CIP-CONDESAN Benchmark Site in Aroma, Bolivia

A Research Agenda

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The objective of this document is to summarize the research in the Aroma province to date and to facilitate further research there. In 1997, CONDESAN formally created a partnership with ASPROLPA, a dairy producers association based in Aroma. Although the specifics of this collaboration are still being decided, CONDESAN basically agreed to study the adoption of dairy production in the region. Additionally, CIP, through project 14, has been working in the province. This document is the result of two months of fieldwork conducted by Erin McCormick, in Aroma, two visits by Paul Winters and a visit in August by Alain de Janvry and Elisabeth Sadoulet. While in the field, we were effectively assisted by Federico Mamani, head of the experiment station at Patacamaya and CIP-CONDESAN representative in Aroma, and by Professor Cesar Ibarra Guerrero, also from CIP-CONDESAN. In this report, we outline a number of economic studies that could be conducted in Aroma and would help in understanding the process and the impact of the shift to dairy production. We present a description of the important characteristics of the Aroma economy, followed by the main research questions identified in the field, and an outline of a research strategy to answer these questions.

A. BACKGROUND

This section describes the information we collected on the region's economy – namely important market failures, migration trends, environmental problems, and agricultural production systems in Aroma.

1. *Incomplete land markets*

Land markets in Aroma are constrained by the manner in which land was allocated to communities. In originario communities -- communities that existed prior to the 1953 Agrarian Reform -- the community was given a single land title, called pro-indiviso. The community then divided the land between community members, often leaving some communal land. Individual community members have a recognized de facto right to land within the community. However, lacking legal titles, farmers are reluctant to buy and sell land for fear of making an illegal transaction that could be rescinded in the future. In ex-hacienda communities -- communities created by the 1953 Agrarian Reform -- community members have titles to small plots of land. However, due to the fear that they will lose their land to "the patron", farmers are reluctant to buy or lease their land, particularly to non-community members. In both originario and ex-hacienda communities, decisions about land allocation often need the approval of the community. Land sales between community members are often accepted, but sales to non-community members are generally prohibited. One motivation is the lack of clear titles and concerns over conflicts. Another motivation is the desire to maintain community traditions, such as labor and financial contributions to public works, which may be lost if members sell land to outsiders. Given the concerns over property rights and reluctance of communities to allow outside entry, land sales are extremely limited and consolidation of holding through land purchases is difficult.

With the high level of migration (over 50% of families in most communities) a significant amount of the land is owned by migrants who could conceivably sell their land. Although many of the non-resident community members hold onto land for insurance purposes (in the case of a negative income shock they can return to farming), it is likely that, given the opportunity, some would sell their land. Additionally, the shift to dairy production has created a demand for the consolidation of disperse parcels

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and investment in production (a desire to buy land by more successful dairy producers). Both of these forces are increasing the pressure for institutional innovations that will allow land sales.

For farmers that wish greater access to land, an alternative to land sales is land rental. Land rental markets may compensate for the failure of the land sales market, thereby alleviating the land constraint. The evidence suggests there is a significant amount of rental activity. Large landholders that are labor constrained rent land to small landholders. Migrants, who are unable to sell their land, allow their land to be used by their relatives (often receiving little or no compensation) or rent their land to community members. It is essential that someone use their land to maintain their property rights. Contracts include both fixed rent contracts (often paid with sheep) and sharecropping contracts. How well rental markets compensate for limited sales is not clear.

2. ***Migration***

As in much of the Andes, a large percentage of the young people in Aroma have left agriculture and have migrated to the cities outside of Aroma (the population growth rate for Aroma for 1976-1992 was -0.5%). Communities are left with a disproportionate number of households headed by older males. Employment and educational opportunities in the nearby La Paz, and in other cities such as Cochabamba and Oruro, are attractive options for the rural poor. Locally, the limited economic opportunities in Aroma due to a relatively fixed amount of land and high-risk, subsistence agriculture push rural inhabitants to migrate. In general, land is only acquired through inheritance. Inheritance customs require that the head of the household divide his land between his sons. (Women only inherit land when they have no brothers, and they are never given permanent titles to the land.) Often the father does not have his land consolidated in one contiguous plot (for risk diversification purposes) and the sons inherit a parcel of each plot. Through generations, the amount of land that is inherited by each son is reduced, leading to a process called "minifundizacion." Unable to maintain a subsistence level of income and faced with particularly difficult years such as drought years, family members, or entire families, are forced to migrate to urban centers. Most permanent migrants only return for major festivals (once or twice a year). The high migration of labor, particularly younger males, limits the amount of labor available to the household and in the market.

Historically, return migration has not been extremely common. When the household head dies, or can no longer manage the farm, a family member (often the oldest male) may return to take over the farm in order to maintain rights to the land. Some farmers also returned after failing to successfully attain an adequate living standard in the urban centers. Recently, the adoption of dairy production has significantly increased family farm income. Consequently, farming is becoming more profitable than under the prior crop-production system. This increase in profitability has prompted some migrants to return from the city to work on the family farm. Thus, return migration is becoming more common.

3. ***Resource degradation***

Visual assessment of resource degradation is difficult, but the areas of potential problems are: overgrazing of communal and individual land, salinization, tola extraction, and sedimentation of waterways.

Loss of land productivity due to excessive grazing is a potential problem on both private and communal property. On private plots, farmers note that they are experiencing symptoms of decreasing land productivity such as loss of certain grasses, soil compaction, and lower agricultural yields. On communal lands, overgrazing occurs when farmers are land constrained and thus must access communal lands, and when the rules of access to common property pasturelands are lenient. In Aroma, rules of access to common property resources (CPR) vary greatly with respect to the length of fallowing periods, users fees, sanctions for non-compliance, collective decision making processes, and in their ability to monitor the CPR. In communities that have strict rules of CPR access, land-poor farmers graze heavily on their own plots, possibly reducing land productivity in the long run. In communities with lenient rules of access, land poor farmers may use the CPR intensively, thus reducing the long-term productivity of the CPR. While overgrazing may not be a serious problem at present (some studies suggest that it is not), it is

likely to become a greater problem as dairy production intensifies. Monitoring the long-term trends in land productivity as dairy continues to intensify is extremely important.

Irrigating fields with saline water combined with inadequate drainage is a primary cause of salinization. There are several communities that irrigate their fields with water from the Rio Desaguadero, which has a high salt content because of upstream salt deposits. Because of the topography of certain regions, water is not drained sufficiently. Improving drainage then has the potential of reducing the incidence of salinization. One potential use of lands that are already saline and currently unproductive is kauchy production. Kauchy does well in the saline soils and can be as feed for animals. The planting of kauchy has been occurring over the last few years on a limited basis (some of the initial development of this innovation was done by Roberto Quiroz). Hopefully, large tracks of saline land, which are currently not utilized for any productive purpose, will be planted with kauchy in the future. Developing and promoting technologies that will assist in reducing the current rates of salinization and allow productive use of saline soil has a high potential payoff.

The systematic extraction of the tola is occurring primarily on private lands. Although farmers themselves extract some of the tola for use as fuel (many have switched to gas), most of the tola is destined for Patacamaya and elsewhere (for fuel for bakeries). Each day in the field, trucks filled with tola were observed leaving the communities bound for Patacamaya. The value of tola in Patacamaya was claimed to be 3-3.5 bolivianos per bundle. The intermediaries (a bakery owner himself in one case) pay the farmers 2.5 bolivianos per bundle. They approach farmers with "good" tola and ask to harvest it for this price. The quantity of tola that could be obtained from one hectare of land depends largely on the size of the tola. One farmer noted that residents are aware of the fact that they are damaging their land in the long run by extracting the tola, but are pushed to exploit the land to generate present income. Tola is also extracted when farmers decide to plant alfalfa on a plot. Over the last 20 years, the introduction of alfalfa and the increased demand for tola in Patacamaya is likely to have led to a decrease of tola in the area.

In some communities, farmers noted that an additional environmental problem they face is the sedimentation of waterways. The farmers build makeshift dams to collect water for irrigation. These dams lead to sedimentation, causing the river to become so shallow that flooding of fields occurs more frequently. The problem of sedimentation was seen as a catch-22. If the dams are not built, then farmers do not have irrigation water. If they are built, they cause flooding. The farmers are currently looking for funds to rent a machine that removes the sediment from the riverbed. They also want funding for a project to build a permanent dam (the assumption being that this would alleviate the sedimentation problem). The implications of new dams and irrigation systems on overall water availability (is it a zero sum game?) and on salinization need to be explored.

4. *Risk management*

Agricultural production in the Aroma province is extremely risky, primarily due to uncertain rainfall (drought) and temperatures (frost). To compensate, farmers have developed mechanisms to manage risk. Two common mechanisms that small farmers employ are (a) planting a wide variety of crops and (b) maintaining parcels of land in different ecological zones. Although many communities are located in the main ecological zone - "planice" - each community has a wide variety of micro-zones that differ in their access to irrigation and in their soil type. For generations, families have had a parcel of land in each micro- zone in order to diversify risk. This has exacerbated the process of "minifundizacion" because fathers give each son a parcel of his land in each zone. As farmers move towards dairy production, there is a desire to consolidate holdings to reduce production costs. Farmers appear willing to give up some of the benefits of risk diversification to improve the efficiency of dairy production.

5. *Irrigation/water*

Farmers consistently noted that water limited production (particularly in a drought year.) Irrigation (even though it may lead to salinity problems) is extremely important. Irrigation systems do

exist in many communities. Strict rules of management govern the irrigation systems. Each member of the system receives a water ration based on the number of "shares" he has in the system. Members are required to participate in the maintenance of the primary and secondary canals, while tertiary canals are the responsibility of individual farmers. There seems to be some trading of water by users (an informal water market) although the importance of this was not clear. Stealing water is punishable by loss of the water ration for a year. Land with irrigation is considered much more valuable than non-irrigated land and is almost exclusively used for alfalfa production.

Farmers without irrigation often asked about the possibility of installing a micro-irrigation system. The importance of irrigation can be seen in the experience of one farmer who lived in a community in which an NGO had developed a small irrigation system two years before. The NGO provided supplies and the members provided the labor. In the past two years, the farmer had sold his truck, some of his sheep and criolla cows and his house in La Paz and used the money to purchase a tractor and a number of improved cows. The total investment was estimated to be $10,000. The reasoning for the investment was that irrigation had allowed production of alfalfa, improving the returns to dairy production. As noted above, the potential and effects of developing new irrigation systems should be explored.

There are some limited attempts to use groundwater to irrigate fields. This is not yet widespread and it is not clear how much potential there is for using groundwater. There does seem to be growing interest in using motorized pumps to extract groundwater.

6. ***Dairy production***

The most important recent development in the Aroma economy is the diffusion of dairy production in the region. Until 1986, agricultural production in this region revolved around the cultivation of potatoes, barley, and other subsistence crops, and raising livestock for meat. In 1986 the Programa Autogestionario Campesino (PAC) took the initial steps to promote dairy farming in the region by building roads and introducing alfalfa – the primary forage crop. In 1989, PIL, then a state-owned milk production enterprise, began collecting milk from several communities in Aroma. With the help of PIL agronomists and several N.G.O.s, improved cattle breeds (primarily Holsteins) were introduced to the region. Although there are other market avenues for farmers, such as producing fresh cheese and yogurt, PIL is the dominant purchaser of milk in the region. As a means of organizing milk production, disseminating information, and negotiating with PIL, the milk-producers formed their own organization called ASPROLPA in 1990. Recently, La Gloria, a privately owned company, purchased PIL Andina from the state.

PIL and ASPROLPA collaborate in organizing milk production. Each milk-producing community has at least one collection center where farmers deliver their milk in the morning. PIL trucks come by collection centers to pick up the milk daily and take it to the processing plant. At present the current price of milk is 1.25 Bolivianos/ liter. PIL sends payments to the collection center for its total milk production twice a month. The ASPROLPA representative is responsible for recording the milk production of each individual and for their individual payments. Farmers receive more income from milk in the rainy season when forage crops are more available.

Dairy production has exploded over the last ten years. For most farmers, dairy production is far more lucrative and less risky than the production of meat and crops (the one exception being the production of tunta, a freeze-dried potato.) Dairy production also alleviates liquidity problems by providing a steady source of cash every 15 days.

The increase in income due to dairy production has prompted farmers to begin a process of dairy specialization and land consolidation, mostly through trading and renting land. The consolidation of land (from scattered plots) is desirable because it facilitates monitoring of the herd and reduces costs (both in terms of labor costs and lost milk production) of traveling to a number of parcels.

There is tremendous heterogeneity in the degree of specialization in milk production, the level of productivity, and the paths of capitalization. Table 1 notes some of the characteristics of ASPROLPA members. Note that there is significant variability in the composition of herds and the level of milk production. The ability to invest in dairy production and the path of capitalization depends on one's initial asset position, particularly the amount of (quality) land and the ability to access credit and assistance from aid organizations. In general, the wealthiest farmers are the most specialized in dairy production and have the highest levels of productivity, while the poorest farmers continue to cultivate a wide variety of subsistence crops.

TABLE 1: FARM CHARACTERISTICS

	Mean	***Std. Dev.***	***Min.-Max.***
Total cows	9.29	4.67	1-31
Criollo	3.86	4.24	0-31
Hollstein	3.90	4.54	0-28
Brown-Swiss	1.53	2.17	0-21
Milk producing cows	2.85	1.74	0-11
Criollo	1.16	1.36	0-8
Hollstein	1.25	1.51	0-10
Brown-Swiss	0.44	0.83	0-8
Milk production per day	9.98	11.50	0-83
Sold to PIL	7.30	9.13	0-60
Cheese production	2.00	4.34	0-30
Home consumption	0.68	1.21	0-10
Total area operated	16.08	11.49	1-120
Land in alfalfa production	2.32	2.07	0-20
Land in barley production	2.35	1.54	0-10
Land in oat production	0.47	1.18	0-20
Land with grasses	0.30	0.86	0-10
Land with native pastures	4.04	7.20	0-96
Land with crops	2.37	3.41	0-30
Infrastructure			
Corral	20.0%		
Feeding trough	4.1%		
Water trough	9.0%		
Shelter with roof	11.5%		
Pump for drinking water	18.5%		

(Data from a survey of 509 Aroma milk producers in 1997).

Key dairy production investments include improved cow breeds, alfalfa and other forage crops, and physical capital such as enclosed shelters and troughs. As evidenced by the regression in Table 2, improved breeds such as Holsteins and Brown Swiss (valued at over $1000) have a higher impact on milk production than Criolla cows (valued at $300). In addition to differences in cow-breeds, farmers vary in ownership of other dairy production related investments. From Table 2 we see that having a roofed shelter and a feeding trough significantly impact daily milk production. However, as Table 1 shows, most Aroma milk producers have not made investments in the physical capital necessary to maximize their milk production. Milk production per cow, per day, ranges from a few liters (2-4) to up to 20.

TABLE 2: REGRESSION OF DAILY MILK PRODUCTION

(tobit)

	Coef	*t-stat*
Total cows	0.33	1.72
Milk producing cows		
Criollo	0.55	0.90
Hollstein	3.02	5.11
Brown-Swiss	3.05	4.12
Land in alfalfa production	0.90	2.33
Land in barley production	-0.15	-0.34
Land in oat production	1.22	2.47
Land with grasses	1.67	2.71
Land with native pastures	0.06	0.62
Land with crops	-0.65	-3.38
Land under fallow	-0.36	-3.66
Corral	-2.01	-1.16
Feeding trough	8.62	3.10
Water trough	-1.60	-0.75
Shelter with roof	5.34	2.60
Pump for drinking water	0.08	0.05
Located in Ayo-Ayo	1.92	0.99
Located in Umala	-9.27	-6.50
Constant	9.43	2.82

(Data from a survey of 509 Aroma milk producers in 1997).

Capital accumulation (of dairy cows) can occur in several ways including: (a) inheritance of dairy cows or of assets that can be reinvested in dairy cows, (b) access to animal banks, (c) boot-strapping by gradually improving local animals through cross breeding with improved animals, (d) use of non-farm activities (labor market, mining, urban migration) or sale of crops (potatoes) to generate the threshold liquidity needed to invest in dairy cows, and (e) access to formal credit that can be invested in animals.

Accumulating improved cows and expanding herd size can be difficult due to a problem of adverse selection in the market for dairy cows. While sellers know the attributes of a cow, it is difficult for potential buyers to evaluate the value of a cow (e.g., the daily milk production, adaptability to altitude, etc.). Buyers would be foolish to pay a premium for what is claimed to be a high value cow since they lack the proper information. Thus, sellers of high quality cows would not sell them on the open market. The low value cows push out the high value ones. This is clearly evident in the weekly market in Patacamaya. When talking to farmers selling dairy cows, nearly all admitted they were selling the cow because of low production. The only exceptions were a few distress sales (unfortunately these sellers are unlikely to get the true value for their cow.) Transactions in dairy cows tend then to occur between farmers who know each other well. ASPROLPA tried to improve the market for dairy cows by holding a market for members only on August 14. Presumably, information is better within the association and reputation would help facilitate sales (a farmer wouldn't want to be known within the association as having cheated another member.) Unfortunately, few sellers showed up for the market and the relatively high number of buyers (with cash in hand) suggested there are limited avenues for purchasing quality dairy cows. Another potential solution, proposed by Carlos Leon-Velarde and Roberto Quiroz, is the registering of the cows owned by association members. With a public record of an animal's heredity, information on the animal would be more transparent.

ASPROLPA members have several concerns about their ability to remain competitive in the long run. First, more fertile areas that are closer to the La Paz market could potentially be converted into dairy zones, which would compete against the less-efficient Aroma region. Furthermore, Bolivia's policy of trade liberalization may lead to an influx of milk products from Mercosur and elsewhere. It is not clear whether this latter concern is well founded because Aroma farmers occupy the market for fresh milk and cheese.

B. RESEARCH QUESTIONS

The Aroma Province is an interesting research site to investigate the dynamics of rural poverty and to explore potentially effective strategies for escaping poverty. It is an area of significant poverty, with considerable heterogeneity in the types of rural poor, and of environmental stress due to wind erosion and salinization associated with intense grazing and irrigation. At the same time, the area is undergoing a dynamic process of change due to the rapid diffusion of fresh milk production by many categories of households, including very poor ones. Diffusion is occurring in spite of the capital and skill intensity of this activity. Hence, there is an on-going process of change that can be monitored, and experimented with, to better explore the following challenges:

i) Increasing the entry of the poorest households into commercial dairy production while preserving food security. If dairy production is to be effective as an instrument for poverty reduction, social incorporation of the poor needs to be monitored and enhanced.

ii) Increasing the efficiency of milk production among participants. This is important since overall efficiency is low; affording large gaps that can be captured. There is also considerable heterogeneity in efficiency levels across households. Low efficiency households risk being eliminated if prices fall as milk production expands to regions with comparative advantages over Aroma.

iii) Accelerating the process of convergence toward the idiosyncratic optimum dairy operation for each household according to its fixed factor endowments and abilities.

iv) Identifying the environmental effects of the spread of dairy activity and proposing instruments to reduce the tradeoffs between income gains and environmental costs.

Based on these challenges, the following research questions could be investigated:

1. *Process of diffusion of information about efficient dairy systems*

Entry into milk production and achieving efficient levels of production requires information about the technology of dairy production (genetic improvement of dairy cows, animal nutrition and health, quality of products delivered), farming systems that include animal feed (irrigated alfalfa, barley), markets for milk and animals, and contracts with agro-industry. There exists a variety of sources of information with differential quality, and specific households have access to different sources. They include:

i.) ASPROLPA (the Association of Milk Producers in the Aroma Province), the milk processing plant “Lecheria PIL,” government and NGO extension agents;
ii.) Neighbors, kin, commercial producers, early innovators;
iii.) Community members in monthly meetings;
iv.) Private services; and
v.) Migratory experience, providing information some of which is transferable.

Survey data would allow us to ascertain whether the quantity and quality of information is a limiting factor to adoption and improving efficiency. What was the process of information diffusion? What were the main sources of information for important decisions? When did they obtain that information? How much learning was achieved through self-experimenting as opposed to from others? How informed are farmers about what their neighbors are doing, and are neighbors willing to be sources of advice? Over time, are those that had access to more information in the past able to access new information more easily? That is, is the information gap getting bigger or smaller over time? How much do different households know about dairy production, farming systems with animal feed, markets, and contracts?

2. ***Process of capitalization in a dairy herd***

There are clearly different strategies of capitalization. Of interest here is to analyze what strategies are effective for poor households who start with a minimum endowment of land and local multipurpose livestock. Capitalization paths to acquiring improved dairy cows include:

i.) Inheritance of dairy cows or of assets that can be reinvested in dairy cows;
ii.) Access to animal banks;
iii.) Boot-strapping by gradually improving local animals through cross-breeding with improved animals;
iv.) Use of non-farm activities (labor market, mining, urban migration) or sale of crops (potatoes) to generate the threshold liquidity needed to invest in dairy cows; and
v.) Access to formal credit that can be invested in animals.

A survey should identify the household and farm characteristics and limiting factors that make farmers more likely to follow each path of capitalization (i.e., labor, land and credit constraints, degrees of risk aversion and flexibility). What are the components of each package (are the technologies divisible or lumpy?) What set of limiting factors prevent farmers from adopting dairy production? What household and farm characteristics make farmers more likely to enter via one of the options listed above (i.e., risk aversion, land and credit constraints, labor shortages)? Which specific aid programs such as subsidized credit, animal banks, and seed donations would facilitate capitalization by poor farmers?

3. ***Efficiency differentials***

There is a wide variation in levels of production efficiency, with even the most efficient milk producers still considerably below their full production potential. Production efficiency can be improved in the following ways:

i) Acquiring improved dairy cow breeds;
ii) Consolidating land to facilitate monitoring and reduce the transactions cost of walking the cows from one pasture to another;
iii) Feeding cattle high-protein forage crops instead of native pasture plants.
iv) Improving physical capital such as stables and troughs;
v) Building water pumps and irrigation canals to provide year-round irrigation; and
vi) Providing technical assistance to educate farmers on cow sanitation and health.

Survey questions should focus on identifying types of inefficiencies among farmers with certain household and farm characteristics. What are the limiting factors to efficient production (for example, access to information, labor shortages, land and credit constraints)? What are the best strategies, in terms of institutional and technological innovations, to improve production efficiency among both the most and least efficient producers (for example, the low-cost-stables that Carlos Leon Velarde has promoted in Puno)? What are the best strategies for reducing the efficiency gap among ASPROLPA producers?

4. ***Dairy intensification and the environment (FONTAGRO project)***

The shift from subsistence agriculture to intensive dairy production is changing land use and management practices in the Aroma province. The adoption of dairy production has a number of implications for the environment including:

i) Increased wind erosion due to removal of tola for alfalfa planting and reduced vegetative cover on fields during alfalfa fallowing periods;
ii) Increased water use for alfalfa through irrigation, which may cause salinization, and river sedimentation;
iiii) Increased pressure on a limited resource base -- due to an increase in the number of dairy cows – potentially causing long-run productivity losses.

Developing solutions to each problem requires that we understand not only the environmental problem itself, but also the socio-economic causes of the problem (poor or rich households, communal or private land, land with irrigation, etc.) Many environmental problems are related to the household's ability to invest in resource conservation, which is determined by the household's asset position. Therefore, to comprehend the relationship between the environment and poverty (the vicious cycle), we must examine the types of asset poverty, the types of environmental degradation, and their connection.

Remote sensing data and land productivity measures designed to correspond with household data would allow us to answer the following questions: To what extent is the productivity of farmland decreasing over time? What management practices lead to productivity losses? What household assets are most important in determining the management of natural resources (land endowment, access to credit, education, etc.)? What effect has the movement to dairy production had on resource management? For which type of farmers is this impact greatest?

C. RESEARCH STRATEGY

To address the research questions proposed in the previous section and to facilitate future research in Aroma, we propose a research strategy involving three stages – a baseline study, immediately followed by a series of case studies and a future set of studies.

1. *Baseline study*

The baseline study would include four components. The first is the collection of data already gathered on the site. Both the USAID sponsored Small Ruminants-CRSP and ORSTOM have worked in the Aroma province in recent years. A number of other institutes and NGOs have also worked in this area. PIL has been collecting milk in the region for nearly a decade and presumably has data on milk collection. ASPROLPA in collaboration with PDLA (a Danish sponsored project) collected the data presented earlier. The first stage of the baseline study would then be to gather all the data and information that already exists on the site. This has already been initiated this summer through our fieldwork, but a lot of work remains to be done.

The second component of the baseline would be the collection of remote sensing and productivity data. (This would be done in collaboration with Roberto Quiroz and Federico Mamani.) This data should be collected to understand land use changes over the last decade and current level of productivity. This activity needs to be well coordinated with the third and fourth components of the baseline.

The third component of the baseline study would be the collection of community and regional data. A community-level survey can be done through discussions with key informants or small groups within each community. Regional and institutional data can be collected from informed sources working with NGOs or government ministries in the area.

The final component of the baseline study would be a household-level survey. Careful survey design would be essential to allow the survey to be used for a number of near term and future studies. The survey would be a household-level survey, which would include detailed questions on household characteristics, crop production, dairy production, labor (male and female) and land use, credit access, etc. Although not exhaustive, the survey should be of sufficient size for statistical analysis. Farmers surveyed

should include members and non-members of ASPROLPA, communities in ASPROLPA and non-ASPROLPA communities, etc.

2. *Case studies*

The case studies would focus on gathering detailed information from a subset of the surveyed farmers in order to answer the specific question outlined in Section B. Some information is difficult to gather from questionnaires and is best elicited through other methods. For example, understanding the process of capitalization requires detailed recall information. Most likely this is best done through visual methods. The best methods for obtaining this information still needs to be explored. These methods are likely to require a long-term commitment to fieldwork.

3. *Future possibilities*

Given a strong start on the research, as suggested above, there would be a number of possible avenues to pursue in the future. Data could continue to be collected to monitor the effects of dairy intensification on poverty, the region and the environment. Both CIP and CONDESAN (through its partners) will be dedicating resources to improving agricultural production in Aroma. Ex-ante assessments will be possible given the level of information that will be gathered. As new technologies are introduced their adoption and impact can be more easily evaluated. Interventions in support of increased participation in dairy production by poor households and in support of intensification of sustainable dairy production would be managed following an experimental design to allow monitoring and measurement of impact. In this fashion, the CIP-CONDESAN intervention in Aroma would serve as an ongoing laboratory with potentially strong implications for learning how to effectively design and manage rural development interventions to help reduce poverty and environmental degradation.