Contracting Out of Poverty in Peru: Some Experimental Approaches

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Abstract: Poor, rural farmers are often left out of the market. They may not be able to compete with large farmers who can provide firms, such as grocery store chains or exporters, a consistent and quality product. These barriers to entry may be an outcome of the scale of production but also of a small farmer's inability to commit to a contract. At the time of sale, if market prices are higher than contracted prices, farmers may renege and sell in the open market. While a farmer that reneges on a contract will probably pay a price of not having his contract renewed, the empirical evidence suggests this is not a strong enough deterrent. There is also evidence that firms renege on the contract at the point of sale. We propose three innovative contract structures to solve this problem and open markets to small farmers of high-value crops in Peru. The contracts will be tested and narrowed down in the laboratory and then applied with coffee producers in several rural communities in Peru with the support of CEPICAFE. The proposed research will show which contract structures work and will measure improvements to overall farmer welfare. We expect the results from the implemented contracts to be applicable to contract farming in other regions of Peru as well as in other countries.

Introduction

Contract farming has shown to be an effective way to integrate farmers into the benefits of expanding domestic and international markets. It also continues to grow even after the initial stages of product development. Nonetheless, contract farming and its benefits have been concentrated in a small segment of farmers, mainly medium-sized and relatively more educated. It is not clear why smaller and less educated farmers are excluded from these kinds of arrangements. The most commonly cited explanations are size limitations and fixed costs. The small farmer is too small to make such an investment profitable, or the farmer cannot afford to make such an investment. In addition, though, there is evidence to suggest that small farmers are unable to commit to the contract. We propose to open up markets to these farmers by designing contract mechanisms that are incentive compatible and improve the welfare of small farmers.

Interestingly, while there is a tendency for contracts to go to large farmers, research shows that access to small farmers might be advantageous to a firm, mainly because it increases the firm's capacity to respond to market conditions. These are gains to coordination that are not mediated by markets. While the technological barriers of small farmers into contract farming are real and important, we want to highlight evidence that shows that incentive problems are partially responsible for the failure of contract farming among small holders. A misalignment of incentives might prevent gains from trade to be realized, albeit far less so for large farmers. Large farmers are easier to monitor and catch cheating. Also, the gains from trade with large farmers might be substantial enough for repeated interaction to be viable given the probability of renewed interaction.[1]

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[1] The Folk theorem holds either because the discount factor is close enough to 1 or because the gains from cooperation are large enough in comparison to defection. The situation we describe is very much a prisoner's dilemma game since both players have a dominant strategy to defect

In this research, we ask, is it possible to design contracts that engage small farmers in production and increase their welfare? We believe it is and propose several mechanisms to do so. The common cases where contract farming has been successful are those where the firm has monopsony power over the final crop. For example, there is not a large market for asparagus in Peru, so farmers must sell to an exporting firm with few alterative firms to sell to. We propose to explore a more general case where markets are competitive and ask if we can find contractual arrangements that work and encourage firms to engage small farmers. We propose to experimentally investigate alternative contractual arrangements that help resolve the incentive misalignment problem.

Our innovation is that we will implement these contract structures with coffee farmers in Peru. Peru is an ideal venue because of the diverse geography, potential for contract farming with agricultural products, and the on-site technical support we will receive to implement the contract structures. We propose three contract designs to address the issues of cheating by the farmer and the firm. The proposed contract structures are joint ventures or partnerships, linked production, and linked contracts.

Examples of Contracting Problems

There are many ways in which contract farming can be considered a failure. At the private level, participants may fail to experience significant gains (higher returns and/or lower risks) or those experiencing gains might represent a small segment of the population (large farmers, men, etc). At the social level, contract farming might deteriorate environmental quality or create social differentiation. We will consider successes and failures at the individual level. In

particular, we will consider how sustainable these arrangements are and the estimated gains to farmers and/or firms.

The next few examples describe different failures of contract farming. In particular, we concentrate on those cases where contract farming involved small farmers but failed, i.e. failure to meet quality standards or failure to comply with the contract. As we will see, reasons explaining these failures range from inadequate levels of monitoring and the existence of short term gains to deviating from contracts (moral hazard). We also list a few cases where procurement was predominantly from large farmers as an optimal response to the monitoring issues by the contractor.

1. Tendency towards large holders

1. Farmers that comply with standards

a. According to Dolan and Humphrey (2001), the growing consumer interest in food safety and origin of product has shifted export horticulture toward larger contract farms and vertically-integrated processor-exporters. For instance, food safety standards on green beans exports from Kenya forced new contractual arrangements. The share of smallholders in the export sector declined from 60% in 1980s to less than 30% in 2003 (Jaffee, 2003, Kimenye, 1993). The largest exporter of Green Beans in Zambia (York Farms) procured production mainly from its own farms or large growers. These large farms are mainly owned by white settlers and rich former copper mines workers. Thus, they tended to be more skilled, educated, and endowed with financial (cash) and physical (land) capital. Because York Farms needed to comply with residue limits, York Farms would have needed to adopt close coordination and monitoring of smallholders which was too costly for the firm to bear. Thus, York Farms was never able to engage smallholders into production (Okello et al., 2006).

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b. A principal disadvantage of contracting, particularly in developing countries, is the high level of transaction cost associated with providing inputs, credit, veterinary and extension services. These transactions costs are often excessive if large numbers of small farmers are spatially dispersed and infrastructure is poor or lacking (Key and Runsten, 1996). In this regard, it is estimated that dealing with large farmers, who need fewer provided inputs and deliver in greater volumes, can save up to 30% in transaction cost (Runsten & Key, 1996; Coulter et al, 1999). Moreover, additional supervision and monitoring costs have to be considered in conjunction with the non-cost effective delivery of services and inputs to farms that are small and spatially dispersed.

2.   *Failure because of not appropriate supervision*

a. In 1973, a modern-formal contract on vegetables was introduced in Thailand. The foreign joint-venture (Thai-Israel) was a huge vertically integrated corporation (The Eisenberg Group of Companies) that included from farm production to processing and exporting. The Thai Farming Company was responsible for supervising land preparation, inputs use, equipment installation, harvesting and processing. Despite the big investment made by this company in supervision and technical assistance, the company failed because cash-constrained farmers sold directly to middlemen for cash (Wibonpoongse et al., 1998).

b. Boselie et al. (2003) provide the example of *Hortico* in Zimbabwe where small producers made a loss of about 40% because of inadequate quality on their first crop. Though this number improved with time, the authors report that significant losses were incurred in the distribution of the product to markets. Moreover, the authors also report the case of the firm TOPS in Thailand that tried to integrate small vegetable producers who had previously been part of integrated pest

management (IPM) program supported by FAO. This initiative failed also because small producers were not able to meet the quality specifications.

c. Reardon and Berdegué (2002), Reardon et al. (2003), Weatherspoon and Reardon (2003) and Shepherd (2005) discuss how as supermarket chains expand and consumers become more sophisticated, supermarkets find it profitable to establish their own supply chains (including dedicated distribution centers), set private standards, and establish lists of preferred growers linked via contracts. Unfortunately, as Weatherspoon and Reardon (2003) document, most of the fresh fruits and vegetables sold to supermarkets come from medium and large farmers. These are growers that can meet the volume and quality requirements more easily and that can provide a steady supply throughout the year. Balsevich et al. (2003) estimates that 80% of fresh fruits and vegetables supplied to supermarkets in Costa Rica came from medium or large growers or packers on contracts.

d. In discussing the experience of contract farming with small farmers in Punjab by multinationals like Pepsi/ Hindustan Lever (a subsidiary of Unilever), Singh (2002) finds that farmers defaulted by contracting with a competitive local firm who benefited from the original contracting firm investment. Indeed, open market prices were often high enough to induce default. The observed default rate was high (above 50%) each time the gap between the contract and the open market prices was large (3–5 times). It is important to note that these product, tomato and potato, have available outside marketing options. Interestingly, the inability of the farmers to meet the quality requirements was an endogenous response to the profitability of the local demand for lower quality product.

e. Another downside risk faced by contracting firms is the possibility that growers may divert inputs (such as feeds) supplied to other purposes and may sell output outside the contract

(especially when market price rises above the guaranteed fixed price) thereby reducing yields. Apart from this, contracting firms also suffer from shocks like disease outbreaks, bad weather conditions, or growers' negligence or failure to produce to managers' specifications. However, contracting firms have sometimes managed to minimize this risk by offering incentives in case farmers surpass the performance standards (such as mortality rate and feed conversion ratio) set at the beginning of the contract (Delgado et al 2003).

2. Problems to producer that accepts contract farming

a. *Contractor monopsonistic power*: Some costs of contract farming to the producer include the loss of autonomy (as they do not actually own the contracted livestock or crop), loss in bargaining power, increased production risk due to homogenization, and reduction in producer's pay if not all contracted quotas are purchased (Schrader, 1986; Currie & Ray, 1986; Glover, 1984; Glover, 1987; Korovkin, 1992; Morvaridi, 1995; Pasour, 1998; Rehber, 1998; Wolz et al, 1999).

b. *Increase in specific production risk:* Production risk increases as a result of investment in highly specific fixed production assets such as land, buildings, and equipment that might be obsolete in case contractual arrangements cease (Featherstone and Sherrick, 1992; Royer, 1995; Rehber, 1998).

c. *Higher costs*: Contracting could also reduce producer's income. Contracting could penalize a contracted farmer with high levels of capitalization and managerial skills where an open market exists for the same output, thus reducing his income (Runsten & Key, 1996; Rehber, 1998). In most cases, if not all, output prices paid to the producer could be less than spot market prices because of the reduction in marketing risk to the farmer and as a result of increased market

power of the contracting firm. In cases when the output price rises above the contract price, the grower loses his earning potential (for extra profit) since he typically gets a set price (or limited supply) from the firm. Additionally, farmers might be considered the only subject responsible for the environmental externalities that production might generate.

d. *Contractor defaults:* Poultry farmers observe the widespread practice by contracting firms of manipulating the quality of day-old-chicks (DOCs), manipulation of the count of birds at harvest and the "fixing" of scales (Tiongco et al., 2006). Farmers are sometimes supplied by contractors with DOCs that are hatched from leftover eggs (not observable at the time of delivery) which lead to poor survival and performance. In addition, there are cases where contractors fail to deliver inputs (such as DOCs) on time thereby reducing the number of batches per year that are stipulated in the contract. Finally, small farmers complain of charges for services and inputs rendered to the farmer and the net payment for the raw commodity supplied (Glover, 1987; Abbott, 1994; Runsten and Key, 1996).

Research Design

Our research design will address the issue of failed contracts between small farmers and firms. We propose to develop contracts that will be tested both in the laboratory and in the field to improve small farmer welfare. The strategic environment in which the farmer and firm interact is one where small farmers are at a disadvantage relative to large farmers. This is due to minimal experience in repeated interactions with the firm and lack of capital to make the necessary investments to enter in the product market. Small farmers need help with initial investment, i.e. with seeds or technical assistance, to be able to produce these high-value crops. Without the firm's assistance, small farmers cannot enter this lucrative market. Large farmers do not need this help. At issue is the incentives that both small farmers and firms have to renege on the

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agreed upon contract. We outline the basic strategic game that is the basis for our experimental contract design below.

The Game Firms and Farmers Play

Figure 1 presents a representation of the strategic situation that firms and farmers face. Firms have available resources E that can be partially invested with a farmer for the production of a new product. Farmers have an amount r of available resources. These resources might be time, money or favors. As the examples in the Introduction describe, a typical contract includes an investment by the firm (I) and a promised price (p_1) to the farmer. The description of the game in Figure 1 implicitly assumes that farmers cannot undertake the investment in the product on their own. This is a realistic assumption since the production of high value products normally requires technical assistance, special seeds or working capital, little of which small farmers have. Firms have an information advantage in the knowledge of what the market demands that farmers do not have.

After investment has taken place and production is attained, farmers must decide whether to sell the crop back to the firm or to sell it independently to an alternative buyer at price p_2. Price p_2 is higher than p_3. Price p_2 already includes the implicit cost of cheating like hiding production or transportation costs. In case the farmer decides to sell the crop to another buyer, the firm incurs a loss equivalent to the original investment I.

In the case the farmer decides to sell the crop back to the firm, the firm has the opportunity to renegotiate the selling price p_3. Renegotiation of the final price by the firm takes several forms. The most common form is to discount quantity by quality. The firm claims the quality of the product is not up to its standards, so it buys each unit at a lower price. The

Aligning Incentives

The success of contract farming among medium-size and rich farmers defies the description of incentives presented above. As mentioned before, successful examples of contract farming are normally situations where the firm has monopsonistic power over farmers. This occurs because there is no local market for the product (e.g. asparagus in Peru, high-quality rice, fruit and flowers in Thailand) or because the firm has technological advantage in processing the output. Absent these exceptional cases, contract farming relies on reputation and long-term relationships to maintain a working supply chain.

It is useful to analyze the conditions for an equilibrium with trade in an infinitely repeated context for this game. Consider that the firm discounts future payoffs according to a discount fact δ_1 and that the farmer discounts future payoffs according to a discount factor δ_2. As is standard in the literature on repeated games, discount factors can also be thought of as the probability that firm and farmer will interact again. According to this interpretation, firms facing many small farmers will have lower discount factors and farmers with a low trust of firms will have lower discount factors also.

For a contract (I, p_1) to be implemented by both parties, the firm must find it in its own benefit to pay p_1 to the farmer rather than losing him and the farmer must find it in its own benefit to sell at price p_1 rather than to sell at price p_2 to an alternative buyer. Formally,[2]

$(E-I+P-p_1)/(1-\delta_1) \geq (E-I+P) + E \times \delta_1/(1-\delta_1)$

and

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[2] Strictly speaking, these conditions correspond to the equilibrium which uses reversion to the worst subgame perfect equilibrium as a threat. Other equilibria exist.

$p_1 \geq (p_2 - r)(1-\delta_2)$

These conditions assume that the outside option of the farmer is 0. This implies that if the firm ever renegotiates, it should set p_3 to 0. Combining both equations imply that the acceptable price p_1 for both the firm and farmer must satisfy the following condition:

$(p_2 - r)(1-\delta_2) \leq p_1 \leq \delta_1(P - I)$

This condition shows that a contract might fail to take hold either because firms have little to benefit in following through with a contract or because farmers fail to do so. For instance, the potential gain with small farmers, P-I, might be too small for the firm due to transaction cost or the low level of sophistication of small farmers. If so, technical transfers or education might relax this constraint. Absent technical restrictions, firms might be tempted to defect from agreements because there are plenty of substitutes for small farmers, i.e., small farmers are in excess supply. This is equivalent to δ_1 being too low. On the side of the farmers, contracts might fail because spot market prices are high. This might occur where firms have local competitors and have no monopsonistic power or because cash constraints or lack of access to credit markets make evaluation of future gains irrelevant or not high enough.

Figure 2 shows a simple modification of the original contract that relaxes the constraint imposed by the incentive for farmers to defect. This modification of the game encompasses other contracts like joint ventures, warranties, linked markets and others. We present the simplest version of it to illuminate the logic behind these alternative contractual schemes. The new contract requires that the farmer give the firm a ransom of an amount R ($R \leq r$). The ransom is returned to the farmer if the original contract is followed and kept by the firm if the farmer decides to sell the product to an alternative buyer. The equilibrium with ransoms implies a new equilibrium condition as follows:

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$(p_2 - r - R)(1-\delta_2) \le p_1 \le \delta_1(P - I)$

The new condition enlarges the set of possible equilibrium prices and might potentially resolve the incentive problem faced by the firm and the farmer. Note that ransom R can take many forms, such as a collateral, work in advance, access to cheaper credit or product markets, or joint investment with the firm. The particular form it will take depends on the specific market conditions at hand.
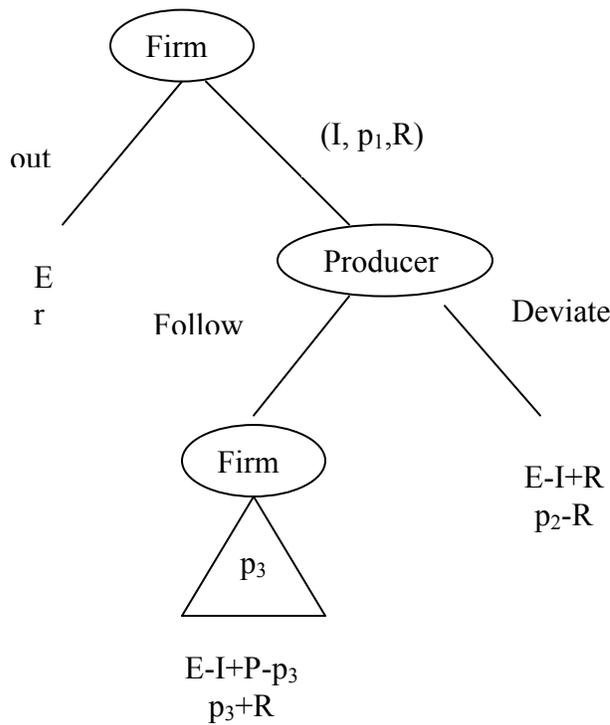
FIGURE 2

Contracts with ransom are useful to solve the incentive problems originating in the lack of monopsonistic power by the firm. While this is a realistic case in the markets we are interested in analyzing, it is the case that if the firm is the only buyer, the likely equilibrium price will favor the firm rather than the farmer. The case of Frito Lay in Peru and e-Choupal, owned by ITC, in Maharashtra in India are examples of this. Our simple model suggests some possible

solutions to this problem. One option is to directly affect the value of δ_1. This can be done by creating mechanism in which information is transmitted easily among producers. For instance, it is possible to make the reputation of the firm public as a way to make it costly for the firm to cheat. Alternatively, as the case of Nestle in India shows, it is possible to create independent ways to measure the quality of the product with accuracy, for instance, using third party enforcement. Finally, the farmer's outside options can be directly affected by fostering competition in the product market as well.

Experimental Design

The experiments will test three contracting mechanisms designed to mitigate cheating and to help make markets more accessible to small farmers. We will first test these mechanisms in the small, in a controlled laboratory setting, with farmers from the targeted population before trying them in the field with actual contracts to coffee farmers. The advantage of testing in the laboratory first is that we will be able to refine the mechanisms and see which mechanism works best before running the more costly field experiments.[3] This approach has been used before with other field experiments on water auctions (Cummings, Holt and Laury, 2003) and transfer programs to welfare recipients (Eckel, Johnson, Montmartre and Rojas, 2006). Once we have the mechanisms we would like to test in the field more refined, we will work with INCAGRO (a company that works with farmers in Peru) and CEPICAFE (an association of coffee companies) to offer actual contracts to farmers growing coffee. This will allow us to see the impact of these contracts on behavior and the welfare of small farmers.

The first contract design is a joint venture. This contract requires that the farmer share in the investment costs of production. In the parlance of our model, the farmer has to pay a ransom

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[3] Testing all the mechanisms in the field, rather than the lab, would require several spatially diverse communities and several years to test which mechanism has the most potential. In the interest of cost and efficiency, pre-screening in the lab allows us to use the most effective mechanism quickly at a small cost.

to get the required investment to begin production. The ransom could take various forms. Instead of providing the seeds and fertilizer for free, the firm provides them at a reduced cost. Or, the farmer is required to work in exchange for the initial investment provided by the firm. Or, the farmer is required to provide collateral for the investment loan, and the collateral will be returned to the farmer upon delivery of the product. This contract addresses the issue that farmers might be willing to sell the crop to an alternative buyer by collapsing the system into one in which the farmer has a stake in the ultimate delivery of the product.

The second contract design is linked markets. The farmer is required to provide the firm two goods. One of the goods is the targeted high-value good that the firm would like to purchase. The other good is a good that the contracting firm has an advantage over other firms in purchasing. Either the contracting firm is the only buyer of the second good, or only the contracting firm can possibly find a market for the good. The farmer would be provided a reasonable price for the second good, and the contracting firm will only buy the two goods together. If the farmer does not provide the second good, the firm will not buy the first good. The contract has to be such that occasional competitors would find it difficult to compensate small farmers for the losses in the second-good market.[4]

The third contract design is linked contracts. Linked contracts extend the idea of joint liability common in the micro-credit literature to the case of contract farming. In linked contracts the firm invests with several farms and severs future interactions if a certain number of farmers deviate from the agreement. If the loss of future gains of partners generates social or monetary payoffs to the defector, the set of possible self-enforcing agreements is enhanced.

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[4] Contracts linking products have a long history in Peru. They emerged as a response to the scarcity of labor during the expansion of cotton and sugar production in the early 20th century. It was called "enganche" and was based on giving consumption credit to workers. Enganche, however, was infamous due to the abuse of power.

However, while this contract is incentive compatible at the individual level, it is not necessarily incentive compatible for coalitions. That is, even if individuals might not find it profitable to deviate on their own, groups of individuals might want to do so. This issue has already been found to be important in the group lending literature. We propose a new contract design that is also coalitional incentive compatible if social sanctions are available. In particular, the contract is based on temporally splitting the timing of the investment and of the payment of a ransom. That is, a subgroup receives an investment and promised price while the rest provide a warranty. If the contract is successfully implemented, the inactive farmers become the investors and the previously active become warrantors. This simple modification of group investment breaks the group incentives to deviate at any given period without overly reducing availability of contracts. Intuitively, the incentives are similar to rotating savings.

None of the above contracts address the issue of firms cheating at the point of sale of product. To address this, one option is to publicize the reputation of the firm to the farmers, so that there is no asymmetry of information about reputation. Another option is to adopt an independent quality control at the point of sale to mitigate any lowering of price by the firm under the auspices of bad quality from the farmer. Any of these options could be used in any of the contract mechanisms.

All of the above contracts and their variations will be tested in the lab first. The basic game will follow the theoretical game outlined in the Research Design section. The firm offers a contract to the farmer. The farmer decides to take the contract or not and produces the good. A market price is drawn from a distribution of possible prices, so there might be a high or low market price. The farmer then decides to sell the good to the firm or sell it on the open market. If the farmer reneges on the contract, he gets a one-period profit from deviating, but the firm can

choose not to interact with the farmer again. If the farmer does not renege, the firm decides what price to offer the farmer. This basic decision game is repeated for several periods. We will run sessions of the basic game to establish the empirical observation that firms and farmers cheat in this environment.

Since all the contracts are based on the idea of repeated interactions, all treatments will reproduce infinitely repeated games in the lab. This is basically done by pair matching where the probability of ending the relationship is randomly determined with a fixed probability. The baseline is important because it reveals how high the short-run incentives to deviate have to be in order for cooperation to fail.[5] We will also implement an alternative design that shares some of the properties of repeated games but it might be more easily implemented in practice. The idea is to create an excess supply of farmers and to pick partners at random. This design rewards well behaved farmers and punishes defectors by returning them to the pool of unemployed until a new opening is available. We will discuss below why this version of the problem might be important in the field versions of the experiments.

We will test out variations in the basic game with the three contract structures outlined above. So, in total, we will have four treatments: baseline, joint venture (ransom), linked markets and linked contracts. The importance of running the last three treatments is to see how the various contract structures work in practice and to obtain measures on farmer and firm welfare. We will also test out the various mechanisms to mitigate cheating on the side of the firm.[6]

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[5] The experimental literature provides important examples of sustained cooperation due to non-monetary payoffs (see Brown et al. (2004)). We are proposing to find contracts that work even in the absence of non-monetary payoffs to cooperation.

[6] There is considerable detail on the implementation and design of experiments that we are obviating in the proposal for reason of space. For instance, the linked contracts treatment would require from us to experimentally reproduce the possibility of social sanctions in case of defection. Fehr and Schmidt (2000) provide an early example of efficiency gains in public good games when costly sanctions are allowed. Another important issue is how to translate the theoretical social sanctions to *in the field* social sanctions.

The laboratory experiments will be run within subjects to allow us to control for initial levels of cheating and the effects of the contracts. So, the basic structure of an experimental session will be to have a subject participate in a repeated baseline version of the contract and then repeated interactions with one of the three contract structures. No subject would participate in two of the proposed contract structures.

The experiments will be run in Peru with CEPICAFE farmers from the areas in which the contracts will be implemented. This allows us to test out these contract structures with our target population. We will invite the population of farmers in the area to participate in the lab experiments, and we will randomly select a portion of the population to actually participate in the experiments. This allows us to control for selection into the experiments.

The laboratory experiments will follow a 3 x 2 design. Each experimental session will have one of the three contract structures (i.e. baseline-joint venture, baseline-linked products or baseline-linked contracts) and one of the two structures to mitigate cheating by the firm (i.e. information on reputation or independent monitoring of quality). This means there will be 6 different experimental sessions. This will allow us to see what combination of contract structures holds the most promise of mitigating cheating and increasing farmer welfare. Each experimental session will have 20 subjects and each session will be run twice. So, in total we will have 240 subjects. The cost per subject will be $15/subject (including show-up fees) and the total cost for the laboratory experiments will be $3,600 for subject payments.

While the design above would produce enough information on the quality of different contracts if we knew the payoff functions of subjects, we normally do not know this information ahead of time. We will therefore run additional sessions to calibrate the payoffs of the baseline treatment. Testing the working of behavior in simple repeated games is potentially useful due to

recent findings indicating that optimal contract design is different if subjects have non standard utility functions. Indeed, if reciprocal motives are strong, incentive contracts might be harmful to cooperation rather than helpful. Similarly, if people care about reference points and are loss averse, the cost of implementing contracts might be distorted. The fact that we will be able to analyze these issues with subjects in the lab and in the field is an added benefit of our approach.

Based on the outcome of the laboratory experiments, we will take the two most promising contract structures, from the side of mitigating cheating on the part of the farmer and on the part of the firm, and test them in the field. The experiments will be run with coffee farmers in several agricultural areas in Peru, with the help of INCAGRO and CEPICAFE. CEPICAFE has agreed to offer the two contracts to coffee farmers and INCAGRO has agree to help in the implementation. INCAGRO has a long-standing excellent reputation in the areas we will be working, and CEPICAFE is a well-known association of coffee companies. This partnership is essential to the successful implementation of the contracts in the field because the farmer must believe that the contract will be implemented as is stated.

There are several agricultural products that experience the problems presented in the introductory section and for which we know contractual arrangement have had only limited success. We have agreements to work with coffee producers, and there are other products that could work as well (i.e. artichoke, mango, and potato). The areas growing these products have a combination of medium size farms specializing in one crop together with smaller farms that devote only a small portion to commercial products. Our work will be carried out among small holders. In addition, and given IFPRI is our main partner, while in Peru and once we have initial results we will also start conversation with the International Potato Center (CIP), a sister center of IFPRI to try also to work with contract farming in potatoes.

An important component of our research design is for contracts to be followed through. That is, we need to create conditions similar to markets and increase the credibility that punishments will be carried out. That is, the field experiments need to be such that participants believe that a state-funded intermediary will be *tough* when required.[7] The easiest way to assure that firms do not behave altruistically is for INCAGRO to work with firms, such as CEPICAFE, to try out these new contractual arrangements. This prevents INCAGRO from renegotiating contracts. Absence of that, the research design section suggests that the way to create credible threats is to create an excess supply of applicants for the program. That is, we will create contracts that are attractive but will not allow for universal participation as a way to credibly establish the future costs of defection. Indeed, random assignment to treatment within treatment communities can create the desired incentives. Note that creating excess supply of applicants would police altruistic principals as well since rewarding defectors has an opportunity cost of not helping a potentially honest farmer.

One of the principal investigators is currently undertaking a survey of several of the agricultural areas we propose to work. That study and its follow up will provide the basic information to select control and treatment areas. Moreover, additional matching funds from the aforementioned project will be secured to sample the treated and control areas more intensely. We consider that two treated and two control communities per treatment and product should be enough to evaluate the potential of new contractual arrangements. As mentioned above, the treated areas will offer new contracts only to a minority of producers as a way to credibly create scarcities. Moreover, we consider that the involvement of INCAGRO will be crucial to transmit the idea that successful trials might generate increased business.

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[7] Treatment compliance on the side of the firm is particularly important in the Peruvian case because Peru has a long history of condoning agricultural debt.

Policy Integration and Outreach

We believe that this proposal will help enormously to design new institutional mechanisms which will favor the inclusion of smallholders to link them to dynamic markets through efficient contract farming arrangements and improving the welfare of the poor. Consequently, beyond academic documents, we will target policy makers in the Ministry of Agriculture, the Sierra Exportadora Program, developments practitioners in NGOs, among others, through dissemination forums and policy-relevant bulletins. With this purpose in mind we will develop a document of optimal strategies for contract farming arrangements. This document will use all the findings from our research and develop policy recommendations as well as potential strategies that institutions can use to improve their access to smallholders.

Our disseminating efforts will be based on four main pillars:

(i) **Internships for Students/Practitioners outside of Lima**: We believe one of the best ways to disseminate research results is by helping young researchers or practitioners in less developed regions develop skills they will use in the future when in charge of implementing the recommendations obtained from our study. With that in mind, we will offer two internships to the best students in universities outside of Lima. The students need to be interested in designing mechanisms to better link small holders to dynamic markets. The internship will involve these junior researchers in the project and will train them intensively in the techniques and methodologies applied. The expected result is that once they go back to their hometowns they can transmit what they learn to their colleagues and start the development of a local network.

(ii) **Discussion Forums**: We will hold two seminars with the help of GRADE and INCAGRO, one outside of Lima and the other in Lima. Each of these seminars will consist of two

sessions. In the first session, all the findings of our research will be explained. In the second session, the **optimal strategies document** will be presented and will be commented on by policy makers, practitioners in the area as well as authorities of the local governments. We plan also to write, at the end of the project, an article that will appear in an issue of "Análisis & Propuestas", a bulletin edited by GRADE and distributed to a broad local audience in hard copy and internationally through an electronic version. (see http://grade.org.pe/). This policy brief will also be published as an IFPRI policy brief.

(iii) **Journal Articles**: we will develop academic papers and submit them to journals. All this work will be presented in a final seminar directed to major stakeholders.

(iv) **Establish a network of agri-business stakeholders** for sharing lessons to replicate successful models of vertical coordination in the high-value food sector. We will prepare a road map for promoting these types of institutional designs. A close interaction with stakeholders through workshops and advisory councils will guide the entire research process to ensure its relevance.

(v) **Public and Private Awareness:** We envisage that the long term impact of the project's results will result in a greater public and private awareness of the importance of the appropriate design of mechanisms to be able to include small holders to dynamic markets. Additionally, the optimal strategies document will have as its main aim to be a crucial tool to take into practice the results of the research by the policy makers and institutions like INCAGRO and Sierra Exportadora. Clearly, the ultimate beneficiaries are the poor and small holders with limited acces to dynamic markets.

Impact Indicators

In the first year, the project will develop baseline indicators based on formal surveys of farmers and semi-structured surveys of traders, processors, exporters, and other actors in the value chain for the products and the communities in which the experiment will be implemented. The outputs will include assessment that focus on the impacts on smallholders of the access to contract farming arrangements and on the reduction of transaction cost on the contractor side as a result of the institutional arrangement implemented.

In the second year, data collection will be limited to monitoring the project goals and to carry out diagnostic surveys to evaluate the perceptions of participants in the experiments. These will serve to identify problems and improve the effectiveness of the interventions in increasing access of small holders to dynamic markets thought the contract farming arrangements.

In the third year, the formal household surveys will be repeated to evaluate the impact of the interventions on marketing behavior, farm income, and the incidence of poverty. The value-chain analysis, which includes semi-structured interviews with traders, processors, and exporters, will also be repeated to estimate marketing margins and trader perceptions of the impact of the. Thus, the project will measure impact in terms of agricultural prices, margins, rural income, and poverty, as well as the perceptions of farmers and traders on the three different contract structures proposed.

Organizational capacity and management plan

The project will be carried out by five institutions: IFPRI, Georgia Institute of Technology, Georgia State University, Group of Analysis for Development (GRADE), INCAGRO and CEPICAFE. IFPRI will provide overall leadership and use its previous experience as the framework for analysis, which it has developed and is currently applying in

examples of Frito Lay in Peru and Rachata in India fit this pattern. The price, P, represent the market price of the output the firm can guarantee for itself.

The standard solution to this game (the subgame perfect Nash equilibrium) is for the firm not to invest with the farmer at all. Why? If the farmer honestly follows the contract, the firm will renegotiate the price (p_3) to zero or the minimum outside option of the farmer. Given the optimal strategy of the firm, the best strategy for the farmer is to sell the crop to any alternative buyer offering more than the producer's outside option.   The equilibrium of this game is therefore for no trade to occur at all. This is inefficient.

The game presented in Figure 1 can be extended to include the possibility that prices fluctuate or for the possibility of asymmetric information between the firm and the farmer. However, this game already provides us with a description of the basic incentive problems hampering the expansion of contract farming among small, poor farmers.
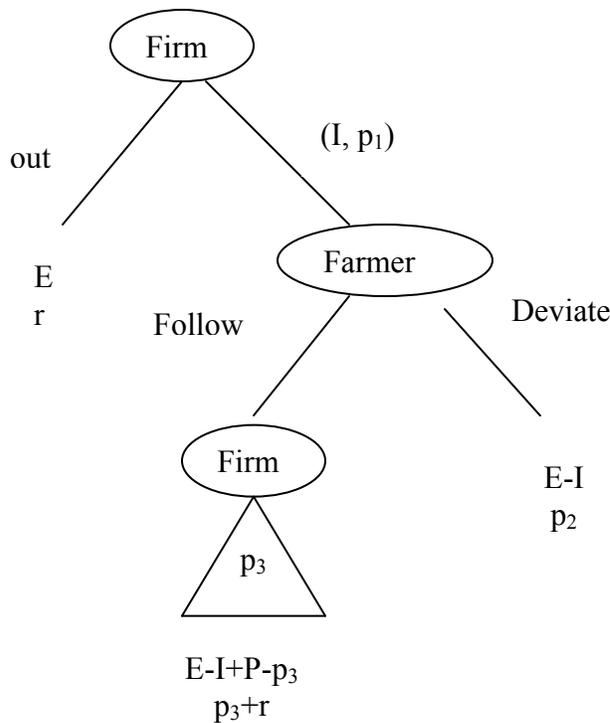

FIGURE 1

rural development projects in Africa and Central America (See IFPRI (2003). IFPRI is one of the 15 international agricultural centers that are members of the Consultative Group on International Agricultural Research (CGIAR). IFPRI's mandate is to reduce poverty by carrying out research, outreach, and training activities related to agriculture, food, and nutrition policy in developing countries. IFPRI has a budget of approximately US$40 million and employs more than 80 researchers, complemented by a management and support staff of 80.

Three features of IFPRI are particularly relevant to its capacity to implement this project. First, IFPRI is currently developing a project entitled "Development of the Rural Economy in the Sierra of Peru" which supports the Government of Peru in the implementation of a strategy for rural poverty reduction for the following three years. The project will develop a knowledge base for prioritizing public and private investments based on the characteristics of different microregions in the rural Sierra as well as their economic potential and the bottlenecks that impede increases in production. With this information for three specific regions in the country the project will design and implement pilot projects to broaden the use best practice operations found elsewhere or to create new solutions to observed bottlenecks. In this sense the current proposal will complement enormously with the ongoing IFPRI activities and will at the same time allow us to implement our results in the three pilot regions. Second, IFPRI has solid experience in conducting impact evaluations of social programs, infrastructure, and ICTs, including the use of experimental methods. Finally, IFPRI has earned a reputation for rigorous policy-relevant research in developing countries, including management of large multicountry projects.

The Andrew Young School of Policy Studies (AYSPS) at Georgia State University together with the Georgia Institute of Technology's School of Public Policy will provide all the technical support and expertise on experimental economics primarily through Georgia State

University's Experimental Economics Center (EXCEN). Georgia State University has over 10 years of experience in designing and implementing economic experiments, both in the laboratory and in the field. The university's lab is responsible for designing the Georgia Irrigation Auction. This auction structure is currently in incorporated in the laws of the state of Georgia as a mechanism to reduce water use in the case of a drought. The lab at Georgia State University created and designed the final institution.

GRADE will provide a base in Peru for local researchers and join with IFPRI in the design and implementation of the development strategies proposed by this project. GRADE's major expertise is that during the last fifteen years GRADE has carried out various studies concerned with the farming sector and the factor markets essential for its development. Among these, research was done on agricultural sales products markets, the rural financial market and labor and land markets. Of special importance is the work on property rights and its impact on rural markets. Even though farming continues to be the most important source of income for rural populations, an increasing proportion of income comes from non-farm sources. Policies aimed at improving the situation of the rural population needs to keep this fact in mind. This has led to orienting this area of GRADE's research to analyzing how public goods and services and private investment can facilitate a more integrated development of rural markets. In this vein projects have been developed about market integration and transaction costs in Peruvian agriculture, strategic links among farming and non-farming activities, geography and rural development. Also, research on this area has studied agricultural policy reforms, the benefits brought to rural people by investments in roads, opportunities for rural investment and strategies for sustainable agricultural development, among other topics. Research in this area has also analyzed the state of farming policy in Latin America.

Project evaluations performed at GRADE in several public programs in education, training, health, infrastructure, within others, had systematized the incentives for operators and recipients, and measure and analyze the costs and benefits of such incentives. GRADE uses quantitative methods to assess the impact of these programs. It should be noted although that systematically and scientifically assessing programs also has political and bureaucratic implications. Assessment of a program underway is usually resented if a bureaucracy has already been established for such program. Therefore, a culture of assessment needs to be built, and this constitutes another expertise of GRADE in implementing clearer accountability mechanisms and transparent and efficient use of scarce public resources. Impact assessments are important to different groups, including users of the program, taxpayers towards whom the government has a social responsibility, institutions funding the program and institutions entrusted with program funding.

INCAGRO (Innovation and Competitiveness for Agriculture) will be the government development agency under the Ministry of Agriculture which will allow us to implement in the local communities the proposed experiments. INCAGRO relies on a system of distribution of financial resources for technical assistance allowing individuals or groups to cover part (up to 80 percent of the total) of the contracting costs for the execution of productive (new or already existing) projects within these framework they will allow us to use their networks of producer associations and local governments to be able to implement our three experiments.

Finally, CEPICAFE, which was founded in Piura on the 25th of March 1995, is a second level non-profit organization which represents coffee and sugar cane producers of the Piuran Mountains and the Northeastern Peru. Currently, CEPICAFE consists of 71 base organizations and 8 zonal committees with a total of 4,811 producers, all of whom are linked to coffee firms

which target their production mostly to the international coffee markets. CEPICAFE has managed to position its coffee in the principal high quality markets: organic, fair trade, sustainable and gourmet, in various European and Northern American countries.

CEPICAFE will provide us the support to implement the proposed contract farming arrangements within their organization. The main advantages of this are threefold. First, CEPICAFE coffee is produced solely by small-scale family farmers, exactly the type of farmers this proposal is targeting. Secondly, their producers cultivate their coffee under shade and fruit trees which also could provide additional high value products over which we can explore our contract farming arrangements. Finally, the Piura region, where these producers and firms are located, started to produce coffee 100 years ago, which gives the realistic environment of competition and alternative buyers which we want to control for in this new design so as to reduce the risk of contract farmers defecting.

Collaboration and Capacity Building

One of the major impacts of IFPRI research is its investment in building local capacities. As part of the project, researchers from IFPRI together with our collaborators from Georgia State University, Georgia Institute of Technology, GRADE, INCAGRO, and CEPICAFE will work closely in training the agencies in CEPICAFE and other agencies in charge of the Rural development in Peru to build capacities so that the local team can take into consideration the results of the project in their future strategies. Moreover, and as part of the "Development of the Rural Economy in the Sierra of Peru" we will include the results in this project as part of the preparation of a plan for the implementation of the relevant solutions found in the three specific regions to be intervened. The challenge here is to interface the inherent top-down decisions

associated with many public investments in rural development strategies with the bottom up interests of smallholders.

Support of USAID Objectives and Initiatives

The goal of the proposed USAID/Peru Strategic Plan and Program is to promote the expansion of sustainable opportunities for improved quality of life of Peruvians through democratic institutions and processes. In these sense the proposed project clearly is consistent with these major goal through two main channels: first by fostering an improved quality of life by better linking small farmers to markets. This will help the most vulnerable and disadvantaged Peruvians to take greater control of their future, to improve their economic conditions, to become better nourished, healthier, and have access to resources to improve their education level.

Moreover, the proposed project is directly related to the strategic objective 2 of USAID mission in Peru, i.e. increase economic opportunities for the poor in selected economic corridors. As shown in Figure 3 one of the pillars of this objective is to improve access to and participation in markets of the poor. With this objective in mind the proposed project tries to develop institutional designs that will incorporate small holders to dynamic markets. Specifically, our project will provide important inputs into the development of the Economic corridors The economic corridors approach implemented by USAID differs from the secondary city market town concept in that it identifies and supports the dynamic commercial linkages and trade flow among one or more key secondary cities and many smaller communities of a third order in a given geographical area. Our proposed mechanisms are exactly target to enforce and create the commercial linkages needed to incorporate the poor by improving the access and participation in markets.
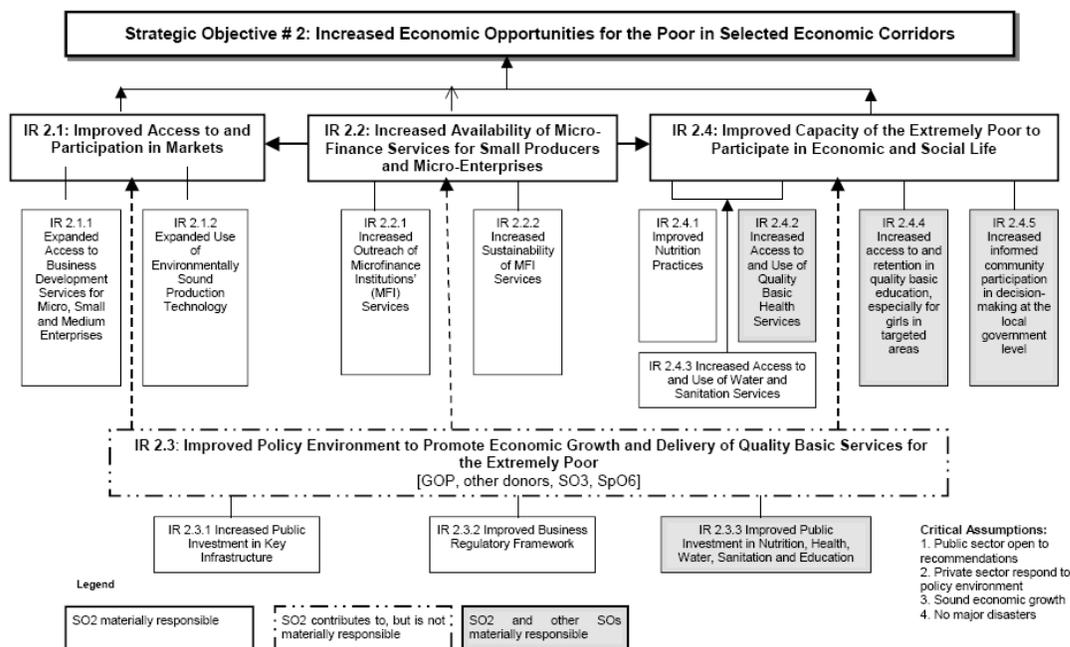
Source: USAID Country Strategic Plan for Peru.

Figure 3

Broader applications

Smallholder cultivation is the hallmark of agriculture in much of sub-Saharan Africa, Latin America and South Asia, where intensity and density of poverty still remains high. In South Asia, for example, out of 125 million farm holdings, more than 80 per cent have an average size of 0.6 hectare and farmers with less than 2 hectares account for 40% of total food grain production. In sub-Saharan Africa, more than two-thirds of the holdings have an average size of less than one hectare and account for over 90% of agricultural output. In Latin America there is also a huge inequality in the distribution of land. FAO estimated that the largest 7% of land holdings in the region (those above 100 hectares) accounted for 77% of the land, while the smallest 60% had only 4% of the land (Morley, 2001). Most of these smallholders practice either subsistence farming or operate largely in local markets due to lack of connectivity to more

lucrative markets at provincial, national or global levels. As a result, incentives remain weak, investments remain low, and so does the level of technology adoption and productivity, resulting into a low level equilibrium poverty trap. The mechanisms that we are testing in this project could easily be replicated in Sub-Saharan African countries and in South Asia. Specifically, IFPRI clearly will strongly support the implementation of the results of these projects in different countries given its objective is to develop international public goods.

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Qualifications of research staff

Marco Castillo, will provide research capacity in economic experiments. He has seven years of experience running experiments in the laboratory and in the field (e.g. in South Africa, Honduras and Peru). His research is on discrimination, bargaining, and social interactions. His work has been published in the *American Economic Review* and the *American Journal of Agricultural Economics*. Dr. Castillo is an assistant professor at Georgia Institute of Technology and is a native of Peru. He worked for Grupo de Analisis para el Desarollo (GRADE) in Lima from 1988-1994.

Javier Escobal, is an economist with a masters and doctoral studies from New York University and a PhD. degree in Development Economics at Wageningen University. Currently he is a Research Director and Senior Researcher in GRADE. In the area of Economy and Rural Development, his work has concentrated on evaluating the impact of the macroeconomic adjustment and structural reforms in the farming sector. In the area of Poverty and Equity he has focused his analysis on rural poverty, specifically in determining the role played by public goods and services in raising the standards of living among the rural poor. In 2000, the Global Development Network (GDN) granted Javier Escobal and Maximo Toreo with the Award for Outstanding Research on Development for their joint work on the geographical dimension to development. In 2001, Escobal was distinguieshed with the John Simon Guggenheim Memorial Foundation Fellowship to continuie pursuing his research about the links between rural producers and markets. During the same year, at the Global Development Network (GDN) annual conference, Javier Escobal was awarded with the medal for best research in Infrastructure and Development, for his work on the measuement of transaction costs in peruvian agriculture. He is a member of the Permanent Seminar on Agrarian Research (SEPIA), the International Network of Research on Production Systems (RIMISP) and the Global Development Network (GDN). He has been an advisor to the Ministry of Economy and a member of INDECOPI'S Commission on Technical Regulations. Currently he is a Principal Investigator for Peru of the project "Young Lives: an international study of childhood poverty", a longitudinal study developed also in Ethiopia, India (Andhra Pradesh) and Vietnam. The Project follows more than 2,000 children in poverty conditions in Peru during the first fifteen years of their life.

Ragan Petrie will provide research capacity in economic experiments. She is an assistant professor at Georgia State University. She has been using experimental methods for seven years to explore research topics such as discrimination, bargaining, and gender differences in expectations. Her work has been published in the *American Economic Review*, *Journal of Public Economics*, and the *American Journal of Agricultural Economics*.

Maximo Torero's (IFPRI) research work lies mostly in analyzing poverty, inequality, importance of geography and assets (private or public) in explaining poverty, and social exclusion in income, labor market and credit markets. Additionally, Torero's research had also include several detailed studies in the impacts of titling on the reduction of risk of expropriation, gains from trade of land, credit access, including the likelihood of obtaining formal credit, and provision of public goods at the level of the neighborhood. Dr. Torero has extensive field experience in Peru and in several Latin American countries.

Timeline

Activity	Month																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Literature Review	▨	▨	▨	▨	▨													
Implementation of experiments																		
- Selection of sites to be intervened				▨	▨	▨												
- Coordination with INCAGRO	▨	▨	▨	▨	▨													
- Design of experiments				▨	▨	▨	▨											
- Implementing experiments in the lab								▨	▨	▨								
- Implementing experiments in the field											▨	▨	▨	▨	▨	▨		
- Development of basline surveys											▨	▨	▨					
- Development of database with results													▨	▨	▨	▨		
- Development of followup surveys																	▨	▨
- Final data base																		▨

Activity	Month																	
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Data Analysis																		
- Analyzing results from field experiments	▨	▨	▨	▨														
- Analyzing results from baseline and followup			▨	▨	▨	▨												
- Modeling risk measures			▨	▨	▨													
Outputs																		
- First paper							▨	▨	▨									
- Second Paper										▨	▨	▨						
- Policy brief													▨	▨				
- Policy seminar													▨	▨				
- Capacity building						▨	▨							▨	▨	▨		
- Final report																	▨	▨

Benchmarks and goals of the project

OBJECTIVES	VERIFICABLE INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS AND RISKS
The main objective is to support the small holders by linking them to dynamic markets and to support the Government of Peru in the development and implementation of a strategy for rural poverty reduction in the Sierra of Peru.	• Validate institutional designs that will promote vertical coordination arrangements to link smallholders to dynamic markets. • Involvement of local communities and governments in the implementation of the project. The emphasis will be to try to implement the results in some communities of the three sub-regions of the Global IFPRI project for the Sierra of Peru.	• Implementation at a pilot level by INCAGRO of the institutional arrangements that the project identify as successful. • Communities adopting contract farming arrangements and food processors and supermarkets linking to small farmers.	• Technical risks in the implementation of the project. • There are political risks specially to implement the institutional design at the level of local governments.
REASON			
Support the strategy of rural poverty reduction in Peru and the efforts of the GOP to reduce poverty in the Sierra by developing Institutional designs to connect small holders to dynamic markets.	• The number of specific pilot projects designed and funded. • Number of Capacity building workshops and seminars at the Central, local and regional governments to implement pilots and projects.	• 3 experiments implemented in the field by month 13th, and at least 3 additional pilot projects by month 19th. • At least 2 testable solutions implemented. • 3 capacity building workshops and 2 seminars with major stakeholders will be delived by month 34th of the project.	• Technical risks in the implementation of the project. • There are political risks specially to implement the institutional design at the level of local governments.
LOGICAL FRAMEWORK TO FOLLOW EACH OF THE COMPONENTS			
COMPONENTS			
Implementing experiments in the lab	• Design experiments • Testing and validation of experiments in the lab.	• Document with a detail review of previous work on contract farming and the major coordination costs identified. • Document detailing methodology and experiment design. • Experiments design and running by month 7th.	
Implementing experiments in the field	• 3 experiments implemented in the field coffee and artichoque.. • 3 experiments implemented in the field for mango and potato.	• 3 experiments for coffee and artichoque implemented by month 13th. • 3 experiments for mango and potato implemented by month 19th.	• There is a technical risk if the assumption behind the problems being solved is not replicable to the four products under study.
Impact evaluation	• Implement impact evaluation stratedy • Identify outcomes and impact indicators.	• Baseline survey implemented by m onth 13th. • Followup surveyt implemented by month 18th • Impact evaluation report finished by month 24th.	• There is a technical risk that practitioneers in charge of implementing the pilots won't accept to implement an impact evaluation framework.

OBJECTIVES	VERIFICABLE INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS AND RISKS
Preparation of a plan for the implementation of the relevant solutions found in component two and three and capacity builting.	At the level of the community ▪ Development plans for selected communities within the Global Sierra project of IFPRI where the succesful institutional designs can be implemented. At the central government level ▪ Built capacities at the Ministry of Agriculture and INCAGRO. ▪ Built in capacities in the Economic corridors projects implemented by USAID Peru (Strategic Objective 2 of USAID plan).	▪ A manual of capacity building for local governments and for institutions similar to INCAGRO. . This manual will include an impact evaluation module and also a guide on how to implement the Institutional designs proposed. ▪ 3 capacity building workshops and 2 seminars with major stakeholders will be delived by month 34th of the project.	▪ There is a political risk that thecommunities selected won't agree to implement the proposed framework in their design of their regional plans.