



College of Agriculture and Applied Economics
 208 Hutcheson Hall (0401)
 Blacksburg, VA 24061
 (540) 231-6301 Fax: (540) 231-7417

U.S. Agency for International Development
 Ronald Reagan Building
 Washington, D.C. 20523-1000
 (202) 712-4810 Fax: (202) 216-3524.

Investigation of the Promotion and Adoption of Sustainable Natural Resource Management Agricultural Practices in the Chimbo Watershed of Ecuador

**Julia Gibson,¹ Erin Zeiders,¹ Lindsay Hall,¹ Jessica Martin,¹ Andrew Sowell,¹
 Moazir Céleri,² Carlos Monar,² Luis Escudero,² Victor Barrera,²
 Jeffrey Alwang,³ Darrell Bosch,³ and George Norton³**

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1. Students, Virginia Tech
2. Scientists, INIAP
3. Professors, Virginia Tech

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Introduction

Developing countries are confronted with the challenges of improving food security, health, wellbeing, and environmental quality, all while competing on an international scale. The Sustainable Agriculture and Natural Resources Management Collaborative Research Support Program (SANREM CRSP) has been dedicated to improving Natural Resource Management in small-scale Agriculture in the sloped areas of the Andean Region.

SANREM in Ecuador has focused on the Chimbo River Watershed in Bolívar Province, an area characterized by intense environmental vulnerability, weak local governments, high poverty, and limited access to communication and transportation. Declining productivity associated with the degradation of the natural environment has also caused low incomes and reduced nutrition among farm families. The study reported on here was supported by SANREM for the purpose of observing the effectiveness of ongoing attempts to diffuse sustainable agricultural practices and encourage adoption of soil and water conservation practices in the upper and lower reaches of the watershed.

Background

Subsistence farming in this fragile area has had negative impacts on the watershed due to erosion, agro-chemical runoff, loss of biodiversity, deforestation and other resource pressures. Bolívar province has a total population of 169,370, with 72% living in rural areas. The province has the highest poverty index in Ecuador, with 77% of the households lacking basic needs (Andrade). SANREM has previously found that in 10 years, the value lost in the productive systems due to resource degradation is between \$346.50 and \$2851.72 at present value per hectare (SANREM Report 18). Bolívar is characterized by a strong reliance upon small-scale agriculture, limited off-farm opportunities, and a dire need to address environmental concerns. Additionally, Bolívar is a source of much of the water in the Guayas River, which provides water to Guayaquil, the largest population center in Ecuador.

The Chimbo River Watershed, the principal watershed in the region, is comprised of two sub-watersheds: the Illangama River Watershed and the Alumbre River watershed. Each of these sub-watersheds has a unique set of circumstances and challenges to be considered in devising resource management solutions.

The Illangama River Watershed, which includes Guaranda, the capital of the province, is comprised of 12,829 hectares and approximately 7,500 inhabitants as of 2004 (Slusher and Weeks 2007). The Altitude in the agricultural relevant portion of the Illangama sub-watershed vary from 2400 to 4500 meters, causing the climate to be cool. This upper sub-watershed is characterized by agricultural systems that largely revolve around potatoes and pasture. Crops such as barley, haba, and various Andean tuber crops are also commonly grown. The Illangama watershed is dominated by small-scale dairy producers who typically sell cheese to local intermediaries. Indigenous farmers make up a substantial percentage of the population in the region.

The Alumbre River Watershed lies below and to the south of the Illangama River Watershed and is distinguished by a Corn-Bean agricultural system, although wheat and peas are also important parts of the agricultural system. The lower watershed ranges in altitude from 600 to 2400 meters. As the climate is somewhat warmer, some fruit species such as *Mora* and *Naranjilla* are grown in the region. The population in the lower watershed is typically of a mixed Indigenous and Spanish background.

Reduction of soil quality resulting from destructive practices and limited off-farm opportunities are chief causes of poverty in both watersheds. Unfortunately, the land degradation is occurring rapidly. According to a SANREM Report, in 10 years, the value lost in the productive systems would be between \$346 and \$2852 at present value per hectare (SANREM Report). The reliance in Bolivar Province upon small-scale agriculture indicates that poverty alleviation could depend upon improved management of natural resources. Improved management of soil and water quality represent two ways in which watershed management projects can contribute to poverty alleviation as well as environmental protection (Johnson et al. 2008).

Work Alliances

The SANREM CRSP project in Bolivar Province is implemented by INIAP, the National Institute for Agricultural Research in Ecuador. This organization has been active in certain communities in the Illangama and Alumbre watersheds investigating and promoting soil conservation management and improved agricultural practices. The practices they have offered to the local farmers through individual farm visits and group workshops are:

- 1) Contoured Plowing
This planting of crops in alignment with the slope of the land promotes the formation of ridges from soil accumulation. With this practice, soil loss from water erosion is reduced.
- 2) Crop Planting in Strips
This planting of crops in contoured strips promotes the rotation of crops and reduces the soil loss from plowing. The slope and degree of the strip depends on the grade of the land and soil type.
- 3) Live Barriers
Live barriers are constructed with perennial native plants with deep roots, medium height, and strong stems. With this practice, erosion and wind strength are reduced which improves protection of crops and aids in the formation of terraces.
- 4) Deviation Ditches
Deviation ditches are constructed to improve the conservation of soil in severely sloped land. They serve to reduce the strength of water erosion, and aid in the absorption of water into the soil. They also serve in the formation of terraces when constructed with permanent vegetation.
- 5) Planning of Fruit Species (Alumbre)
The planning of native fruit species in the lower watershed of Alumbre provides year-round cover to reduce soil loss from erosion and promotes biodiversity of native species adapted to the local climate while also providing nutritional supplementation and income sources to the existing crops.

- 6) Slow Forming Terraces
Although costly and labor-intensive, the construction of terraces is the most effective practice in reducing the severity of the slope and the resulting loss of soil and degradation of water from erosion.
- 7) Forestation and Reforestation
The planting of native trees and the maintenance of primary forests aid in the conservation of soil and purification of water by root systems. They also protect crops by decreasing the impact and severity of winds.
- 8) Watering Systems
The construction of watering systems improves production by ensuring the constant flow of water to crops and helps permit year-round production. It is especially crucial in areas with high vulnerability to dryness, such as the Illangama watershed during the dry season.
- 9) Reduced or Minimal Plowing
With this practice of preparing the soil, instead of tilling the soil completely, the producer will only do a partial till so as to leave a vegetative cover on the soil to protect from the impact of rain. There is a tradeoff in costs for this method because the producer will spend more on herbicides and less on labor, but will conserve a substantial amount of soil.
- 10) Rotation of Crops
Crop rotation promotes improved harvests by preparing the soil for future crops and ensuring the maintenance of nutrients in the soil. The most common rotation in the upper watershed is a pasture-potato.

Objectives

The objective of the SANREM CRSP is to support Sustainable Agriculture and Natural Resources Management decision makers in developing countries by providing access to appropriate data, knowledge, tools, and methods of analysis, and by enhancing their capacity to make better decisions to improve livelihoods and the sustainability of natural resources. In this phase of the program, the four objectives are as follows:

- 1) Identify economic, social, political, and environmental conditions in the watersheds and understand their determinants.
- 2) Identify environmentally sustainable alternatives to enhance income generation including alternatives such as new crops, on- and off-farm income-generation strategies, and improvements to existing practices.
- 3) Evaluate impacts of alternative actions, policies and interventions on income generation, and social and environmental conditions on both a local and watershed scale.
- 4) Build local capacity to evaluate policy alternatives, make and enforce decisions, and strengthen social capital.

In this project, the team hoped to investigate how farmers decide what practices to use, learn how information is best communicated to farmers about improved practices, analyze how household constraints affect ability to adopt, and evaluate how watershed land use decisions are made. It observed and analyzed relationships among social, environmental, and economic characteristics in the communities and the corresponding adoption of conservation practices and participation in

training workshops. Based on the resulting analysis, conclusions were made on specific improvements to further the measurement and advancement of the social, economic and environmental impacts of improved agriculture techniques.

Methods

The dispersion of the population in Bolivar Province provides unique challenges for the diffusion of knowledge on improved practices as well as the gathering of information on the adoption of practices, and participation in agricultural and economic training events. The team employed a participatory appraisal approach to meet the objectives of the study. Prior to conducting the appraisal, the team developed 22 hypotheses addressing the relationships among environmental, social, and economic conditions, and the participation in workshops and the adoption of conservation practices.

Semi-structured interviews were conducted on 96 farms focusing on household characteristics and labor, farm characteristics and crops, the adoption of practices and participation in workshops, and the use of banks and credit. The questions were designed not as a quantitative survey but to provoke open-ended dialogue that served to bring to the forefront the most predominant issues in individual farms and the communities at large. By investigating obstacles farmers faced within the four themes of the study, strategies could be formed to remove these obstacles and identify more efficient methods of information dispersal.

Observations

During the four-week process of interviews with local farmers, the team made several observations regarding social and environmental problems in both the Illangama and Alumbre watersheds. These observations were key in discovering the causes of the obstacles to adoption of the conservation practices and therefore potential solutions. Specific constraints to farmer implementation varied between the two sub-watersheds due to differences in culture, financial and environmental conditions, and types of institutions present.

Perceived Environmental Problems:

The most prevalent environmental factors in the lives of the farmers in the Illangama watershed were related to wind and changes in weather patterns. Global climate change has altered the rainfall received in this area, and, as regions in the Tropics have their seasons defined by precipitation, this is a detrimental shock that the agricultural community must absorb.

Regardless of season shifts, the communities in the upper watershed are at an altitude at which they will always be vulnerable to frost and hail damage. Two-thirds of the farmers in Illangama cited wind erosion as the major problem degrading their land's fertility, as opposed to 10% of farmers who noted water erosion. This can be explained by season crop cover protecting soil during the heaviest rain events and the fact that wind erosion occurs most heavily in the months when land is lying fallow or is in between harvest and planting.

Water contamination was cited from numerous sources, including agrochemicals (as cited by 13% of farmers), trash (13%), bathroom waste, washing clothes, and dead animals being left in ditches upstream.

Farmers who had adopted improved practices were also concerned with their neighbors activities, with 16% being concerned about the effects of poor management on surrounding farms, which include practices like burning, deforestation, and a lack of adoption that erodes soil down the slopes to other farms. Two of our *high adopting* farmers mentioned increased air pollution from vehicular traffic, and one very well educated farmer was concerned with the decrease in biodiversity from agricultural production, destruction of natural habitat, and lack of native plant species.

Perceived Social Problems:

Ecuador is characterized by extreme environmental changes in short distances, and the distinct climatic differences between the Illangama and Alumbre watershed were complemented by distinct differences in the social atmosphere as well. Although SANREM CRSP and INIAP had been conducting workshops and individual farm visits for a shorter period of time in the Alumbre watershed, they also faced other issues. High levels of migration combined with a lack of perception to environmental problems perpetuate social acceptance of a lack of action. Also, not only is there a lack of communication of positive results between neighbors, there are reports of violence between neighbors.

The team conducted interviews with local leaders and organizations in Ecuador. These included FEPP, Codesarollo, Proforestal, MAGAP, Cruz Roja, Ministeria de Agua, Banco de Fomento, and AgroPecuaria. The team also interviewed the Alcalde of Chillanes in the lower watershed. Many of these organizations deal with social or environmental issues that the country now faces. Banco de Fomento was interviewed in order to assess the challenges that local farmers may face in obtaining credit, which is addressed in another section of this report. The goal of the interviews as a whole was to understand which issues concerning Ecuador are most crucial and in need of immediate attention.

Environmental Issues:

Main issues concerning the environment relate directly to pollution. The disposal of trash is a big concern among local leaders as there are no advanced systems in place for the management of waste. A related issue is water contamination. A meeting with Proforestal revealed that rivers get more and more polluted as they travel downward through the watershed, picking up more and more pollutants along the way. This is a major problem for both animals and humans as there may not be an effective way of cleaning the water in every area. Furthermore, there is a lack of programs in general to address this problem, so it will continue to worsen. Another environmental concern is erosion. INIAP and other organizations continue to work on this issue by teaching improved farming practices and planting native tree species. FEPP stressed the importance of forest management rather than simple forest planning. One problem here is that new forests are not being correctly managed even if they are well-planned. This takes a lot of participation from everyone.

Social Issues: Many goals for Ecuador include education and investment in children. Among the suggested improvements for education are new technologies and computers in schools, and just more schools in general. Improved nutrition, especially for children, is also a major goal. A major problem among all communities is the discrepancy in market prices. There are no set prices for market items. For example, farmers may sell their cheese at a market for a much lower price than it will ultimately be sold at for at a commercial level. This is a problem for local farmers because they work twice as hard to gain half the profits of others. In general, many local leaders thought that many problems could be solved by strengthening community bonds. Having communities work together, exchanging strengths and weaknesses could be an improvement. For example, having standardized prices for items across different communities would lead to price equality and more prosperity for farmers. Changes such as these are small steps toward improving quality of life.

Upper Watershed:

The participatory appraisal conducted in the upper (Illangama) watershed contained a total of 65 families. The questions asked during the semi-structured interviews were the same across households, but the number of responses, while larger than in the lower watershed, is still not large enough to be used for valid statistical analysis. The sample is, however, large enough to provide basic trends and supplemental information for observations in the watershed.

Historically, INIAP has a more consistent presence in the Illangama watershed, particularly in the community of Culebrillas. Because of the relationships that INIAP personnel have cultivated with the local farmers, they were very willing to participate in the interviews and aided us with insight into potential improvements for the future. The team has observed that the regular presence of INIAP in the upper watershed before the start of the SANREM CRSP project has successfully resulted in higher levels of adoption than in the lower watershed. Throughout the upper watershed, this higher rate of adoption of conservation practices was also accompanied by higher participation in events than in the lower watershed. The primarily indigenous population, which comprises the upper community in the upper watershed, have lived and worked the same land for decades, leading them to have strong ties to the land and desires to preserve it for future generations, social ideals crucial to the continued success of conservation practices.

Throughout Illangama, the people exhibit a strong sense of community and high organizational capacity and frequently work together on mutually beneficial projects through a communal system of labor known as *minga*. In the *minga* system, community members help each other with agricultural activities on individual farms and work together for larger goals, such as community irrigation, where multiple families benefit. Additionally, eight communities in the upper watershed have been organized into a second-level Indigenous organization known as the Cog-diacg. Illangama's strong communal organization provides a base for farmer-to-farmer diffusion of technologies and a strong base of participation in management of resources.

While working towards soil conservation goals in the upper parts of the watershed, INIAP and SANREM CRSP have also been creating change with improvements in existing agricultural systems. One significant enhancement has been the adoption of improved varieties of potato, which yield more than previous varieties. Another improvement has been improved mixes of

grass for cow grazing, which has increased the yield of dairy cows. Such improvements help farmers to make the best use of the land and to reduce the tendency of degrading sensitive páramo, or highland, ecosystems.

To further encourage adoption of good practices in the region, INIAP should focus on providing training that utilizes the forms of organization within the watershed as a means to organize people around natural resource management objectives. Training in conservation practices should compliment efforts to improve existing agricultural potential. Furthermore, SANREM and INIAP should seek to widen the scale of their activities, bringing conservation training to more communities in Illangama. The team has observed that individualized visits that complement the training in the workshops are the most effective means of ensuring adoption of practices. Because there are many obstacles to attending workshops, by visiting farmers directly, INIAP ensures that the information is being received in direct correlation with the problems observed on individual farms. Although many indicated a familiarity with INIAP, the largest barriers to participation included lack of awareness of workshop times, and distance to the workshops, as none existed in their immediate community. It has been noted that generally, the people who responded that they are not interested in adoption of practices have corresponding low exposure to the workshop information or to farms where the positive results of adoption can be seen.

Generally, environmental conditions in the upper watershed are harsher and agricultural options are more limited. Principal crops in the region include: potatoes, *mashua*, barley, onion, *haba*, and some other root and leguminous crops. Diversification of crops is difficult in this region because of the extreme conditions, but this diversification is not entirely necessary as there is a high reliance on dairy production as an income source. While dairy is a steady source of earnings, several producers noted that they receive unjust prices from intermediaries, indicating some possibility for gain from the creation of a producers' cooperative.

Historically, a degree of overlap has existed between the efforts of The Ecuadorian Progress Fund (FEPP), the Red Cross, and INIAP's work in Illangama. In order to ensure that maximum results are achieved, these organizations should maximize information exchange to minimize parallel efforts in the region. SANREM CRSP and INIAP should increase coordination with these organizations and local government officials to increase reception of conservation information and to improve dispersion of information to isolated communities. The current system of isolated work and minimal sharing of research and workshop results leads to inefficient overlapping of work and wasted resources in duplication of information.

Lower Watershed:

The participatory appraisal conducted in the Lower watershed included 31 agricultural families. This sample is too small to make any concrete quantitative conclusions using graphs or tables, and instead, general trends and observations were made. The team noted a number of issues in the communities in the lower watershed that make work in the area difficult. These observations are listed below along with suggestions for SANREM on strategies for communicating with farmers in this area.

SANREM CRSP and INIAP have not been working in the lower watershed as long as the upper watershed, and understandably have a less established reputation in the local area and therefore, initiating interviews was slightly more difficult. Hopefully, with time, the farmers will become more open to improving the condition of their land using SANREM CRSP's conservation practices. However, there are noteworthy difficulties facing SANREM CRSP in its work in this area.

The people who live in the lower watershed do not conserve their natural resources as much as the indigenous people in the upper watershed. This difference may be due to the fact that, unlike the farmers of the upper watershed who have always lived in that area and feel a deep connection to their property, the lower watershed residents are relatively new to the area. Springing from that lack of connection is a limited concern to take care of the land. Another possible reason for lack of conservation practices in the lower watershed is that the farmers do not see a great need to adopt improved practices because the effects of poor management are not as obvious to them. There is a distinct difference in the sense of community, and many farms are not friendly, or are even violent against their neighbors. If farmers are not aware of the harm they are inflicting on downstream neighbors by their trash or chemical use, they do not see the need to change their ways. The generally larger distance between households adds to this lack of community organization in which information and technology could potentially be dispersed. Also, there is a high rate of migration in the lower watershed community, and many of the people in the lower watershed work off their farms in construction and businesses in the city. This makes their farm a secondary concern, reducing the amount of time they have to work on their farms, which may affect whether or not they adopt SANREM CRSP's practices. Overall, a great concern in the lower watershed is that the people do not have an instilled sense of responsibility to prevent further contamination and erosion, thus they adopt improved practices with less regularity.

To illuminate the realities of the dangers threatening the Alumbre watershed, it is important that SANREM CRSP and INIAP continue to hold workshops and farm visits in the lower watershed communities. The workshops should be tailored to what the people of the lower watershed need and want to learn. By catering to local needs, SANREM CRSP and INIAP can more effectively demonstrate the necessity of conservation practices. SANREM CRSP may need to reassess its methods of delivery to focus on having a larger number of workshops in many different areas of the region. Immediately following workshops, individualized follow-up visits to farms further encourages farmers to apply conservation practices and to offer personalized guidance on what each particular farm needs.

Workshop attendance in general is lower in Alumbre than in Illangama. In the interviews conducted, farmers were asked what they learned at the workshops, and what they wanted to learn. The people of Chillanes want to learn how to cultivate different crops, how to manage finances more effectively, how to adopt technological improvements, and improvements in animal management, but most of workshops focus only on SANREM CRSP's conservation practices. These are very important to the farmer's success, but the farmers we talked to did not see that adoption of these practices would lead to financial improvements in their production. SANREM CRSP needs to include better advertising of what the people of the lower watershed would like to learn in these workshops in order to increase attendance at their workshops and therefore have improved dispersion of the benefits of their practices.

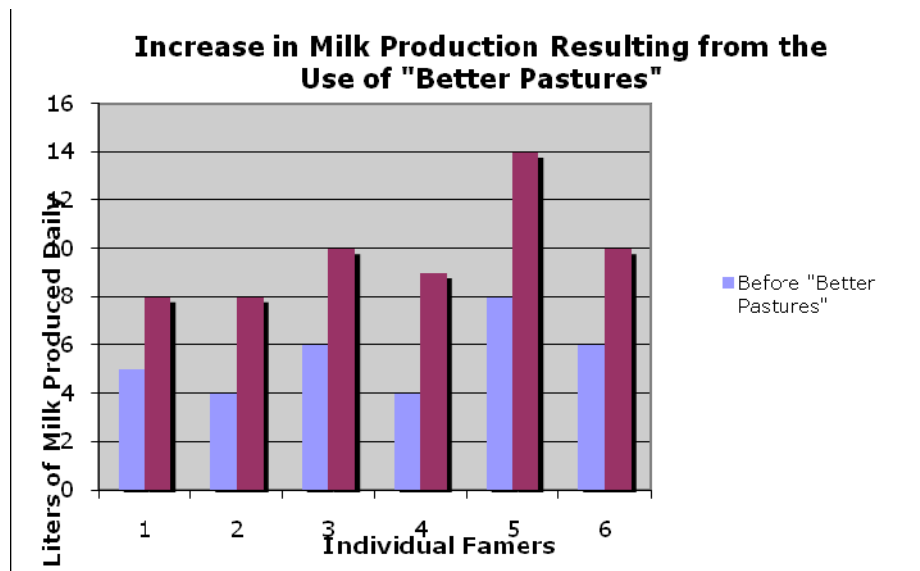
A potential advantage in the Alumbre region is its climate, which is more temperate than the Illangama watershed. Currently in the watershed, corn-bean systems are highly utilized, in addition to wheat and peas. Beyond these, there exists a great potential for further diversification of crops, namely the cultivation of fruit species. If diversification of crops and conservation methods can be realized, the watershed could develop a significantly stronger economic base for its agricultural activities.

To ensure that there is continued open dialogue and continued interest in the topics of SANREM CRSP workshops, repeated questioning into topics of importance for the farmers should occur at each workshop and individual farm visit. It is apparent that residents of the Alumbre watershed will only adopt significant lessons from an organization that teaches them something they see as useful not only environmentally but economically as well. Additionally, it would be useful for INIAP to have a more consistent presence in the lower watershed. As is, extension agents are located out of Guaranda, which results in more travel time to get to the lower parts of the watershed. If an agent were living and working in Chillanes, it would allow for a more consistent, nearby presence in the Alumbre watershed.

Specific Findings

SANREM's Practices Increase Production

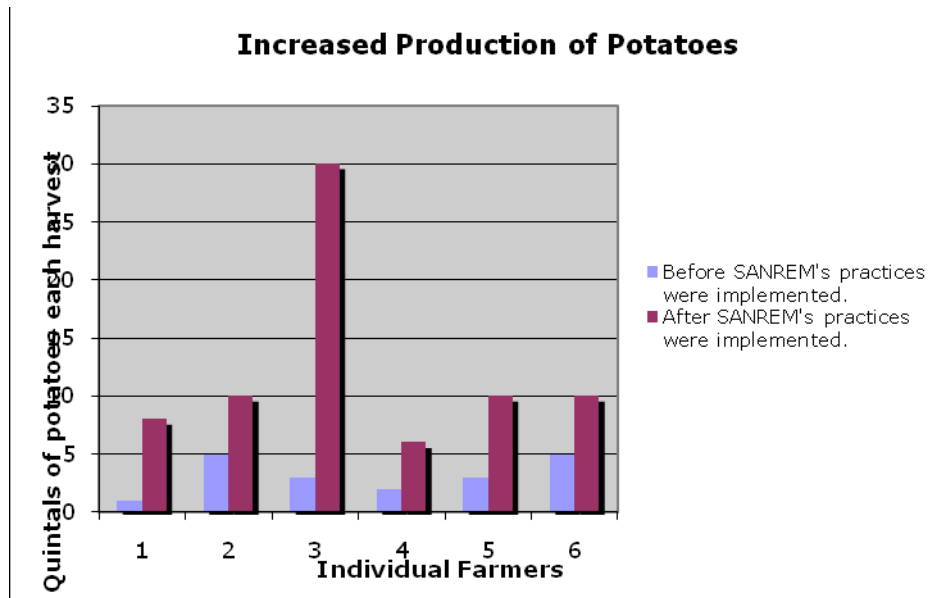
We found that when farmers implement SANREM's practices they see dramatic increases in production. This creates more of an incentive for the farmer to implement more practices. There are two graphs below displaying production before and after practices are applied. From them one can clearly see that SANREM's practices work very well and are benefitting farmers in the region.



This graph shows that, when farmers upgraded their fields to include better grasses, their production increased dramatically. Increases in production is a powerful incentive among these farmers. So, we recommend that when SANREM technicians provide work shops or visit farmers that they reference this data and explain that although implementing these practices

requires some time and capital investment, it is very little in comparison to the returns generated by the upgrade.

This graph also shows why people who implement one practice start implementing more. The practices recommended by SANREM improve yields and generate greater wealth for all farmers who implement them.



This graph shows the increase in the production of potatoes with the implementation of improved practices. As the graph shows, there are dramatic increases in production levels as the result of these practices. In all cases, production increased by at least fifty percent. This is a dominant trend that will be useful for SANREM technicians when they are talking to farmers about implementing conservation practices.

It is also valuable for us to see the improvements made by SANREM's conservation practices. SANREM's work in the area is making a dramatic difference in these farmers' production levels. The land has much more potential than what it was being used for before SANREM's practices were implemented.

Hypotheses

From the original 22 hypotheses created by the team on diverse topics such as family size, environmental vulnerability, distance from market, and number of animals, interviews revealed that 7 hypotheses were valid and proved correct. Differences between Illangama and Alumbre results were noted individually, but many of the same correlations could be seen in each locality. These findings are crucial in identifying perceived economic, environmental and social problems within each community and improving the current system of dispersing information to create more effective adoption of conservation practices in both the Illangama and Alumbre watersheds and potentially other communities in the future.

To clarify the information below, here is a brief explanation of the differences between High, Medium, and Low participation. Low participation is when a farmer attended 2 or less SANREM workshops over the three year period SANREM has been in the area. Medium participation is attending three to five workshops over three years, and high participation is attending over five during the three year period.

The differences between Low, Medium, and High adoption revolves around the Medium adoption category. To qualify as a Medium adopter, farmers have to have adopted both contoured plowing and cultivating in strips, or the farmer can have adopted a large practice such as man-made terraces. A low adopting farmer has adopted less than contoured ploughing or cultivating in strips or possibly has adopted nothing at all. High adopters have adopted contoured plowing, cultivating in strips, and another practice.

H1: Increased participation in SANREM CRSP and INIAP workshops corresponds with greater adoption of conservation practices.

Participation in Workshops

	High	Medium	Low
High	8	7	6
Medium	3	3	11
Low	0	6	21

The data in the low participation and high participation columns of this table follows the initial expectation that high levels of participation correlate with high levels of adoption. The low participation column has the most families in the low adoption column, which proves that families with low participation are also low adopters. On the other hand, the high participation column has the most families in the high adoption column, which indicates that high participation correlates with high adoption.

The medium participation column does not follow the expected trend, but instead is fairly evenly divided between high and low adopters. However, upon further investigation, there is a strong logic as to why there is a division between high and low adoption in this category. The high adoption families attended three or more SANREM CRSP workshops over the course of three years. They also received visits from Carlos Monares on a monthly basis. The low adoption families attended two or fewer SANREM CRSP workshops over three years, and on average, they did not receive visits from INIAP personnel on a monthly basis. Therefore, high and low adopters differ in the amount of information they received. The three barriers for adoption that were mentioned by the low adoption families were: not knowing the dates of the workshops, distance to the workshops, and lack of interest in applying practices. In conclusion, participation in SANREM CRSP's workshops directly correlates with farmers' adoption of SANREM's practices.

H2: Families with higher parental education participate more in workshops and adopt more conservation practices recommended by SANREM CRSP.

Years of education gained by adult male	Low Participation	Medium Participation	High Participation
7-12 yrs	7	5	4
6 yrs	16	6	5
1-5 yrs	11	2	4
0 yrs	14	6	3

This table shows a correlation between higher education and a higher level of adoption. This may be because educated individuals are able to read the material and do research on their own. Thus, they are more aware of the environmental threats to their farm’s yield and their family’s health, which creates a greater interest in SANREM’s workshops.

Years of education attained by adult male	Low Adoption	Medium Adoption	High Adoption
7-12 yrs	7	3	6
6 yrs	7	7	13
1-5 yrs	2	9	6
0 yrs	10	5	8

This table shows a trend that the higher education an individual has the higher their participation in SANREM CRSP workshops. This maybe due to a higher educated person’s exposure to life outside of their community resulting in increased receptivity to new opportunities for making improvements and risk taking on their farm. Higher levels of education allow higher rates of literacy, which would improve one’s ability to understand of the technical side of farming, as well as problems in the watershed in general. Interviews with individuals with lower rates of education also correlated with less awareness of alternative practices and reduced feelings of responsibility to the land and importance of conservation.

H3. Initial adoption of conservation practices leads to increased future adoption of practices.

Results overwhelmingly show that if a family adopts one conservation practice, they will likely adopt more practices in the future. It was extremely rare that a farm would adopt only one improved practice without adopting more upon seeing the positive results of adoption. In the majority of cases, families who adopted did so with at least three improved practices. This suggests that people who adopt practices generally like the results, and therefore want to adopt more. This is good information for INIAP to use to persuade people to adopt. If farmers who adopt like their practices and experience better environmental and economic results, such as higher yields of milk from using improved grasses and generally larger crop yields per hectare,

these results will more easily be spread by word of mouth, and are greater incentives for future adoption in farms who have never adopted before.

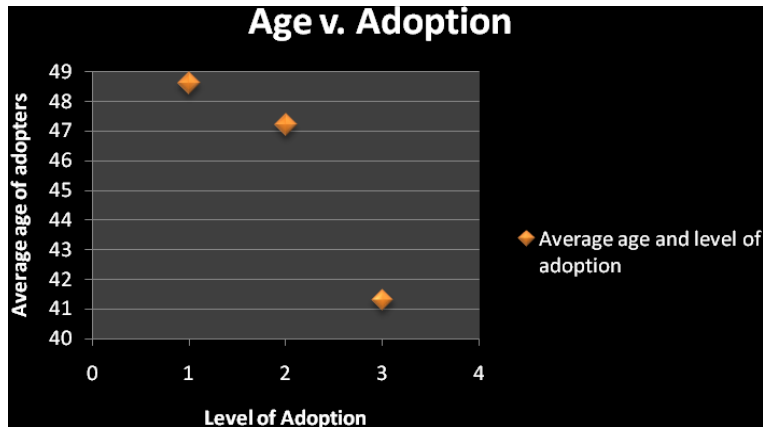
H4. Communication among neighbors and within communities affects individual adoption.

Because of the qualitative style of the semi-structured interviews, there was no statistically significant evidence for this hypothesis; however, there is a strong influence between neighbors when it comes to adoption of practices. Many communities in which people live in close proximity to each other share a trend of either almost all adopting or almost all not adopting practices of conservation. Those individual farms or entire communities which are located in the more isolated areas and who do not have as much contact with neighbors or INIAP are less likely to adopt. A combination of word of mouth and participation in community events are extremely beneficial in the diffusion of SANREM CRSP's message, and isolation from these factors is a detriment to the incentive to adopt conservation practices. It is also very likely that if community leaders adopt practices, then people in the community will do the same. Again, communities with high social capital and farms with good neighborly relations are more likely to adopt than those isolated farms and communities with little communication on environmental issues and benefits to adopting conservation practices.

The people of the Illangama watershed have the largest high social capital communities. People seem to communicate about the practices they are using with the best results and share this knowledge with each other. This is diffusion of information that benefits the work of SANREM CRSP and INIAP without any expense or personnel labor. However, it is difficult to affect change in communities with low social capital and low intra-community communication, as each household needs to be reached individually to spread information on incentives to conserve natural resources and improve agricultural management practices.

The case with Alumbre watershed communities is very different than in the Illangama watershed. Many people in Alumbre do not get along with their neighbors, and certainly did not share information on harvests or improved practices. Because of the easily perceived lack of intra-community interaction there, lower attendance in the workshops was expected, and was documented. The SANREM CRSP and INIAP projects are also newer in this area, and although there is no established system like the Illangama community *minga* workforce, there is potential for an expansion in the existing community organizations that could increase neighborly dialogue. Also, as time goes on, those farmers with newly adopted practices will begin to see more and more results and may begin to share these improvements with neighbors.

H5. The age of the head of the household affects adoption of practices. Based on the team's interviews, in general, younger farmers are more likely to adopt. Although there are some exceptions to this rule, the graph below shows that low adopters tend to be older than high adopters.



This table was made by taking the average age of adopters at each level of adoption and plotting it against levels of adoption, with increasing levels from 1-3 plotted on the x-axis. It clearly shows that the average age of high adopters is younger than that of low adopters. The team hypothesized that this was true because younger farmers are probably more eager to adopt new practices and less set in their ways. The trend suggests that the older the farmer, the more resistant they are to change. Many times, the younger member of a family were much more eager to adopt or learn about better practices than were the elders of the family. Also, younger generations were more likely to have had access to higher levels of education. This is not true in all cases, but is a general trend.

H6: Increased participation in community organizations lead to increased adoption of practices.

In this section, social capital is defined primarily in terms of holding a formal leadership position in a community or being of close relation to someone who does. In several interviews, the question was posed as to whether the people were otherwise active in the community, although that does not factor significantly in this analysis, as being ‘active’ is largely a subjective term.

In our analysis, 29% in the *high adoption* group, or 6 of the 21 individuals, held some positions of leadership in their community. Of those in the *medium adoption* category, we found that only 1 out of the 17 had positions in community, although several noted being active in community or being related to people who held formal leadership positions. Finally, of the 27 individuals in the *low adoption* category, only one had a formal position of leadership in the community and none noted direct relation to community leaders. A strong correlation persists that those who participate as leaders in their community tend to adopt more management practices. Additionally, we found at least one example where a non-participating farmer had adopted several conservation methods because his brother was a community president and worked with INIAP. In general, community leaders who adopt have a potential to influence their neighbors to conserve as well.

The one community leader who did not show a high level of adoption is one whose community is described as having less steeply sloped land, thus, people in the general area have less interest in using soil conservation methods because they do not perceive erosion as a significant problem. He described his community as having knowledge of the practices, but not using them

because of disinterest. In general, the leader believed that more effort needed to be spent on motivating people, but mentioned that they were in the process.

In the analysis of Alumbre, although the sample size was smaller, similar results were found linking those who adopted more with higher likelihoods of holding positions of leadership in the community. In general, it was more difficult to find high adopters in the lower watershed as Alumbre was characterized by lower interest in soil conservation, which carried into the leaders of communities as well. In two cases, local leaders had participated significantly with INIAP, lived on sloped lands, yet neither had begun to adopt any practices. One recognized soil loss to be a problem, but cited rocky soil as a reason for not applying practices.

H7: Individual farm visits from INIAP personnel leads to increased adoption of practices.

In order to understand the connection between adoption of practices and direct visits from INIAP technicians, participants were asked if officials from INIAP had ever visited their farms to work with them directly. In Illangama, of those who were high adopters, 81%, or 17 of 21 individuals reported that they had received visits from INIAP officials. Among medium adopters, 24%, or 4 of 17 individuals, had received direct on-farm assistance. Only 22%, or 6 of 27 individuals in the low adoption group reported visits from INIAP officials. It follows that on-farm work with INIAP has tended to result in higher levels of conservation method adoption. Alumbre results show a similar correlation, although there are significantly fewer high adopters in general.

Recommendations

The conducted interviews show that SANREM CRSP efforts are making a significant impact in the regions where frequent workshops are complemented by regular individualized visits from INIAP personnel. However, there are several aspects of the organizations' management that could be improved to have a more widespread and efficient impact in its diffusion of improved conservation practice information. The areas with the largest potential for improvement are: expanded research and education of local community members, individual and community incentives to adopt, and communication with other local organizations.

The primary responsibility of INIAP is in the area of research, and it is within this mission that local communities could benefit greatly from expanded knowledge as to the types available soil erosion controls that improve water quality, and the results of practices already implemented elsewhere. While improved soil management does offer a means to address water quality issues via reduced silt deposits (Kerr 2007), there must also be a focus specifically upon improving water quality. The project could benefit from identifying common sources of point and non-point source pollution to local waterways. Research into pollutant sources should also identify improvements in farming, industrial, or household, practices that could result in improved water quality. Research in these areas should be complemented by the dissemination of results to local farmers so that workshops are teaching the most up-to-date information to local community leaders and farmers.

Once there has been sufficient research into the best management practices in each microclimate in the Bolívar Province, creating a demand for the adoption of these practices is the next step. If farmers were paid for the environmental services of maintaining their native plants, they would

be less likely to plant foreign pine and eucalyptus species to sell for commercial forestry. Also, if there existed a federally subsidized loan available for reforestation and construction of conservation works, there would be a higher level of financial capability and incentive to protect the environment. Along with the education of local community members concerning research results, there should be a segment where social issues are addressed, as financial incentives alone cannot change everyone's minds. A movement is needed in the upper and especially the lower watershed to accept responsibility for the care and betterment of each individual's land.

There are many government and non-profit organizations working in the Bolivar Province, and several whose missions overlap with the work of SANREM CRSP. Currently, while there is common informal exchange of information, there is no formal protocol to communicate with these other institutions, or share research results. This leads to frequent duplication of research, and inefficient and uncoordinated efforts in the field. If local organizations coordinated frequently, they could create a mutually beneficial plan that would reduce costs by halting duplication and complementing the existing infrastructure and education.

Through improved coordination, organizations could avoid parallel work in similar communities and expand work into previously isolated communities. By offering training in a larger variety of locations, those individuals who have limited time or means of transportation could easily participate. Such coordination of efforts could be best achieved with the direction of the local government. The obstacle to such direction is that local politics is too often based on short-term thinking, whereas natural resource management is based on long-term payoffs. Convincing local actors (and the general public) that their wellbeing is reliant upon long-term resource planning is a requirement for the sustainable management of the local ecology and economy.

Recommended Workshop Themes

During the interviews, the team requested workshop themes of interest for the farmers in the future. While responses varied by geographical area due to the difference in climate, crops, and income sources, there were several recurring themes throughout. By far, data collected showed that they desired training in the adoption of conservation practices, specifically in the areas of reduced chemical use and the production of organic fertilizers. Farmers also showed interest in learning more about irrigation systems, management of native tree species, and implementation of living barriers. Of the farmers in both the upper and lower watersheds, 55% would be interested in attending workshops on these topics.

One-third of farmers polled sought more information on pasture management, livestock nutrition, dairy and cheese marketing, and cattle breeds. Economic development in this region would be greatly furthered by systems that could allow for greater market access, while reducing the power of intermediaries in setting prices. Small plot sizes and high reliance on agriculture make it imperative that potato-pasture rotations produce the most economically beneficial yields.

Farmers in the Illangama watershed have the greatest experience with crop cultivation, and therefore only 20% of farmers sought advice about crops, planting, and harvesting. Information about potato, quinoa, *haba*, barley, and wheat could be provided through the one-on-one visits from INIAP employees, while improved use of pesticides could be dealt with as a part of workshops on reduced agrochemical use. In Illangama, where handmade artwork is a source of

income, workshops were requested on types of handicrafts and woven goods. Other themes recommended by farmers include workshops on administration of farm business, marketing, and information on the use and availability of credit.

Work with women's groups and the establishment of workshops about family nutrition, health, and food preparation may be combined with information on the management of native medicinal plant species. The large number of responses to the question of preferred workshop themes is indicative of communities who are strongly interested in improving environmental quality and overall quality of life.

Importance of Credit

As soil conservation often leads to long-term benefits but short-term costs, another connection worth analyzing is that between credit use and adoption of practices. In this study, participants were asked if they were aware of the availability of credit and also if they had used it. While most participants were aware of possible sources of credit, only slightly more than half had ever formally taken out a loan. In Illangama, the results showed that 57% (12 of 21) high adopters had used credit. Medium adopters had similar results, as 53% (9 of 17) had used credit at some point. In the low adoption group, 52% (14 of 27) had used credit or were in the process of using it. In Alumbre, on a smaller scale, the results also showed that there was no significant correlation between use of credit and adoption of practices.

Use of credit in the watershed appears to have very little correlation to higher levels of adoption of conservation practices. An explanation for this could be found in the purposes for which the credit was taken out. In most cases, credit was used to buy farms, cows, seeds, or to cover other basic startup costs associated with agriculture, but rarely for natural resource purposes. Additionally, a few farmers reported using credit for housing improvements, fertilizer purchases, and guinea pigs. Through interviews with local government officials, local organizations, and banks, the team discovered that while commercial reforestation loans are available, no other formal loans specifically for natural resource management exist.

To test hypothetical interest in such a program, participants were also asked if they would be willing to take out a loan to aid in natural resource management if a government agency provided the credit at low interest and ease of repayment. In Illangama, 73% (33/45) responded positively, while in Alumbre, 61.3% (19/30) indicated interest in such a program. Farmers were also interested in using future credit for the establishment of native trees, improved dairy, and seeds for potato and mixed pasture. Some suggested that they would be more comfortable using the credit for these projects if it could be taken out by the community and then implemented with community labor. This question provides at least hypothetical evidence that such a program would be met with some degree of interest if it were made available.

Currently, Banco de Fomento, the local branch of the federal bank, provides low-interest, government-subsidized credit to farmers who qualify based on low income, but no such program currently functions based on use of credit for natural resource management purposes. The banks do not consider diffusion of technology/conservation to be their duty (Solano). A change in the local and federal government's financial support of conservation practice construction needs to

be enacted in order to support SANREM CRSP and INIAP's efforts to diffuse conservation technology.

Obstacles to Credit Use

A significant obstacle to the adoption of conservation practices is the lack of financial capability. Both private and federal banks have loans available to farmers, but they often require writing which is a hindrance to the illiterate population, or require proof of ownership, which is difficult to produce on many farms. Additionally, many loans require a cosigning from members of the community to verify that someone will pay the loan if the receiver of the loan cannot. This sort of arrangement is also difficult to agree upon.

The team discovered that over a quarter of farmers were not using credit due to collateral and financial barriers. For example, deeds and cattle vaccinations can be demanded as collateral in an area with scarce veterinarians. Renters, children working on parents' farms, and farmers who have not yet received their legal documents from IERAC (The Ecuadorian Institute for Agrarian and Colonization Reform) are particularly challenged when trying to secure a loan.

Approximately the same number of farmers were constrained by institutional barriers to credit and of those interviewed, 10% considered the amount of paperwork to be a major barrier. The timelines of monthly loan payback does not meet the needs of many farmers who work by an agricultural calendar where capital flows in after the harvest. This prevents the establishment of cyclical credit use, as farmers who are already using credit cannot take out new loans, even if their credit is good.

Cultural frameworks in rural communities and current economic conditions create a unique set of opinions and potential obstacles towards credit use. Many farmers do not trust the banks and do not want to take on financial risks with agriculture, which is already void of solid guarantees. If their harvest falls though, some farmers may risk losing their land or having a low credit score that prevents them from seeking help again. Machismo, pride, and egoism also prevent use. In order to facilitate the use of loans for environmentally beneficial practices in the future, specific workshops to target these concerns should be conducted.

Conclusions

The issues found in the Chimbo River Watershed of Ecuador's Bolívar province represent a situation common to many Andean communities. Resource management is essential to the sustainability of agriculture in the region and the wellbeing of the economy. As the SANREM project advances, a few points will be vital for its continued success.

First and foremost, an understanding of the factors that influence adoption is essential. Through this study, we have seen that families are more likely to adopt measures if the head of household 1) is younger, 2) participates in training of some sort, 3) has more education, 4) is a leader in the community, or 5) relates well to neighbors who adopt practices. Other factors also affect the adoption, but these are the primary connections found by the research team.

Another factor not found in this research, but likely to be important is price received by producers as it provides an incentive to invest further in agriculture or to seek off-farm work. As a case study in Bolivia demonstrated, those who had labor invested in off-farm work were less interested in investing in on-farm conservation technologies. As resources degrade, the problem becomes cyclical as farm income is lowered, increasing the need for off-farm work and reducing time spent in agriculture (Zimmerer 1993).

This research did not find a significant link directly between work away from the farm and reduced use of conservation practices besides the observation that Alumbre on the whole had a higher tendency towards off-farm work, while Illangama had higher incidence of conservation method implementation. Although the direct link was not found to be substantial, attention should be paid to ensure that local agricultural prices are reasonable and provide an incentive for farmers to invest themselves in agriculture. Furthermore, pursuit of higher yielding varieties and higher-value crops will help provide a direct incentive to continue agriculture.

In the lower watershed, a more permanent presence is needed to continue to build trust among the locals. While seeking out conservation goals, attention should be paid towards developing crop systems with better, more diverse, rotations and greater use of fruit species. This is particularly important because the area has a favorable climate to fruit species, which can help conserve soil and make agriculture more profitable. Efforts to improve conservation in the lower area should emphasize profitability since to stimulate greater investment of resources into agriculture.

The Chimbo River Watershed in general could benefit from more long-term planning and stability. This begins with a government that sees resource issues and community needs in the long-term. Furthermore, it relies upon the participation of all local actors. INIAP and SANREM CRSP have a powerful opportunity to impact local conditions economically and improve the environment of the province, which can come with significant benefits locally and beyond. This requires a continued presence and a dedication to delivering much-needed extension services to the agricultural sector. Water is life, and through the continued management of this watershed, this project has the opportunity to impact the lives of the citizens and stabilize what remains a fragile ecology.

Acknowledgements

Throughout this six-week investigation, many valuable observations and useful findings have been collected which can help SANREM CRSP's future work in Ecuador and throughout the world. The support of the United States Agency for International Development has been invaluable in ensuring the means to examine the current conditions in the Bolivar Province, and therefore improve community quality of life in the future. The project could not have been accomplished without the participation and support of the people of Ecuador. Their friendly and curious demeanors have made the intern experience more than a scientific investigation, but also an unforgettable cultural exchange. The INIAP personnel were priceless in their scientific expertise, knowledge of the Quechua language, and familiarity with the physical and cultural geography. The local organizations provided insight into the official and unofficial procedures of the local institutions, and the areas in which all could benefit in the future. The successful coordination among all parties involved made the experience vastly more interesting and productive.

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Appendix

- 1- List of Hypothesis
- 2- List of Survey Questions for Interviews
- 3- Recommendations from Farmers for Workshop Themes
- 4- Knowledge of Environmental Problems
- 5- Credit Survey Information

Appendix: 1 List of Hypothesis

- 1- Los mas pobres no participaron en los eventos de SANREM
 - a. Son localizados en los tierras peores- mas grandes pendientes
 - b. Ubicado en lugares que necesitan mas la ayuda de las programas
- 2- Los quien participen mas adoptan mas
- 3- Las familias mas grandes participan mas en los eventos de SANREM
 - a. No tiene dinero para viajar a las reuniones o no tiene tiempo
- 4- Las familias con más labor masculino puede adoptar o construir las practicas con más facilidad
 - a. Más probables a adoptar las practicas mejores de nivel uno porque son labor intenso
- 5- Las personas con más educación son más probables a participar y adoptar
- 6- Si mujeres participan mas en los talleres, sus familias son más probables a adoptar las recomendaciones
 - a. La poder que mujeres tienen en la acción de hacer decisiones en la familia
- 7- Las personas con tierras más vulnerable se adoptan más
 - a. Hay mas riesgo de perder suelo, dinero si no hacen nada
 - b. Las fincas abajo de otros fincas que no adaptan, tienen que adoptan más porque tienen mas problemas de erosión desde arriba
 - c. Pollution from the top affects lower altitude farms, which have to implement more because of erosion from above.
- 8- Secuencia de adopción- si alguien adopta uno, va a adoptar más
 - a. Ve las resultadas y ve que vale la pena
- 9- Se los vecinos adoptan, es más probable que yo adopto también
 - a. Para las personas quien no han participado en los talleres, pero sus vecinos los han adoptado, y ven los resultados y se gustan, ellos también adoptaran las practicas mejores
- 10- Edad de las personas a cargo de las fincas
 - a. Los agriculturas viejos no quiere cambiar tan mucho como los jóvenes
- 11- Lo mas viejo la finca, lo menos la adopción
 - a. Si son nuevas fincas en las familias, los nuevos dueños querrían saber todas las nuevas tecnologías y maneras de manejarlas
- 12- Hogares de familias- “encabezados” por mujeres se adaptan más
- 13- Acceso al trabajo fuera de la finca afecta adopción
- 14- Fincas más cerca al centro de población (de Guaranda) o el mercado adoptan más
- 15- Mas pastura (% de tierra) relaciona con menos adopción
 - a. No necesita la protección del suelo
- 16- Lo más la capital social, lo mas la adopción
- 17- Familias con acceso a buyes adoptan más
- 18- Las familias que reciben visitas regulares de Lucho y Carlos y compañía adoptan mas
 - a. No es necesario ir a los talleres para adoptar las practicas
- 19- Las familias con acceso al crédito adoptan mas
 - a. Acceso a los bancos
- 20- Elaboración (valor agrado) a los productos afecta adopción
 - a. Familias más entrepreneurial son mas creativos?

Appendix 2: List of Survey Questions for Interviewers

Consenting Script:

Good morning. We are students and faculty from Virginia Tech, a university in the United States, and from INIAP in Ecuador. We are working on a project to promote sustainable natural resource management in the Andean Region. We are trying to learn more about why farmers do or do not use specific practices to protect soil and water resources. We would like to ask you about your opinions and experiences with the use of conservation practices as well as factors such as credit availability, labor availability, and risk that might affect the use of farming practices. Your answers and those of other participants will be used to guide our research on how best to promote the use of conservation management practices by farmers. Your answers will be kept completely confidential. Your answers to these questions are voluntary and you may stop the discussion at any time. You may answer some questions and choose not to answer others. Are you willing to answer our questions?

Questions Asked:

Tema 1: La Casa, La Familia & Los Géneros

- a. ¿Cuántos personas conforman su familia?
- b. ¿Cuántos años tienen cada persona?
- c. ¿Cuántos años han cultivado la tierra en la finca?
- d. ¿Quién conversa más con los vecinos y las personas en la comunidad?
- e. ¿Ud. es activo en su comunidad o tiene una posición en la comunidad? ¿Puede describir su posición en la comunidad?

Trabajo:

- f. ¿A qué edad comienzan a trabajar los niños?
- g. ¿Quién hace el trabajo en el campo?
- h. ¿Cuántas horas Ud. trabaja en su campo diariamente?
- i. ¿Cuántas horas el/ella/sus chicos/ su esposo/a trabaja a su campo diariamente?

Decisiones:

- j. ¿Quién toma las decisiones finales en la familia?
- k. ¿Quién es el jefe de hogar?
- l. ¿Quién controla/regula las actividades de campo?
- m. ¿Quién controla/regula las finanzas o presupuesto?

Educación:

- n. ¿Cuántos personas de la familia han ido a la escuela?
- o. ¿Por cuántos años Ud. fue a la escuela?
- p. ¿Qué estudió Ud.?

Tema 2: Las Practicas & Los Cultivos

- a. ¿Alguién en su familia ha trabajado afuera de la finca para ganar dinero?
- b. ¿Quiere Ud. más oportunidades para trabajar fuera de la finca?
- c. ¿Hay una diferencia entre los trabajos de hombres y los trabajos de mujeres? ¿Todos ayudan con trabajar en la finca, cocinar, y lavar ropa o hay diferencia?
- d. ¿Que es su rotación para sus cultivos y que es la duración para cada cultivo?
- e. ¿Puede Usted trabajar con sus vecinos, si no tiene muchos hombres en su familia?
- f. ¿Qué prácticas ha adoptado Usted en su finca?

- g. ¿Como prepara el suelo antes de sembrar? ¿Usa Ud. labor de animal o tractor?

Tipo de Tierra:

- h. ¿Cuántos hectáreas tiene Ud.?
i. ¿Para cuales cultivos usan riego?
j. ¿Piensa Ud. que su finca esta en riesgo a problemas ambientales?
k. ¿Piensa Ud. Que su tierra es plano pendiente o muy pendiente?
l. ¿Cuáles son los problemas de su finca mas importantes para Ud.?
m. ¿Le afecta las prácticas de manejo de las fincas aledanias?
n. ¿Ud. nota enchancamiento después de una lluvia?
o. ¿Considera que existe contaminación en la parte de arriba?

Tema 3: Economía- Trabajo, Bancos & Crédito

Los Bancos:

- a. ¿Ha usado crédito para cubrir alguna necesidad?
b. ¿Ud. crea que tenga acceso de crédito en bancos o de un prestamista?
c. ¿Piensa Ud. que hay obstáculos para conseguir crédito del banco?
d. ¿Haría Ud. un préstamo para el manejo de recursos naturales?
e. ¿Conoce el porcentaje de interés anua para un préstamo?
f. ¿Cuál es la mejor época del año para obtener un crédito?
g. ¿Por cuántos años conoce Ud. que existe crédito?

La Cosecha:

- h. ¿Cuáles cultivos tiene Ud.? ¿Cuáles son para vender y cuáles para consumo?
i. ¿Después de cosechar, que hace Ud. con los productos?
j. ¿Da valor agregado a sus productos?
k. ¿Ha cambiado su manera de producción para mejorar las sistemas de producción?
l. ¿Podría describirme el proceso de la siembra, la transformación y la venta?
m. ¿Transforman los productos en el sitio?

Tema 4: Talleres, Adopción & SANREM

Talleres:

- a. ¿Ha participado en los talleres de manejo de recursos naturales que ha organizado INIAP/SANREM?
b. ¿Cuántos veces en los últimos 3 años?
c. ¿Por qué no asiste Usted a más talleres
d. ¿Qué aprendió Usted?
e. ¿Cómo estas reuniones han contribuido en el manejo de su finca?
f. ¿Hay otras temas en lo que quiere aprender en las talleres?
g. ¿Que día de la semana es mejor para ir a las talleres?

Participación:

- h. ¿Quien en su familia va a los talleres?
i. ¿Cuales son los obstáculos para participar en los talleres?
j. ¿Ha trabajado con empleados de INIAP o otro grupo en su finca aquí mismo?
k. ¿Cuántas veces lo han visitado estos empleados?
l. ¿En que mes del año los representantes de INIAP lo han visitado?
m. ¿Por cuantos años lo han visitado?

Practicas:

- n. ¿Cuándo aplicó su primera practica?
- o. ¿Y desde entonces, cuántas ha aplicado?
- p. ¿Piensa Ud. que las prácticas son eficaces y vale la pena implementarlas?
- q. ¿Por qué aplicaría más prácticas o por qué no aplicaría más prácticas?
- r. ¿En el futuro, piensa que va a adoptar más prácticas?
- s. ¿Podría indicarme más sobre estas prácticas?
- t. ¿Si sus vecinos adoptan una nueva práctica, Ud. también pensaría en adoptarla?
- u. Si Ud. adopta una nueva práctica, los vecinos están más probable a adoptarla?

¿Hay algo sobre su comunidad o su finca que usted gustaría comentar o discutir?

Observaciones:

- a. Localización- los tierras peores- mas grandes pendientes
 - a. Ubicado en lugares que necesitan mas la ayuda de las programas
- b. Rico o Pobre: Riqueza del acomodaciones, hogar/casa,
 - a. Material natural o otro más caro que usan para construir, si tienen suelos, baños, tamaño de los paredes, cubierta, electricidad, hornos para llena.
 - b. Herramientas (tractores, arados, etc.)
- c. Animales que están en la finca
 - a. Hay bueyes? Cuántos? Hay vacos, cerdos, gallinas.
- d. Ropa de la familia: collares en las mujeres, zapatos
- e. Mujeres: quien habla mas- el padre o la madre, quien parece que tiene mas poder en la casa?)
- f. La distancia entre de la finca y el centro/mercado
- g. Pastura: Cuantos animales, cuantos parcelas son solo de pastura

Appendix 3: Recommendations from Farmers for Workshop Themes

Recommended Themes, as per the Farmers Interviews:

Conservation Practices: 53

- 11 Organic fertilizer [reduced chemical use]
- 8 Conservation practices
- 8 Irrigation/Water
- 8 Native species (trees)
- 4 Barreras vivas
- 4 Soil conservation
- 3 Zanjas
- 2 Curvas de nivel
- 2 Terrazas
- 1 Natural resource management in general
- 1 Wind erosion prevention
- 1 Cultivos en fajas

Animal Sciences: 32

- 11 Pasture management
- 8 Livestock nutrition
- 8 Dairy/Cheese
- 5 Cattle breeds

Cultivation Capacitation: 21

- 6 Potato
- 6 Better cultivation methods/Agriculture
- 2 Better seeds
- 1 Haba
- 1 Quinoa
- 1 Barley
- 1 Wheat
- 1 Lanchas
- 1 Insectos
- 1 Weed control

Human/Societal Programs: 18

- 6 Artesania/Tejidas
- 4 Family nutrition/Health
- 3 Administration of farm business
- 2 Medicinal plants
- 1 Alternatives to tractor [till] use
- 1 Marketing
- 1 Credit

Appendix 4: Knowledge of Environmental Problems

Perceived Environmental Problems:

Water issues: 24

- 11 water erosion
- 8 Contaminated water
- 5 no regular access to irrigation water

Wind/Weather Issues: 97

- 43 wind erosion
- 23 frost damage
- 18 summer draught/winter flooding [seasonal changes]
- 13 hail

Ag Issues: 20

- 12 chemical fertilizers
- 8 potato worms/pests

Human [lack of institution] Issues: 29

- 12 trash
- 5 Neighbors not using practices/poor management
- 4 erosion from nearby farms
- 2 Burning
- 1 Pollution from buses
- 1 Bathrooms
- 1 Washing clothes upstream
- 1 People getting sick
- 1 Deforestation
- 1 Air contamination

Other: 18

- 11 NONE MENTIONED
- 2 Less problems on own farm
- 1 LESS wind erosion
- 1 Water has IMPROVED
- 1 ashes from volcano
- 1 Dead animals in ditches upstream
- 1 Decreased biodiversity

Appendix 5: Credit Survey Information

About Credit:

Collateral/Financial Barriers: 25

- 7 Collateral (nonspecific)
- 6 Land titles (renters/don't have them)
- 5 High costs of monthly payments
- 3 Deposit of 20% for Co-Op loans/High cost of collateral
- 3 Difficult to repay
- 1 Cattle vaccination

Institutional Barriers: 20

- 9 Too much paperwork
- 5 Feel disenfranchised from institutions
- 2 One Year Loans are not enough/terms are too short
- 1 Already using credit, can't take out more
- 1 Too much time for approval

Uses:

- 4 [FEPP/Co-Op] cows
- 3 Potatoes
- 3 [Co-Op] Seeds
- 2 [FEPP/Juan Pio] land
- 2 Pasture
- 1 Jornales
- 1 Artesania

Future/Desired Uses:

- 15 NRM
- 4 Native trees
- 4 Ganaderia/Cows
- 4 Seeds (for potato, pasture mixes)
- 1 Buying more land
- 1 Fertilizers
- 1 Cuy
- 1 Better house

Opinions:

- 4 Doesn't want to take on risk/ag has lack of guarantees
- 3 Economic crisis/current distrust of banks
- 1 Pride prevents use

- 1 Possibility of losing land
- 1 Would like Community Credit projects
- 1 Got into debt, no longer interested

Attachments:

Final combined SANREM excel spreadsheet