

## Project 6. Agriculture and Human Health

### ***Rationale***

Agricultural technology and related production, processing and distribution systems present opportunities to enhance human nutrition and livelihoods through food-based agricultural interventions. At the same time, technology and management choices can and do present risks to human health. There is an opportunity to develop an analytical science-based approach that de-compartmentalizes the sectors of agriculture, ecosystem health and human health, that can generate transdisciplinary evidence for establishing health risk pathways associated with agriculture technology and ecosystem management choices, demonstrating effective agricultural interventions for improved human health, and influencing policy in relevant sectors with stakeholder participation.

CG centers such as CIP are ideally placed to take up this opportunity given their extensive knowledge of agricultural technology options, their high legitimacy with agricultural and food related stakeholders, and their commitment to health-related Millennium Development Goals. The Science Council (SC) identifies eight MDGs to which the System Priorities can contribute. Four of these are health related. As there is currently greater investment in the production and dissemination of health and environment global public goods than agricultural, CG center presence with relevant research evidence is one important way of including agricultural interventions when policy makers consider resource allocations to improve health outcomes. *Science Council Sub-priority 5C, specific goal 2*, recognizes that joint processes involving health, environment and agriculture stakeholders in a transdisciplinary way (as included in Output 1 below) provide greater opportunities for agricultural-based research to impact on poor small farmer households.

This MTP project is designed to address both the positive and negative aspects on human health of the CG research agenda. The project brings health science professionals into the CG system to work from an agricultural science base to demonstrate the gains possible from a transdisciplinary approach to the complex, intertwined challenges of demonstrating how improved agriculture productivity contributes to improved human health as well as poverty reduction.

### ***Changes***

For this project, the international recruitment of a clinical human health nutritionist 2006 and physician-epidemiologist division leader in 2007 whose primary skills and research programs are focused on human health improvement and the reassignment of an agricultural anthropologist reverses the earlier budget cuts that concerned the SC.

**Output 1** Integrated health and agriculture strategies to reduce pesticide exposure risk and promote healthy and sustainable agriculture among farm families in Ecuador, Peru and Bolivia designed and promoted

Illness related to the agricultural use of highly hazardous (WHO category 1a and 1b) pesticides affect substantial proportions of small farm households in the developing world, directly through acute poisoning of young children (accidental), emotionally distraught persons (suicide) or heavily exposed applicators (occupational) and chronic adverse health effects among a broader cross-section of farm and consumer populations (plus those from mutagenic dithio-carbamate fungicides). Understanding of adverse health effects among the scientific community, some civil society actors and some governments has moved from regarding them as controllable externalities (exposure is the farmers fault due to poor handling) to recognizing the effects as inherent consequences of current technological approaches to intensification of agricultural production among the majority of poor small farmers.

CIP-conducted research has contributed to this shift in understanding through baseline studies that demonstrated the scope of the problem as far in excess to that previously believed, unassailable evidence of exposure and health impacts of exposure and sophisticated modeling of joint agricultural and health production impacts of potato based agricultural systems in northern Ecuador – the Trade-Offs Analysis approach. Subsequent pilot work demonstrated the potential to reduce neurotoxic impacts through farmer

field schools and community based health education in the same region. Yet other CIP work has shown that pesticide dependence among small farmers in Andean communities continues due to inadequate information to farm households, including that on toxicity and alternatives, heavy domination of input markets by highly hazardous and mutagenic pesticides rather than alternative crop management technologies, and weak policy environments that could restrict use and support alternatives.

In dealing with adverse health impacts of agricultural pesticide use, CG centers have a comparative advantage compared to health institutions that practice research for development in that they can bring together the disciplinary mix to understand production-health relationships (methods), know or can discover ways to reduce pesticide use (knowledge), and have legitimacy among agricultural stakeholders who must be involved in improvements (social capital). Other CG centers have conducted pesticide and human health research including IWMI in Sri Lanka, though further development was into a clinical research program now funded by the Wellcome Trust, which leaves the agricultural production of adverse health effects untouched. Only CIP has linked their ICM, participatory training and agricultural platform research with testing of approaches to reducing pesticide use and human exposure.

This line of research will become progressively more important for the CG as the work in high value fruits and vegetables develops. The systems where these crops are produced are characterized by their intensive use of protectant agrichemicals. CG work with these systems will inevitably be challenged on issues of occupational exposure and food safety.

Current and planned work in this project seeks to

- identify additional opportunities for IPM to reduce dependency on highly hazardous and mutagenic pesticides, thereby increasing productivity and human health (relevant to **SC sub-priority 4D, specific goal 6**);
- improve the characterization of the poor and their agroecosystems and identify and evaluate means ex ante to simultaneously improve agricultural production and human health risk management through improved tools and information systems (relevant to **SC sub-priority 5D**); and with new funding from CIDA-IDRC extend its reach to
- enhance production of selected vegetables through improvement of farming systems, particularly IPM for intensive horticulture, with improved occupational safety for producers and food safety for consumers (relevant to **SC sub-priority 3A, specific goal 2**).

**Output 2** The value of orange fleshed sweet potato as a component of food-based approaches to improved nutrition is demonstrated.

Promotion of orange-fleshed sweet potato (OFSP) as one of a few foods that can provide very high amounts of highly bio-available beta-carotene was identified during CIP's strategic planning process as a potential major contribution to confronting widespread Vitamin A deficiency and its associated child and maternal mortality, particularly in Sub-Saharan Africa. Recent CIP-sponsored studies in South Africa have shown that OFSP is efficacious in improving vitamin A status and can be a complementary strategy to existing nutrition intervention programs in areas where it can be grown productively. The advantage of agricultural, food based approaches are multiple:

- greater coverage of the at-risk population compared to low coverage rates of public health service based Vitamin A supplementation in very poor countries such as Mozambique;
- co-development of improved livelihoods for vulnerable populations with associated improvements in resources, access to Vitamin A rich foods and self-esteem compared to continuing dependency upon food handouts through Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome treatment centers; and
- sustainability of such coverage through ongoing agricultural production and marketing independent of health service cutbacks due to fiscal crises.

The main current challenges related to OFSP achieving such impacts lie in limited adoption by poor small farmers and limited dietary modification by vulnerable households to include beta carotene rich OFSP. The current Harvest Plus Reaching End User (REU) project focuses on identifying cost-effective and sustainable strategies to disseminate OFSP and to create demand for OFSP in Mozambique and Uganda. Demonstrated success will be translated into best practices that can be applied to future work in this area

and other biofortification programs. We plan to examine the potential of OFSP to improve livelihoods and to increase pro-vitamin A intake of HIV/AIDS affected households. Hence our work will also respond to **SC sub-priority 2C, specific goal 2** by testing of the best means to enhance the diets of nutritionally disadvantage populations, including those with HIV/AIDS, an area of growing recognition among health researchers, with limited sets of human health service options at present. As indicated by the SC, such demonstrating impacts on human malnutrition requires medium to longer term research, in which we plan to engage.

## ***Description of Impact pathways***

### **Output 1**

Drawing on the growing literature on knowledge exchange and the involvement of beneficiaries and research users in the production of research, our action research processes follow a series of deliberate steps, currently in provinces of Ecuador and in the near future with metropolitan regions of Ecuador, Peru and Bolivia. These steps seek to link the Pro-Poor Research and Development Cycle and Impact Pathway analysis approaches in ways consistent with the growing health promotion literature on shifting human health risk distributions through multiple channels.

We meet with organizations of the principal beneficiaries of the project –the poor small farming households– and the principal local end-users of the project results –NGO and government agricultural extensionist professionals, human health NGO and government personnel and other interested stakeholders– to share our understanding of the likely burden associated with agricultural use of highly hazardous pesticides and the opportunities for change in existing agricultural and human health practices. We jointly develop and implement methods to characterize current practices and associated burdens. CIP researchers then analyze the qualitative and quantitative data to share with partners for joint interpretation. We jointly decide upon potential interventions to change current practices with available resources from CIP and partner organizations, and proceed to jointly implement the interventions. Finally, we jointly set up information systems that can monitor changes that may be attributed to the interventions and in evaluation of platform work, those practices that remain unchanged and require different responses. In this way, capacity building in transdisciplinary action research occurs for agricultural and health personnel and students who participate in the processes as part of thesis research or internships.

End-users of the science produced by these research processes include national and international researchers and development experts in agricultural, health and environment fields, extension agents, civil society organizations and policy-makers. Conditioning factors include Free Trade Agreements in the Americas which may change the market and policy context for production input costs and outputs. Further, the weak and often adverse policy environment, which includes influential actors with strongly held positions that may be threatened by the research outputs, means that counter moves will likely occur to protect market share. CIP commits to continuing as an actor, speaking to the science generated by the research, and sharing the science internationally, with adaptation to other contexts as appropriate.

### **Output 2**

Current CIP-implemented HarvestPlus REU research includes identifying key bottlenecks in the production-marketing-consumer continuum and developing low-cost interventions to relieve these bottlenecks, including the commercial villages approach in East and Southern Africa. Using nutritional assessment methods (currently in Project 1 output targets), the role of these strategies in changing pro-vitamin A intake and vitamin A status of vulnerable groups will be assessed in conjunction with partner organizations (NGOs, NARS and universities) and the beneficiaries (small farm households and their organizations). As intervention research, change among those involved with different interventions will occur, with impacts measured among participating households. Conditioning factors include the potential of rapid climactic changes or droughts in the output areas and reductions in partner capacity through health problems including HIV/AIDS.

## **Research approach to develop International Public Goods (IPGs)**

### **Output 1**

As noted in the Rationale section, CIP's research on agriculture-pesticide health impact linkages has a history of producing IPGs in the demonstration of ongoing neurotoxicity with regular highly hazardous pesticide use led by the new division head and pioneering TOA modeling lead by agricultural economist colleagues. Demonstration of reductions in highly hazardous pesticide use and concurrent increases in net productivity in Farmer Field School (FFS) potato production plots was also an IPG. Likely future IPGs include the effects of introduction of human health concerns into agricultural production multi-stakeholder platforms, including greater emphasis on ICM and consideration of consumer food safety concerns into marketing activities and the adaptation of multi-level modeling approaches that incorporate provincial and sub-provincial agricultural input supply and ecosystem variables into more sophisticated assessment of agroecosystem-human health relationships.

### **Output 2**

As noted in the Rationale section, CIP's research on OFSP efficacy in improving Vitamin A status is already an IPG. Methods development for large scale assessment of change in OFSP intake and Vitamin A status as part of agricultural intervention projects, currently in Project 1, will also produce an IPG. Exemplifying the difficult process of attribution of agricultural intervention effectiveness in improving nutritional status of a target population is the experience documented a recent publication by the regional SSA CIP office and university partners. The team chose a suitable location to achieve an adequate effect size, mounted sufficient resources, implemented the research in a rigorous manner and analyzed it using sophisticated biostatistical techniques to demonstrate the important potential role of agricultural food-based interventions with OFSP in improving Vitamin A status. We expect similar IPGs to be forthcoming with the proposed output targets for 2008 & 2009.

## **Elaboration of Partners' roles**

### **Output 1**

The capacity of NARS scientists is strengthened through joint participation in analysis of benchmark characterization data, formulation of intervention responses, preparation of training materials, and policy advocacy through participation in multi-stakeholder platforms that guide the project process. Additional partners in Peru, Ecuador and Bolivia are in the process of being identified as part of scaling out.

<b>Major Partner</b>	<b>Strategic Role and Complimentary Capability</b>
University of Toronto (ARI)	Occupational safety and epidemiology
Epidemiology Departments of Provincial Health Office in Carchi and Chimborazo, Ecuador	Establish enhanced surveillance systems on pesticide poisoning, data collection, interpretation and intervention planning
Universidad Politécnica de Chimborazo (University)	Integrate students in cross agriculture-health research process
COMPAPA (promoted by Papa Andina) in Ecuador with farmer organization, development NGO, and NARS participation (INIAP)	Multi-stakeholder platform which engages in designing information collection, sharing interpretation, prioritizing interventions, and implementing them
Ministries of Agriculture (Peru, Ecuador, Bolivia)	Monitoring pesticide use
Colorado State University (ARI)	Pesticide policy reform

### **Output 2**

NARS participation is occurs in current REU research in Mozambique and Uganda but is still under development for their involvement in newer projects.

<b>Major Partner</b>	<b>Strategic Role and Complimentary Capability</b>
World Vision (Mozambique)	Implementation of agriculture based interventions involving OFSP
Save (Uganda)	Work with households with HIV/AIDS on ongoing basis