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

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A Proposal to the IDRC

Canadian-CGIAR Collaborative Research Grants in Agro-Ecosystem Management for Human Health

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PROJECT OVERVIEW

General Objectives: 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.

Specific Objectives:

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 tradeoff/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.

Abstract:

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 programme 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 (NGO) 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 cluster 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.

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Project Leader: Charles Crissman, Ph.D.

Collaborating Research Institutions:

- Instituto National Aut nomo de Investigaciones Agropecuarias (INIAP)
- McMaster Institute of Environment & Health (MIEH), McMaster University
- Programme for Appropriate Technology in Health (PATH Canada)

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Collaborating NGO=s:

Agricultural extension NGO=s in Ecuador, including the Centro Educativo de Servicios Agricolas (CESA), the Fondo Ecuatoriano de Progresum Populorm (FEPP), and CARE-International.

ADMINISTRATIVE AND CONTACT INFORMATION

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No other donor agencies are funding this proposal. No other donor agencies are considering this proposal for independent funding.

PROBLEM AND JUSTIFICATION

Potato Production in Ecuador:

Cultivated on over 60,000 ha, the potato is a dietary staple and an important source of income in the Ecuadorian-highland potato-and-dairy farming sector. The intensely commercial production from 8,000 farms in the Carchi potato zone, the study site, makes it the most important in the country with over 17,000 ha and 40% of national production. However, current methods of potato production make it the field crop with the heaviest pesticide use in the sierra and one of the heaviest users in the country. Among the purchased inputs used by farmers are the highly toxic insecticides, methamidophos and carbofuran, to control foliage-damaging insects and the tuber-damaging Andean weevil (*Premnotrypes vorax*), and the dithiocarbomate fungicides, maneb and mancozeb, to control late blight (*Phytophtera infestans*). With Montana State and McMaster Universities, CIP conducted an extensive study of pesticide use in the Carchi potato-dairy farming system (Crissman et al. 1998). Applied an average of 7 times during crop growth, pesticides made significant contributions to potato yields.

Health Impacts:

As in many parts of the developing world, such pesticide use results in substantial adverse human health impacts (Forget et al, 1993). The health component of the pesticide study highlighted the lack of adequate pesticide management and levels of occupational exposure sufficient to cause acute poisonings within hours (Cole et al., 1998). Active surveillance for pesticide poisonings found a poisoning rate of 171/100,000 comparable to other rates in farming communities using similar technology in the developing world (Crissman, Cole and Carpio 1994). Occupational poisonings were mostly among men, with resultant time off work, and suicides/intentional ingestion mostly among young women. To examine longer-term health effects of pesticides, a cross-sectional study compared the farm population with a control population of citizens not involved in farming. The farm family populations had significantly more nervous system problems than controls, as measured by symptoms, clinical signs and sensitive tests of cognitive function known as "neurobehavioural tests" (Cole et al., 1997). Levels of neurobehavioural function varied by agro-ecological zone (based largely on rainfall and insecticide use variations), levels of education and acculturation, production activities, application practices and potato consumption.

The potato consumption factor is concerning. It could represent pesticide residue intake of importance to not only farm families but also distant consumers. It could also act as an indicator of as yet unmeasured household factors such as pesticide contact (e.g. pesticide impregnated clothes, particularly by women), availability of sanitary facilities (for washing) or differential methods of food preparation (which may destroy residues for some). Alternatively, it could represent nutritional factors associated with social status. In another Ecuadorian highland community, poorer families consumed relatively more potatoes and less meat (Berti and Leonard, 1998) and experienced higher rates of micronutrient deficiencies (Berti, 1996). Dietary deficiencies of micro-nutrients such as iron, zinc or iodine may cause neurobehavioural effects similar to those observed (Gibson, 1990). Hence, the first broad research question:

1. Do differences in modifiable pesticide contact, food preparation methods, dietary intakes or other household factors independently account for variations in neurobehavioural function?

Sorting out the contributions of these various potential factors in conjunction with the project participants, local stakeholders and project scientists should allow for consideration of alternative agricultural household practices and means of jointly promoting them. Farm women and national nutritional and laboratory scientists will be central to this process.

Changing Agricultural and Household Management Practices:

Nevertheless, actions to reduce pesticide exposure should not await further understanding of other contributory

factors to neurobehavioural deficits. Two approaches are advocated: safer use and use reduction. Safer use has led to reductions in poisonings in some developing countries employing considerable resources and cross-sectoral linkages (e.g. Shi et al, 1985) yet changes in longer-term effects have not been evaluated. Impressive use reduction has occurred in national Integrated Pest Management (IPM) programs based on farmer-field schools (e.g. Kenmore, 1991) or partnerships for sustainable agriculture (Thrupp, 1996) yet information on human health impacts have been lacking. Peden (1998) has argued that such agricultural-practice changes should result in human health improvements, though such a working hypothesis so far lacks substantial empirical support except in the nutrition area.

Fortunately, CIP and INIAP have developed a series of technologies appropriate for use in IPM and integrated disease management (IDM) for the principal pests and diseases of the potato in northern Ecuador, all of which promote reduced pesticide use (CIP 1996a, 1997a, INIAP & CIP 1995). For several years, INIAP has conducted research in implementation of IPM under its mandate from FORTIPAPA, a Swiss-funded project to strengthen the potato research capacity of INIAP (INIAP & CIP 1998). Co-Principal Investigator Victor Barrera (INIAP) is the leader of the IP/DM component of the FORTIPAPA programme. In its Quito experimental station, CIP has its global headquarters for late blight pathology and integrated control and maintains its most advanced late blight resistant populations. With INIAP, it is actively introducing these materials to farmers based on the Farmer Field School concept (CIP 1997b, INIAP and CIP 1998). CIP, INIAP, and local and international NGOs are also collaborating in projects aimed at developing innovative participatory methods to introduce improved integrated crop protection practices to a wider range of potato producers (INIAP 1998). The proposed project will link directly with these projects providing information for the development of health and safety related training materials and extending participatory education to related women=s groups. Hence the second broad research question:

2. Can a participatory education program for both women and men result in changes in agricultural production methods and household management approaches with resulting decreases in pesticide exposure and improvements in health status, particularly neurobehavioural function?

If such improvements can be demonstrated in each of the components, local farm families, agricultural-extension program personnel and other stakeholders should all be sufficiently convinced to move beyond the pilot sites. At the same time, important empirical support for the agricultural system change resulting in health improvements should become available.

Policy-Analysis Tools:

One of the challenges in agro-ecosystem management is developing analytical tools that can extrapolate beyond particular sets of farm households in a localized agro-ecosystem to regions at which broader economic and social policies are developed. Members of the proposed research team developed a Tradeoff Model to incorporate farmer economic decision making as the link between micro-level production, health and environmental factors and macro-level policy or technology changes (Crissman, Antle and Capalbo, 1998). Using a statistical production efficiency approach, they showed that farmers with adverse neurobehavioural impacts were worse decision makers and consequently less efficient farmers, a synergistic effect (Antle, Cole and Crissman, 1998a). Using systems modelling with simulations in the Tradeoffs model, they projected that adoption of IPM and safe handling practices would result in significant reductions in health risk (Antle, et al., 1998b). Currently two multi-institutional CIP projects are underway in the same Carchi site chosen for this proposal, in order to generalize the Tradeoffs Model to additional soil related environmental factors (CIP 1996b; MSU & CIP 1996). The overall goal of these Tradeoffs Projects is to develop and introduce a decision support system (DSS) based on computer simulation models (see summary in Appendix 2). This system will enable direct empirical comparisons of changes in agriculture, the environment and human health for specified agro-ecosystems, due to policy or technology changes. Linking the proposed project with these existing projects makes possible the empirical incorporation of nutrition and neurobehavioural factors along with the agricultural and environmental benefits of IPM/IDM and safe-use

practice. Hence, the third broad research question:

3. What are the likely synergies and tradeoffs between health, agricultural production and environment in the broader region; how do they vary across different genders and ecological zones; and how are they changed by the IPM/IDM/safe-use interventions envisaged?

Expanded Tradeoffs/Synergy models should permit more informed policy dialogue among public health, environmental and agricultural organizations and ministries in Ecuador to promote overall agro-ecosystem health. They should also inform and improve decision capacity among regional and international stakeholders involved in CONDESAN, an IDRC-funded development consortium in the Andean region.

PROJECT OBJECTIVES

(See General and Specific Objectives in Project Overview)

METHODOLOGY:

Conceptual Frameworks

Many conceptual frameworks are relevant to the proposed project. Underlying all project components is an understanding that human health is part of Agro-ecosystem health (Smit et al, 1998) though the extent to which all relevant relationships can be measured and modelled remains limited (Eyles, Cole and Gibson, 1996). We draw on ethnographic understandings of household practices, participatory research approaches to joint documentation and development of insights, dietary assessment methods and laboratory residue-analysis methods in our research design. We favour epidemiologic approaches which recognize both household/farm-level factors and individual-level factors as determinants of health status and modifiers of the effectiveness of interventions. Throughout we recognize the importance of gender-based information to document the often diverse life spaces and activities of women and men (Kettel, 1996) and gender-based analysis to reflect the differential policy responses (Morris, 1997). Finally, we see economic tradeoff/synergy analysis as a useful empirically based approach to integrating the vast diversity of information on agro-ecosystems relevant to decision making and policy development (Antle et al, 1998b).

Methods will be described by each objective, with project management aspects (timing, tracking indicators and responsibilities) laid out in the accompanying Logical Framework (Appendix 5).

Objective 1 - Understanding Household and Dietary Factors (Cole, Berti and Barrera)

The principle design to meet this objective is a cross-sectional survey with qualitative, quantitative and data linkage components. As well, longitudinal farm-level data collection will be initiated. Much of the field work will be completed in the first eight months of the project.

1.1 Sample selection: A sample of approximately 40 potato farming households (HH) in the San Gabriel and El Angel watersheds, jointly drawn with the IPM projects, will be asked to freely participate in the surveys, training and ongoing monitoring. Eligible farm HH will be located in the potato-dairy zone, appear in the local land-tax registries, contain a minimum of four potential adult participants per household (for multi-level modelling purposes) and be willing to participate in the training program (objective 2). Relatively equal numbers of women and men between the ages of 15 and 65 and with at least three years of schooling (for neurobehavioural assessment purposes) will be recruited within each household. Such sampling would result in about 100 farm participants of each gender, sufficient to establish important relationships, based on previous work. Written informed consent will be sought by the field interviewers in conjunction with the research co-ordinator in keeping with international standards as adopted in the Declaration of Helsinki. Submission of the protocol and consent procedures to ethical review boards at the Universidad Catolica and McMaster University is underway and approval will be obtained prior to project initiation.

1.2 Household pesticide management practices: Recruitment interviews, preliminary field observations and survey questions will provide the basis for a semi-structured survey of women in the HH sample on HH pesticide management knowledge, attitudes, and practices (KAP). The survey will be supplemented by direct observations resulting in field notes on each household by the interviewers. Interviewers will be encouraged to take a problem-solving approach to potential pathways of exposure, in collaboration with study participants, which in turn will guide sampling for residues.

1.3 Pesticide residuals analysis: Articles of clothing, household materials, potatoes and other foods, prepared in the fashion typical to the zone, will be selected for each household based on the above data. The Toxicology Laboratory of the Universidad Cat lica (directed by Dr. Ramiro Merino) will finalize the protocols for obtaining samples and conduct laboratory analysis for pesticide residuals. Based on previous research and current knowledge, the principal active ingredients in use will likely be carbofuran, methamidophos and maneb/mancozeb. High performance liquid chromatography, gas chromatography and other standard laboratory methods used in earlier work, will be employed.

1.4 Nutritional assessment: Through three 24-hour dietary recalls per subject, on non-consecutive days, the diet of various family members will be characterized. Intakes of macro- and micro-nutrients will be estimated based on Ecuadorian and international food composition databases using COMIDA software developed by Dr. Berti. Direct observation of food preparation and Acommon pot@ consumption will take place. Anthropometric measurements (triceps and subscapular skin fold thickness, upper arm and forearm circumference, height and weight) will supplement the nutrient intake data.

1.5 Neurobehavioural assessment: A reduced World Health Organization (WHO) Neuro-behavioural Core Test Battery will be employed, concentrating those tests associated with pesticide use, protection practices and/or potato consumption in earlier modelling: digit span, block design, Benton, Trails A & B, visual and auditory reaction times, Santa Anna and pursuit aiming (Cole et al, 1997). Locally adapted measures of information and similarities will function as relative control variables. Local norms on all these are available from the earlier project, facilitating rapid individual scaling for feed back to participants and index construction for modelling purposes. In addition, we will include grip strength (using an adjustable JAMAR) as a measure of power, and questionnaire measures of years exposed to pesticides of different kinds, past pesticide poisonings, alcohol use, and confounding medical conditions.

1.6 Agricultural production data: In collaboration with monitoring surveys of the IP/DM projects, we will register farming practices, costs, and revenues using weekly diaries completed by collaborating farmers. Such monitoring will be amplified to include farm household working days lost due to illness, and when possible, identification of those episodes that are pesticide related. In addition, each farmer will complete a semi-structured interview on field pesticide-use practices similar to that being used in FORTIPAPA to assess changes in agricultural practices.

1.7 Statistical analysis: Data coding, entry and preliminary descriptive analysis will occur at CIP with nutritional intake modelling undertaken at PATH and multilevel multivariate statistical analysis at McMaster University/Institute for Work and Health. Other relevant variables will come from sister eco-regional projects. The aim is to identify additional factors at the zonal, household and individual levels associated with poor neurobehavioural function and excess household days lost due to illness, particularly pesticide related. Relevant factors and suggestions for modification will be incorporated as feasible into women=s training programs and subsequent field promoter activities as part of objective 2.

Objective 2 - Intervention Evaluation (Barrera, Crissman and Cole)

The principal evaluation design for this component is a repeat cross-sectional survey approximately two years after the baseline survey, supplemented by longitudinal data principally on agricultural production practices, work-days lost and household practices over time.

2.1 Educational materials: Materials will be developed for farmer-to-farmer education and self study. Based on FAO IPM work in Indonesia, the contents should include: spraying frequency, number of pesticides per tank, WHO Hazard levels and chemical families of pesticides, protective equipment used by sprayers, sprayer maintenance, routes of pesticide contamination, household storage and disposal practices, and acute and chronic health effects (Murphy, 1998). Complementary funding will be sought to experiment with mass introduction via farm supply stores of low cost poncho-style impermeable back and shoulder protectors and disposable gloves. A different mix of topics and accompanying materials will be required for work among farm women, reflecting different concerns about pesticides, different pathways of exposure and different roles in the household.

2.2 Training: Training will be conducted in pilot sites in Carchi province chosen jointly with the IPM projects and collaborating NGOs (INIAP 1997). Training will follow the participatory philosophy of the Farmer Field School adjusted to local conditions. This implies a sequence of training events in farmers= fields during a complete growing cycle with considerable dialogue among farmers and technical staff. Complementary to the field events, women=s groups will be organized, from among the same households participating in the farmer field schools, for in-house schools around household practices. Field notes by event organizers (including project interviewers/promoters) will document participation, concerns, suggestions and other relevant qualitative information. In addition, field promoters/interviewers will continue various forms of reinforcement visits and discussions individually and in groups in the year subsequent to the formal training.

2.3 Measures: The household pesticide management practices, agricultural practices and neurobehavioural assessment components of the baseline survey will be repeated about two years after establishing the baseline. Some reduction in questions on household management may be anticipated based on those factors found useful in explaining variation under objective 1. Changes in use rates of protective gear application practices, storage and disposal practices and HH safe management will be corroborated through observations with participating households. Ongoing agricultural production data will again be available as well as broader technology adoption surveys, pesticide sales registers and protective equipment sales registers from sister projects.

2.4 Statistical analysis: In addition to descriptive work and modelling within the cross-sectional data as *per* objective 1, longitudinal analyses will be carried out, permitting assessment of the extent to which changes in practices result in changes in neurobehavioural function and work-days lost due to illness over time. Differences

between women and men and across farm households will be assessed and explanations tested if such differences are found.

Objective 3 - Modelling for Policy purposes (Crissman and Cole)

Econometric modelling will use data and relationships from the above components and sister projects in the eco-regional program to incorporate health into synergy/tradeoffs analyses which can be generalized to the regional level. Computer and software resources of Montana State University will be used to meet this objective.

3.1 Changes in productivity: As *per* earlier work (Antle et al., 1998b), a system of equations will be estimated based on a production cost function and a health function among farmers. As pesticide exposure declines, neurobehavioural scores are expected to improve due to partially reversible effects, and the model will capture an effect on farm managerial productivity.

3.2 Changes in Tradeoffs/Synergies: The productivity effect listed above will be explicitly related to health, value of agricultural production and environmental impacts in the tradeoffs analysis. With information on improved neurobehavioural function, reduced work-days lost due to pesticide related illness and technological changes from adoption of IP/DM, the tradeoffs/synergies for these changes will be simulated using methods found in Crissman, Antle and Capalbo (1988). As in previous work, heterogeneities across ecological zones will be examined. These analyses will enable replacement of suppositions with more precise technical coefficients.

Both these modelling exercises will help fill the void in empirically based estimates of the impacts of changes in agricultural management on the environment and human health.

RESULTS AND DISSEMINATION:

The first year=s results from this project will not only establish a baseline of information for comparison with post-intervention data, but will address the concern about potato consumption being a pathway of exposure to pesticides. Early results will indicate 1) the extent to which nutritional deficiencies may be contributing to observed neuro-behavioural symptoms, and 2) relative household exposure to pesticides due to household storage and handling of pesticides, handling of household materials impregnated with pesticides, food consumption, and food preparation practices.

These results and their interpretation will be documented in technical progress reports *and* communicated directly to the sample families who can take remedial action. The INIAP and NGO=s who train farmers and train the trainers will be able to appropriately adapt their safe-handling messages according to the household exposure pathways documented in the project=s first year.

Results that document the extent of change in pesticide handling practices will be used to evaluate the effectiveness of training programs; the CIP, Farmer-Field Schools and the INIAP will be involved in interpreting and acting on the results.

Assessment of farmer and family health (nutritional and neuro-behavioural), farm productivity and pesticide exposure both before and after training intervention will be incorporated in statistical health-effects and economic-production models to assess the tradeoffs between health and production in the potato agro-ecosystem. These analyses will be widely disseminated throughout Latin America to government and non-government development specialists, policy makers, practitioners and other stakeholders through the existing networks of the CIP, INIAP, CONDESAN and NGO=s, both electronic (e.g., CONDESAN=s INFOANDINA) and organizational. Seminars, workshops (and their published proceedings), project reports, and research publications will also be invoked as appropriate to reflect the various target audiences. It is anticipated these results will help justify the investment in

IPM/IDM/safe-handling practices by validly demonstrating net positive trade-offs.

The training phase of this project generates no research results *per se*; however, the materials themselves will be used, distributed, revised, adapted and extended to farming communities many times beyond the initial study group. The ultimate beneficiaries of both the research and training outputs of this project are the farmers and families active in potato agriculture in Latin America.

APPENDICES

1. Curriculum Vitae of Principal Investigators:

    Charles Crissman, Ph.D.
    Donald Cole, MD, M.Sc., FRCPC
    Victor Barrera, Ing.
    Peter Berti, Ph.D.

2. Summary of the ATrade-Offs Project@

3. Letters from Collaborating Research Institutions and Project Partners:

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    McMaster Institute of Environment & Health (MIEH), McMaster University
    Programme for Appropriate Technology in Health (PATH Canada)

    Universidad Catolica de Ecuador
    CONDESAN
    SM-CRSP Project
    Eco-Regional Fund Project
    FORTIPAPA

4. Literature Cited

5. Logical Framework for the Research Project

6. Budget Notes and Budget Table

7. The Research Institutions

Appendix 1

Curriculum Vitae of Principal Investigators:

Charles Crissman, Ph.D.

Donald Cole, MD, M.Sc., FRCPC

Victor Barrera, Ing.

Peter Berti, Ph.D.

Appendix 2: Summary of the ATrade-Offs Project@

Summary of the 1) USAID Soil Management-Collaborative Research Support Program (SM-CRSP) project: *Tradeoffs in Sustainable Agriculture and the Environment in the Andes: A Decision Support System for Policy Makers;* and 2) the DGIS Fund For Support To Eco-regional Programs project: *Regional scaling of field-level, economic-biophysical models*.

The collaborating institutions are: the Instituto Aut nomo de Investigaciones Agropecuarias (INIAP) of Quito, Ecuador, the International Potato Centre (CIP) office in Quito, Montana State University (MSU) in Bozeman, Montana, the Pontifica Universidad Catolica de Ecuador (PUCE) in Quito and Wageningen Agriculture University (WAU) in Wageningen, The Netherlands.

The general objective of this five year project which began in 1996 is to provide a decision support system for assessing tradeoffs between agricultural production and the environment for different economic, agricultural and environmental policies, and agricultural research. The principal outputs from this product include: 1) a model of economic and physical impacts of technology and policy on natural resources, 2) a decision support system for land use planning incorporating technology and policy impacts, 3) research and policy recommendations based on models and data developed in the project, and 4) trained individuals.

The combination of economics, soil science research and crop and dairy modelling advances methodological development of a conceptual model that links economics and environmental research for the purpose of policy analysis and technology evaluation.

The product development team will integrate developmental research, strategic research and outreach activities. The adaptation of the decision support system is developmental research that will require utilization of existing secondary information from sources such as soil survey, land use survey, weather, farm production and economic data. The models used in the decision support system have largely been developed and calibrated for non-tropical conditions and will need strategic research to close knowledge gaps about the behaviour of selected physical processes in highland tropical conditions. The toxicology and soils laboratories in the Universidad Catolica and INIAP will be key contributors in this area. As the decision support system is developed, the NGO=s will implement outreach activities through transmitting results and providing feedback links to and from their collaborating communities.

The project is being executed in Carchi Province in Ecuador and in Cajamarca Province in Peru in collaboration with the national agricultural research institutes and NGOs. These sites are also CONDESAN research sites and as such currently house other research and development activities of CONDESAN members. The project provides for scholarships for MS and Ph.D.-level training at Dutch and US Universities. The project has a logistical infrastructure of field offices staffed with full time research assistants provided with vehicles.

Appendix 3

Letters from Collaborating Research Institutions and Project Partners:

Instituto National Aut nomo de Investigaciones Agropecuarias (INIAP)

McMaster Institute of Environment & Health (MIEH)
McMaster University

Programme for Appropriate Technology in Health (PATH Canada)

Universidad Catolica de Ecuador

CONDESAN

SM-CRSP Project

Eco-Regional Fund Project

FORTIPAPA

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Appendix 5:

Logical Framework for the Research Project

Appendix 6: Budget Notes and Budget Table

All figures are in Canadian dollars. Inflation in Ecuador is currently 30-40% per year but the Ecuadorian sucre (S) devaluation rate matches it. Based on this, no significant inflationary impact on spending during the duration of the project is expected. The current exchange rate is about S5250 to US$1; the Canadian-US exchange rate is hovering around 0.68.

Because this is a longitudinal study, the greater proportion of the work and expenses will take place in the first and third years. To comply with IDRC=s limit of $50,000 CAD per year, it is anticipated a revised schedule of fund transfers and spending will be negotiated with IDRC once the grant is awarded.

Salaries:

Research Coordinator: The ideal candidate is Ecuadorian national, and female with participatory rural development experience. She will be hired full-time for years 1, 3 and part of 2.

Psychometrician: Jadira Bola os; has experience in previous pesticide project. He will be hired half-time for years 1 and 3.

Epidemiologist: Dr. Donald Cole is also a Co-PI on the project. The CIP will finance his work from other funds in its natural resource management program.

Nutrition Specialist: Dr. Peter Berti is also a co-PI on the project; his time (one day/week for two years) is donated by the Programme for Appropriate Technology in Health (PATH Canada) and funded by a fellowship from NSERC (Natural Sciences and Engineering Research Council) through the Centre for Indigenous People=s Nutrition and Environment (CINE) at McGill University, Montr al , Qu bec , Canada.

Data Manager/Analyst: This is a local-hire staff position in the CIP Quito office. CIP will assign 0.25 FTE of this position, on average, to the project.

Project Leader: Dr. Charles Crissman (CIP) is the coordinating PI for this and the Tradeoffs Projects; since this project will be jointly executed with those, the CIP anticipates considerable efficiencies in administration. CIP will assign 0.20 FTE of this position to the project.

Research Assistant: Ing. Patricio Espinosa (CIP), also active in the Tradeoffs Projects, will provide further administrative support. CIP will assign 0.20 FTE of his position to the project.

Research Expenses:

Health measures training/monitoring: Dr. Fernando Carpio will lead the health-measures training of interviewers as he did in previous pesticides project.

Incentives for study participants: cash payments to household members participating in the project.

Field interviewers/promoters: to be identified with aid of INIAP and NGO=s once project is approved.

Assessment tools: equipment (less than $1,000 each) to assess neuro-behavioural and nutritional status.

Software: statistical software to conduct multilevel analyses to be purchased; nutritional software ACOMIDA@ (COMputerized, Interactive, Dietary Analysis) provided by PATH Canada.

Pesticide residue analysis: the Toxicology Laboratory of the Universidad Cat lica will do the residual testing, under the direction of Dr. Ramiro Merino.

Capital Equipment:

Vehicle and vehicle insurance: CIP will assign the research coordinator full-time use of a vehicle drawn from its CIP-Quito motor pool. The 1998 declared insurance value of the vehicle to be assigned is $13,000. The 1998 value of the insurance on this vehicle is $560.

Consultants:

Statistical consultant: S. Ibrahim has advanced statistical experience with multi-level modelling. He works for the Institute for Work and Health (Toronto, Canada) and will be paid on a cost-recovery basis.

Travel:

International travel: Round trip between Toronto (Canada) and Quito (Ecuador): Donald Cole is scheduled for two trips per year in years 1 and 3, and one trip in year 2; Peter Berti is scheduled for one trip per year.

Dissemination:

Seminars: costs of organizing and hosting seminars at field locations and in Quito, e.g., rentals, supplies, printed materials, travel subsidies.

Support Services:

INIAP maintains field offices with a phone, fax and email in Carchi, Cotopaxi and Chimborazo, the sites for the health surveys and the training. INIAP will contribute the use of its offices and communications equipment to the project for its duration. The value of renting a project office and obtaining communications services was calculated for the 36 month life of the project at a rate of $300/month rent and$150/month for communications services.

Overhead:

CIP normally charges a 25% overhead to execute projects. CIP appreciates the support of innovative donors such as IDRC that recognize the importance of understanding the linkages among environmental, agricultural and health systems in sustainable agriculture. Given the limited funding available for this project and the importance CIP attributes to its development, the institution is forgoing a portion of its normal overhead. In-kind overhead was calculated at the standard 25% rate.

Appendix 7

The Research Institutions:

The International Potato Centre (CIP)
Lima, Peru

Instituto Nacional De Investigaciones Agropecuarias - Iniap
(National Agricultural Research Institute)
Quito, Ecuador

McMaster Institute of Environment and Health (MIEH)
McMaster University
Hamilton, Ontario, Canada

The Programme for Appropriate Technology in Health - Canada
PATH Canada
Ottawa, Ontario, Canada

THE INTERNATIONAL POTATO CENTRE (CIP)

Lima, Peru

The International Potato Centre, known worldwide by its Spanish acronym, CIP, sees the potato and other Andean root and tuber crops as under-exploited resources for agricultural development and hunger relief in developing countries. Founded in 1971, CIP has worked to enhance the cultivation, yield, processing, and consumption of potatoes. Its original mandate was expanded to include sweet potato and, more recently, other Andean roots and tubers that are in danger of extinction. In a broader vein, CIP is now looking at natural resource management in the Andean eco-region.

CIP headquarters are in La Molina, outside of Lima, Peru=s capital, in an irrigated coastal valley. CIP also has experimental stations in Huancayo in the high Andes and in San Ram n on the eastern, rainforest -covered slopes, taking advantage of Peru=s varied geography and climate. The Centre has another high Andes experiment station in Quito, Ecuador, and a worldwide network of regional offices and collaborators.

CIP has recruited an international team of more than 70 scientists from 25 countries, supported by nearly 500 nationally-recruited staff. In its first year of operation, CIP was funded by five donors. Today, the centre=s $18 million budget is underwritten by 26 international donors.

CIP is a member of the Consultative Group on International Agricultural Research (CGIAR), a network of 16 international research centres, supported by the World Bank, the United Nations Development Programme (UNDP), the Food and Agriculture Organization (FAO) of the United Nations, the United Nations Environment Programme (UNEP), and about 45 governments, multilateral institutions, and foundations.

The Centre is an outgrowth of two programsCa joint North Carolina State University-Peruvian government potato research project and the Rockefeller Foundation=s International Potato Program headquartered in Mexico.

Vision Statement of the International Potato Centre

The International Potato Centre (CIP) works to stimulate major increases in world food supply by providing access to the full potential of root and tuber crops. CIP promotes, through scientific research, the use of genetic resources and improved agricultural technologies that increase the production and use of potato, sweet potato, and other root and tuber crops in developing countries. The Centre also contributes to better management of agricultural resources in the world=s mountain regions, an area where the potato is a significant contributor to the well-being of resource-poor farmers.

CIP=s principal task is to assure that high-yielding root and tuber crops such as potato and sweet potato take their appropriate place in agricultural food systems. Centre scientists foresee a tripling of these crops' contributions to world food supplies over the next twenty-five years.

The Nature of CIP

CIP is first and foremost a research institution that seeks to contribute knowledge, technologies, and materials for improved food production. Centre scientists conduct their work as part of a larger organization, the CGIAR, and share its objectives: productivity increasesCparticularly for the world=s poorest peopleCsustainable agriculture, and the strengthening of national agricultural research capabilities.

CIP contributes to the CGIAR in a limited research area defined by commodities (potato, sweet potato, and Andean root and tuber crops) and eco-regions, in CIP=s case the Andes. CIP, in close association with national research

systems, selects priority activities within these major work areas. These priorities are continually refined against changes in the way crops are grown, as well as changes in science and in national programs.

Increasingly, CIP employs its expertise in convening global research initiatives that involve a range of institutions that can contribute to the Centre=s objectives. As opportunities arise, research is conducted in partner and client institutions around the world.

CIP Mandate

CIP's research program for potato and sweet potato includes the diagnostics of production systems; germplasm conservation and utilization; crop, soil, nutrient, and pest management; and post-harvest storage, processing, and marketing. These activities represent the largest component of the Centre=s global research program, covering five regions and more than 25 countries. The Centre collaborates closely with countries in the developing world and with at advanced institutions. All germplasm-related activities are governed by the Convention on Biological Diversity and are conducted in close association with corresponding United Nations agencies.

Since its inception, CIP has studied Andean root and tuber crops and the production systems in which they grow. Extreme poverty in the region has resulted in the rapid deterioration of biodiversity and land and water quality. The loss of natural resources required for sustainable productivity further aggravates this dilemma. In response to the urgent needs of the Andean region, CIP is the convenor of an eco-regional research activity for sustainable Andean agriculture. This initiative is part of the CGIAR's program on Global Sustainable Mountain Agricultural Development, which was convened in response to the United Nation's Conference on Environment and Development (UNCED) Agenda for Sustainable Mountain Development.

The Consortium for the Sustainable Development of the Andean Eco-region (CONDESAN, the Spanish acronym) was founded in 1992. CONDESAN conducts its work at six benchmark sites and on the areas of biodiversity, soil and water resources, food systems, and policies. Work on biodiversity promotes *in situ* and *ex situ* maintenance of genetic resources of unique Andean root and tuber crops and the use of indigenous knowledge about their cultivation, properties, and utilization. This work is conducted through a consortium of institutions from the Andean region, including public, academic, private, and non-governmental organizations, as well as international research centres and institutions from industrialized countries.

Ecoregional Research

Ecoregional research develops integrated resource management systems for sustainable agriculture and food production using insights into the comparative productivity and sustainability of land use systems for a specific agro-ecology in a given region. To do this effectively, eco-regional studies may need to supplement for the dominant commodities in the region existing knowledge on topics such as management, storage, marketing, processing, and policy. The eco-regional approach emphasizes the synthesis of a wide range of knowledge sets to compare land use strategies for different environments. This synthesis requires special capabilities such as systems analysis and modelling that can accommodate spatial and time dimensions not normally considered in crop improvement research.

Several factors drive changes in land useCnew technologies, changes in policies, and shifts in the natural resource base. Research intervention in land use thus depends on new technologies and policy changes that come from commodity research. Ecoregional research is therefore best conducted by institutions intimately familiar with the commodities associated with the major land use systems in an eco-region.

Finance and Administration

CIP=s 1997 income totalled $24.7 million (contributions $23.3 million and $1.4 million other incomes), down 6% from an all-time high of $26.3 million in 1996. Investments in potato research represented 59% of the Centre=s total income, responding to continued growth in the demand for the crop in developing countries and the potential of CIP technologies to support this stimulated production. Investments in sweet potato totalled 23% of Centre income. Spending for the lesser-known Andean roots and tubers, natural resources management and the Global Mountain Program were 4%, 11%, and 3%, respectively. Centre investment allocated according to CGIAR categories were: increasing productivity, 43%; protecting the environment, 26%; saving biodiversity, 9%; improving policies, 5%; and strengthening national programs, 17%.

Further information may be found at web site: http://www.cgiar.org/cip/ciphome.htm

INSTITUTO NACIONAL DE INVESTIGACIONES AGROPECUARIAS - INIAP

NATIONAL AGRICULTURAL RESEARCH INSTITUTE

Quito, Ecuador

Mission

The mission of INIAP is to provide agricultural technology. In fulfilling its social function, INIAP places major emphasis on generating knowledge, technology and services as a function of the demands of small and medium-size farmers, drawing up strategies and mechanisms that enable its beneficiaries, users and clients to effectively participate in the decision making process and establish their own priorities.

Objective

The objective is to research, develop, adapt, and apply scientific and technological knowledge for the purpose of increasing the competitiveness of the agricultural and agro-industrial sectors, within the context of natural resource and environmental sustainability, as well as to achieve full mobilization and development of human capital to promote scientific and technological innovations in agriculture.

National Departments and Programs

The technical structure of INIAP's agricultural research activities is divided into Programs (products) and Departments (disciplines). Programs: Rice, cocoa, coffee, tubers and roots, corn, banana and plantain, animal husbandry, leguminosae, soybean, small cereals, fruit, agroforestry. Department: Plant protection, soil and water management, genetic resources and biotechnology, food science and quality, economics and biometry, and planning.

Validation, Technology Transfer and Training

INIAP supports the process of technology generation, validation, transfer, and dissemination using a systems approach; provides training to public and private sector extension workers on the concepts and methodologies used in this process; and supports training on production technologies delivered at the Experimental Stations.

Institutional Cooperation

INIAP maintains formal relations with national and international, public and private organizations and institutions with common goals, for the purpose of sharing technological, human, bibliographic, and other resources, in order to avoid duplicating efforts and costs and take advantage of the knowledge and products generated by other institutions.

CORPOINIAP

Corporaci n INIAP (CORPOINIAP) is an Ecuadorean private law entity created for the purpose of collaborating with and supporting INIAP to improve its technology generation and transfer activities, as well as to produce the goods and services required for the development of the agricultural sector.

Technical Services at the Experimental Stations

INIAP has seven Experimental Stations and eight Experimental Farms located in several agro-ecological areas in the country. All units have laboratories, seed plants, green houses, agricultural machinery, equipment, and vehicles.

Technical Services

- $ Sale of seeds.
- $ Seed processing.
- $ Soil and plant tissue analysis, interpretation and recommendations.
- $ Analysis and identification of pathogens causing diseases in and damage to crops.
- $ Efficiency tests for agrochemical products.
- $ Training courses on agricultural technology.
- $ Nutrient analysis of ingredients, concentrates and pastures.
- $ Food analysis (bromatology).
- $ Seed quality analysis, as well as analyses of residues, pesticides and plant toxins in products for human consumption.
- $ Recommendations.

Institutional Projects

Strengthening the production of Registered, Certified, Basic and Pre-basic seeds of the main tropical and temperate crops. Strengthening human resources by means of medium- and long-term training plans. Strategic institutional alliances with partners and beneficiaries, as well as higher education institutions (universities). Work oriented to national and international competitiveness. Research oriented to the rational management of natural resources, using holistic approaches and systems. Research on non-traditional crops, such as Andean and Amazonian fruit trees, as well as aromatic and medicinal plants .

Information Resources

Several data bases containing the information generated at INIAP's Experimental Stations and Farms during 34 years of scientific research. Information in the International Agricultural Science and Technology System (AGRIS), for which INIAP acts as National Liaison Centre.

MCMASTER INSTITUTE OF ENVIRONMENT AND HEALTH

McMaster University, Hamilton, Ontario, Canada

Founded in 1991, the McMaster Institute of Environment and Health (the MIEH) has earned a distinctive and respected reputation for research, education and outreach in the environment and health field. Through pursuing its mission:

> *To mobilize research expertise towards unravelling the complex interactions of environment and health; to promote inter-disciplinary and inter-sectoral research; and to effectively communicate research results to appropriate audiences;*
>
> *To facilitate education in environment and health for a broad range of students from undergraduate to post-professional levels; and*
>
> *To serve decision makers, policy makers, stakeholders and the public in all sectors of society through consulting, advising and sharing expertise on environmental health issues,*

it has created broad and effective networks of expertise, knowledge and skills to explore complex research questions and to apply results in innovative ways.

McMaster itself consistently ranks among the leading research-intensive universities in Canada. Its forward-thinking philosophy has been lauded by corporate leaders and academics alike; they chose McMaster as the most innovative Amedical/doctoral@ university three years in a row in nation-wide surveys by *Maclean=s* magazine.

The McMaster Institute of Environment and Health both contributes to and benefits from this vibrant research energy. It integrates elements of the University=s innovative health-sciences program with its proven environmental base in the social and ecological sciences to create unique, dynamic networks of expertise. The MIEH mandate assumes that human health and ecosystem health are interdependent; thus it mobilizes expertise from all Faculties at the university to gather a deeper and broader understanding of environmental health issues.

Research expertise in Environment & Health at McMaster is clustered around such areas as:

- Environment and Human Reproductive Health,
- Effects of Air Quality on Health,
- Environmental Epidemiology, Toxicology and Nutrition,
- Psycho-Social Effects of Environmental Contamination,
- Perception, Appraisal and Management of Risk,
- Values and Ethics, and
- Environmental-Health Policy.

The MIEH is the home of the Eco-Research Chair in Environmental Health which has itself spawned many research projects transcending the usual departmental boundaries. The Chair=s programme also offers a unique Post-Professional Diploma Program in Environmental Health: designed to provide new skills and knowledge in the principles and practice of environmental health, it appeals to public-health professionals, physicians, community-health nurses, and those in labour and non-governmental organizations dealing with environmental-health issues. For 1998-99, the diploma has been extended to a distance-education format through the Internet.

Environment and health activities at McMaster were so effective that in 1997 the University recognized the field as

a *strategic* area for growth; it committed new resources to environment and health (including two new faculty positions) that will reinforce McMaster=s capacity and leadership in this area.

Further information about the MIEH may be found at web site: http://www.mcmaster.ca/mieh/

PATH CANADA

The Programme for Appropriate Technology in Health - Canada

PATH Canada is a non-profit, non-governmental organization whose goal is to improve health, especially the health of women and children, in developing regions of the world. Its mission is to increase the effectiveness, availability and appropriateness of practices and technologies used in primary health care. PATH Canada's definition of "technology" includes:

- the systems and practices through which health care is delivered
- the equipment and devices used in primary health care
- the information and skills that must accompany each technology

PATH Canada bridges the gap between user and provider of primary health care services. Through field assessment and operations research, it identifies user needs, and assists in identifying priority actions. It works with local partners to design and implement projects to adapt practices and technologies to specific social, cultural and resource settings.

Partners

PATH Canada works in partnership with: universities and colleges, government technical agencies, non-governmental organizations (NGOs), professional associations, private companies, and service organizations in Canada and in developing countries.

Working Methods

PATH Canada provides the following support to partners:

- assistance in identifying priorities and designing projects and programmes
- specialized technical expertise
- co-management of projects and programmes
- joint searches for project funding

Specific Programme Areas

- Micronutrients
- Malaria Control
- Tobacco Control
- HIV/AIDS / Reproductive Health

Funding

PATH Canada projects have received funding from the International Development Research Centre (IDRC), the Micronutrient Initiative, the International Tobacco Initiative, the Canadian Public Health Association (CPHA), the Canadian International Development Agency (CIDA), and UNDP/World Bank/WHO-TDR.

Governance and Affiliation

PATH Canada is guided by a Board of volunteer directors with practical international health expertise drawn from private companies, NGOs, universities and government. Management of activities is the responsibility of the programme staff based in Ottawa:

Sian FitzGerald, Executive Director
Alan McRae, Financial Officer
Peter Berti, Nutrition Advisor
Catherine Reed, Programme Coordinator
Brijitte Reppen, Project Officer

The organization is affiliated with PATH International, a non-governmental international organization based in Seattle with field offices in Jakarta and Lombok, Indonesia; Nairobi, Kenya; Manila, Philippines; Bangkok, Thailand; Hanoi, Vietnam; Kiev, Ukraine; and Washington, D.C.. PATH International has been designated as a World Health Organization collaborating centre in hepatitis B vaccination, research in human reproduction, and AIDS.

PATH Canada maintains close links with the Canadian Society for International Health, with which it shares office space.

Further information may be found at web site: http://www.synapse.net/~path/