ANNUAL PROGRESS REPORT

Climate Variability and Household Welfare in the Andes: Farmer adaptation and use of weather forecasts in decision making

Year 2 of 3: May 1 2000 - April 6, 2001
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Regional Collaborating Institutions:

Promotion and Research on Andean Crops-Bolivia (PROINPA)
Center for Research in Natural Resources and the Environment- Peru (CIRNMA)

SUMMARY OF ACTIVITIES YEAR 2

A second year of household surveys was applied to 45 families in Bolivia to study changes in the economic portfolio. Cluster analysis of the 1999 data was performed, as well as an analysis of the variables affecting income and diversification through canonical correlations. Analysis is on going on coping strategies in Bolivia. A theoretical framework and survey were developed to replicate this research in Peru. Two communities were selected and 102 households surveyed. Data base development and entry were completed. Data cleaning and construction of variables is continues for both Bolivia and Peru. The first year of research on local knowledge systems and use of forecasts started in Bolivia, using case studies. Data collection for the study of local knowledge and diffusion through nodes was completed in San José. A similar methodology will be used in Peru the next year. A review of local knowledge on forecasts and its effectiveness during a drought and El Niño was completed. Analysis of the networks for diffusion of information withing and outside the community was initiated this year to identify the characteristics of potential beneficiaries of climate forecasts. To calibrate the biological models for simulations, data collection/monitoring for a year on potato varieties was carried out. The models will be used, along with other existing biological models, to simulate scenarios of events and impact on households based on the livelihood strategies identified in Bolivia and Peru. The First Expert Panel and Scientific Conference took place on July 10-13, 2000, in Puno Peru. A web site is currently being constructed: **http://www.ssu.missouri.edu/Clima/**

ACTIVITIES IN YEAR 2

Field Work/Monitoring and Data Collection

Survey instruments were developed for the field research activities in Bolivia and Peru. A theoretical framework developed for Bolivia was adapted to Peru, and guided the development of the survey for two new sites. As with the case of Bolivia, agreements were developed with the communities and CIRNMA to conduct the production and income surveys in two peasant communities. A review of previous studies and data availability guided the selection of Santa María and Anccaca. Both are agropastoral communities with different levels of market integration and combination of production activities. Community organizations provided a space for field researchers to live while the field activities are being carried out.

Bolivia Year 2

1. Completed data collection of a household economic survey to identify livelihood strategies and corresponding economic portfolios in San José Llanga (45 families) for a second agricultural year 1999-2000.The second year questionnaire was developed with the advisory group, and finalized by the principal investigators. After field testing it was applied in September and October of 2000. A data base format was prepared at CIP in November. Data entry was completed in February in Bolivia, while monitoring potato varieties and the study of networks was going on. The data base is currently being cleaned at MU. The variables will be constructed for the portfolio evaluation of the second production year in Bolivia. This should take place during the months of June-August.

2. Continued data collection of yields and monitoring performance of potato varieties in San José Llanga, which include both local and introduced varieties, of 12 families. This is a second year monitoring of varieties, for two purposes, information to calibrate the biological models, and to determine the performance of alternative technologies. Varieties introduced by PROINPA performed very well under frost conditions during year one. Potatoes were selected for seed from the production in the first year, for both distribution to other families and second year planting. Results on the performance of these varieties were presented at the first Expert Panel and Scientific Conference in Puno on July of 2000. Similar information is currently being gathered (completion expected at the end of June) for calibration by PROINPA and CIP for year 2. There is especial interest in performance because these are farmer produced seeds used in year 2. Excessive rains resulted in 95% loss of a variety that has high market value.

3. Completed data collection for case study on networks to access information about forecasts in San José Llanga, Bolivia. Data was collected from 70 households on information flows between zones, among households engaged in similar production activities, and relations with two outside institutions that deliver information on agriculture and forecasts. Case studies of a radio and a government organization are being analyzed.

4. Data collection for a study, The Role of Potatoes in Andean Household Portfolios: Analysis of Interaction Between Local and Introduced Knowledge, Potato Production and Household Economic Activities, using case studies of ten families in San José, as well as regression analysis of three data sets. Susan Materer, a graduate research assistant in agricultural economics completed. Her thesis will be completed during the month of July.

Peru Year 1

5. During the month of August-September the theoretical model adapted to Puno conditions was developed. This informed the construction of the survey, which took place in the month of October. Field testing of the survey took place in October. The data base was developed at CIP.

6. Completed data collection of a household economic survey to identify livelihood strategies and corresponding economic portfolios for the first year in Santa María and Anccaca (107 families), Puno, Peru. Data collection took place during the months of October and November, and during the month of January. Data entry took place in December and in February-March. Variable construction for the analysis of portfolios will be completed for the second Expert Panel and Scientific Conference (July 2001).

7. Monitoring of representative households in Santa María (12 families) and Anccaca (7 families) on household composition, infrastructure, crop production, livestock production, non agricultural activities and migration, credit, decision making and access to information through networks continues. This activity started in November of 2000 and will end with the production cycle in June. Climatic conditions in the areas are being monitored. Detailed information on potato production, varieties, strategies, and yields under drought and frost are being gathered. Some of the crops monitored by the project were lost to river floods during the period January-March of this year.

Modeling/ Analysis/ Preliminary Findings

Household portfolios and livelihood strategies

Developing profiles of household economic portfolios. Livelihood strategies change through time, conditioned by many factors, among them climatic events. With data gathered in the first year survey, economic portfolios were constructed for each household. The diversity index was calculated to measure the degree of diversification of income sources. Using the typology identified in 1995 with cluster analysis, a comparison through time, from 1993 to 1999, showed growth in a non agricultural activity to deal with the drought of 1995. In years where the stress was not present off farm activities decreased significantly. In 1999 a group of households exhibited a lower diversity index. This group emphasized potato production, and its larger share in the portfolio was reflected in the decrease of the index. Analysis of potato production by this group and by the elderly in the year of El Niño seems to stress their vulnerability within

agriculture production. Cluster analysis of the matrix of variables again identified three groups of households with distinct strategies (November in Bolivia), with age, crops and livestock being variables that cluster households. Analysis of the results continues, and should be completed by the second expert panel meeting. To evaluate the robustness of the cluster results, a new analytical tool was applied to the data matrices for 1993, 1995 and 1999, canonical correlations. Two response variables, income and diversification, are related to age, labor, forages, sheep, cattle, wages, and crops. Preliminary results coincide in identifying off farm strategies and livestock assets as mechanisms to cope with drought, and the growth of crops as a significant income earning strategy in the late nineties. Completion expected in August of 2001.

Case study of the role of potato production in Household Portfolios in San José Llanga and the knowledge of forecasts. The analysis of ten case studies conducted in San Jose Llanga found that there were very apparent differences among identified groups of households. Potatoes are an essential income-generating crop, in-kind and monetary. The dairy producers, or input intensive households, wanted to grow improved varieties to increase their market interaction. However the households did not devote time and inputs to potatoes and did not generate a surplus for market. The more extensive households devoted time and inputs to potatoes and produced this crop for market and home consumption. The elderly households produced potatoes for different reasons. For some households it was the only source of income, while others used it to increase market interactions. This research shows that there is increased desire to plant market oriented potatoes, but due to competition in land, labor, and inputs not all households can devote these resources to produce a crop for market.

Shocks and stresses influence household production strategies. A common mechanism to deal with these is chuño (freeze-dried potatoes) production. Most households did not worry about climatic problems, citing the ability to recover seed from fields and use chuño for food and as an income source. The productive extensive households and the elderly deplete their assets more when there is a shock to the household. Climate plays an important role in deciding where and when to plant. Local indicators aid households in determining if years will be wet, dry or normal. The type of soil that is used for potato planting is determined the nature of the year being wet, dry or normal. Also some indicators are able to determine if the rains will be early or late. Therefore these indicators allow households to make important production decisions.

Biological models: Scenario Analyses with process-based models

Simulation models might be the only cost effective option to analyze the expected outcomes of agricultural production under different climatic, soils, and management conditions. In order to have valid results, the models must be calibrated in situ, to test its validity. During the reporting period the SUBSTORE potato model was adapted to the climatic conditions of the study areas. A new sub-routine to simulate the effect of frosts during different physiological stages of the plants was developed and successfully tested. We now can analyze scenarios for the two most important products, milk and potato. A few scenarios for potato production were analyzed. In the Puno site, the model shows how advantageous is to advance planting date when water for irrigation is available.

The production can be increased from 6 to 18 t.ha-1. If no irrigation is available, there is little that can be done to cope with extreme frost events. On the other hand, the impact of early and late frosts on different cultivars was tested for San Jose climatic and soils conditions. The frost tolerant varieties tested outperformed the cultivars not selected for frost tolerant traits. More details are given in the annex.

Local knowledge systems and use of forecasts

Forecasting and local knowledge in Peru A study assessed the ability of forecasting by the farmer community and forecast institutions, based on two events, the drought of 1989-90, and El Niño Event of 1997-8 in Peru (Claverias). The purpose was to find the complementarities between local and scientific forecast knowledge. On important aspect of this review is that it highlights the similarities that exist in the indicators and actions taken by farmers in this Aymara agropastoral and semiarid region of Peru, and Bolivia's semiarid highland region of La Paz. The household survey results of year one in Bolivia coincided with these findings. On going research (interrupted by the floods during the months of January and February) in San José Llanga is detailing forecast indicators related to timing of activities and to perceptions about the outcomes of the production year.

Forecasting and the agricultural calendar Currently a calendar that relates to crop decisions based on local forecast knowledge is being completed in Bolivia. Decisions on time and space are impacted by the forecasts. Farmers adjust according to onset of rains, and expected amount of rains by adjusting timing of planting, and location of planting. How decision makers weigh the local knowledge forecast when the different indicators provide contradictory information is the focus of on going field work.

Networks for diffusion of information Year 2 research activity on mechanisms to diffuse forecast information is based on a case study of San Jose Llanga as a community, and differences within groups and neighborhoods on access to information by type of main economic activity is on-going (Espejo, R., J. Gilles, C. Valdivia, and C. Jetté. 2001. "Estudio de Redes de Información Climática en San José." Study of Networks of Climatic Information in San José Llanga.). With a case study methodology, the network of local forecast information about the agricultural year is analyzed. Case studies for different commodities inform on the structure of networks within and between neighborhoods in this community. The study addresses local networks, use of information from outside sources, and a case study of two organizations working on delivery of information that are external to the community. This study is a development of the initial finding on sources of information for decisions, and forecast on the production year developed in year 1.

Potential Beneficiaries of Climate Forecasts

By identifying distinct economic portfolios differences between groups are being analyzed in terms of the potential benefits of accessing forecasts. Currently through the portfolio approach, degree of vulnerability (measured by the diversity index) is being analyzed. The biological models will be used, along with the different portfolios, to determine the vulnerability measures in terms of

income changes, and asset changes of different groups of households. This will provide information on coping ability, but not necessarily on ability to use of information.

Gilles et al discuss the constraints of forecast information to benefit household producers in the Andean region, because of the current regional to macro level (skill) of forecasts. On going research on the nodes of information diffusion, and type of information aims to identify the disconnect between potential users and organizations in the generation and diffusion of information arena.

Workshop Organized

First Expert Panel and Scientific Conference July 10-13, 2000, Puno Peru.

This workshop encompassed both the presentation of research findings, and a review of project activities by an expert panel. Twenty researchers from Peru Bolivia and the US attended the workshop. The panel of experts consisted of seven researchers in the fields of local knowledge on forecasting, climate forecast models for the Andes, crops and livestock models to simulate climatic impacts, and assessment into the causes of poverty in the highlands. Members included representatives from the climate forecasting community and officials involved with early warning and disaster prevention (the Early Warning and Food Security Systems - Sistema Nacional de Seguimiento de la Seguridad Alimentaria y Alerta Temprana).

The theoretical framework was discussed in light of first year findings, and potential application for Peru. The position papers are listed in the outputs for year 2 section. Recommendations in three areas were developed. The first was the plan of research activities for year 2 in Peru and Bolivia. The second was to develop a research proposal and identify funding to study the relationship between local knowledge informing local forecasts and decisions, and variables that are measurable, such as winds, frosts and rainfall at periods when observations are made, to establish if there is a relationship between both, the local knowledge forecasts and the events. The third was monitoring in year 2 of Bolivian farmers fields to monitor the potato varieties produced and selected by farmers, which we pursued because of availability of funds. The conference presentations are listed in the outputs section.

IMPLEMENTATION ISSUES

Research is constrained by the agricultural activities. Most of the data collection takes place during periods of slow down in activities. These months are July through September, and January through March, before harvests being. Our delays with fund transfers were mostly between the US and the region and within the region. The organizations and researchers were creative to deal with this constraint. The floods of the beginning of the year did delay access to the field, both for monitoring activities, as well as meetings and data collection, both in Bolivia and Peru. The floods at both sites were a problem for the farmers. Floods during the months of January - March made difficult field work, especially the second part of the survey in Peru and the monitoring and forecasting calendars in Bolivia. As a result there has been some delay in completing data collection. The situation was very difficult in Bolivia as access to the community was almost impossible. The

floods affected the farmers' delivery of milk to the collection areas in Bolivia. Floods in Puno are being compared to the one of 1985-86. Some farmers lost almost 95% of the crops.

OUTPUTS YEAR 2

Presentations

Gilles, J., S. Materer, and C. Valdivia. 2001 (forthcoming). "Re-evaluating Climate Forecasting: Lessons from Indigenous Systems." *64th Rural Sociological Society Meetings*, August 15-19. Albuquerque New, Mexico. Abstract available.

Gilles, J. 2001. "Indigenous Knowledge and Climate in the Andes" Presentation made for the Environmental Sociology Seminar Series on March 9, Department of Rural Sociology, MU, Columbia.

Valdivia, C., C. Jetté, R. Quiroz, J. Gilles, and S. Materer. 2000. "Peasant Household Strategies in the Andes and Potential Users of Climate Forecasts: El Niño of 1997-1998." *American Agricultural Economics Association Selected Papers*. July 30- August 2. Tampa, Florida. Paper and abstract available.

Gilles, J., F. Galindo, C. Valdivia, and S. Materer. 2000. "Knowing the Future: Climate Forecasting, Farmers and the Food System." *63rd Rural Sociological Society Meetings*, August 14-18. Washington D.C. Abstract and paper available.

Valdivia, C. "Climate Variability and Household Welfare: A Theoretical Framework." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru. Abstract available.

Valdivia, C. "Profiles of Users of Climate Forecasts: Experience from San José Llanga." Taller: Variabilidad Climática y Bienestar familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru. Abstract available.

Materer, S. "Production Strategies under Risk: The Case of San José Llanga." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru. Abstract.

Lagos, P. "Andean Climate Forecasting." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru.

Claverias, R. "Knowledge of Andean Farmers About Climate Predictions: Elements to verify these." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru. Abstract and paper available.

Baigorria, G. "Crop Simulation Models and Applications." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru.

Jetté, Christian. "Factors Related to Poverty in the Altiplano." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare

in the Andean Zone.) July 10-12. Puno, Peru. Abstract available.

Choquevilca, J. ""SINSAAT, Food Security and Early Warning Systems in Bolivia." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru.

Quiroz, R. "Dairy Production in the Bolivian Altiplano, and future Developments." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru.

Carrillo, R. "Introduction of Frost Tolerant Potato Varieties in San José Llanga." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru.

Carrillo, R. "The Agricultural Calendar, Decisions and Climate: Experiences from San José Llanga in 1999." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru.

Valdivia, R. "A Preliminary Assessment of Potential Research Sites in Puno." Taller: Variabilidad Climática y Bienestar Familiar en la Zona Andina. (Workshop: Climatic Variability and Family Welfare in the Andean Zone.) July 10-12. Puno, Peru. Abstract available.

Valdivia, C. 2000. "Climate variability and household welfare in the Andes." At session Climate & Agriculture Studies in Uruguay, Bolivia, and SE USA Aplicación de Pronósticos Climáticos en Agricultura: Métodos, Experiencias y Oportunidades en América Latina. IAI - CIP conference: May 16-17.Lima, Peru.

Publications

Valdivia, C. and J. Gilles. 2001. "Gender and Resource Management: Households and Groups, Strategies and Transitions." *Agriculture and Human Values.* 18 (1): 5-9.

Valdivia, C., J. L. Gilles, and S. Materer. 2000. "Climate Variability, A Producer Typology and the Use of Forecasts: Experience From Andean Semiarid Small Holder Producers." *Proceedings of the International Forum on Climate Prediction Agriculture and Development*. International Research Institute for Climate Prediction. Palisades, New York. pp. 227-239.

Abstracts

Valdivia, C., J. L. Gilles, and S. Materer. 2000. "Climate Variability, A Producer Typology and the Use of Forecasts: Experience From Andean Semiarid Small Holder Producers." *Proceedings of the International Forum on Climate Prediction Agriculture and Development*. International Research Institute for Climate Prediction. Palisades, NY p.31.

Working Papers

Valdivia, C., C. Jetté, R. Quiroz, J. Gilles and S. Materer. 2001. "Peasant Household Strategies in the Andes and Potential Users of Climate Forecasts: El Niño of 1997-1998." Agricultural Economics Working Paper AEWP-2001-4. Department of Agricultural Economics, University of Missouri. Columbia, MO.

Materer, S., C. Valdivia and J. Gilles. 2001. "Indigenous Knowledge Systems: Characteristics and Importance to Climatic Uncertainty." AEWP-2001-03. Department of Agricultural Economics, University of Missouri. Columbia, MO.

Materer, S. and C. Valdivia. 2000. "Analysis of a Climatically Variable Production season." AEWP-2000-10. Dept. of Agricultural Economics, University of Missouri. Columbia, MO.

Materer, S. and C. Valdivia. 2000. "Household Production Strategies in a Climatic Variable Zone." AEWP-2000-9. Dept. of Ag. Economics, University of Missouri. Columbia, MO.

Reports (field research reports and reviews/positions papers)

Claverias, R. 2000. "Conocimientos de los Campesinos Andinos sobre los Predictores Climáticos: Elementos para su verificación." (Andean Peasants' Climate Forecast Knowledge: Elements to verify these knowledge). Mimeograph.

Espejo, R., J. Gilles, C. Valdivia, and C. Jetté. 2001. "Estudio de Redes de Información Climática en San José." (Networks of Climatic Information in San José Llanga.) Mimeograph.

Thesis Research

Susan Materer. Thesis "The Role of Potato Production in Diversified Household Economic Portfolios: Study of San José Llanga, Bolivia" M Sc Agricultural Economics. Expected graduation Summer 2001.

Cheston Easter. Thesis Proposal "Markets and Effect of Transaction Costs on Household Participation in the Southern Highland Region of Peru." M Sc Agricultural Economics. Proposal to the Dorris D. and Christine M. Brown Research Fellowship, International Agriculture Programs. Expected start of field work June 2001.

Workshops Organized

Climate Variability and Family Welfare in the Andean Region: Family Adaptation and the Use of Climate Forecasts in Decisions Making. Panel meeting of researchers and experts, organized in collaboration with the International Potato Center and Centro de Investigación de Recursos Naturales y Medio Ambiente (CIRNMA). July 10-12, Puno Peru. 2000.

LINKAGES

GRADE, Peru Manuel Glave and Rebecca Harris, **IFPRI** (International Food Policy Research Institute) , World Meteorological Organization/ Interamerican Development Bank study assessing the socio-economic impacts of ENSO in Latin America and the Caribbean. At this point we have exchanged information about the projects and approach of our Puno study as they are planning to work in this site.

Sistema Nacional de Seguimiento de la Seguridad y Alimentaria y Alerta Temprana SINSAAT Bolivian Institution in the are of use of climate forecasts (National System of Food Security and Early Warning), with Javier Choquevilca, coordinator to participate in the expert/advisory panel, and to develop a case study of this organization about delivery of information.

Intermediate Technology Development Group, Peru, Eduardo Franco. Meeting in November on the data base they have developed on information about floods drought and other catastrophic events, as they appear to have a data base that includes the Peruvian research sites. We will invite him to present at the second expert panel and scientific conference in July 2001.

IAI Linking to projects on climate forecasting and use in the Andean Region: Through Walter Bowen and Roberto Quiroz (International Potato Center) with Jim Jones (University of Florida) IAI project to discuss Climate Prediction Applications for the Andean Region. May 2000. Agreement to develop a network, a list serve/discussion group.

Leeds University Projects on Natural Hazards: David Preston, Senior Fellow, School of Geography. University of Leeds, UK, working in Tarija Bolivia. We are exchanging research results.

IRI Participation in a Conference June 6th-8th 2001 at IRI, Palisades, New York. "Workshop on Communication of Climate Forecast." Also developed a faculty development proposal for the University of Missouri to spend a week at IRI in their applications area.

COLLABORATORS

Collaborating Institutions in the region*:*

Javier Aguilera, PROINPA, Promotion and Research on Andean Crops-Bolivia
Jorge Reinoso and Roberto Valdivia, CIRNMA, Center for Research in Natural Resources and the Environment, Peru
Javier Choquevilca, SINSAAT, Sistema Nacional de Seguridad Alimentaria y Alerta Temprana (National System of Food Security and Early Warning)

Co-Investigators in the region*:*

Guillermo Baigorria, International Potato Center
Bruno Condori and Ramiro Carrillo, PROINPA-Bolivia
Rigoberto Espejo, Sociologist

Graduate Students*:*

Susan Materer, M Sc Agricultural Economics
Fernando Galindo, PhD Rural Sociology
Cheston Easter, M Sc Agricultural Economics

Undergraduate*:*

Justina Condori, Agronomy, Bolivia

SUMMARY OF FUTURE ACTIVITIES FOR THIS AND YEAR 3

Year three will focus on analysis and completion of the research activities in the second site. Analysis of the data for Peru and Bolivia on households strategies and economic portfolios will be completed by the end of August in Bolivia and the end of November in Peru. This year's focus will be on evaluation of the theoretical framework for identifying profiles of potential users, study of the diffusion of local knowledge and forecast, and case studies of organizations in Peru working on the delivery of information. Analysis will concentrate on the use of the economic portfolios approach and the characteristics of users to evaluate the groups that may benefit from forecast information. A case study of the effects of networks and other characteristics of the household on transactions costs. The last workshop, synthesis of findings will take place in the region.

Appendix in other file