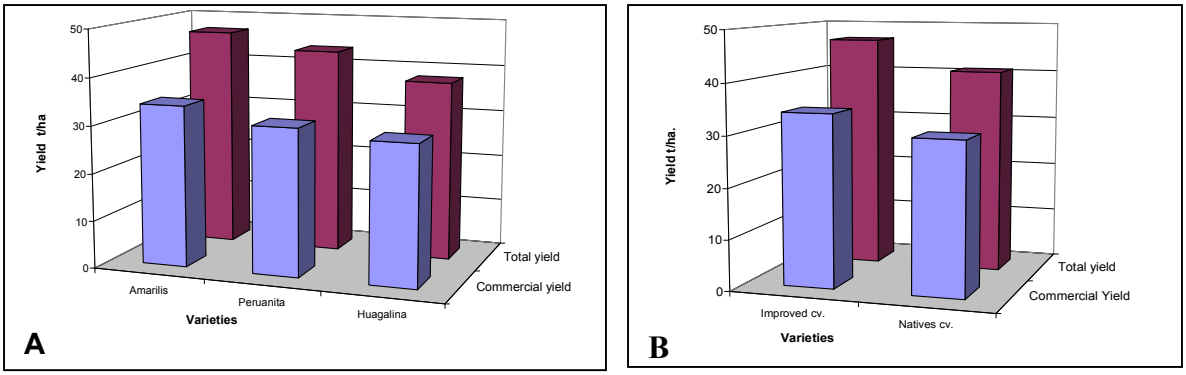

Figure 3.3.4. (A) Total and commercial yield of two natives varieties; and (B) average natives varieties compared with cultivar Amarilis. 2006 cropping season, Calvario and Cargache and Rumi Rumi communities, Peru.

According the analysis of variance, there were no significant differences among the yields of the improved variety Amarilis and the native variety Peruanita, but both were significantly different from Huagalina. Total yield of Amarilis was 46.8 t/ha with 34 t/ha of commercial yield, while average total yield of both native varieties was 40.7 t/ha with 30.06 t/ha of commercial yield. When data was analyzed through orthogonal contrasts between average of native varieties and Amarilis, results were not significantly different either. Results indicate that native varieties have also high yielding potential contradicting the fact that improved varieties yield better. In addition, economic analysis based on partial budget analysis was carried out, and results indicated a clear advantage in additional net income on the part of the native varieties was better because of higher

prices in the market (Figure 3.3.5). According to the results, facilitating farmers' access to markets of these potential high-value varieties represents an opportunity for increasing income for highland farmers of Peru.

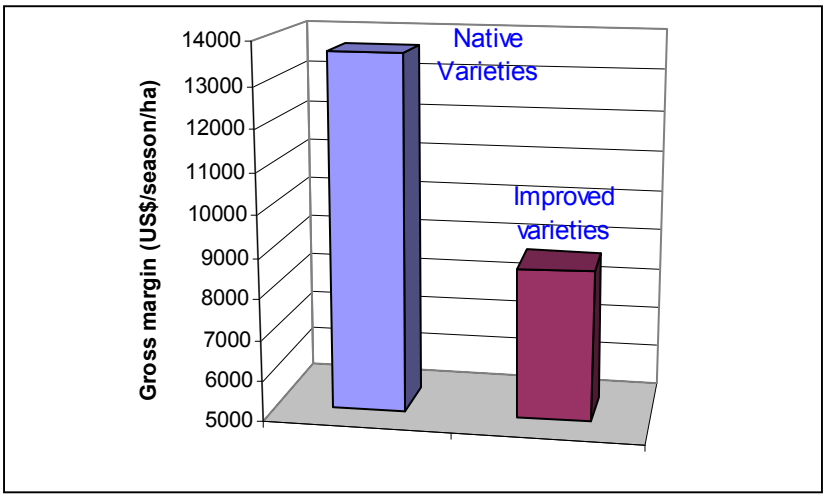

Figure 3.3.5. Advantage of native varieties in familiar income. 2006 cropping season, Calvario and Cargache and Rumi Rumi communities, Peru.

e. <u>Evaluation of quality seed produced with positive selection.</u>

The lack of quality seed was identified as one of the main problems at all pilot sites, but only in two of them, specific experiments were conducted to evaluate alternatives. In the case of Peru, six experiments were conducted over three cropping seasons to test the added value of positive selection. Managing seed through positive selection can be considered as a knowledge intensive technology because farmers need to know how to recognize healthy from unhealthy plants and particularly to identify symptoms of virus diseases.

In Cushuro and Raumate communities in Peru, different types of quality seed of Amarilis variety were compared during three growing seasons. The idea was to evaluate yield according to seed sanitation status. The treatments were 1) local farmer seed with no selection (loc 0506), 2) local farmer seed selected with positive selection for one season (loc0405), 2) certified seed with two seasons of multiplication with positive selection (cert0405) and new certified seed (cert0506). These treatments were evaluated in a complete randomized block design.

Results in both communities showed that there were no statistical significant differences in yield between both two and one year certified seeds suggesting that

degeneration did not occur or its influence did not affect yield from one year to the other. However, yields of certified seed were statistically different from local seed yield because of better health status.

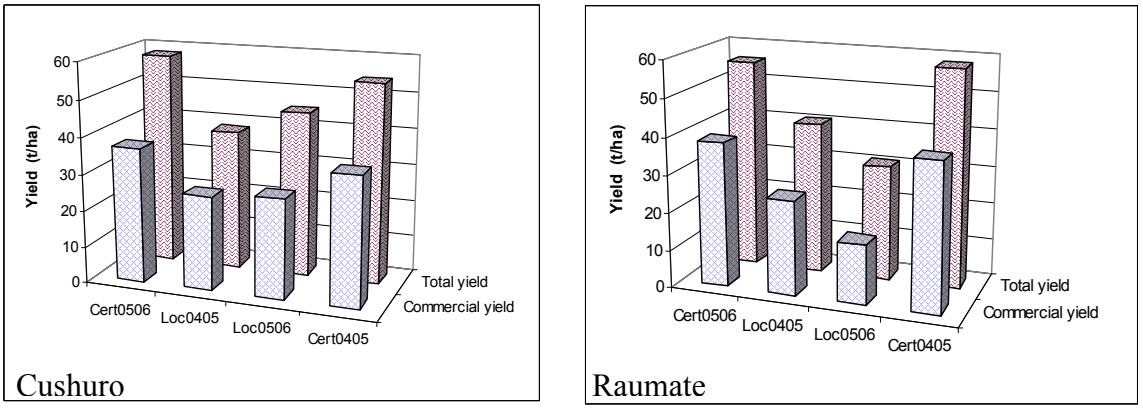

Figure 3.3.6. Results of Cushuro and Raumate communities showing total and commercial yield. 2004 – 2006 cropping seasons.

In Cushuro, yield of new certified seed was statistical better than the certified seed with two years of multiplication (58 and 54 t/ha respectively). On the contrary, in Raumate yield of certified seed with two years of multiplication and positive selection was better than the yield of new certified seed with 58t/ha and 56 t/ha respectively (Figure 3.3.6).

Whereas in Cushuro the results of positive selection in local seed did not show a clear improvement of yield, in Raumate, it was clear that positive selection increased the yield in 33% (from 30 t/ha to 40 t/ha). It was also clear that, being a knowledge intensive technology, the differences across communities could be explained because of different understanding of the principles involved and differences in the skills. Farmers in Raumate understood the principles better than in Cushuro. These results suggest that farmers can improve the quality of the local seed using positive selection, which could become a better alternative than buying certified seed, which is expensive and scarce.

f. Evaluation of technologies related to soil fertility management

From the experience at each pilot site, it was clear that factors such as the poor quality of soil, deficient soil fertility, increasing soil erosion and over cropping could influence potato yields. A total of 51 experiments were carried out in Ethiopia, Peru and

Uganda aiming at finding local alternatives to improve soil fertility as part of potato management.

Table 3.3.4 shows a summary of the experiments and their results across countries.

Table 3.3.4: Participatory experiments conducted to assess soil fertility technologies in Ethiopia, Peru and Uganda between 2004 and 2007.

Country	N° Exp.	Technology / treatments	Assessment
Ethiopia	28	Treatments: • Organic fertilizer application (recommended rate) • Inorganic fertilizer application (DAP 195 Kg/ha & Urea 165 Kg/ha) • Combination of both organic and inorganic fertilizers (half recommended rates) • Zero fertilizer application (Control)	Yields were better using inorganic fertilizer application, but chemical fertilizers were very scarce and expensive in rural areas. Therefore, mixtures with organic fertilizers could also be an alternative.
Peru	6	Treatments: • Manure (farmyard) • Chemical sources • Manure & chemical combined • Farmer mangement	Use of combined fertilization was better; but manure fertilization was recommended because yields were higher than those with chemical sources.
	2	Treatments regarding the use of lime • Add calcium sulphate • Without calcium sulphate	Results were not visible in one cropping season.
	2	Response to levels of fertilization • Sub doses • Optimal doses • Over doses	Optimal dose fertilization was recommended.
	2	Organic fertilization • Local manure (farmyard) • Humus • Commercial manure • Complete fertilization	Commercial manure and manure generated similar yields, but local manure was recommended, because commercial manure was too expensive.
	3	Effect of Nitrogen levels • 50% less than optimum N level • Optimal N level • 50% more than optimum N level	Optimum nitrogen doses were recommended.
Uganda	8	Rates of fertilizer to obtain higher proportion of tuber sizes for the industry • 0, 40, 80, 120 and 160 Kg/ha of NPK 17:17:17 fertilizer.	The use of 120 to 160 Kg of NPK was recommended.

From a total of 51 soil fertility participatory experiments, 96% (49) were useful to increase farmers knowledge, these experiments helped them to have a better understanding about the behavior of organic and inorganic fertilizer according to types of soil. Most of the experiments generated useful results for farmers and only 2 experiments related to adding lime to acid soils in Peru were not conclusive because this technology needs a long time to change the characteristics of the soil and have effects on yields.

As an example, in Ethiopia, four kinds of fertilizer types were evaluated, including organic fertilizer application (recommended rate), inorganic fertilizer application (DAP 195 Kg/ha & Urea 165 Kg/ha) and combination of both organic and inorganic fertilizer application (half recommended rates) and a control without application. This experiment was conducted in Randomized Complete Block with three replications, and was evaluated through both FRG and FFS approaches in Jeldu, Dendi, Wolmera and Alemaya districts, using cultivars Jalenie, Menagesha, Tolcha during two cropping seasons.

Results from FRG showed that inorganic application gave significantly higher yields followed by the mixture of organic and inorganic fertilizers, except in Jeldu 2005 (Figure 3.3.7). Averages of all treatment indicated that application of inorganic fertilizer gave 6 % yield advantage over the control while inorganic fertilizer application gave 45 % yield advantage over the control. The mixture of organic and inorganic fertilizer gave 20 % lower tuber yield compared to inorganic fertilizer applied treatment but gave 19 % and 25.3 % more yield over the organic and the control, respectively.

These results were completely different obtained through FFS; where variation was found among varieties, treatments and sites. The results related to soil fertility treatments depend on the type of soil, so it would not be possible to make general recommendations. This also justifies the need to conduct participatory research so that farmers can assess the technologies by themselves according to local conditions.

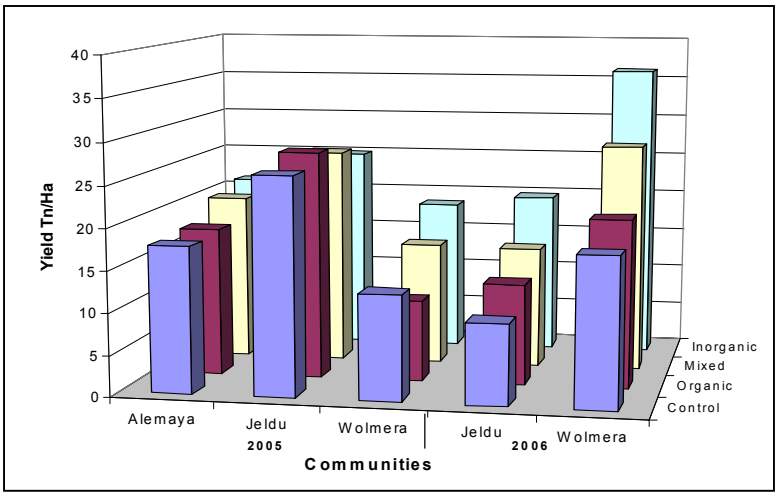

Figure 3.3.7. Effect of soil fertility treatments on potato tuber yield (t/ha) at different locations in 2005 and 2006 growing season with Farmer Research Group (FRG). Ethiopia.

Average of all treatment indicated that application of inorganic fertilizer gave the highest yield advantage (55 %) over the control whereas application of the mixture of organic and inorganic fertilizers gave 51 % more over the control. Application of organic fertilizer gave the lowest percent yield advantage compared to inorganic and the mixture of the two; however, it gave 32 % more yield over the control.

Variety Degemegn generated the highest yields in both seasons compared to variety Jalenie and Menagesha (Figure 3.3.8). In 2005 variety Degemegn gave 5 % more tuber yield compared to Jalenie but yield differences between variety Degemegn and Menagesha did not exceeded 1 %. In 2006, Degemegn gave 37.3 % more tuber yield compared to the yield obtained from variety Jalene. This yield variation may not be attributed to the yield potential of the variety but it may be due to the variation in the soil fertility status of the field.

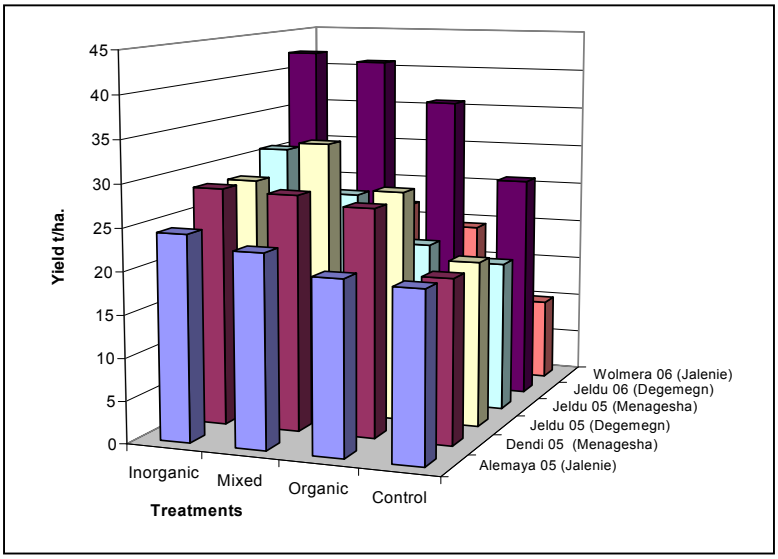

Figure 3.3.8. Response of potato varieties to soil fertility management in FFS fields at different locations, in 2005 and 2006 season. Ethiopia.

In general, application of inorganic fertilizers lead to attain higher tuber yield in all locations and in all varieties except the yield obtained at Jeldu site in 2005, where mix of organic and inorganic fertilizer gave 14 % more compared to inorganic fertilizer applied treatment. But mean tuber yield differences between inorganic and mixed fertilizer treatments were not significant. Application of organic fertilizers gave about 7 % more tuber yield compared to the control plot, which did not justify the marginal cost of preparing and using organic fertilizers. However, this type of fertilizers may have positive effects beyond the potato season.

g. Evaluation of post-harvest technologies.

Storing ware potatoes was considered a priority in Ethiopia where potato tubers are usually stored in the soil, with the consequent losses caused by diseases and insects. Therefore, an alternative type of storage facility for ware potatoes was compared to farmers' practice in 13 experiments (Photograph 3.3.2). The collected data on weight loss reveals that there was no variation among the local and the improved methods of ware potato storage for all varieties studied. However, qualitative data showed that there was a significant variation between the storage methods in terms of taste, color change, sprouting and pest infestation, favoring the improved method.

It was observed that following farmers' practice, which consists of storing potato on the ground under beds, exposes the tubers to rapid sprouting, color and taste changes within few days. Especially in Alemaya district the tubers stored in the ground pits showed rotten and excessively sprouted tubers almost totally unlike the ones put in improved structures. In addition, piecemeal harvest exposed the tubers for pest infestation. Even though, it is possible to use potato for ware through piecemeal harvesting for some months, the loss through pest infestation is extremely high. Thus, this method and other farmers' practices are not effective for handling ware potato.

Photograph 3.3.2. Ware potato store in Alemaya, Ethiopia. 2006.

h. <u>Evaluation of agro-input supplies for potato management</u>

In Uganda, the Area based Agricultural Modernization program (AAMP) supports farmers with seed potato, fertilizers and pesticides with the aim of demonstrating them the benefits of agro-inputs in increasing potato yield for commercialization. Therefore, eight participatory experiments using agro inputs for improving potato production for commercialization were conducted. Results indicate that AAMP support with improved agro-inputs (improved seed, inorganic fertilizers and fungicides) resulted in increased potato yields, and were statistically different from the non-AAMP supported unimproved agro-inputs (un-improved seed and non-use of agrochemicals) (Figure 3.3.9).

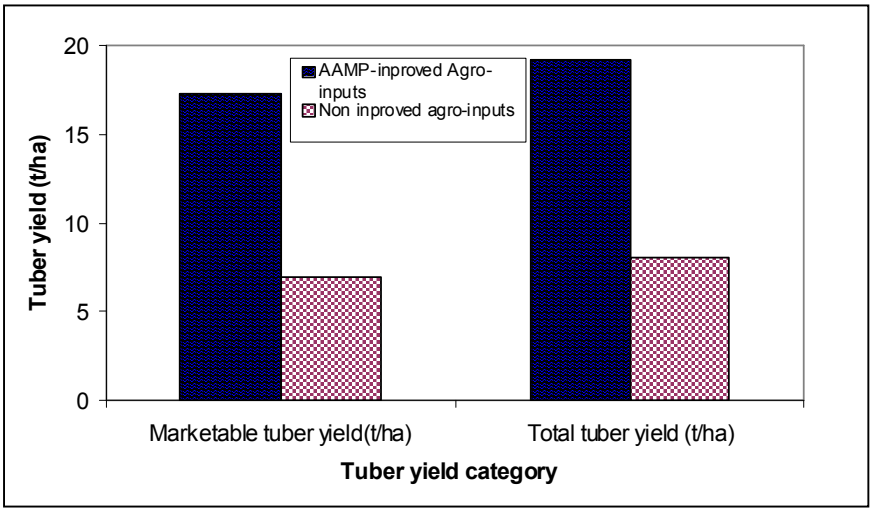

Figure 3.3.9. Total and marketable tuber yield of potato from AAMP supported improved agro-inputs (seed, fertilizer and fungicides) and non-AAMP supported un-improved agro-inputs (by five AAMP supported farmer groups) in Buhara sub-county-Kabale district (2004 B and 2005 A).

In the same way, in locations where AAMP supported farmer groups with only improved seed and fungicides but no fertilizer, yields were higher than the non-AAMP supported farmers who used un-improved seed with no fungicide and fertilizer application, but the difference was not very significant.

3.3.3. Conclusions from agronomic results generated through participatory research

Most of the experiments have generated useful information for stakeholders, particularly farmers. However, it has been observed the difference between input-based technologies and knowledge intensive technologies. It is easier to implement and to evaluate a technology based on potato seed, clones or fertilizers because the effects on yield are clearly expressed and farmers can observe the results clearly as well. Input-based technologies do not require substantive training for farmers unlike knowledge intensive technologies that require farmers to understand biophysical principles of crop management before using a technology, so suitable training (for example through FFS) becomes essential for participants to be able to internalize new concepts such as biological cycle, pest behavior, the relationship of diseases and insects with the environment, identification of disease symptoms, etc. In the same way, it is critical that

facilitators also improve their understanding of those principles to be able to help farmers' learning process.

The analysis of results indicated that a significant proportion of the results that came from participatory experiments could be analyzed also in statistical terms with acceptable coefficients of variability, which highlights that farmers can be real partners in research despite the variable conditions in which they operate.

3.4. Guidelines for Decision Making based on the results of the project

3.4.1. Introduction

The results presented in the previous sections of the report aimed at contributing with key information for enhancing institutional decision-making regarding PR. In this section, key pieces of information are summarized according to each PR method evaluated with the IFAD grant.

Some papers have already been produced reflecting on the institutional experiences, which could also support decision-making. In the paper by Ortiz et al., (2008), the inter-institutional experience of CIP and CARE in Peru for the last 12 years was documented, in which the support of the two last IFAD grants is highlighted (see Appendix 1). In addition, the paper by Ortiz et al., (2007) reflects on the main results presented in this report and was presented to a recent workshop analyzing participatory research after 20 years of the launching of the "farmer first" approach (Appendix 2).

3.4.2. Results about PR methods

3.4.2.1. Farmer Field Schools

The investment:

a. What is the cost of running one FFS? (Including personnel, inputs, training materials, etc.)
   - From US$ 667 for soil fertility in Uganda (23 participants) to US$ 1,554.95 for IDM-LB in Ethiopia (25 participants).
b. What is the average cost of one participating farmer?

- From US$ 28.3 for soil fertility dose in Uganda to US$ 93.5 also for soil fertility in Uganda.

c. What type of logistic support should a FFS facilitator have?
   - Transportation (usually motorbike).
   - Stationery and small equipments/materials to train farmers.
   - Camera for documentation.
   - Allowance.

The human resources needed:

a. How many FFS could one facilitator run efficiently?
   - One facilitator can run five to six FFS in one season.

b. What type of skills should a FFS facilitator have?
   - High spirit of teamwork.
   - High communication skill with farmers.
   - Good background of agricultural knowledge.
   - Strong commitment, patience, sociability, ability to brainstorm farmers, respect and love for farmers.

c. What type of training should an FFS facilitator receive?
   - Training that helps him/her to acquire high leadership quality and facilitation skills.
   - Training regarding group dynamism.
   - Training on participatory development.
   - Training on rural sociology and extension.
   - Technical training on potato production.

d. What type of technical/ methodological supervision should a facilitator receive?
   - Regular follow up whether the methodologies and technologies are being implemented correctly. The quality of the implementation makes a difference.
   - Follow up whether the field sessions are going on according to plan
   - Technical backstopping from researchers.

- Frequent supervisions and encouragements from the institution administrators.

The technologies with which FFS work better

a. It would be preferable to use FFS with the following technologies:
   - **Integrated disease management**, **soil management and seed management through positive selection** because these are knowledge intensive technologies, which require hands-on learning processes in order to facilitate farmer understanding of complex concepts. For this purpose FFS was found to be the best participatory research approach to train the farmers effectively.

b. It would **not** be preferable to use FFS with following technologies:
   - **Evaluation of varieties with resistance to late blight** and **Post harvest management of ware potato** because this technology is input-based and does not require intensive training. Therefore, farmer research groups with less emphasis on training would be recommended.

3.4.2.2. Farmer Research Groups

The investment:

a. What is the cost of running one FRG? (including personnel, inputs, training materials, etc.)
   - From US$ 157 for post-harvest in Ethiopia (5 participants) to US$ 1049 for resistant clones in Peru (7 participants).

b. What is the average cost of one participating farmer?
   - From US$ 22.3 for natives varieties in Peru to US$ 348 for resistant clone evaluation in Bolivia.

c. What type of logistic support should a FRG facilitator have?
   - Transportation.
   - Stationary.
   - Camera for documentation.

- Allowance.

The human resources needed:

a. How many FRG could one facilitator run efficiently?
   - One facilitator can run nine FRG in one season.

b. What type of skills should a FRG facilitator have?
   - High communication skill with farmers.
   - Good background of agricultural knowledge.

c. What type of training should an FRG facilitator receive?
   - Training on participatory research.
   - Training on rural sociology and extension.
   - Technical training on potato production.

d. What type of technical/ methodological supervision should a FRG facilitator receive?
   - Regular follow up whether the technologies are being implemented correctly
   - Follow up whether the farmers have undergone meetings on their fields and discussed progress
   - Technical backstopping from researchers.

The technologies with which FRG work better

a. It would be preferable to use FRG with the following technologies:
   - **Evaluation of varieties with resistance to late blight** and **Post harvest management of ware potato** because this technologies are input-based and do not require intensive field training sessions and intensive facilitator role. It can be demonstrated to the farmers with less supervisory role of the facilitator.

b. It would not be preferable to use FRG with the following technologies:
   - **Integrated disease management** and **soil management** because these technologies require regular field sessions to be effectively understood and sustainable implemented by farmers.

3.4.2.3. Seed Multiplication under Shared Risk

The investment:

a. What is the cost of running one shared risk with an average of 12 participants? (Including personnel, inputs, training materials, etc.)
   - From $US. 374 in the third year to $US. 900 in the first year.

b. What is the average cost of one participating farmer?
   - From $US. 26.3 to $US. 74.2.

c. What type of logistic support should a FFS facilitator have?
   - Transportation (permanent).
   - Stationery and small equipments/materials to train farmers.
   - Camera for documentation.

The human resources needed:

c. How many shared risk could one facilitator run efficiently?
   - One facilitator can run five share risk groups in one season, each group with an average of 12 participants.

d. What type of skills should a FFS facilitator have?
   - Be horizontal in the learning process.
   - Facilitate tools to make farmers learned and adopt technologies.
   - Good background of agricultural knowledge.
   - Be proactive to make the information useful to farmers.

e. What type of training should a shared risk facilitator receive?
   - Training on participatory development.
   - Training on monitoring and evaluation of farmer's groups.
   - Technical training on technical issues.

g. What type of technical/ methodological supervision should a FRG facilitator receive?
   - Bi-annual follow up of the responsible of the project to enhance skills and adjust weakness that can happen during the process.
   - Annual technical report of the progress of the project.

The technologies with which shared risk work better

a. It would be preferable to use shared risk with the use of certified potato seed because with a proper management of high quality potato seed will generate high productivity and plus the higher price of potato seed compared with table potato price will increase farmer's income and thus will make the methodology sustainable, assure availability of potato seed of next cropping seasons, and avoid proliferation of pest and diseases.
b. It would **not** be preferable to use shared risk with the implementation of informal seed because cost analysis don't show positive economic benefit for farmers while there is no guarantee for clean seed.

3.4.2.4. Grant and Monitoring

The investment:

a. What is the cost of running one grant and monitoring method? (Including personnel, inputs, training materials, etc.)
    - From US$ 291 to US$ 594.
b. What is the average cost of one participating farmer?
    - From US$ 11.7 to US$ 25.2.
c. What type of logistic support should a FFS facilitator have?
    - Transportation (permanent).
    - Stationery and small equipments/materials to train farmers.

The human resources needed:

c. How many shared risk groups could one facilitator run efficiently?
    - One facilitator can run eight grant and monitoring groups in one season.
d. What type of skills should a FFS facilitator have?
    - High communication skill with farmers.
    - Good background of agricultural knowledge.
e. What type of training should a shared risk facilitator receive?
    - Training on participatory development.
    - Training on monitoring and evaluation of farmer's groups.

- Technical training on technical issues.

f. What type of technical/ methodological supervision should a FRG facilitator receive?
   - Follow up of the responsible of the project.
   - Technical report of the progress of the project.

The technologies with which grant and monitoring work better

a. It would be preferable to use grant and monitoring with the use of high yielding and disease resistant potato varieties.
b. It would **not** be preferable to use grant and monitoring with the promotion of fungicides or fertilizer because they are unaffordable and not easily accessed for Ugandan farmers.

3.5. Governance of the project.

The steering committee (SC) was the main governance mechanism of the project, which included representatives from each country and the coordinating institution (CIP). The idea was that the SC could guide the project implementation, assess the progress and provide the general guiding principles that were used by the institutions to define specific work plans. The Steering Committee included Juan Demeure, Rolando Oros (PROINPA, Bolivia), Guillermo Frias (CARE-Peru), Ignatius Kahiu (Africare, Uganda), Gebremedhin Wgiorgis (EIAR, Ethiopia), and Oscar Ortiz (Coordinator, CIP).

The SC members evaluated the progress of the project based on the reports submitted and the presentations during the annual meetings. They provided comments about the reports and presentations and cross checked with the logic framework of the project, initially approved by IFAD. In general terms, SC members agreed that the project made good progress in most of the countries during the three years of implementation, with some members indicating fair progress in some cases. Monitoring and evaluation were identified as key elements for the last phase of the project, and partner institutions were urged to prioritize the selection and monitoring of key indicators for data collection.

3.6. Financial report

A copy of the financial report of the project is included here.

3.7. References

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3.8. Appendixes

Appendix 1. CIP – CARE experience documented. Abstract of the paper accepted for publication in the Agriculture and Human Values Journal in early 2008.

Organizational learning through participatory research: CIP and CARE in Peru.

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Abstract. Participatory research (PR) has been analyzed and documented from different points of view, with emphasis on the benefits generated for farmers. The effect of PR on organizational learning has, however, received little attention. This paper analyzes the interaction between a research and a development institution, the International Potato Center (CIP) and CARE in Peru, respectively, and makes the case that PR can contribute to creating a collaborative learning environment among organizations. The paper describes the evolution of the inter-institutional collaborative environment between the two institutions for more than a decade, including an information-transfer period (1993–1996), an action-learning period (1997–2002), and a social-learning period (2003–2007). Several lessons learned from each period are described, as are changes in institutional contexts and stakeholders' perceptions. The case shows that research and development-oriented organizations can interact fruitfully using PR as a mechanism to promote learning, flexibility in interactions, and innovation. Interactions foster the diffusion of information and the sharing of tacit knowledge within and between organizations, which in turn influences behavior. However, the paper also argues that long-term inter-organizational interactions are needed to facilitate learning, which can be used to influence the way organizations implement their interventions in a constantly changing environment.

Key words: Impact assessment, Institutional learning, Interactive learning, Participatory research, Peru.

Appendix 2:

Participatory Research and Potato-Related Innovation Systems in Bolivia, Ethiopia, Peru and Uganda.

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Paper to be presented in the "Farmer first revisited: farmer participatory research and development twenty years on" Institute of Development Studies, University of Sussex, Brighton, UK. 12-14 December 2007.

Abstract
This papers presents the experience of trying to understand the potato innovation systems, the component stakeholders, their interactions, and particularly looks at the factors that farmers, field practicioners and institutions take into consideration when dealing with participatory research (PR), which includes the perceived benefits, costs, skills and contextual aspects needed to engage in PR meaningfully. The paper presents the analysis of innovation systems in Bolivia, Ethiopia, Peru and Uganda, and the view of the main stakeholders about PR, and the implications for scaling-up and out of PR approaches.

Full version in: http://www.farmer-first.org/

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