



Human Health and Changes in Potato Production Technology in the Highland Ecuadorian Agro-Ecosystem

Progress Report # 1

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Research Team and Collaborating Institutions:

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Steve Sherwood	CIP	Quito
Fabian Muñoz	CIP	Quito
Lilián Basantes	CIP	San Gabriel
Mariana Perez	CIP	San Gabriel
Luis Escudero	CIP	San Gabriel
Victor Barrera	INIAP	Quito
Jovanny Suquillo	INIAP	San Gabriel
Manuel Pumisacho	INIAP	Quito
Donald Cole	McMaster Institute for Work and Health,	Hamilton
Peter Berti	PATH	Ottawa
Julia Krasevec	PATH	San Gabriel

Project proposal original goals and purposes (These goals and purposes remained unchanged during the reporting period)

Goal: To improve the health and welfare of rural residents through improving the sustainability of the potato-dairy farming system in highland Ecuador; to promote safe pesticide management practices as part of a program of integrated pest and disease management (IPM/IDM); and to demonstrate to policy makers and other stakeholders the beneficial linkages between changes in agricultural management and improved human health.

Purposes:

1. In collaboration with farm women and men, *to understand* the relative importance of household practices potentially related to pesticide contamination and dietary/nutritional factors in explaining poorer neurobehavioural function between different genders in farm households.
2. In collaboration with farm men and women, *to evaluate* the health impacts for each gender of training/demonstration programs on safer pesticide use and IPM/IDM.
3. In collaboration with local and regional stakeholders, *to integrate* the above findings into tradeoffs/synergy models which relate agricultural management strategies, environmental factors, household factors, farm productivity and human health for use in policy decisions which affect agro-ecosystem management.

Research Problem (as originally presented):

In the Andes, potatoes are a dietary staple and an important agricultural crop in the potato-and-dairy farming system; pesticides are an essential part of current production technology. Previous research in Ecuador showed that pesticide use was associated with adverse health impacts on farm families. Ecuador's sustainable agriculture program seeks to reduce farm health risks by encouraging integrated pest/disease management (IP/DM), safe field use of pesticides and improved farm household practices, without adversely affecting production. The proposed project will help achieve this development priority.

This research will extend previous studies and build on an ongoing program of eco-regional research. The latter includes an IPM implementation program of the national agricultural research institute (INIAP), national non-governmental organizations (NGOs) and a CIP-INIAP-Montana State University project on measuring *tradeoffs* between the environment and agricultural output. The proposed project will support the CIP-INIAP-NGO participatory farmer-to-farmer training under FORTIPAPA by introducing IPM and safe pesticide use practices at pilot sites to farm families and women's groups in particular.

A self presenting sample of farm households in Carchi Province, Ecuador, will participate in an assessment of household practices and dietary factors and then be monitored for improvement in neuro-behavioural function due to changes in potato production technology and safer pesticide-use practices. Selection of equivalent numbers of women and men, linkage with other agro-ecological data from sister projects and gender stratified analyses will permit clarification of differential factors and effects across genders and ecological zones. Through statistical health-effects and economic-production models, observed changes will be related to changes in production efficiency, likely environmental impacts and synergies/tradeoffs between health and productivity in the potato-and-dairy farming system. Addition of human health to the ongoing eco-regional research program will both improve benefits to farm families and strengthen the policy relevance of the program's findings.

Project design and implementation

This project includes both explanatory and intervention components. As the purposes state, we want to better understand pesticide usage, nutritional status and human health inter-linkages. At the same time that we are engaging farmers and their families this through innovative participatory training methods to promote reduced use and better management of these dangerous products. Yet the combination of observation and intervention with a multidisciplinary team in a time of economic crisis poses a number of challenges.

The first is participant recruitment. Participatory training methods call for self-presentation of interested farmers and farm families at community events organized in conjunction with community leaders. The project team has to build relationships with the communities where the project will be executed, a process that takes time. The project team made contact with five communities before identifying those where activities are currently being executed. The combination of community selection and engagement to obtain self presentation took much longer than originally anticipated. Nevertheless, three communities have been identified: La Libertad, Santa Martha de Cuba and San Pedro de Piartal. These are potato farming communities of small holder farmers located on the valley walls in three distinct sites (and cantons) in Carchi Province, with the first overlapping with the larger MANRECUR project in the El Angel watershed.

The second is obtaining baseline information on knowledge, attitude and practices of pesticide use by production and household heads through the use of a structured surveys. The survey had to be carried out with a larger group of potential participants prior to knowing clearly which communities would participate or who might participate in farmer field schools, women's groups and other "interventions". Hence a fourth community was surveyed before it became clear that participation in other activities would be low. Given the long time for study site selection and initiation of some intervention activities to promote awareness and participation (e.g. the provincial conference), some change in awareness may occur before all "pre" assessments have been made. As community interest builds, we may expect other households to join the project, some of whom may or may not have completed the survey and so will have to do so as they join (after community meetings about pesticide problems).

The third is the time commitments associated with participation and the desire to make it worthwhile for project participants. Fortunately Steve Sherwood and Lillian Basantes, both have considerable experience in participatory approaches, Steve among small farmers and Lillian among women. In community meetings a variety of needs beyond concerns about pesticide use have been identified. The research team supports a variety of intervention activities. In addition to farmer field schools, these may include:

- adapting agricultural production change strategies to farmer needs (e.g. include technical assistance by the FORTIPAPA agronomist involved in field monitoring as well as farmer field schools);
- providing concrete services in keeping with the agro-ecosystem and project objectives (e.g. obtaining resistant bean or vegetable seeds for home gardens, one area of interest among farm women);

- increasing youth and children's awareness of problems associated with pesticide use (e.g. school involvement); and
- providing fuller explanatory and supportive services among those that may be affected by pesticides (e.g. health service training not only in treatment of acute poisoning but also household disruption due to chronic cognitive/emotional problems documented both in neurobehavioural assessments and in feedback interviews).

Several of these may occur with other institutions and potentially with community-NGO project funding apart from ECO-SALUD but with some facilitation by ECO-SALUD members. Nevertheless, the particular situation of agriculture and the economy may change in practice, as participants feel 'under siege'.

Fourth, inter-disciplinary and multi-method research is particularly challenging at the field level. Working cultures for field staff members (e.g. agricultural extension, participatory research, feminist social change, health services, etc.) are built on different sets of assumptions, methods of resolving conflicts, ways of planning and perceived roles in interacting with project participants. Methods range from community forums and focus groups, through field notes and individual questionnaires, to biomedical measures. Members of the team may find it hard to appreciate what is involved in the different methods and the specific challenges each colleague faces. The co-investigators and senior research staff perceive the need to provide more training and support in dealing with such challenges.

This links with a fifth challenge, that of encouraging research team members to see their work as combining research and intervention. For example, a group gender analysis provides data relevant to explanation as well as being part of the intervention. Feedback on health status to community members and linking some problems with pesticide exposure is also an intervention, though formally more related to assessment. Similarly, ongoing field monitoring will inevitably involve dialogue with farmers in which not only do we learn about their production methods but also they learn technical aspects of potato farming including alternative approaches.

Sixth, the quantitative data structure for the project is complex. It incorporates assessment, intervention and monitoring data sources which must be linked through a fundamental unit of analysis. The social unit has a combination of productive, reproductive and service functions that do not easily fit into the usual designations of family, household or production unit. Hence the designation "unidad productiva/reproductiva y de servicios". Fabian Muñoz has proposed a data file that would link individuals and participation in different project components to this 'unidad'. Work needs to continue with all members of the research team to assist them in seeing the way the information components of the project link.

Seventh, gender issues remain a focus whose impact is gradually being understood both within the field research team and the communities. Women on the research team are among the first working in the INIAP field office. Flor Maria Cardenas of FORTIPAPA has conducted gender analysis workshops with them. Participatory diagnosis of gender roles has been carried out in two communities under the leadership of Lillian Basantes, one in a group of women and another in a mixed group.

Project Outputs towards Objectives/Purposes during 1998-1999 (activities completed in 1998-1999 Logframe and additional ones that developed over the year)

Purpose 1: Baseline assessment

- Communities and participants selected in San Francisco (La Libertad), Santa Martha de Cuba, and San Pedro de Piartal
- Baseline survey of pesticide use and management practices completed in four communities
- Neurobehavioural battery and other health assessments carried out, preliminary description completed and community/ participants informed in La Libertad
- Nutritional assessments initiated by Canadian Society for International Health/PATH Canada intern

Purpose 2: Intervention evaluation

- Participant training manual completed, FFS courses designed
- Completed Training of Trainers Course (including 2 of Eco-Salud research team members)
- Participatory gender analysis conducted in one community (San Francisco – La Libertad)

Purpose 3: Tradeoffs Model integration

- Participation of Eco-Salud team in annual Tradeoffs Program meeting in Quito, March, 1999.

Purpose 4: Dissemination

- Community meetings for feedback of research results
- Encounter with Consejo Agrario Provincial (Agricultural Council)
- Provincial conference on Pesticide Impacts on Health, Production and the Environment in Carchi (see papers below)

Publications, reports, conference presentations:

Basantes, Lillian (October, 1999). Reunion con grupo de mujeres, San Francisco de la Libertad. Sistematizacion, analisis e interpretacion de resultados. San Gabriel, CIP-INIAP

Basantes, L., S. Sherwood. "Health and potato production in Carchi." Presentation in the Second International Meeting of the Global Initiative on Late Blight. Quito March 4-8, 1999.

CIP-INIAP (1999). Impactos del uso de plaguicidas en al salud, produccion y medio ambiente en Carchi. Compendio de Investigaciones. Conferencia del 20 de octubre de 1999. Hostería Oasis, Ambuquí.

Cole, D. "Plaguicidas y salud en el cultivo de papa: aspectos metodológicos, técnicos, y económicos. In CIP-INIAP, 1999

Crissman, C “Impactos economicos del uso de plaguicidas en el cultivo de papa en la Provincia de Carchi. In CIP-INIAP, 1999.

Espinosa, P. Estudio de Línea base sobre el conocimiento y manejo de los pesticidas en el Carchi. In CIP-INIAP, 1999.

Sherwood. S. and Lillian Basantes, *Papas, Pests, People, and Power: Addressing natural resource management conflict through policy interventions in Carchi, Ecuador*. Presentation for the conference "Ruralidad sostenible basada en la participacion ciudadana", 13 - 15 October 1999 in Zamorano, Honduras.

Viteri, H. “Efectos Neuropsicologicos del uso de plaguicidas en el Carchi.” In CIP-INIAP 1999

Project collaborations and further proposal development:

1. FAO/MAG Farmer Field School (FFS) Training of Trainers (TOT) Course – This first regional course in South America was funded by the FAO Global IPM Facility in Rome. Steve Sherwood of the Eco-Salud project team was instrumental in attracting the course to Ecuador. He served in curriculum development and course facilitation. Lillian Basantes (also of Eco-Salud) served as facilitator for some course activities. Collaboration with the FFS TOT course created an important human resource base for the further diffusion of the project implementation objectives. Jovanny Suquillo (principal INIAP field collaborator) successfully completed the three month training. Course participants helped in preparation of FFS manual.
2. Agreement with the Ministry of Agriculture (MAG): Fernando Chulde of MAG San Gabriel office to run two Farmer Field Schools. A MAG-FAO TCP is in the works to institutionalize FFS at the national level.
3. Tradeoffs Program Collaboration: Building on the conceptual framework of the tradeoffs model (Crissman, Antle, Capalbo, 1998), a group of projects have been developed to foster close linkages and opportunities for joint analysis, modelling and policy contributions. This program currently consists of the SM CRSP Tradeoffs Project, the IPM CRSP Potato Impacts Project, the Eco-Regional Fund Methods Development Project (DME) and Eco-Salud. The IPM-CRSP is a new project collaboration since the Eco-Salud proposal was awarded (see Appendix). Relevant contributions to the Eco-Salud project include involvement of a gender analysis specialist, Sarah Hamilton, and funding for the agricultural production monitoring research team member, Luis Escudero. In the March 1999 Tradoffs meeting in Quito, the Eco-Salud team presented on project design, discussed means of integration and carried out joint planning with investigators in all of these projects.
4. Eco-soils: Investigation for the ecological management and productivity of soils in the Ecuadorian Andean Eco-region: This is a CIP-INIAP-U. Guelph collaboration financed by the Competitive Grants for Research fund of the Agricultural Services Modernization Program (PROMSA) of the Ecuadorian Government. The objective of this three year project is to screen various agricultural practices for their impact on the regenerative capacity of soils

with a special emphasis on the biological component. This project adds an important component of soil husbandry as a new scenario for application to the Tradeoffs Model. This proposal was awarded and will receive initial financing in December.

5. INSTRUCT (Inter-American Networking for Studies and Training in Resource Usage for Community Transformation, a CIDA Tier 1 Program). Eco-Salud researchers provided important linkages to Ecuadorian expertise on pesticides and health (Raul Harari of IFA) to assist with training. They have also been involved in assisting INSTRUCT researchers with proposal development for incorporation of human health impacts of pesticide use among indigenous people in another watershed.

Appendix 1: Excerpt from IPM-CRSP Work Plan for Latin American Site in Ecuador

III. Training and Socioeconomic Activities

III.1 Modeling impacts of changes in pest management technologies (joint research activity with the SOILS CRSP)

- a. **Scientists:** C. Crissman, P. Espinosa – CIP; R. Jacome – INIAP; J. Antle – Montana State (SOILS CRSP); P. Pardey and S. Wood – IFPRI; G. Norton, S. Hamilton – Virginia Tech.
- b. **Status:** New activity
- c. **Objectives:** To (1) assess the impacts of IPM technologies on land use and management, farmer income, and pesticide use, (2) assess the aggregate economic impacts of the IPM technologies developed on the IPM CRSP, including spillovers across regional and national boundaries, (3) assess the health and economic impacts of IPM CRSP technologies by gender .
- d. **Hypotheses:** (1) Land use and management, farmer income, and pesticide use will not be affected by IPM technologies generated on the IPM CRSP, (2) IPM CRSP technologies do not have economic impacts or spillovers, (3) IPM CRSP technologies do not have differential health and economic impacts by gender
- e. **Description of research activity:** A bio-economic simulation model will be used to address objective one. This model is currently being developed on the SOILS CRSP to explore the effects of factors such as changes in technologies and prices on land use and management, revenues, income stability, erosion, contamination of water tables, etc. This model is being developed for the same geographic region where the potato IPM work is underway on the IPM CRSP. It is proposed that reductions in pesticide use be measured or projected due to generation and adoption of IPM technologies on potatoes and that these pesticide use changes be fed into the bio-economic model as a scenario, with modifications made to the model as needed. To address objective two, it is proposed that the per unit cost reductions measured or projected due to IPM CRSP technologies be combined with measured or projected information on adoption and included in an economic surplus model to generate aggregate benefits. All changes in input use, outputs, and prices are being measured for each of the CRSP experiments. This information will be used to help generate per unit cost changes. Information on agro-ecological zones assembled by IFPRI and included in a GIS model will be used in the economic surplus model to help define the potential spillovers of the technologies. For objective three, survey information on household labor allocation and income distribution within the household will be used to project gross gender-differentiated

economic impacts. Health impacts by gender will be examined by collecting information on activities by gender that might directly (e.g. applying pesticides) or indirectly (e.g. washing clothes of pesticide applicators) lead to pesticide exposure.

- f. **Justification:** Knowledge of farm, regional, and aggregate level impacts of IPM is essential for designing IPM programs and pest management recommendations, for justifying programs and research activities, and for designing environmental policies and programs. These impacts often spill over across regions and have differential effects within the household. The Ecuador potato site provides an excellent opportunity to join together modeling efforts and data generated on two CRSPs and by two international agricultural research centers to produce unique impact assessment information. Application of the models developed at this site may provide a template for subsequent joint research activities in other sites as well.
- g. **Relation to other research activities at the site:** This project directly complements other research activities underway on the SOILS CRSP on bio-economic modeling and at CIP and INIAP in general and on the IPM CRSP in particular to control late blight, Andean potato weevil, and potato tuber moth. It uses the results of those other research activities to generate the raw material needed to conduct the impact assessments.
- h. **Projected outputs:** The activity will produce both models and reports that describe impacts of the IPM research on potatoes in Ecuador.
- i. **Projected impacts:** The results should generate information on which technologies to promote in training programs, on which IPM alternatives might justify further research, and on the benefits of pest management policies or regulations that influence pesticide use. It should provide information to help in justifying IPM programs.
- j. **Start:** September 1998
- k. **Projected completion:** September 2003
- l. **Projected person-months of scientist time per year:** 6
- m. **Budget:** INIAP/CIP: \$8,360, Montana State: (covered by Soils CRSP), Virginia Tech: \$19,050 (including \$10,000 for graduate student support), IFPRI: \$15,400

Appendix 2: New Methods in Presenting Research: Hypertext Compact Disks and Andean Watersheds

Participating Institutions:

- CIP/CONDESAN
- University of British Columbia – Institute of Resources and Environment
- Universidad de Caldas – Facultad Post-Grado
- University of Cuenca – Programa de Manejo de Agua y Suelos (PROMAS)
- Universidad Nacional de Puno –
- IDRC – Proyecto MANRECUR 2

General Objective:

To introduce to Latin American researchers the use of hypertext media for presenting agricultural/environmental research problems and research results.

Specific Objectives:

- Through a series of workshops, train five research teams working in five different research sites in the high tropical Andes in the design and preparation of hypertext compact disks for presentation of the nature of agriculture and environment in highland tropical watersheds.
- The research teams produce five compact disks which profile their work in the five different sites.
- Present this work in fora during the UNEP Year of the Mountain.

Justification:

The incorporation of sustainability criteria in agricultural research and development agendas has brought an increasing level of complexity in the problems to be confronted. What was a commodity oriented approach was broadened to a farming systems approach and is now an approach that is concerned with the environmental setting and impacts (among other things) of farming systems. All this is to be done preferably within a setting where stakeholders are consulted and advised. Identifying, relating and communicating all the complimentary and conflictive elements of an agenda to promote the sustainable development of a given region is a difficult and time consuming task.

The development of modern computer-based multimedia systems offers new opportunities to consult and communicate with stakeholders during consultation and results sharing exchanges. The Institute for Resources and the Environment of the University of British Columbia has developed expertise in the use of hypertext-based presentation in both compact disks and in web sites in the internet. Their expertise comes from cases of working in the problems of watershed development and management in both Canada and developing countries. Hypertext-based presentations allow an unprecedented flexibility in structuring the many biophysical, agricultural,

economic, and cultural interrelationships found in these settings. Hypertext allows users to move in a non-linear fashion among the various elements. It further allows information presentation to be layered. A first layer can be for users simply wanting to familiarize themselves with what is happening. A second layer can present analysis and additional layers can go deeper into analysis, theory and data presentation. Further, the media can be continually updated. As new research or development results are achieved, the compact disk or web site can be updated. This supercedes the traditional problem of deciding when to cut off research for presentation in a book or research paper.

CONDESAN has promoted the concept of pilot sites as a basis for fundamental research and extrapolation and horizontal sharing of research results among the collaborators in the consortium. These pilot sites are generally watershed based. Lessons learned in these pilot sites highlight the extreme biophysical and agricultural heterogeneity found in the watersheds. This project will bring teams from the CONDESAN sites in La Miel, Colombia, Carchi, Ecuador, Cajamarca, Peru, and Puno, Peru along with the non-CONDESAN site in Cuenca, Ecuador to a series of workshops conducted by the Institute for Resources and the Environment of UBC. In these workshops representatives of the research teams will learn principles of problem statement and information presentation appropriate for hypertext media are taught in a hands-on environment. These representatives will take these principles back to their research teams where the hypertext “stories” will be developed and produced. Followup workshops will critique interim efforts and compare lessons across research sites. After 12 months, the final product will be a compact disk with hypertext presentation of the watersheds or research sites and the research programs and results relevant to that watershed or research site.

The United Nations General Assembly designated 2002 as the “International Year of Mountains”. There are and will be many significant regional and international events organized around this theme. To have the complex problems and ongoing work to solve those problems of a selection of watersheds or research sites from the tropical Andes captured on compact disks can reach a wide and influential audience .

Appendix 3:

Eco-soils: Investigation for the ecological management and productivity of soils in the Ecuadorian Andean Eco-region

(original title in Spanish: Eco-suelos: Eco-Suelos: Investigación para el manejo ecológico y productivo de suelos en la ecoregión andina del Ecuador)

This is a three year project financed by the Competitive Grants for Research fund of the Agricultural Services Modernization Program (PROMSA) of the Ecuadorian Government, a World Bank financed program.

Participating Institutions:

- Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP), Quito, EC
- Centro Internacional de la Papa (CIP), Quito, EC
- Land Resource Sciences, Guelph University, Guelph, Ontario, CA
- Fondo Ecuatoriano Populorum Progressio (FEEP)-Regional Bolívar, Guaranda, EC
- Universidad Estatal de Bolívar-Facultad de Ciencias Agropecuarias, Guaranda, EC

Objectives:

- Develop research methods to evaluate the impact of agricultural practices in the regenerative capacity of soil, with an emphasis on the biological component.
- Identify useful practices to improve productive management and sustainability of soils.
- Diffuse these new alternatives and methodologies.

Justification:

Farmers and agricultural researchers in Ecuador have long noted productivity loss in soils used in potato cultivation. According to farmers, soils become 'tired' and take longer rotations to recuperate originally observed productivity. This has led in their opinion to greater presence of pathogens and pests in the soil and in turn has led to ever increasing amounts of pesticide use. It is well known that living organisms in the soil play a crucial role in the management and maintenance of physical aspects (porosity, aeration, drainage, and infiltration), chemical aspects (pH, nutrient cycling and availability) and in biological aspects (antagonism, nitrification) of soils. However, in Ecuador almost the entire effort in research in and promotion of soil conservation has been in chemical and physical aspects. The impact of agricultural practices in the biological component of soils has been ignored.

It is known that practices such as mixed cropping, rotations and the use of organic amendments tend to favor diversity and abundance of soil organisms. At the same time, modern monoculture with its associated use of agri-chemicals is known to reduce the capacity of soils as a buffer and thus its productivity. Thus in Ecuador there is a clear need to improve the management of abiotic and biotic factors to improve the sustainability of soil management. This project will complement existing projects in INAIIP and CIP that promote integrated potato management and evaluation of the costs in productivity, environment and human health of the agricultural

technologies and policies. This project will integrate knowledge from entomology, extension, microbiology, phyto-pathology and soil sciences to promote improved awareness and understanding about the principles and practices required to optimize the management of soil. The project participants will develop new tools for analyzing alternative practices and identifying new more appropriate management regimes for the present and future of agriculture in the region.