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Inclusive innovation in agricultural value chains: lessons from use of a systems approach in diverse settings

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ABSTRACT

Systems approaches are widely promoted for inclusive innovation, but their use and results are seldom evaluated. We assessed applications of the Participatory Market Chain Approach (PMCA), which combines elements of innovation system and value chain approaches, in eight cases in Africa, Asia, Europe, and Latin America. We found that the PMCA performed best where the policy environment favoured value chain development, the chain offered significant potential for value addition, and the PMCA was implemented with high fidelity to its basic principles, and as part of a larger development effort. Facilitation was crucial for developing locally appropriate implementation procedures and engaging smallholders, commercial entrepreneurs, researchers, and other service providers throughout the PMCA application. By focusing on commercial innovation, the PMCA offered a strategic entry point for stimulating more systemic innovation. We conclude with six lessons on (1) how commercial innovation can trigger broader innovation; (2) the need to engage commercial entrepreneurs in innovation processes; (3) the importance of committed, motivated and capable facilitators; (4) the advantage of embedding the PMCA in a broader development effort; (5) how systems approaches can help R&D organizations respond better to market demands; and (6) the contributions of systems approaches to innovation capacity.


KEYWORDS

Agricultural research; collective action; innovation system; marketing; social capital; value chain development

1. Introduction

Systems approaches are increasingly being advocated for promoting agricultural innovation and value chain development (VCD), but few of these approaches have been evaluated. In this paper, we assess the performance of a systems approach known as the

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Participatory Market Chain Approach (PMCA), which engages smallholder farmers, small and medium-sized commercial entrepreneurs, researchers, and other relevant service providers in inclusive innovation processes. The PMCA has been used in more than 20 value chains in Latin America, Sub-Saharan Africa, Asia, and Eastern Europe. Based on eight well-documented case studies and evidence from other cases, we analyse how attributes of the external environment, the value chain, and the PMCA intervention influence outcomes. We conclude with lessons for improving the future use of systems approaches for inclusive innovation in value chains.

2. Perspectives on agricultural innovation and value chain development

One of the main challenges for research organizations everywhere is to generate useful knowledge that supports sustainable development (Clark et al. 2016). It has often been assumed that promising new technologies generated by agricultural researchers would be widely adopted by farmers and lead to increased food production and reduced hunger and poverty (Adato and Meinzen-Dick 2007). However, many new technologies fail, and the benefits of successful ones often accrue disproportionately to well-off farmers (de Janvry and Sadoulet 2020). Concerns with the uneven diffusion of research technologies and continued rural poverty have driven a search for more inclusive approaches that include marginalized groups in innovation processes and in the resulting benefits (Heeks, Foster, and Nugroho 2014; Swaans et al. 2014).

2.1. Agricultural innovation

Since the early 2000s, an agricultural innovation system (AIS) perspective has emerged that shifts attention from research to innovation, which is viewed as a dynamic, interactive process among actors involved in growing, processing, packaging, distributing, and using agricultural products (World Bank 2012, 3; Klerkx, van Mierlo, and Leeuwis 2012).

Interventions inspired by AIS thinking highlight the role of facilitators or innovation brokers who enable others to innovate, by stimulating interaction, social learning and joint research and development (R&D) activities and who improve the connections between research, policymaking, development programmes and economic activities carried out by individuals from different organizations, social strata, and academic backgrounds (Klerkx, Hall, and Leeuwis 2009; Adejuwon 2016).

The best-known practical applications of AIS thinking are in multi-stakeholder innovation platforms (IPs) – formal or informal network structures designed to foster technical, social, economic, and institutional innovation (Kilelu, Klerkx, and Leeuwis 2013). Considered to be promising vehicles for increasing the impact of agricultural research for development, most IPs have been established and facilitated by international agricultural research centres or non-governmental organizations (NGOs) (Schut et al. 2018). IPs are characterized as multi-stakeholder structures that provide a space for diverse actors to interact, learn from one another, and work together to identify challenges and capture opportunities. However, studies indicate that participation in IPs has generally been skewed toward smallholder farmers, researchers and/or NGOs, vis a vis commercial entrepreneurs. Consequently, they have tended to focus on finding technological solutions to production problems, rather than marketing or institutional innovations.

Project teams and platforms have seldom emphasized marketing and engagement of businesses until the project completion phase (Davies et al. 2016; Hermans et al. 2017; Thiele et al. 2011a).

The present study analyses a different type of systems approach – one that emphasizes innovation *processes* rather than *structures* and stresses the importance of commercial innovation as an entry point into the broader AIS.

2.2. Value chain development

Value chains that generate low incomes for smallholders and other market actors discourage investments in new technologies and innovation. VCD stimulates economic development and contributes to empowerment and poverty reduction by considering the chain as a whole and improving links between small farmers, traders, processors, and consumers. Development programmes have incorporated VCD approaches into their poverty-reduction strategies. But few research organizations have effectively mainstreamed, or incorporated, VCD into their programmes (Reardon et al. 2019; Stoian and Donovan 2020).

Rural families at the bottom of the income pyramid have limited access to land and capital, and these resource constraints often limit the impact of value chain interventions on extreme poverty (Tobin, Glenna, and Devaux 2016; de Janvry and Sadoulet 2020). Nevertheless, many smallholders and small- and medium-sized market agents participate in dynamic high-value markets and benefit from them (Devaux et al. 2016; Reardon et al. 2019). It has been observed that more systematic evaluation of value chain interventions is needed to learn about the factors that influence success and failure, and how context, socio-economic constraints and intervention strategies influence outcomes and the distribution of benefits (Hainzer, Best, and Brown 2019; Stoian and Donovan 2020). The present study presents a systematic evaluation to answer these questions.

2.3. Complementarity of AIS and value chain approaches

AIS and value chains often share partners, and systems approaches may be particularly useful in rapidly transforming value chains for high-value products (World Bank 2007, 9). However, there has been little systematic exploration of the complementarity of AIS and value chain approaches (Devaux et al. 2016; Kilelu et al. 2017). This paper analyses an approach that incorporates elements of AIS and VCD approaches.

Innovation – whether on farms or along the value chain – relies on ‘stocks of social trust, networks, and values upon which people can draw to improve their livelihoods and pursue shared objectives’ (Cofré-Bravo, Klerkx, and Engler 2019, 55). Multi-stakeholder approaches rely heavily on ‘bridging social capital’ to overcome the barriers to communication and trust that result from differences in participants socioeconomic backgrounds, resource endowments and stakes in the value chain. As noted by King et al. (2019, 125) ‘trust is the relational glue that enables or constrains social interactions, knowledge sharing and innovation processes’.

AIS and value chain approaches have mainly been used in donor-funded projects. Mainstreaming these approaches in R&D organizations has been constrained by narrow organizational mandates, specialized academic training, pressures to deliver

measurable results on short timelines, and donors' preference for projects that employ the 'latest' approaches rather than consolidate ones already in use (Klerkx, Hall, and Leeuwis 2009; Schut et al. 2015; Bentley et al. 2020). The result is 'a patchwork of seemingly rushed attempts of trial and error, rather than a process of continuous improvement' (Stoian and Donovan 2020, 36). The present paper explores how systems approaches may contribute to innovation capacity even if they are not mainstreamed in an organization's core programme.

3. The Participatory Market Chain Approach

The PMCA was developed by Papa Andina, a regional programme hosted by the International Potato Center (CIP), that was supported by the Swiss Agency for Development and Cooperation (SDC) and other donor agencies (Devaux, Ordinola, and Horton 2011). From 1998 to 2011, Papa Andina worked to reduce poverty in the Andean highlands by fostering inclusive innovation and development of potato value chains. In 2003, Papa Andina began to work with 'Rapid Appraisal of Agricultural Knowledge Systems' (Engel and Salomon 2003). RAAKS proved useful for bringing stakeholders together to identify market constraints and opportunities, but it did not go beyond the diagnostic phase. As steps and tools were added for facilitating inclusive innovation, the PMCA emerged as a new approach.

The primary focus of the PMCA is on new product development/improvement (i.e. commercial innovation), which is seen as a trigger for further commercial, technical and institutional innovation. Market entrepreneurs are involved as much as possible to share their knowledge and perspectives, to stimulate their interest and to ensure their ownership of the innovations developed. Influential individuals in government and the development community are also involved at key points to build wider support for the PMCA.

Devaux et al. (2009) emphasize the roles of social learning, social capital formation and joint R&D activities in the PMCA. Social learning refers to the process through which people learn together, by jointly defining problems, searching for, and implementing solutions, and assessing the results (Koelen et al. 2002). Through interaction, individuals who begin with different perceptions of a situation and the potential for change can develop common perspectives and insights. Dialogue and social learning strengthen trust and social capital, which are essential for effective joint action and innovation.

Initially, facilitators/innovation brokers play strategic roles by engaging relevant stakeholders (smallholder farmers, small and medium-sized commercial entrepreneurs, researchers, and other service providers); coordinating multi-stakeholder processes; arranging for needed technical inputs; fostering communication; and mediating conflicts. Over time, their roles should decrease as local stakeholders assume more responsibility for innovation. Facilitators should not be involved directly in innovation or commercial activities, to avoid conflicts of interest.

A PMCA user guide and a trainers' guide have been published (Bernet, Thiele, and Zschocke 2006, 2010; Antezana et al. 2008). An implementation protocol identifies the main components of a three-phase implementation process (Figure 1 and Annex 1, in Supplemental Online Material).

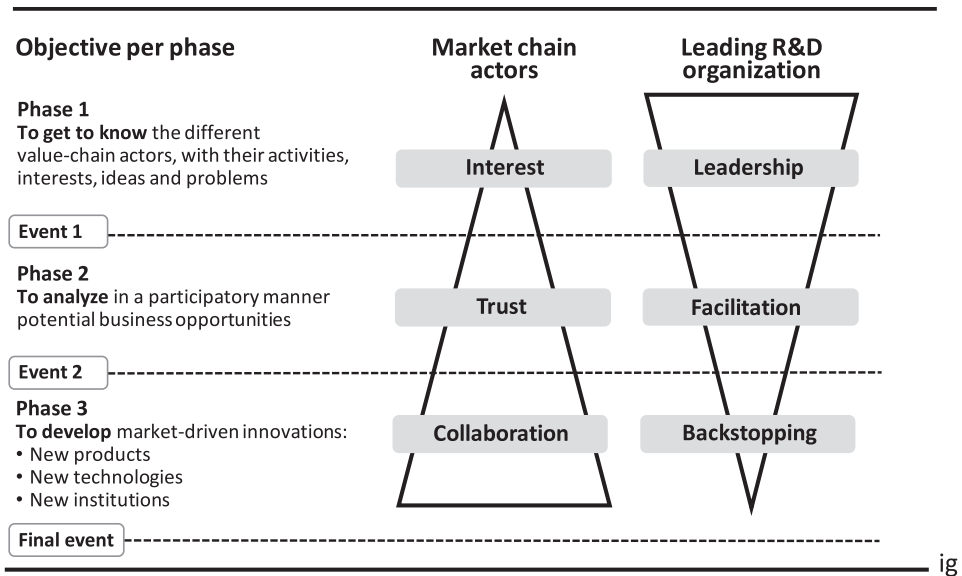


Figure 1. Three-phase structure of the PMCA. Source: Bernet, Thiele, and Zschocke 2006.

Phase 1 begins with actor mapping and analysis of the target value chain, to learn about the chain and the interests and priorities of key actors, and to identify areas where innovation could produce mutual benefits. After about three months, a first stakeholder event is organized to discuss initial findings with stakeholders and encourage new actors to join future activities. In this event, three or four ‘thematic groups’, composed of representatives of diverse stakeholder groups, are generally formed to focus on specific areas of innovation.

In Phases 2 and 3, thematic groups are held on the premises of different participants (for example, on farms or research stations, at processing plants or in markets) to promote interaction among stakeholders and learn about the different steps in producing, processing, marketing, and utilizing agricultural products.

In Phase 2, the groups meet several times over three or four months, to analyse potential business opportunities. The main challenges are to engage a wide range of relevant stakeholders – including market entrepreneurs – and to keep the groups focused on market opportunities, rather than production-related problems. At the end of Phase 2, a second stakeholder event is held to discuss the opportunities identified and priorities for innovation.

In Phase 3, the groups continue their work over three to six months, organizing technical or market studies; developing new products, packaging, or labelling; or obtaining needed permits and licenses. Phase 3 closes with a large public event where prototype innovations are presented by the stakeholders.

By the end of a PMCA application, some early innovators might already be using new practices. But the goal of the PMCA is to trigger innovation processes that continue in the future. For this reason, ex-post evaluations are needed to document and analyze the outcomes and benefits that emerge over time.

The PMCA is inclusive in that it engages previously marginalized groups in innovation processes and shares the benefits with them. The approach as originally formulated was not inherently gender-inclusive, but its participatory activities engaged and benefitted women (Sarapura et al. 2017). Subsequently, Mayanja et al. (2016) have developed a prototype guide for integrating gender more effectively into the PMCA.

4. Analytical framework and case study methods

4.1. Analytical framework

The analytical framework developed for this study (Figure 2) is inspired by the Institutional Analysis and Development (IAD) framework (Ostrom 2005, Figure 1.2, 15), which has three main components: (a) the Action Arena in which participants interact; (b) three clusters of variables that influence the Action Arena (Biophysical Conditions, Attributes of Community, and Rules); and (c) Outcomes.

To focus attention on innovation processes, Devaux et al. (2009) adjusted the IAD framework and relabelled the Action Arena as the Innovation Arena. For the present paper, we have further adjusted the IAD framework to highlight specific factors ('innovation drivers') that influence inclusive innovation processes and outcomes.

Following Devaux et al. (2009, Figure 1, 33), the central focus of attention in our framework is the Innovation Arena, where social learning, formation of social capital, and joint R&D activities take place. The Innovation Arena is influenced by clusters of factors,

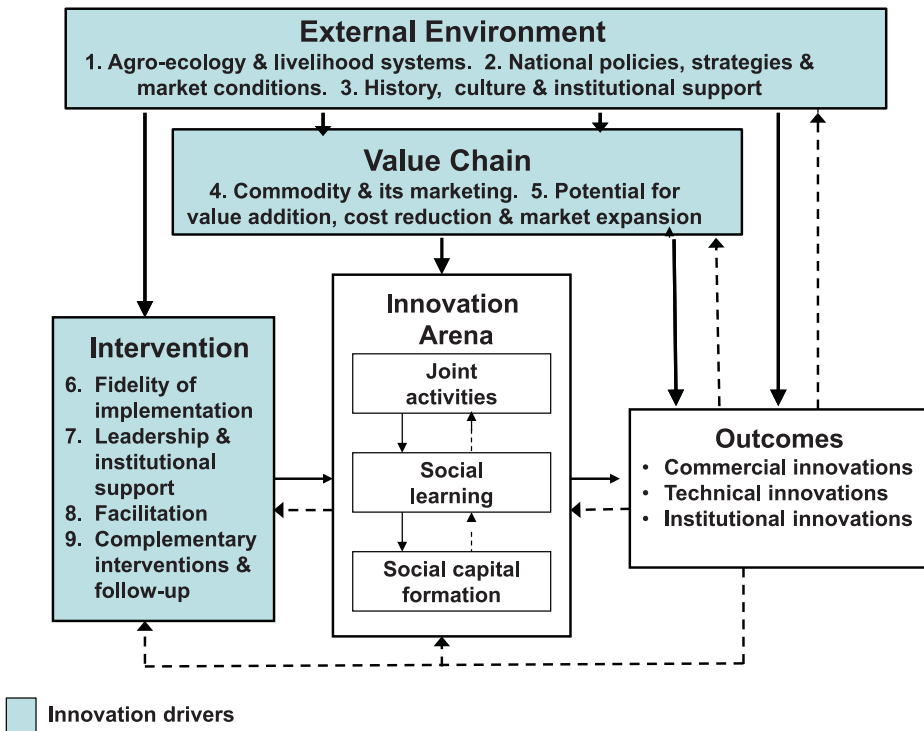


Figure 2. Framework for analysis of inclusive innovation in agricultural value chains. Source: Authors elaboration, inspired by Ostrom (2005, Figure 1.2, 15).

referred to here as ‘innovation drivers’, within the External Environment, the Value Chain, and the PMCA Intervention. Based on previous studies, our own work in agricultural innovation, and a preliminary analysis of the case studies, we identified nine main innovation drivers (Figure 2 and Annex 2, in Supplemental Online Material).

In our framework, the main Outcomes are commercial, technical, and institutional innovations. *Commercial innovations* refer to new or improved products that are successfully marketed. *Technical innovations* are novel technical methods that are used in producing, processing or marketing commodities. *Institutional innovations* are changes in norms, rules and organizations that govern interpersonal relations or transactions (e.g. introduction of contract farming or establishment of a farmer marketing coop).¹

As can be seen from the broken lines in Figure 2, these outcomes may influence the processes that take place in the Innovation Arena and the PMCA Intervention. For example, successful commercial innovation may stimulate participants to invest more time and other resources in joint activities that lead to other commercial innovations.

Over time, outcomes may also influence the Value Chain and the External Environment. The development of a new tomato sauce may encourage smallholders to expand tomato production or change post-harvest practices. It might also motivate policymakers to support other value chain interventions. In contrast, an intervention that fails to produce viable innovations may discourage farmers, traders, processors, and policy makers from working with systems approaches in the future.

4.2. Case study methods

Through internet searches, project reports, research publications and personal communications, we have identified PMCA applications in value chains for aquaculture, cassava, coffee, dairy products, fruits, handicrafts, hot peppers, plantains, potatoes, sesame, sweetpotatoes, tomatoes, vegetables, wine and yams. Annexes 3–6 (in Supplemental Online Material) provide information on the known PMCA applications and the documentation available on each of them.

In this paper, we analyse eight published cases for which sufficient empirical information is available for use of our analytical framework. As suggested by Yin (2018), we excluded a few cases on the grounds that they would not add significant additional information or insights that would change the results of our analysis. We developed a protocol for organizing information on each case in relation to the main components of our conceptual framework and prepared eight case study reports (Annex 4). These serve as the main source of information for our analysis, which also draws on primary project documentation and publications, personal communication with local informants, and our own personal knowledge of the cases. One or more of the authors were directly involved in Cases 1–6.

To aid in comparative case analysis, we developed a scoring matrix based on our analytical framework and the nine identified innovation drivers. We then scored each case for the influence of each of the innovation drivers, the intensity of innovation processes, and the amount of commercial, technical, and institutional innovation. The results of this scoring exercise (Figure 4) inform our analysis of cases and the lessons presented.

5. Case summaries

This section includes eight case summaries, in the order in which they were implemented. The structure and content of the summaries reflect the three-phase PMCA structure and the main components of our conceptual framework for the analysis of inclusive innovation in agricultural value chains. For brevity, the case summaries do not include detailed information on activities within each phase of the PMCA.²

5.1. Market development for native potatoes in highland Peru (2003–2005)

Since the 1990s, political stability and infrastructure improvements have stimulated agricultural growth in the Peruvian highlands, where potato is the main crop. Whereas smallholders frequently grow native potatoes (landraces) for home consumption and local sale, large farmers generally produce modern varieties for sale in urban markets. Until recently, most urban consumers considered native potatoes to be an inferior food consumed by highland people.

The PMCA was applied in the context of a comprehensive programme to improve the competitiveness of Peru's potato sector, known as INCOPA.³ Hosted by CIP and supported by SDC, this programme engaged more than 20 national and local organizations in two applications of the PMCA; establishment of multi-stakeholder platforms; providing support for policymaking; information campaigns; and strengthening of local organizations.

The PMCA provided smallholders, ministry officials, researchers, and a wide range of value chain actors with their first opportunity to work together to promote inclusive innovation. Based on an initial analysis of potato value chains, native potatoes were prioritized for a second application of the PMCA, because they were grown primarily by smallholders and were believed to have substantial niche market potential.

Interactions in thematic working groups, field visits and public events triggered innovation processes that have continued for several years and have generating numerous benefits. New products developed during the PMCA application included Peru's first brands of high-quality fresh native potatoes (*Tikapapa*) and colourful native potato chips (*Jalca Chips*). These early successes triggered snowballing innovation processes that have led to the development of many other new products (Figure 3).

Involvement of managers from the country's leading supermarket (Wong) was crucial for introducing new potato products to urban consumers. Involvement of officials from Peru's Ministry of Agriculture enhanced the legitimacy of the PMCA and motivated public officials to launch an information campaign on the nutritional and cultural value of native potatoes. These activities have contributed immeasurably to the image of the native potato as a national treasure.

Scores of gourmet native potato products are now sold in supermarkets, and many have been exported. Local researchers and service providers, backed up by CIP researchers, have supported innovation by identifying suitable native varieties for processing, and supporting improvements in seed quality, pest management and agronomy. Local NGOs have provided smallholders with technical and organizational support and market information. A multi-sector working group promoted establishment of Peru's National Potato Day, celebrated annually since 2005, and successfully



Figure 3. New product development triggered by the PMCA, Peru. Source: Devaux et al. 2020.

lobbied the United Nations to celebrate 2008 as International Year of the Potato. Triggered by the PMCA, these measures have stimulated increases in both the supply of and the demand for native potatoes in Peru and have helped raise international awareness of the importance of the potato as a resource for improving nutrition and reducing poverty.

5.2. Value chain innovation with root crops and vegetables in Central Uganda (2005–2007)

Based on the Peruvian work, a post-harvest programme funded by the United Kingdom's Department for International Development (DFID) encouraged Papa Andina to apply the PMCA in Uganda's sweetpotato value chain and provided funding for Phase 1. At the request of local participants, the exercise was broadened to include potatoes, tomatoes, and hot peppers – crops grown by smallholders which were believed to have significant market potential.

Papa Andina's PMCA specialists were actively involved in planning, fund-raising, and training, and backstopped the exercise. The *PMCA User Guide* was field-tested by a team of facilitators (seven professional women from local R&D organizations). A study visit to Peru and Bolivia for 17 Ugandans promoted interaction and team building among participants and cemented their commitment to the PMCA. Notably, the director and other key individuals at the Mukono Zonal Agricultural Research and Development Institute (MUZARDI) played key roles in this case and in later work with the PMCA.

During Phase 3, several commercial innovations emerged, including improved packaging, labelling and quality assurance for potato chips, orange-fleshed sweetpotato flour, and tomato sauce. New products included sweetpotato chips, hot pepper

pickles, and introduction of a new sweetpotato variety in a supermarket. Some of the original products are still in the market, while others have been replaced by improved versions.

Many of the contacts and interpersonal relations built up during the PMCA contributed to business deals, collaboration among R&D organizations and continued work with the PMCA. The Ugandan facilitators formed a community of practice that continues to function with MUZARDI at its hub. Members of this community have applied the PMCA in value chains for cassava, grain amaranth, maize, pineapples, and indigenous African leafy vegetables (Case 7) and have provided PMCA training for R&D professionals in Uganda, Kenya, Tanzania, and Rwanda.

5.3. Coffee market development in Peru (2007–2008)

Cases 3 and 4 were led by local development organizations in the context of the Andean Change Alliance (Thiele et al. 2011b), which evaluated the use of participatory R&D methods in inclusive innovation.

Peru produces some of the world's best coffee, but little of it is consumed locally. While large operators export nearly all their harvest, smallholders find it difficult to export their produce or find domestic markets. For several years, the international NGO Practical Action supported small-scale coffee production and marketing in San Martin Department, with mixed results. It then used the PMCA to stimulate development of the local market for high-quality coffee.

The main local partners, in this case, were members of a women's food processing group and the leader of a struggling smallholder coffee producers' cooperative. The small number and limited diversity of participants limited social learning and social capital formation.

With support from visiting coffee experts, the women's group developed a new brand of coffee for the local market. Its appearance seems to have stimulated some other entrepreneurs to launch their own brands.

After completion of the PMCA, there was limited follow-up, and both the women's group and the coffee producers' cooperative ceased operations. Nevertheless, a few members of these organizations have continued to process and market their own coffee with their own local brands. In 2018, four small enterprises sold about 13 tons of processed coffee.

5.4. Conservation and marketing of native potatoes on Bolivia's Altiplano (2007–2009)

In this case, the PMCA was applied in the value chain for native potatoes grown by poor farmers on Bolivia's Altiplano – a cold, high plateau where the agricultural potential is severely limited, only the hardiest of crops can be grown and population density is low. Smallholders produce native potatoes mainly for home consumption and sell a few potatoes in local markets or to intermediaries.

A local service organization known as CAD⁴ facilitated the PMCA application, with technical support from Bolivia's Foundation for Research and Promotion of Andean Products (PROINPA). CAD led product-development and market-testing

with rather passive participation of members of a fledgling Network of Native Potato Producers (PROPANA). Based on a market survey in Phase 1, participants decided to develop a new product – selected, bagged, and washed fresh potatoes with the brand name *Miskipapa*. Phases 2 and 3 focused on contacting government offices to obtain political support, developing promotional materials and preparing batches of *Miskipapa* for sale in local fairs, supermarkets, a hotel, and a company store.

Public events at the end of each phase of the PMCA were well attended, but working group activities were few and poorly attended, with most participants coming from CAD and PROPANA. Exacerbated by class differences and prejudices against indigenous farmers, there was little interaction between farmers and market intermediaries.

The lack of participants' diversity – particularly the absence of commercial entrepreneurs in working groups – limited the successful development and marketing of new products. Additionally, the farmers' network found it difficult to acquire native potatoes in the quantities and qualities sought by urban buyers and lacked adequate facilities for storing and preparing potatoes for sale. *Miskipapa* never achieved market viability, and soon after completion of the PMCA, PROPANA ceased operations.

5.5. Innovation in potato value chains in West Java, Indonesia (2008–2009)

Potatoes and other vegetable crops are important income sources for smallholders in the highlands of West Java. Snack foods made from cereals and root crops are integral to Indonesian food culture, and demand for them is steadily increasing. Potato sales to supermarkets and processors are rising fast, but smallholders find it difficult to assemble the large amounts of potatoes demanded by the new buyers and to finance their operations when the new buyers pay for potatoes only 30 days after delivery.

The PMCA was applied within a project to improve vegetable marketing in West and Central Java, implemented by the Indonesian Vegetable Research Institute (IVEGRI) and supported by the Australian Centre for International Agricultural Research. A marketing specialist at CIP's local office coordinated the PMCA and specialists from Lima provided training and backstopping. Care was taken to involve diverse stakeholders in group activities focused on commercial innovation.

Key local partners included West Java's Department of Agricultural and Food Crops and a large NGO, Daarut Taichid. Facilitators from these organizations were enthusiastic about the PMCA and committed to its goals and principles.

During Phase 3, the PMCA triggered at least 13 distinct innovation processes, most of which involved processed products, such as potato chips. After completion of the PMCA application, PMCA team members continued to support innovators in business development while project funds lasted. After international funding ended, there has been no follow-up or systematic evaluation. But the PMCA appears to have contributed to inclusive development by allowing small producers and processors – especially women with experience in preparing and marketing snack foods – to exploit new market opportunities, expand their operations and raise their incomes and social status.

5.6. Market development for organic and typical regional products in Albania (2009–2011)

In the 1990s the Albanian government launched an economic reform programme that stimulated market development. However, despite the country's favourable growing conditions for fruits, vegetables, medicinal and aromatic plants, the small-farm economy remained oriented mainly toward home consumption.

In the early 2000s, SDC began supporting the development of Albania's organic agriculture through a project implemented by the Research Institute of Organic Agriculture (FiBL) and Albanian partners. Technical research resolved many supply constraints, but there was little progress with marketing. For this reason, the PMCA was used in the final phase of the project. The work embraced both 'organic' produce for export to the European Union and 'typical regional products' for the domestic market, for which less rigorous and costly certification procedures and appropriate labelling were developed.

One of the developers of the PMCA, who worked at FiBL in Switzerland, introduced the approach as a guiding framework for VCD and provided training and advice throughout the process. In Albania, a 'PMCA Unit' was developed to implement the PMCA. During Phases 2 and 3, more than 200 smallholders and other stakeholders were involved in thematic group activities that contributed substantially to social learning and social capital, which, in turn, facilitated innovation.

An umbrella brand, quality standards and a relatively simple certification scheme were developed for regional products. Labels were developed for around 30 organic and regional products and several technical innovations were introduced. These included plastic tunnels for early planting of organic products, herb driers, cooling tanks and cold chambers for processing facilities. By the end of the PMCA application, 47 regional products were being marketed with the new labels, along with seven new organic products.

When the project ended, the PMCA Unit evolved into the Albanian Association of Marketing. This organization is now responsible for certifying regional products and promoting the development of the organic and typical regional product sectors. Since concluding the PMCA, value chain innovation has been sustained; from 2012 to 2014 the number of regional products expanded from 47 to 62 and the value of sales increased by 30%, to around Euro 540,000. Organic exports of medicinal herbs and spices, mushrooms, nuts, olive oil and other products have also grown.

5.7. Stimulating innovation with indigenous African leafy vegetables in Central Uganda (2011–2013)

African leafy vegetables (ALV) play important dietary roles in rural Uganda as ingredients in sauces that accompany carbohydrate-rich diets. They are mostly cultivated by women in small gardens. Despite their high nutritional value, ALV have received very little research attention.

The PMCA was used in the final phase of an externally funded programme aimed at improving ALV production and marketing. Based on MUZARDI's successful work with the PMCA (Case 2), it was invited to lead this PMCA application. Diverse stakeholders

participated in this application, including more than 20 ALV cultivators, several traders, researchers and extension agents, representatives from several seed companies and food processors. Thematic groups focused on: production and marketing of quality ALV seeds, production and marketing of fresh ALV, and processing.

Group work contributed to social learning, social capital formation and business development. One important outcome was the establishment of a community-based seed group – mainly involving women – which has partnered with private seed companies to market ALV seeds. In one year, the seed group collectively marketed 1240 kg of high-quality locally and through seed companies. Trading with the companies has stimulated development of local skills and practices in product labelling and packaging, as well as the formalization of business processes (Sanya et al. 2018, 687).

The lack of a solid research base for ALV and the absence of functioning commercial Value chains for these products have limited innovation in the short term. Nevertheless, prospects for ALV appear to be improving. Personal observations indicate that cultivation is expanding as is the presence of ALV in urban markets. More consumers now realize that ALV are not just a food for the rural poor but a nutritious component of a healthy diet. To fill gaps in research knowledge, MUZARDI has begun work on various aspects of ALV, including cultivar selection, foundation seed production, post-harvest management, and business development.

5.8. Stimulating aquaculture innovation in Bangladesh and Nepal (2011–2014)

In Bangladesh, fisheries generate a fifth of agricultural GDP, and per capita fish consumption is about 20 kg per year. In contrast, Nepal's fisheries, concentrated in the southern Terai plain, contribute less than 3% to agricultural GDP and per capita fish consumption is only around 2 kg.

Based on its previous work with the PMCA in Nepalese vegetable value chains, the international NGO, iDE, incorporated the PMCA into the European Union-funded Agriculture and Nutrition Extension Project (ANEP) in Bangladesh and Nepal. From 2011 to 2014, ANEP's aquaculture component was implemented by a consortium of R&D organizations led by World Fish. iDE led work with the PMCA and organizational strengthening.

Among our cases, this one is unique for its focus on input supply chains. Most participants were fish farmers, hatchery and nursery owners, and suppliers of feed, fertilizer and aqua medicines. Fewer fish harvesters and traders were involved.

During Phase 2, nine thematic working groups were established in Bangladesh and three in Nepal. Evaluation studies indicate that the interactions that took place in the thematic groups and other joint activities contributed to knowledge sharing and increasing levels of trust among hatchery owners, nurseries, farmers, and extension agents, facilitating improvements in production practices. In the framework of the PMCA, cross-country study visits contributed to knowledge exchange and motivation, 'opening the eyes' of participants to new possibilities back home.

One key innovation has involved replacing Indian carp with small indigenous fish species. Other innovations have included improvements in the use of aquaculture inputs and services. Project evaluations (Jahan et al. 2015; 2018) indicate that innovations triggered by the PMCA have contributed to an approximate doubling of yields and income from fish in both countries. Improved coordination among value chain actors

and collective decision making have helped rebalance traditional trade relationships and power imbalances.

6. Results and discussion

In this section, we summarize patterns that emerge from our case studies in relation to the main components of the framework for analysing inclusive innovation in agricultural value chains (Figure 4). Section 6.1 analyses the influence of innovation drivers in the external environment, the value chain, and the PMCA intervention. Sections 6.2 and 6.3 examine innovation processes and outcomes. Sections 6.4 and 6.5 discuss the scaling of innovations and the contributions of the PMCA to innovation capacity.

6.1. Innovation drivers

6.1.1. External environment

More innovation was generally observed where agroeconomic conditions were favourable and farming was market oriented. For example, in West Java, where potato farming is highly commercial and there is a long tradition of artisanal food processing, there were more innovations than on the Bolivian Altiplano, where smallholders grow potatoes mainly for home consumption. In the cases studied, public policies and strategies generally favoured VCD. The exception was Bolivia, where the government discouraged market-oriented development projects that benefitted private traders and other businesspeople.

VARIABLE	CASES							
	1 Native potatoes Peru	2 Root crops & vegs. Uganda	3 Coffee Peru	4 Native potatoes Bolivia	5 Potatoes Indonesia	6 Organic & Reg. prods. Albania	7 ALV Uganda	8 Aquaculture Nepal & Bangladesh
A. INFLUENCE OF INNOVATION DRIVERS								
Attributes of the external environment								
1. Agroecology & livelihood systems	1.5	1.5	1.0	0.0	2.0	2.0	1.0	2.0
2. Policies & market conditions	2.0	2.0	2.0	0.0	2.0	2.0	2.0	2.0
3. History, culture & instnl. support	1.5	1.5	1.0	1.0	2.0	1.0	0.5	1.0
Attributes of the value chain								
4. Commodity & its marketing	1.0	2.0	1.0	0.5	2.0	1.0	0.5	2.0
5. Potential for value addn./cost redn.	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0
Attributes of the intervention								
6. Fidelity of implementation	2.0	2.0	1.0	0.0	2.0	2.0	2.0	1.0
7. Leadership & institutional support	2.0	2.0	1.0	1.0	2.0	2.0	2.0	2.0
8. Facilitation/innovation brokerage	2.0	2.0	1.0	0.0	2.0	2.0	2.0	2.0
9. Complement. intervnts. & follow-up	2.0	1.0	0.0	0.0	1.0	2.0	1.5	1.5
B. INTENSITY OF INNOVATION								
	2.0	2.0	1.0	0.0	2.0	2.0	1.5	2.0
C. OUTCOMES								
Commercial innovations	2.0	2.0	1.5	0.5	2.0	2.0	1.0	1.0
Technical innovations	2.0	2.0	0.5	0.0	1.5	2.0	1.5	2.0
Institutional innovations	2.0	1.0	0.0	0.0	1.0	2.0	1.5	2.0

Score	Influence of innovation drivers	Intensity of innovation	Outcomes
0-0.5	Negative or small	Low	None
1.0-1.5	Moderate	Moderate	Moderate
2	Large	High	Significant

Figure 4. Scores for (A) influence of innovation drivers; (B) intensity of innovation; and (C) outcomes in the cases studied. Source: Authors elaboration.

6.1.2. Value chain

The PMCA was generally more effective in stimulating innovation in commercial value chains than in subsistence-oriented ones. For example, there were more innovations in the commercial value chains for potatoes in Uganda and Indonesia than in the subsistence-oriented chains for native potatoes in Bolivia. Similar patterns have been reported for other PMCA applications (Annex 3).

Exceptions to this general pattern relate to native potatoes in Peru, sweetpotatoes in Uganda, and typical regional products in Albania – chains that were transitioning from subsistence to commercial orientation when the PMCA was applied. By facilitating improvements in packaging, labelling, and quality assurance, and developing new products that meet consumer needs, the PMCA appears to have accelerated the transition from subsistence to commercial chains. The role of innovation system approaches in accelerating transitions from subsistence to commercial chains should be explored more thoroughly in the future.

6.1.3. Intervention

Engagement of diverse stakeholders, including market entrepreneurs, was crucial for stimulating innovation. In the cases that generated fewest innovations, usually only one or a few stakeholder groups participated actively, limiting social learning, social capital formation, and joint R&D activities. In some cases, the lack of involvement of business interests reflected facilitators' views that PMCA activities should mainly involve and benefit smallholder farmers. In other cases, facilitators lacked contacts with businesses. And in yet other cases, entrepreneurs chose not to participate because they expected little benefit in relation to the time invested.

In all cases, project teams needed to tailor implementation procedures to fit local needs and opportunities. Where facilitation teams had secure resources and benefitted from prior knowledge of value chains (Albania, Case 6), they were able to apply the PMCA more quickly than where facilitators had little prior knowledge of the value chains and new funding had to be negotiated for each phase of the PMCA (Uganda, Case 2).

Effective facilitation has proven to be crucial for success. Attributes of successful facilitators include a flexible and inclusive management style, a solid local reputation, good networking skills, and an ability to quickly identify, assess and utilize new information. Facilitators have benefitted from projects that employed a learning-oriented approach to monitoring and evaluation (Horton et al. 2010).

Successful cases often benefitted from PMCA specialists who provided training and backstopped local facilitators. Interaction between experienced PMCA facilitators and new ones aided the sharing of tacit knowledge and development of needed commitment, attitudes, and skills. Support from leaders of respected local organizations, stable leadership for the PMCA application, and emergence of one or more 'PMCA champions' also contributed to success (Klerkx and Aarts 2013).

The PMCA was generally most effective when implemented within a broader development effort that, depending on the case, included applied research, organizational strengthening, business development, and/or policy support. This occurred in Cases 1, 6, and 8. In contrast, where the PMCA was applied as a stand-alone intervention, there tended to be fewer innovation outcomes, as occurred in Cases 3 and 4.

Dependence on short-term project funding probably limited results in some cases because implementation of the PMCA requires a minimum of several months and can take more than a year. Follow-up support after completion of the PMCA has helped consolidate innovation processes in some cases. The results achieved with native potatoes in Peru illustrate how significant outcomes can be achieved when an integrated systems approach is implemented over a period of several years.

Some projects that have reported the use of the PMCA failed to adhere to the approach's basic principles or to implement its essential components. A common weakness has been for project teams to fall back on their personal networks and traditional mode of working mainly with smallholder farmers to address production problems (e.g. Annex 3.8). Some project teams have taken short cuts, rather than implementing the time-consuming and difficult-to-manage thematic working groups (e.g. Annex 3.10). In extreme cases (e.g. Annex 3.14), the PMCA seems to have been implemented in name only. Low fidelity of implementation has limited innovation in all these cases.

6.2. Innovation processes

PMCA applications are designed to stimulate inclusive innovation through multi-stakeholder activities that foster knowledge sharing, development of common perspectives and strengthening of relationships, networks and trust. The PMCA offered many smallholder farmers with their first opportunity to work with market entrepreneurs, researchers, or other service providers on projects of mutual interest.

Social learning, social capital formation and joint activities appear as separate components of innovation in our analytical framework (Figure 2). But in practice, they were closely interrelated and interactive. Group activities at the start of the PMCA application, such as actor mapping and value chain assessment, stimulated communication and social learning and strengthened interpersonal relationships and trust from the beginning. This, in turn, paved the way for further, deeper collaboration for development and testing of potential new products as the PMCA application progressed.

The cases that generated the most innovation (Cases 1, 2, 5, 6 and 8) generally involved the most diverse sets of stakeholders and involved more group work. In these cases, value chain actors benefitted in multiple ways from the interactions. Benefits have included gaining a greater understanding of the value chain and the functions performed by different actors, new contacts that facilitate business, and access to information and services they didn't have before. Working with commercial entrepreneurs, researchers, and other stakeholders has helped many small farmers to overcome traditional imbalances in knowledge and power. Facilitators have learned a great deal about value chains and have gained communication, negotiation, and management skills, which are valuable for facilitating complex multistakeholder processes.

In the less successful cases (Cases 3 and 4), there tended to be fewer group activities with less diverse participants. In Case 4 and others listed in Annex 3, few or no commercial entrepreneurs were involved in thematic group activities. In Case 4, the main participants were members of a single food processing group. In both situations, the lack of diversity in group work limited social learning and formation of bridging social capital.

In several cases, participants have stressed the value of study visits involving direct contact with the participants of prior PMCA applications within their countries or abroad, for ‘opening their eyes’ and helping them see the potential for making changes in their own environments. In some cases, PMCA facilitators and collaborators have developed informal or formal organizations that have continued to support innovation and VCD after project completion. Examples include a sector working group (Peru), a community of practice and a seed group (Uganda), and a service organization (Albania).

6.3. Outcomes

Most studies of the PMCA have been done at the end of projects and have focused on early commercial innovations. As a result, little information is available on longer-term outcomes such as changes in cultivation, marketing, processing, or norms and arrangements that govern transactions.

6.3.1. Commercial innovations

The most significant commercial innovations emerged in four cases:

Case 1. Numerous high-quality native potato products in Peru

Case 2. Nutritious sweetpotato flour, tomato and hot-pepper sauces and pastes and improved packaging and labelling for potato chip in Uganda

Case 5. New potato-based snack foods prepared and marketed by family firms in Indonesia

Case 6. Certified regional products in Albania

The most visible commercial innovations involved labelling, packaging and quality assurance for processed products, such as potato chips, sweet-potato flour and hot-pepper paste. Innovations with fresh produce included selection, cleaning, grading and attractive packaging. Early successes often triggered further innovation. The first products that entered the market were often replaced by other less costly or higher quality products. Innovation processes tended to snowball ([Figure 3](#)) and lead to broader impacts over time.

6.3.2. Technical innovations

The most extensive technical innovations were reported in aquaculture in Bangladesh and Nepal, where the PMCA triggered important changes in fish species, sources and quality of hatchlings and fingerlings, feed and aqua-medicine supplies, and the general management of hatcheries, nurseries, and fish farms. In Peru farmers growing native potatoes improved their seed systems, planting material, fertilization, pest management, and the selection and grading of harvested potatoes. In Albania, increased sales of certified regional products stimulated improvements in cultivation and processing, including the use of plastic ‘tunnels’ for early planting of vegetables. In Uganda, a women’s group established the commercial production of vegetable seeds.

6.3.3. Institutional innovations

Commercial innovations have stimulated changes in institutional arrangements in both input and product markets. In Peru, vertically integrated value chains emerged for native potatoes that are now sold to supermarkets and large processors. In Uganda,

contract farming of hot peppers for export expanded, an ALV seed group was formed, and some potato processors established long-term relations with farmer-traders. In Albania, a certification scheme and standards were developed for regional products. As PMCA applications ended, several project teams attempted to establish innovation platforms to support continuing innovation processes. However, these attempts have rarely been successful.

6.4. Scaling of innovations

The extent to which new practices are used on a large enough scale to generate meaningful benefits features prominently in contemporary discussions of agricultural innovation. The scale of innovation and the benefits for producers, market agents and consumers have been much larger in the Peruvian native potato case (Case 1) than elsewhere. It is likely that more than 100,000 Peruvian smallholders and small market agents have benefitted from the PMCA. In Nepal and Bangladesh, by the end of the aquaculture project, around 2500 resource-poor farm families had benefitted from the PMCA. In Uganda and Albania, upwards of 1000 low-income households working with root crops, vegetables and typical regional products have benefitted from the PMCA. In the other cases, it appears that fewer than 1000 families have benefitted.

In the Peruvian native potato case, scaling was facilitated by several factors, including supportive economic policies; rapid growth of the economy and the food processing sector; recognition of the value of native potatoes in Peruvian cuisine; involvement of senior managers from the private and public sectors; and use of the PMCA within a broader development programme with stable funding for more than a decade. This confluence of factors led to significant changes in consumer perceptions and uses of native potatoes, stimulating economy-wide increases in both supply and demand (Proexpansión 2011; Morris et al. 2017).

6.5. Strengthening of innovation capacity

The PMCA, like other AIS and value chain approaches, has not been mainstreamed in agricultural R&D organizations. Nevertheless, there is evidence that in some cases, PMCA interventions helped build up the social capital, knowledge and expertise needed to support continuing innovation. The best-known case is native potatoes in Peru. But innovation has also continued in the vegetable and root crop sectors in Uganda, and it has grown substantially in the organic and typical regional product sectors in Albania.

In some cases, informal or formal groups have emerged that support innovation. Ugandan PMCA facilitators established a community of practice, based at MUZARDI, whose members have led PMCA applications in several projects in Uganda and neighbouring countries. Also, in Uganda the vegetable seed production and marketing group set up in conjunction with the PMCA application continues to support the development of the ALV sector. In Peru, a working group has supported the continued development of the potato sector and a learning alliance has fostered knowledge sharing on innovation and related development issues. In Albania, the project's PMCA Unit evolved into a marketing association that provides business development services for producers of organic and regional products. Information is lacking on the state of

innovation capacity and outcomes after project completion in several promising cases (e.g. those in Indonesia, Bangladesh, and Nepal), highlighting once again the importance of evaluating systems interventions not just at project completion but years later as well.

7. Lessons

Based on the foregoing analysis, we have formulated six general lessons related to the use of systems approaches for promoting inclusive innovation in agricultural value chains.

1. *By focusing initially on commercial innovation, an approach like the PMCA can trigger broader systemic and inclusive innovation.* Among AIS and value chain approaches, a unique feature of the PMCA is its focus on commercial innovation as a trigger for further, more systemic, and inclusive innovation. By engaging diverse stakeholders in co-innovation processes in the context of private-sector development, the PMCA stimulates a range of interlinked commercial, technical, and institutional innovations that benefit smallholders as well as small- and medium-sized enterprises along the value chains.
2. *It is crucial to engage commercial entrepreneurs throughout the innovation process.* AIS approaches generally assume the engagement of diverse stakeholders. But most applications of AIS thinking have prioritized the engagement of researchers, NGOs, and smallholder farmers. Commercial entrepreneurs have seldom been considered core participants of innovation platforms, and marketing concerns have been left until late in project development. In PMCA applications, collective action involving diverse stakeholders has strengthened bridging social capital, enabling smallholder farmers and small- and medium-size market agents to represent their interests, acquire external resources, and connect with professional knowledge systems to improve their production and marketing practices. By strengthening interaction among diverse actors toward common goals, the PMCA has fostered communication, social learning, and trust, which in turn have facilitated joint R&D activities and co-innovation. Our cases highlight the benefits of actively engaging commercial entrepreneurs from early in the innovation process. Conversely, the lack of engagement of market agents has been one of the major contributors to the failure of PMCA applications.
3. *Committed, motivated and capable facilitators/innovation brokers are essential for success.* An approach for inclusive innovation like the PMCA is a complex intervention based on a set of general principles. Facilitators who understand the logic of the PMCA and are committed to its basic principles need to adjust the PMCA protocol and procedures to suit the local setting. They also need to understand and be able to apply basic marketing concepts in their specific context, and capture and utilize new information and resources to overcome challenges as they arise during innovation processes. Training and mentoring by seasoned PMCA specialists has proven very useful for inexperienced facilitators. Training is most effective when seasoned professionals train and support less experienced facilitators in the context of actual PMCA applications. Personal interactions, cross-site visits and periodic learning-orienting reviews have also been valuable for knowledge sharing and for motivating and building the confidence of facilitators.

4. *An approach for stimulating inclusive innovation like the PMCA can produce greatest results when it is applied within a broader development effort.* On its own, a value chain intervention like the PMCA cannot have a significant impact on broad development goals like poverty reduction, gender equity or biodiversity conservation. For wider transformational impact, the PMCA needs to be part of a broader development effort that, depending on the local context, might involve applied agricultural R&D, policy support, public awareness or strengthening of farmers' organizations.
5. *Use of a systems approach like the PMCA can help R&D organizations respond better to market demands.* The PMCA's emphasis on catalyzing inclusive innovation in value chains makes it ideally suited for use by agricultural R&D organizations, whose programmes are seldom well grounded in the realities of value chains and food systems. In a PMCA application, where researchers work in partnership with stakeholders to identify problems, test promising solutions and foster user innovation, the knowledge gained can be fed back to research programmes, allowing them to adjust their priorities and enhance the relevance and utility of their research results. For example, because of the initial PMCA application with native potatoes, both Peruvian R&D organizations and CIP expanded their work on native potatoes not simply as genetic resources for breeding programmes but as valuable food crops and cultural resources.
6. *Systems approaches like the PMCA can strengthen innovation capacities even if they are not mainstreamed.* In several cases, there is evidence that the facilitated, participatory processes employed in the PMCA contributed to local knowledge, skills and social capital that later supported continuing innovation. In some cases, individual farmers and market agents have continued to innovate on their own. In others, informal groups of facilitators or value chain actors have emerged that support inclusive innovation. In several cases, agricultural R&D organizations have expanded and reoriented their work on the commodities in question. And in at least one case – Albania – a formal service organization emerged that supports innovation and sector development. Despite the demonstrated effectiveness of the PMCA in several settings and the influence of the approach in the professional literature and development discourse, use of the PMCA, like other AIS and value chain approaches, has not been mainstreamed in agricultural R&D programmes. Mainstreaming could enable deeper and more sustained impact. The present study provides important pointers on the key elements to consider in scaling and mainstreaming.

Notes

1. A commercial innovation in our framework is what the *Guidelines for Collecting, Reporting and Using Data on Innovation* (OECD/Eurostat 2018) define as a product innovation – 'a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market.' Technical and institutional innovations in our framework fall under the *Guidelines'* general heading of business process innovation – 'a new or improved business process ... that has been brought into use by the firm.'
2. More detailed information is in Annexes 4–6.
3. Project for Promoting the Competitiveness of Peru's Potato Sector.
4. Centre for Development Support in Northern Potosi.

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