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Overcoming Constraints to Agricultural Innovation Through the Market: Insights from the Peruvian Andes

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Overcoming constraints to agricultural innovation through the market: insights from the Peruvian Andes.

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Abstract: This paper discusses possible ways to overcome the situation of physical isolation and the multiple failures that pervade Andean villages. Specifically, it studies a training program developed by a Peruvian NGO, which aims at triggering the development of a market for agricultural services that reach the rural poor. First-hand data is used to identify the scope of the market so-created. It is then looked at determinants of successful intervention, through different indicators. The empirical tests developed show that training farmers as on-the-field consultants is a relevant strategy in the adverse environment under study, provided that the practical implementation is well designed and that some particular constraints are properly taken into account. In particular, training specialists on one relevant topic is much more effective than training generalists. Hence, our results should be viewed as one building block in the debate over the design of successful innovative schemes for agrarian extension in the context of isolation traps and cultural constraints.

Keywords: poverty reduction, agrarian extension, community-based consultants, market failures.

JEL codes: Q16, 033.

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1. Introduction

Technological innovation has become crucial to ensuring the development of a competitive agriculture in today's global economy, and to deliver food to the growing world population given land and water scarcities. In Peru, it is also vital for the subsistence of a large share of the national population: "in terms of employment sectors, Peru keeps being an agricultural country, as agriculture accounts for at least one third of the total economically active population (i.e. 4 million workers), the majority of which has a low education and works on small-scale remote family farms" [UNDP, 2005: 95; own translation]. Promoting sustainable economic growth in rural areas and increasing rural incomes are among the most crucial issues to fight the persistent poverty in Peru [World Bank, 2002 and 2006].

In Peru as in most countries of Latin America, governments have developed Agrarian Extension (AE) activities since the middle of the 20th century, in order to help isolated areas overcoming the huge transaction costs that usually pervade them. Following Coello et al. (2004), we define the concept of AE as "every process that helps technology adoption by farmers, in order to enhance their production and profitability". It thus comprises the notion of technical assistance (TA), i.e. advisory and specific technical help to farmers, which is the central topic of the present work.

In the traditional model, government or NGO extension agencies provide services directly to farmers. Yet, "many observers document poor performance in the operation of extension and informal education systems, due to bureaucratic inefficiency, deficient program design, "top-down" transmission of knowledge, and some generic weaknesses inherent in publicly operated, staff-intensive, information delivery systems" [Feder et al., 2001: 45]. In the 90s, wide market liberalization and increased fiscal discipline led to the dismantling of most public systems of services to the small agriculture, leaving those to the private sector. Unfortunately, in most cases, the latter did not take over successfully, which contributed to a generalized increase in rural poverty [Chapman and Tripp, 2003; de la Torre, 2004a].

Therefore, today, developing and strengthening effective markets for goods and services relevant to farmers and rural microentrepreneurs hold significant power to improve the living standards of many poor worldwide. Arguably, private markets can potentially deliver much wider, fairer and more sustainable benefits to poor populations than any other targeted, short-term and small-scale intervention of development agencies. Yet, these expected benefits need strong conditions to actually occur. It is crucial to work on structures

and characteristics of existing markets in order to increase participation by the poor on terms that benefit them [Miehlbradt and Mc Vay, 2005; Kimenyi, 2007]. Important reforms of the business-enabling environment are usually needed, such as securing property rights, mitigating transaction costs, adapting the regulatory environment etc. In addition, in very isolated areas, one needs to actively stimulate local markets. Two basic ways are conceivable to do this: adding suppliers or adding purchasing power to the market.

This paper examines how a Peruvian NGO took the first path to overcome lack of innovation in one of the poorest areas of Peru. It relies on a participatory approach with community institutions to encourage the development of a market for AE services that reach the rural poor. In effect, the intervention amounts to expanding the existing supply by training alternative, local consultants. The hypothesis is that rural poor can pay for relevant services provided an adequate supply is available. Interestingly, another development project was found in the same area, which adopts the demand-driven strategy. That is, this second agency relies on subsidies in order to create (or empower) a rural demand and allow people to start micro-businesses. We discuss it briefly afterwards.

Based on first-hand data, this paper provides various insights about the relevance of the NGO's supply-driven strategy. Our data (particularly the lack of exogenous control groups) do not allow us to actually quantify impacts. However, we measure the peasants' ability (or willingness) to pay, which is at the core of the divergence between the two strategies mentioned. Using a multivariate probit model, we identify some key variables that statistically influence the success probability of the project under study. Especially, we take advantage of an exogenous change in the design of the NGO program to show that training specialists on one single topic (rather than generalists) is much more likely to deliver successful suppliers. *In fine*, we argue that, in the context under study (but probably also elsewhere), training farmers to become suppliers of TA is an effective and sustainable approach to promote long-term development. Once community-based consultants are in place, a marketable demand for their services emerges, even among very poor areas[2].

The success that we evidence is encouraging, as other development programs based on the training of on-the-field promoters generally imply very little diffusion of knowledge to non participants [Feder et al., 2003; Rola, Jamias and Quizon, 2002]. Yet, we are not the first

[2] By contrast, relying on existing private markets may prove to be elusive, since the poor often face strong physical, economic and cultural constraints, which come back to the fore as soon as subsidies stop (in a previous report, Demont 2006 gives empirical indications about the relative failure of the demand-driven strategy).

to assess the empirical relevance of the program under study. Figueroa and Portugal (1998), Coello et al. (2004), La Cruz et al. (2004) and Ita (2005) all reported positive impacts of the training of farmer consultants. However, for the first time, the anecdotal evidence gathered by the NGO's staff is being confirmed through a rigorous quantitative analysis. We pinpoint - and interpret - the field observations that statistically matter by using a set of reliable indicators. We think this work might be relevant for many development projects based on the training of local leaders. For instance, the training's contents, the prevailing community constraints and the incentives that are being given to participants should be carefully studied.

The outline of the paper is as follows. Section 1 describes the target area and emphasizes the poor economic context resulting from its physical isolation. Section 2 explains how the two organizations that we study overcome this situation, as well as their working hypothesis and consequent line of action. Section 3 provides empirical tests about the success of the supply-driven program. Interpretation of the results is offered, especially referring to the community environment. Finally, section 4 concludes.

2. The context of the study area

2.1 Geographical and demographical background

Peru is the fourth largest country in Latin America. It is divided into three well-differentiated zones: (i) the Pacific coastal area, a narrow desert slice of land (11% of the whole territory), in which economic and political activities are concentrated in the productive valleys that command irrigation; (ii) the Andean highlands – hereafter Sierra – (30% of the whole territory), in which agriculture is the main economic activity despite the prevailing aridity and abrupt changes in temperature; and (iii) the tropical lowlands, where forest exploitation as well as tropical agriculture (and petroleum extraction) predominate.

The present work concentrates on the Southern Sierra, where it is estimated that 4,000 native communities are located. Around 325,000 rural households of indigenous origin are living there, which represents 5% of the national population (according to the 2007 Population Census). They represent highly scattered settlements, some of which remain fairly isolated to date, where the Spanish language is hardly spoken but several dialects are used instead. In our study area, Quechua is the main spoken language. Native (or peasant) communities are social organization units that are formally recognized by the New Political Constitution of Peru. Moreover, they are conserving their traditional cultures and tribal

characteristics to a great extent. These are, mainly, direct democracy and rotating leadership, solidarity networks (*ayni* groups), low technicality and spatial mobility in production, collective property of some land and worshipping of nature. This being said, the last decades have witnessed important migration waves towards urban centers and the intrusion of modernity in the countryside.

Throughout recent history, the hyper-centralization of economic activities along the Coast has deprived the Sierra of public investments and proper policies aimed at improving technology and developing commercial agriculture[3]. Hence, several authors explain that the Sierra's narrow dependence of both crop distribution and productivity on climatic and land conditions is principally due to the lack of use of modern techniques and the distance from markets [e.g. Gonzales de Olarte, 1994]. Indeed, while the productive Coast enjoys good interconnections trough the Panamerican road and a network of perpendicular secondary roads, the Sierra is mostly left away from the transportation ways and is therefore driven by a self-sufficiency logic (see below)[4]. As a matter of fact, we observe that the agriculture of the (Southern) Sierra concurrently encounters many obstacles: very small and fragmented farming units, little irrigation, no full-fledged private property on land, segmented and low quality markets, and especially poor technology and knowledge in farming activities [Mazurek et al., 1998]. Therefore, today, the crucially-needed modernization of rural agriculture hinges on the access to adequate training and technology [Mazurek et al., 1998; Lacki and Marcenado, 2003], which the project under study aims at.

The two rural development projects under study take place in the Sicuani and neighboring districts from the Canchis province, in the Cusco department (South-East of Peru). The province is located at an average altitude of 3,700 meters above the sea level and extends around an Interandean valley called Vilcanota, which makes up three distinct ecological and production zones. In the valley floor (3500 to 3600 meters above sea level),

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[3] This hierarchy has been the consequence, above all, of the selection of a specific model of economic development, somehow dictated by the spatial configuration of the country. As a matter of fact, population dispersal and mountainous relief lead to very high per-capita cost of providing infrastructure to remote areas (in addition to technical obstacles). Moreover, tax collection is very costly in those areas as well, which somehow legitimates a lower provision of public goods. Finally, this situation of a favored Coast also results from the culture of "passivity" and the low ability to undertake collective actions of Sierra peasants (mainly due to low educational levels and communication means, as well as to strong aid-dependence).

[4] To give an idea of the importance of the deficit, here follow some statistics from our field survey. The average distance from the sample communities to the nearest town, using the means of transportation available, is exceeding one hour (77 minutes). Actually, 17% of them had no road or hardly motorable tracks to connect their living place, and only 60% had an all-weather asphalted road within reasonable reach. Finally, 70% of them are located in the valley floor, which makes the reported findings all the more impressive. As a matter of fact, in the top zone, the situation is much worse; for instance, one of the sample communities could only be reached by horse, after a fulll-day journey.

people mainly grow corn, broad beans, wheat and vegetables. They usually devote half of their time to cattle farming (bovines, sheep, pork, and poultry), depending on land availability. In the mountainside zone (3600 to 4000 meters above sea level), the chief crops are hybrid potato (i.e. modern varieties), barley, olluco and oca (two traditional tuber crops). Cattle to be found there are mainly sheep and alpacas. Finally, in the top zone (high mountain grasslands, from 4000 to 4800 meters above sea level), agriculture is virtually impossible, except for some native potato species. The main activity and means of subsistence is the herding of lamas and alpacas, whose entire body is made use of.

The 2006 UNDP Human Development Report gives the Canchis province a HDI score of 0.5076, roughly identical to the average score of sub-Saharan Africa. Indeed, in the environment of this study, isolation and self-consumption combine with low technological levels and little TA, to give rise to extreme poverty pockets[5]. Economic poverty leads, among other things, to a low nutritional quality of the food consumed, which is in turn reflected in a chronic child malnutrition rate as high as 38% and in one of the lowest life expectancies of the country (less than 60 years). Besides, the area faces a major educational problem, which is due to high absenteeism of the pupils (mainly due to economic impossibility for the family to bear education costs) and ineffectiveness of the formal educational system (due to poor educational programs, failure to accommodate linguistic diversity, bad professional qualification and low wages for teachers). Thus, even though the average schooling in the area lies around seven years (i.e. incomplete secondary education), 30% of the current rural population is still illiterate.

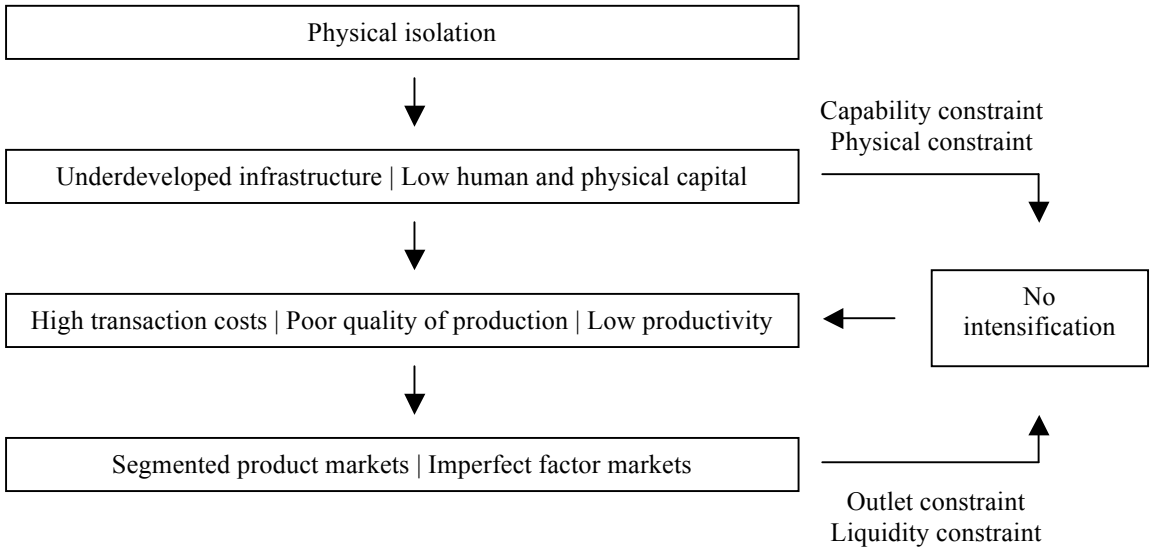
2.2 Economic environment

Let us briefly explain the importance of the challenge at hand. Remoteness, underdeveloped infrastructure, high exposure to natural hazards, cultural and liquidity constraints are automatically reflected in wide differentials between prices paid by final consumers (purchase price) and those received by primary producers (farm-gate selling price). It is thus easy to understand that most Andean peasants, who definitely face those types of constraints, are locked in a semi-closed economy: many of the items that they produce and consume are non-tradeables on world, national and often even regional markets. The vicious

[5] At the national level, 76.5% of the rural population in the Sierra is living below the domestically-defined poverty line and about 50% is considered as extremely poor, in spite of the strong economic growth experienced by the country since 2002 (INEI, 2006).

circle resulting from the situation of physical isolation is illustrated by the figure presented below (adapted from Platteau 2000, p. 50).

Figure 1: The effects of physical isolation on the development of Andean markets



A direct consequence of the segmented nature of markets is that, once an output level is reached that satisfies the current household demand (for consumption, storage, bartering, and solidarity obligations), marginal utility of extra effort is very low (since it would be barely profitable). Peasants are then likely to prefer an activity out of the farming unit, which can generate immediate cash and thus loosen their liquidity constraint (especially during the lean season)[6]. As a result, given the restricted scope of output markets and the context of pervasive market failures, investments required for agricultural intensification will hardly take place spontaneously in the environment under study (especially in the most isolated areas). Similarly, forcing peasants into adopting intensification practices (possibly by giving them some assets), as many development projects used to do, is doomed to fail. This is what the "outlet constraint" in figure 1 refers to.

In addition, recourse to work exchange groups (*ayni*), though necessary in the absence of formal insurance schemes, goes hand in hand with low productivity. True, they represent valuable risk-pooling arrangements and allow expanding every individual's production

[6] A whole range of peasant goods can only be acquired through money, because no member from the social network produces them (those are new substitutes for traditional goods or new necessities, services, agricultural inputs). Moreover, it is clear that those "imported goods" are getting more and more important.

frontier given the traditional diversification strategies of the peasants[7]. Yet, this is a second-best optimality: due to the well-known incentive problems plaguing collective action, efforts applied on individual plots are most likely to be suboptimal. Moreover, the prevalence of low-quality labor is in turn reinforced by very low amounts of human and physical capital in the hands of peasants. This is the "capability constraint" in figure 1. Obviously, poor infrastructure also directly limits intensification possibilities (see the "physical constraint" on the figure).

Lastly, the same constraints greatly affect the development of factor markets (e.g. land, financial and, central to this work, TA services). First, as a corollary from the above discussion, demand for those services is likely to be very limited (i.e. low reservation price and elastic individual demand curves). Second, money is scarce in the Andean economy; exchanges are often settled through informal credit (e.g. among *ayni* groups) and barter. Moreover, the prevailing culture of aid dependence in the area (many public and private programs used to follow a gift logic) certainly exacerbates the limited willingness-to-pay of peasants. Third, linguistic and cultural barriers are strongly at play: it is typically very hard for peasants, who have limited education and speak mainly the Quechua language, to identify suppliers (usually living in town), to play on competition between them, or simply to understand the information provided. This asymmetry of information is the source of much abuse: for instance, many peasants reported that suppliers often used out-of-date products or charged too much ("for the bother"). Furthermore, as explained above, material conditions are very poor. Finally, appropriate technology doesn't always exist, due to lack of *in situ* experimentation, especially for the most elevated zones where effective farming conditions widely diverge because of different conditions of soil, rainfall, elevation and slope. The "liquidity constraint" in figure 1 refers to the necessity for peasants to rely on their own resources.

As far as agricultural modernization is concerned, defeating the logic that we have just described is certainly not easy. Actions on the both sides of the problem are needed: making intensification practices more feasible (through closer, better and cheaper TA) and profitable (through higher trade opportunities).

[7] Peasants typically manage several plots of land with different characteristics (especially in terms of irrigation and property regime) and located at different altitude levels. This is mainly aimed at avoiding land overuse, and at diversifying the crop mix and the multiple risks of the Andean environment.

3. Two approaches to stimulating innovation in poor areas

In the South-East of the Cusco department, we witnessed two development projects aimed at accelerating technological change in rural areas. On one hand, the *Kamayoq* School is a training center for poor farmers, which was set up in 1996 by a Peruvian Non-Governmental Organization called "Soluciones Prácticas ITDG" (hereafter ITDG)[8]. On the other hand, the Corridor Project is a temporary partnership started in 2001 between the IFAD and the Peruvian government (through a loan agreement) and focuses demand conditions.

This work is about the first project. Nevertheless, the presence of another program in the same area, which is addressing the same failure of a given market in a fundamentally different way, provides an interesting perspective while specifying the NGO's project. Moreover, the two projects are intimately linked since some ITDG beneficiaries are using the other project to develop a business and the Corridor project benefits from the presence of the TA suppliers trained by ITDG. Even so, the budget, intervention area and objectives of the two projects are very different[9].

3.1 The *Kamayoq* School

In 1985, the first office outside Europe of ITDG was created in Peru. There, it is "tackling poverty through the generation of practical technological innovations in partnership with resource-poor rural producers" [ITDG, 2006: 10; own translation].

Created in 1996, the "*Kamayoq* School" was designed to train peasants as new suppliers of TA and innovation promoters, active in poor and remote communities of the area[10]. In addition, several farmer consultants are also active for an array of institutions (including the Corridor Project). Therefore, by organizing (and financing) farmer training, ITDG promotes a genuine local market for agricultural and livestock extension services that reach rural poor and hence allows overcoming the isolation failure. The general working hypothesis is that peasants are ready to take steps to solve their problems and improve their

[8] The former and original name of the NGO if Intermediate Technology Development Group (ITDG).
[9] The overall budget of the Corridor Project is USD 30.9 million and it is working in 136 districts from 15 provinces of the departments of Cusco and Puno. By contrast, the budget to organize one promotion of the Kamayoq School is between USD 20 and 50 thousand (according to the last three promotions), and Practical Action is active in 6 districts from one province (Canchis). The Corridor Project should end in early 2008. Consequently, the aim of this work has never been not to draw any comparison of the respective impacts.
[10] The appellation « *Kamayoq* » comes from Inca times and means (in old Quechua) specialists, professionals or investigators (such as, for instance, the *quipu kamayoq*, who knew the knots and colors codes used to communicate in the Inca Empire, or the *chaca kamayoq*, who were the bridge wardens). Some development institutions (e.g. PRODERM) started to reintroduce the appellation in the mid-eighties to refer to expert peasants, with a view to revalorizing native culture. Note that the term Kamayoq admits no plural.

living conditions (and to pay for that). However, they do not find adequate answers under present conditions, i.e. the existing supply of TA is unable to satisfy the latent demand. ITDG thinks that farmer-to-farmer transfers of experience and knowledge are most effective and that it is possible to take advantage of the potential for innovation among the rural poor. Moreover, thanks to the (ever-) lasting presence of the new community-based consultants, the existing demand can gradually expand (through training as well as imitation effects), which can trigger a sustainable and accelerating move towards agriculture modernization and poverty reduction.

The training puts strong emphasis on the value of local knowledge and peasant experimentation with novelties: "the objective is that they eventually become promoters of adequate technological alternatives themselves, with the ability to generate creative solutions to local production problems" [La Cruz et al., 2004: 13; own translation]. ITDG created a pivotal assembly where heads of target communities and the NGO's staff discuss the unfolding of the activities, the use of the budget, the training's contents, etc. The training is bilingual and highly practical[11]. In this sense, the *Kamayoq* School really fills a gap in Peru's formal educational system, which is largely designed to benefit urban families from the high and middle classes (even as far as agricultural education is concerned).

ITDG bases its intervention on traditional rural institutions, local culture, and non-formal economic relationships, in order to accelerate sustainable changes. All the candidates must first be selected by their community in order to participate in the School before being interviewed by the staff. Moreover, the *Kamayoq* are well-settled community members, always available to anyone who needs assistance and is ready to pay for it. They perfectly know the local culture (including the language) and ways of doing things. They are trustworthy villagers. Finally, they ask for lower remuneration than urban professionals since they face much lower transaction as well as living costs, and they accept a whole range of means of payment, in tune with their environment (i.e. payment in hours of work - through *ayni* group, crops or other products and money).

At the time of our fieldwork, the *Kamayoq* School had trained around 180 peasants since its foundation, who have attended to more than three thousand farming families. This

[11] The approach follows the methodology *Farmer Field School*, first developed by the FAO in the late eighties for East-Asian rice-based systems and today promoted by many development agencies (including the World Bank), as a more effective approach to extend science-based knowledge and practices [Feder *et al.*, 2004]. "Through interactive learning and field experimentation, FFS programs teach farmers how to experiment and problem-solve independently, with the expectation that they will thus require fewer extension services and will be able to adapt the technologies to their own environmental and cultural needs" [Godtland et al., 2004: 2].

represented in six cohorts of graduates (one cohort is around one year duration, see table in appendix 2). After the three first cohorts, the NGO operated an important modification of its line of action. It bears noticing that this switch was exogenously-driven, due to a lack of financing. The main change between the two waves was the reorientation towards specialized training on one particular topic instead of general – but also more superficial – training covering several subjects. In addition, the NGO ended input gifts to graduates. The habit to grant sheds, seeds, drugs and other materials to graduates was replaced by a shop with loan facilities.

Finally, graduates from the School, with the support of ITDG, have set up a *Kamayoq* Organization, aimed at guaranteeing a certain sustainability in the service supply, managing it collectively (e.g. on institutional markets), and organizing refreshing and updating courses. It is currently building up and is likely to play a crucial role a few years hence.

3.2 The Corridor Puno-Cusco Development Project

The Corridor Project seeks to "increase rural and urban incomes in the Puno-Cusco area by supporting agricultural production and development of the manufacturing and services sectors by micro- and small-scale enterprises." [IFAD, 2007: website].

We are specifically interested in one sub-component of the program, called "strengthening of rural markets", which aims at fostering the development of rural markets of TA by facilitating the meeting of demand and supply[12]. In order to do so, it does not provide any training but instead enables peasants' demand for TA through important subsidies (typically 90% of the costs). It postulates that there exists an adequate stock of suppliers (even for the poorest zones), which is made up from high school graduates and facilitators who got trained by numerous previous development projects[13]. Therefore, to overcome the under-utilization of available professionals, and to develop sustainable service markets, genuine demand must be created, backed by sufficient wherewithal [Haudry de Soucy, 1998]. The underlying hypothesis is that, upon completion of the project (normally one year), beneficiaries will have developed businesses strong enough to enable them to buy technical assistance. The need for income generation is strongly emphasized and the subsidized assistance always involves commercialization issues.

[12] The other components of the Project include: strengthening of financial services, product certification and access to legal recognition (identity cards etc.).
[13] Interestingly, the project nevertheless offered training to the suppliers hired by the beneficiaries, which were actually taken by almost half of the suppliers.

The peculiarity of the Corridor Project is thus that it acts on demand conditions. In a nutshell, its intervention amounts to paying the wage of professionals whom peasants decide to hire in order to receive technical assistance (as well as for training trips, incentives etc.). The money first goes to a bank account under the control of the leaders of the peasant community and is disbursed in successive tranches, conditional on favorable reports to the institution[14]. In addition, the Project supplies facilitators to help beneficiaries to work their way through various administrative steps such as accountancy, report writing, contract signing and monitoring. Peasants are thus assumed to have well-defined needs and are, indeed, selected on the basis of contests in which they are asked to formulate a micro-development plan for their community.

3.3 Graphical representation of the interventions

Figure 2 below presents a stylized community market for rural services. Peasants' demand (D_1) is modeled as being low and very elastic, as a result from the weak purchasing power of peasants – whose demand stays most often unsatisfied – and the existence of "substitutes" [15]. Professionals' supply (S_1) does not exist below minimum quantity and price (P_{min}) – which is high given transaction costs – and is rather inelastic: urban suppliers are not much willing to increase effort and go to remote communities, because they have relatively good business opportunities in town where they can sell veterinarian products and supply assistance to larger farming units. In addition, the rural market is characterized by high entry costs, especially in terms of social and cultural investment, so that expansion is constrained. As a matter of fact, in most communities, a market equilibrium involving positive quantities of assistance is not feasible, as shown in the figure by the absence of intersection between the curves S_1 and D_1.

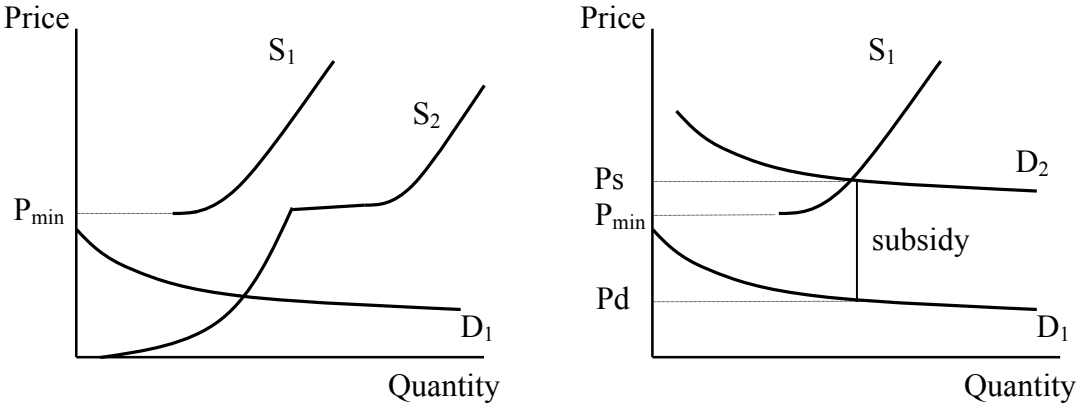
As shown in the left-hand side figure, the ITDG intervention increases existing supply, especially for low prices. The new supply (S_2) starts from a lower level, since farmer consultants accept lower remuneration. As it happens, some of them even supply positive quantities at no charge, out of solidarity and/or duty feelings. S_2 is also likely to be more elastic, as the peasant consultants are more flexible (living on the spot) and accept a wider array of payment modalities. As a result, an interior equilibrium is now achievable, in which potentially large quantities are supplied at low prices. In a second stage, the project is

[14] In practice, every selected community receives USD 5,000 that is shared amongst the constituted groups of the community (usually four).

[15] This means carrying on with traditional technology or letting animals die. Even if TA could be regarded as a "necessity" for peasants given its potential impact, poverty and isolation rather make it a "luxury".

supposed to induce a gradual demand increase, which will raise further the quantities exchanged on the rural market. Yet, the assistance that *Kamayoq* can deliver is likely to reach a limit beyond a certain level, due to poor physical and human infrastructure (on the graph, S_2 gets steeper). However, at that point, professional supply is more likely to be available to relatively richer and more technologically advanced farmers (and S_1 comes back in).

Figure 2: Comparison of two interventions on a local TA market



On the right-hand side figure, the Corridor Project is shown to expand demand by means of large subsidies, which creates a wedge between the price received by suppliers (Ps) and that paid by users (Pd). Most of the subsidy is passed on to the suppliers as a result of the high elasticity of demand. As can be seen from figure 2, this way of overcoming peasants' isolation allows positive quantities to be exchanged on the market, but at relatively high prices (needed to attract suppliers), which may thwart the program's sustainability (if high transaction costs arise again as soon as the subsidies stop).

4 Empirical tests of the merits of the supply-based approach

This section aims at assessing the empirical relevance of the supply-based extension model. It characterizes the market fostered by the intervention of ITDG, and identifies some key determinants of the program's effectiveness. We perform three analyses, based on different layers of data. First, a mean analysis tests some initial assumptions and provides a first idea about the performance of the strategy. Then, an econometric model confirms the main determinants of consultants' activity, as measured by different indicators. Finally, data from our survey is used to deliver some intuitions about the actual scope of the newly created market.

Let us state our main conclusion from the onset: it appears desirable to train specialists as opposed to generalists. Although this was not obvious *per se*, the switch operated by the NGO from one tactic to the other (after the third cohort) unequivocally led to a greater efficiency. In addition, other variables suggest that (i) personal characteristics such as age and education matter for some activities (but not the sex) and (ii) *Kamayoq* are best thought as local complements rather than substitutes to existing commercial suppliers: they seem to be best adapted to places and/or topics that are not currently touched, thus solving the isolation trap. In those conditions, a marketable demand for rural services in poor and remote areas exists. Nevertheless, this demand appears limited in many cases, as the last point of this section discusses.

4.1 Data

We use two data sources. First, we gathered information about *Kamayoq* graduates from ITDG office, as well as some basic geographical and demographical information from the local office of the Agriculture Ministry (such as the location, population and area of villages). These data are used for the quantitative analysis. Then, we conducted a field survey in the target area between October and December 2005, in order to deepen our understanding of the development projects under study. We randomly selected communities from the three altitude zones, which had received (or were receiving) the assistance of ITDG or the Corridor Project, or both[16]. We interviewed 65 different individuals from 20 communities, comprising beneficiaries of both projects and external witnesses (community leaders and villagers). For each of them, we collected information about community, personal characteristics, and specific project-related variables. Some basic descriptive statistics about our sample can be found in appendix 1. In this paper, we focus only on the data about members of ITDG-treated communities (i.e. comprising at least one *Kamayoq*)[17].

A great part of this paper is based on the analysis of the activity of *Kamayoq* graduates. To measure it, we rely on four different sources for each graduate: (i) the activity state at survey time, as perceived by the local staff of ITDG (ii) the use of the NGO's input shop over the years 2004 and 2005, (iii) the participation in official SENASA sanitation

[16] The sets of beneficiaries of the two projects intersect. In our sample, 11 Kamayoq are also Corridor group members and 2 have been hired as Corridor suppliers.
[17] Demont (2006) discusses the whole data.

campaigns since 2002 (collected from the registers of the Agriculture Ministry)[18], and (iv) the presence in an official listing set up by the Ministry of Social Affairs, which contains all the TA suppliers from the area, by specialty. Those four pieces of binary information are then combined to determine whether a graduate is active or not (in the absence of actual activity measures for the entire population). The reason we combine them is that none of the four measures is likely to reflect the actual activity rate for all graduates and with full accuracy. Arguably, the first indicator is a subjective and potentially conservative estimate (though we cross-checked the information by different reliable staff members who have been there since the start of the School). Second, you can possibly be active without having to buy seeds, drugs or other materials at the NGO's shop (though the long distance to and the high prices of private shops make it highly relevant, as indicated by its important use by graduates). Third, sanitation campaigns are specific for graduates trained in stockbreeding and/or animal sanitation. Finally, the official listing might fail to list some "unobtrusive" individuals and does not have data about the last cohort's graduates (since it was written before the end of the training). Nevertheless, when combined, we believe they deliver a fair idea of the activity state of the graduates. We check that the four measures are strongly positively correlated with each other. Moreover, for the graduates in our sample, we observe a strong correlation between those indicators and the actual activity measures that we gathered during the survey. The correlation matrix is provided in appendix.

4.2 Overview

At this stage, we should make clear what we understand by success for the program at hand. The supply of services very rarely represents the main activity of *Kamayoq*. First, the trained peasants keep working within their own farm, because the low remuneration of the services they supply cannot usually provide the mainstay of their subsistence. Moreover, they are trained to be innovators (and not resellers), so that they need to be able to use and experiment with the techniques they promote. Thus, the priority for the *Kamayoq* is to improve their own family business, thereby doing empirical research and demonstrating new techniques to fellow villagers. It is only in a second stage that they will seek to sell out TA in their community. Ultimately, the very successful *Kamayoq* can get contracted by an array of

[18] The *Servicio Nacional de Sanidad Agraria* (SENASA) is a department of the Agriculture Ministry that organizes sanitation campaigns across the country, hiring local professionals. It is associated in Kamayoq training and then invites the successful graduates to participate in official campaigns.

external institutions. Our success indicators are thus chosen to tackle those different levels of activity.

To begin with, this section reports mean activity scores that simply average the four binary information sources listed above, in order to get a crude activity index for each graduate[19]. Table 1 distinguishes specific subgroups of (i) the entire population of the School and (ii) the sample that we interviewed during our field survey. The classification across the different columns relies on some basic assumptions suggested by our fieldwork. First, as explained, there has been an important change in the School's training policy after the 3 first cohorts, and we expect it to have an impact on the activity rate of the graduates. We think that not only the topic of the training matters (i.e. animal sanitation for the last three cohorts – see appendix 3), but the reorganization towards a more efficient, specialized training. Column four makes the distinction. Second, a successful *Kamayoq* probably needs to be a middle-aged peasant who is well anchored in her community, in order to (i) know suitable farming techniques, (ii) stay in the place on a lasting basis and (iii) command a good relationship network. That is, variables such as age, marital status, number of children etc. could matter for the activity rate of the graduates. Third, relatively educated peasants are can probably better understand and to put in practice the training they received. Finally, women are likely to encounter important barriers to supplying services out of the farm[20].

The first observation to make is that many *Kamayoq* are "inactive", as shown by the low mean scores that are reported in the table. In the graduates' population, 38% are reported as inactive by the four information sources that we use and 71% do not reach an average score of 0.5. However, there is a significantly higher activity rate for the three last cohorts: 40% of the graduates are recorded as active by at least two criteria. Broadly speaking, this means that, in a three-year period (between 2002 and 2005), the strategy delivered 37 new rural experts who are actually innovating on their own farm and supplying basic services in 28 different communities. Although it could be higher, this is certainly not negligible. As a result, we have some indications that the supply-based extension model is broadly relevant, though failures exist.

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[19] The MIMDES listing was made at the time of the sixth promotion and does not contain the last graduates from the Kamayoq School, for whom the activity index therefore does not comprise that fourth information source.

[20] As a matter of fact, Andean wives often have to stay home to look after children and small animals, sometimes needing their husband's permission to go out. Moreover, when they do manage to work outside, they often suffer from machismo and opprobrium for not speaking or writing good Spanish, which leads to lower confidence and payments from buyers.

Table 1: *Kamayoq* activity variable [0-1]: mean analysis, by subgroups

Population	**Whole population**	Three last cohorts	Animal sanitation	Age between 25 and 45	No children	Only primary education	Male
All graduates *186 individuals* a/	**0.28**	0.38 ***	n.a.	0.32	0.23 *	0.22 ***	0.29
Sample *26 individuals*	**0.36**	0.60 ***	0.51 **	0.35	0.25	0.31	0.39

Source: registers of the Kamayoq School (line 1) and own survey (line 2).
**** Reported mean is different from the rest of the population at a 1% level of confidence, ** at a 5% level of confidence and * at a 10% level of confidence (using t-test).*
a/ The age, children and education statistics are computed excluding the first promotion for which the NGO could not provide information (except for the surveyed Kamayoq).

Overall, the table thus confirms the above predictions, though not always significantly. The change operated after the first three cohorts of the School appears to contribute to significantly higher activity rates for graduates. Moreover, the topic of the training does not seem to be the sole explanation: some graduates from the first wave are specifically engaged in animal sanitation and, although they do better than the average for all cohorts, they are not as active as the average graduate for the second wave. Let us finally note that our survey selected *Kamayoq* slightly more active than the average (the difference is significant at the 10% level of confidence).

4.3 Econometric confirmation

We now focus on the data obtained from ITDG's records, which have the advantages of being rather objective and complete (they have been recorded for all 160 graduates from cohorts 2 to 6). Therefore, many biases are avoided, including sample selection bias. Good data coverage allows us to estimate econometrically the determinants of *Kamayoq*'s activity and thus test the robustness of the above results.

The aim is not to predict values but instead to identify the ceteris paribus effect of some key variables (and their relative importance) on the probability of peasant consultants to be more or less active. We use a multinomial probit approach. We regress three activity indicators – namely, the NGO's perception, the use of the input shop and the participation in SENASA campaigns – on a same set of independent variables, while taking into account that the three measures are correlated. This technique has the advantage of delivering valid estimates for each activity indicator, thus avoiding any arbitrary and hard-to-read aggregation. The fourth information, the presence in the MIMDES listing, is not available for the graduates

from the last cohort and is therefore regressed separately (using a univariate probit) to avoid a too big loss of precision. Standard errors are clustered at the community level.

For every individual, we regress the activity variables on a "first wave" dummy variable, which takes the value 1 if the individual was trained in the first three cohorts, and on two sets of characteristics: those of the individual and those of the community to which she belongs:

$$Activity_i = \beta_0 + \beta_1 * firstwave_i + \beta_2 * X_i + \beta_3 * C_i + \varepsilon_i$$

The X vector includes the following individual variables: gender, age, number of children, years of schooling, experience (i.e. time elapsed since graduation) and poverty (proxied by low land or cattle ownership). The C vector consists of the following community variables: an altitude dummy that indicates whether the community lies in the valley or higher, the number of *Kamayoq* suppliers in the community (competition – or collaboration – effect), total population and surface area (demand for services). Every explanatory variable is taken at its selection-time value (i.e. before any effect of the training has materialized), avoiding any simultaneity bias. Table 2 presents some descriptive statistics about the variables that are used. Table 3 gives the results of the 'full' regression, controlling for the size of the market, i.e. the community's population and number of suppliers. Yet, this comes at the cost of a reduced number of observations since we are unfortunately missing the population data for some communities (which were not in the Ministry records). We provide the results of the 'basic' regression in appendix, which maximizes the number of observations. Our results are anyway very robust across specifications[21].

[21] Many specifications were actually investigated; all showing very similar results in terms of significance and magnitude of the main variables. Table 3 excludes the variables surface area and number of children (which are never individually nor jointly significant, and whose effect is a priori unclear), in order to maximize the number of observations and thus the accuracy of the model in revealing the magnitude of the variables of main interest (those variables were not available for some individuals and hence force to reduce the number of draws when calculating the simulated likelihood). Similarly, we opt for a single measure for wealth, mixing cattle and land ownership, in order to maximize the number of observations and to apply to different farming profiles.

Table 2: Summary Statistics

Variable	Mean	Std deviation	Minimum	Maximum
NGO's perception	.578	.495	0	1
Shop use	.140	.348	0	1
SENASA campaigns	.113	.317	0	1
MIMDES listing	.285	.453	0	1
First wave	.505	.501	0	1
Sex	.828	.378	0	1
Age	34.90	8.73	18	63
Children	2.75	1.98	0	9
Education (years)	8.05	2.70	3	13
Cattle ownership (heads)	59.75	71.91	1	470
Land ownership (ha)	13.62	31.53	0	100
Poor 1/	.339	.475	0	1
Experience 2/	4.56	3.09	0.5	9
Valley location	.683	.467	0	1
Number of *Kamayoq*	4.50	2.83	1	13
Surface area (ha)	1562.9	1403.98	155	9786
Population (people)	917.10	542.525	36	2642

1/ takes one if the household owns less land or cattle than the 25th percentile of the population living on the same ecological floor (and zero otherwise).
2/ measuring the time elapsed since graduation.

The variable of main interest, "first wave", is very negative and significant for all success indicators. Having been trained in the first wave significantly reduces the probability of being recorded as active, by about 50% on average[22]. The theme of the training certainly plays an important role: it might be easier to supply animal sanitation services (which have been the object of training for the last cohorts – see appendix 2) than services in irrigation or forestry for instance, because they have a more obvious and immediate economic value. But there is probably more than that: candidates who receive a specialized and deep training on one single topic are more likely to be active. It is important to note that there was no change in the selection process between the three first holistic waves and the three last ones, and that we control for a whole range of physical and demographic factors, so that the negative coefficient that we find in the data can be seen as a true consequence of the change in training policy. Still, a potential bias to this conclusion lies in the mere fact that the first wave is older.

[22] Marginal effects are computed as F(x*beta | first wave=1) - F(x*beta | first wave=0), where x is the vector of all explanatory variables taken at their median value, beta is the vector of coefficient estimates and F is the cumulative normal distribution (for every equation). The reported average is for the 3 equations regressed jointly. It is even higher if we add the fourth equation.

However, such a bias exists only if time is thought to erode *Kamayoq*'s activity rate, which is not obvious at all from our field observations. To the contrary, the experience variable seems to indicate that some time is needed before a graduate is able to develop any activity (positive and decreasing effect of experience). Similarly, replacing the first wave variable by cohort dummies confirms that the three first cohorts are significantly less active than the sixth, while the fourth – which is the beginning of the second wave and was already more than three years old at survey time – is insignificant, as is the fifth. Finally, a Ramsey test for omitted variables actually fails to signal such a bias (p-value of 90%).

Let us briefly comment results regarding some of the remaining variables. Interestingly, sex does not seem to play a significant role (except maybe for shop use). This result is somehow surprising: even if it is weakening, gender discrimination is still deeply rooted in the Andean society. Therefore, it might signal the success of the program in training proud and emancipated women as well as in making their environment change through promotional activities, meetings with community leaders etc. Being poor, defined as commanding little land or cattle with respect to other farmers from the same ecological floor, significantly reduces the activity rate by 24% on average. This is an important effect, which ought not be neglected: leaders need to have a minimum asset base to practice. Finally, we observe a negative effect of being located in the valley floor (not significant in the 'full' version of the model). Higher communities tend to have more active *Kamayoq*, which could indicate that the strategy under study is better adapted to remote areas than to places that are relatively close to towns and enjoy relatively better communication links. Distant communities can trigger more activity for resident *Kamayoq*, as a result of lower competition from urban professionals and closer interpersonal ties, among others.

Education doesn't seem to play a crucial role, which is good news as far as the 'inclusive' character of the program is concerned. Schooling tends to have a positive and decreasing effect, but is significant only for the participation to official sanitation campaigns. Some minimum education is probably required to understand to contents of the training and to "market oneself" effectively afterwards. Yet, graduates with (more than) complete secondary education have significantly more income and outside opportunities, so that they could be less active as community consultants - in the SENASA and the shop equations, the maximum of the quadratic function is around nine, while complete secondary education is ten years[23]. For

[23] The negative coefficient in the NGO equation is somewhat misleading since the minimum of the function is at 6 years, after which the impact of education is actually positive (e.g. for the median individual). Besides, note that a traditional 'ability bias' is unlikely to drive the results, since schooling is largely exogenously-determined

the median individual (8 years of education), one extra year of education increases the probability of being active by 15 to 40%, depending on the equation considered.

Controlling for the market size does not bring major changes relative to the 'basic' results (see appendix), but unveils an interesting effect of the number of leaders per community. Competition –or delegation – seems to be at play: having more than one graduate in a given community decreases the individual probability of being active. Yet, beyond a certain number of leaders (in the data, above 5), the probability of being active increases again, perhaps indicating that a critical mass can lead the community and undertake larger projects more easily. Although this observation has also potentially important policy-design implications, we do not want to put too much trust in the exact coefficients since the number of graduates could fail to be strictly exogenous. More 'dynamic' community might have sent more members to the School (although the latter operates a selection, partly trying to balance participation) and, at the same time, allow graduates to be more active, which would bias upwards the coefficients (so that the effect of extra leaders would in fact be even more negative in this case).

Reassuringly, the main results – especially regarding the first wave variable – prove to be robust and consistent across different specifications and across the different activity indicators (the likelihood ratio test for no correlation between the equations has a p-value over 99%, showing the importance of having modeled this correlation explicitly). Our model explains between 25 and 35% of data variation. It is clear that our limited data could not capture some very important – yet hard to observe – determinants such as personal motivation, farming ability, or community externalities. Nevertheless, our simple setup appears to pick some reliable determinants of the activity rate of the farmer consultants, which can probably be generalized to most development project based on training local experts. Farmers with some minimum education and asset base who are trained on one single topic are the most likely to become true technological leaders who can effectively supply services to their community on a lasting basis.

(by wealth for instance), is largely orthogonal to the topics touched by *Kamayoq*, and is fairly homogenous and low anyway.

Table 3: Determinants of *Kamayoq*'s activity (controlling for market size)

Variables	(I) NGO's perception	(II) Use of shop	(III) SENASA	(IV) Listing
First wave	-1.902	- 1.066	-2.382	-2.031
(3 first cohorts)	(0.593)***	(0.310)***	(0.711)***	(1.040)**
Male	-0.008	0.765	0.295	- 0.138
	(0.296)	(0.461)*	(0.345)	(0.336)
Years of schooling	-0.143	0.430	1.058	0.109
	(0.282)	(0.421)	(0.432)**	(0.410)
Years of schooling sq.	0.013	-0.024	- 0.067	0.006
	(0.017)	(0.025)	(0.027)**	(0.025)
Age	0.116	0.240	0.099	0.267
	(0.088)	(0.098)**	(0.097)	(0.097)***
Age sq.	-0.001	-0.003	-0.001	-0.003
	(0.001)	(0.001)**	(0.001)	(0.001)***
Valley	-0.388	-0.558	0.304	0.043
	(0.351)	(0.367)	(0.338)	(0.687)
Poor	-0.678	-0.449	-0.656	-0.468
	(0.247)***	(0.293)	(0.323)**	(0.278)*
Number of *Kamayoq*	-0.416	-0.014	-0.284	-0.051
	(0.120)***	(0.165)	(0.142)**	(0.122)
Number of *Kamayoq*	0.035	0.003	0.025	0.008
sq.	(0.008)***	(0.012)	(0.012)**	(0.009)
ln(Population)	0.391	0.078	-0.318	-0.036
	(0.200)**	(0.243)	(0.223)	(0.216)
Experience	0.089	b/	0.410	-0.265
	(0.200)		(0.214)*	(0.643)
Experience sq.	0.028	b/	-0.016	0.045
	(0.022)		(0.024)	(0.049)
Constant	- 3.053	-7.697	-8.455	-5.529
	(2.433)	(3.144)**	(2.982)***	(2.973)*
Observations a/		*138*		*117*
Pseudo R-squared		*0.3504*		*0.2750*

Clustered standard errors in parentheses. Columns I, II and III are the results of a multivariate probit regression. Column IV is the result of a separate (univariate) probit regression.
** Means a 10% level of confidence; ** a 5% level of confidence; *** a 1% level of confidence*
a/ The observations exclude the first promotion (28 individuals) and those including missing values.
b/ The variable experience was removed from the shop equation because it was insignificant (at 10% confidence level) and it had a strange behavior, due to strong collinearity with other variables.

4.4 Local evidence about the scope of the market

Table 4 displays the answers of members of the sample communities (*Kamayoq*, heads or other villagers) to some key questions from our survey. The last column focuses on communities that benefit from the presence of some graduates from the last three cohorts of the School, in order to bring out the ITDG strategy in its best condition of operation. Overall, this table confirms the positive evolution of the School's performance.

The first variable indicates that *Kamayoq* enjoy good recognition in their community, since all things that matter for Andean communities are actually discussed in assemblies. This is especially true for specialized consultants. Yet, the most interesting piece of information concerns the actual activity of the new leaders. More than 60% of the respondents said that the (specialized) *Kamayoq* of their community were supplying TA at least once a month and at least once a week in 30% of the cases, which indicates that a new market is effectively created. For more than 40% of the interviewees, the training actually led to concrete improvements in their way of farming. The peasants' ability to pay represents the most critical assessment of the relevance of a supply-driven intervention. Our data suggest that most graduates from the second wave of the School are able to charge fellow community members for the services they provide them (88% of the cases). A significant share of farmer suppliers can earn a living by providing rural services: one transaction out of four a wage payment, on top of the products' cost. Interestingly, the possibility to ask for remuneration is linked with the activity rate of the suppliers: in our sample, all the *Kamayoq* who were reported to supply weekly assistance were receiving money, and over 40% of them were earning significant incomes (i.e. charge for labor on top of products). By contrast, when sporadic assistance was reported, no money was involved in half of the cases.

Table 4: *Kamayoq*'s activity: percentage of respondents who gave each answer

	All cohorts	Some graduates from 2nd wave
Community speaks about *Kamayoq* during assemblies	57.41	70.59 ***
Kamayoq supply regular TA	43.64	61.76 ***
Respondent has improved her production thanks to *Kamayoq*	39.22	40.63
Kamayoq charge nothing for services supplied	16.36	11.76
Kamayoq charge products or labor a/	16.36	17.65
Kamayoq charge small amounts of money	30.91	35.29
Kamayoq charge significant amounts of money	18.18	26.47 **
Some *Kamayoq* in the community are inactive	57.69	50.00

*Source: own survey (55 individuals for column 2 and 34 individuals for column 3). *** means that the reported score is different from the rest of the population at a 1% level of significance and ** at a 5% level (t-test).*

a/ This can be exchanges of crops or hours of labor among ayni groups. Note that the answers sum to more than one hundred, since several Kamayoq explained that they charge differently according to different situations.

Finally, half of the interviewees said that some of the *Kamayoq* living in their community were staying idle, echoing the problem of effectiveness that we already identified above. The main obstacles to supplying agricultural services, as reported by the surveyed *Kamayoq*, are: lack of demand (45% of the cases), strong (professional) competition (31%), lack of time (31%), deficient training (9%), lack of profitability (9%), and lack of proper infrastructure or tools (5%).

The difficulties mentioned suggest that (i) if the *Kamayoq* do not break the vicious circle of isolated agriculture (see section 2), they are likely to allocate too little time to the tasks expected from them; (ii) it is necessary for the *Kamayoq* to have an economic interest in the enterprise (especially through selling opportunities and cash income); (iii) the quality of training is very important, so as to allow the leaders to appropriately respond to the demand. As for professional competition, peasants traditionally exhibit more trust or legitimacy in foreign educated professionals (when those are within reach), even though they usually charge higher prices. However, in several cases, the reverse situation has been happening (even in organized competitions such as in the Corridor project), in which demand for professionals' services drops once peasant experts start operating and being truly recognized (see Ita 2005). This shows that peasant consultants can grow through 'market rules', making use of their advantageous characteristics to enter market niches and become recognized in their own community. This being said, it is probably easier outside the valley floor, where very few private suppliers are to be found; *Kamayoq* are reported to supply regular assistance in 33% of the cases in the valley floor, in 50% of the cases in the mountainside zone and in 78% of the cases in the top zone (even though it can refer to "autarchic" activity in the latter case).

Yet, the first two obstacles show clearly that the expected creation of a new demand among the community of the consultants is lagging, which can be due to a series of both endogenous and exogenous factors, including cultural aspects and incentives problems. For instance, as far as the latter is concerned, asking a participation fee to the training could help selecting applicants and motivating graduates. Turning to cultural aspects, tribal characteristics are likely to limit the possibility to do 'business' with fellow community members (for a discussion at length on this issue, see for instance the seminal book of Platteau 2000). However, it is beyond the scope of this paper to tackle those issues.

5 Conclusion

In Peru as in many countries of Latin America, the tendency in the nineties has been the progressive privatization of the agricultural information and the departure from the approach of rural extension with public good characteristics. As a result, many isolated areas became neglected, trapped in subsistence economies. We studied an innovative strategy for accelerating technological change in poor areas, engineered by a Peruvian NGO. The *Kamayoq* School relies on the training of a network of peasant technological leaders and the consequent creation of rural markets for agrarian extension. Its originality lies in the fact that, after an initial (limited) training impulse, it relies on market and non-market relationships that traditionally exist within peasant communities in order to generate a self-supporting movement of propagation of agricultural services.

In this paper, we have shown that such a supply-driven strategy can generate sustainable, wide benefits. In contrast to other development projects, the *Kamayoq* School does not require stringent favorable conditions such as access to reliable private markets and communication means, education and awareness of its beneficiaries, or availability of altruistic heads of community. Moreover, being focused on education and training, the program generates many externalities, which justify some public support. The training received by the *Kamayoq* benefits many people, with multiplying effects, thanks to the assistance provided or imitation effects. A better supply of TA – i.e. cheaper, closer, better adapted – can go a long way in creating an effective market for rural services in poor areas. Evidence reported in this paper indicates that this is especially true when relatively well-off peasants receive a specialized training in one relevant topic. Also, the *Kamayoq* are particularly useful in more distant areas where transaction costs are particularly high for urban professionals. Nevertheless, only about half of the trained peasants can currently be considered as genuine technological leaders and active facilitators of change in their native communities.

In conclusion, in the Andean mountainous areas at least, a supply-side solution appears well suited to tackle the lack of rural innovations. The principles of learning by doing and farmer-to-farmer transfer of experience and knowledge prove to be highly effective and suggest that it is possible to take advantage of the potential for innovation among the rural poor. This is not to say that there does not exist any demand problem. But demand conditions are surely much harder to influence on a lasting basis and should be considered as endogenous to a large extent.

Such a conclusion can probably be applied to many similar development projects based on the training of peasant consultants. Several earlier surveys in Peru, India or elsewhere have emphasized the extensive role of social interactions between neighboring farmers for technology adoption in traditional, rural environments [e.g. Godtland et al. 2004; Foster and Rosenzweig 1995; Conley and Udry 2005]. In this respect, the *Kamayoq* School represents a highly valuable program in the light of the numerous failures and uncertainties usually plaguing rural education programs (see e.g. the survey by Anderson and Feder 2003). Moreover, contrary to many development projects, it is a largely replicable model. Ideally, public spending should provide the subsidy that is naturally needed for public goods such as the information needed to better exploit available economic opportunities.

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Appendix 1: Basic descriptive statistics about the sample

	Kamayoq	Corridor beneficiaries	Heads of communities	Villagers	All
Number of individuals	26	29	14	11	65 a/
Sample percentage	40.0	44.6	21.5	16.9	100 a/
Males (%)	69.2	57.7 *	92.9 **	81.8	71.9
Age average	42.2	43.8	45.9	40.5	43.8
Education average	8.2	7.6	11.9 **	8.1	8.7
Children average	3.2	7.0	12.6	3.4	6.9

*** Means that the reported statistics are different from the rest of the population at a 5% level of confidence and * at a 10% level of confidence (using t-test).*
a/ Categories overlap.

Appendix 2: Correlation between activity variables for Kamayoq in the sample

	NGO's perception	Shop use	SENASA campaigns	MIMDES listing
NGO's perception	1.00			
Shop use	0.219 ***	1.00		
SENASA campaigns	0.271 ***	0.444 ***	1.00	
MIMDES listing	0.483 ***	0.281 ***	0.493 ***	1.00
New income 1/	0.402 **	-0.052	0.098	0.428 *
Frequency of TA 2/	0.464 ***	0.387 **	0.701 ***	0.756 ***
Importance of payment 3/	0.153	0.323	0.442 **	0.547 **

*** significant at 1%, ** at 5% and * at 1% of confidence.*
1/ whether the Kamayoq is enjoying an extra income following her training (between 0 and 2, 1 being a small income and 2 being a high income)
2/ between 0 and 4, 0 being never, 1 sporadically, 2 at least once a month, 3 at least once a week and 4 everyday.
3/ 0 is no payment, 1 is cost of products (drugs etc.), 2 is products and wage.

Appendix 3: 'basic' regression

Variables	(I) NGO's perception	(II) Use of shop	(III) SENASA	(IV) Listing
First wave	- 1.490	- 0.936	- 2.370	- 1.826
(3 first cohorts)	(0.505)***	(0.297)***	(0.540)***	(0.963)**
Male	-0.118	0.819	0.206	- 0.176
	(0.292)	(0.545)	(0.281)	(0.344)
Years of schooling	0.124	0.445	0.987	0.305
	(0.266)	(0.429)	(0.328)***	(0.370)
Years of schooling sq.	- 0.004	-0.022	- 0.064	- 0.008
	(0.016)	(0.025)	(0.020)***	(0.023)
Age	0.122	0.220	0.096	0.189
	(0.084)	(0.094)**	(0.087)	(0.110)*
Age sq.	-0.002	-0.003	-0.001	-0.002
	(0.001)	(0.001)**	(0.001)	(0.001)*
Valley	-0.402	-0.262	0.014	0.046
	(0.290)	(0.259)	(0.251)	(0.454)
Poor	0.518	- 0.404	- 0.639	-0.390
	(0.231)**	(0.273)	(0.273)**	(0.260)
Experience	0.053	b/	0.573	-0.062
	(0.171)		(0.162)***	(0.541)
Experience sq.	0.019	b/	-0.030	0.023
	(0.015)		(0.015)**	(0.037)
Constant	-2.010	- 7.462	-7.115	- 5.250
	(1.985)	(2.696)	(2.342)***	(2.599)**
Observations a/		*157*		*123*
Pseudo R-squared		*0.2529*		*0.2332*

Clustered standard errors in parentheses. Columns I, II and III are the results of a multivariate probit regression (MSL, # draws = 20). Column IV is the result of a separate (univariate) probit regression.
** Means a 10% level of confidence; ** a 5% level of confidence; *** a 1% level of confidence*
a/ The observations exclude the first promotion (28 individuals) and those including missing values.
b/ The variable experience was removed from the shop equation because it was insignificant (at 10% confidence level) and it had a strange behavior, due to strong collinearity with other variables.

Appendix 4: The *Kamayoq* School

Cohort (year)	Communities of origin	Topic	Training's duration (days)	Graduates			Age average	Schooling average
				Total	Male	Female		
First (96-97)	07	Irrigation, native crops, horticulture, stockbreeding, forestation	27	26	19	07	36.7	6.7
Second (97-98)	11	Idem 1st , agro-industry	29	27	22	05	35.4	7.4
Third (99-00)	13	Idem 2nd	27	42	29	13	33.1	7.9
Fourth (02)	15	Animal sanitation, stockbreeding	27	22	21	1	34.8	8.4
Fifth (03)	15	Animal sanitation, stockbreeding	27	35	28	07	35.2	n.a.
Sixth (04-05)	17	Alpaca farming	31	35	35	0	35.6	8.1
Seventh (06-07)	09	Native potatoes farming	a/	23	17	6	n.a.	6.4
Average (1-6)	*13*	-	*28*	*31*	*26 (86%)*	*5 (18%)*	*35.1*	*7.7*

Source: own elaboration from School's records and from Figueroa and Portugal (1998).
a/ Information not yet available at the time of writing.