PRESERVING THE CORE, STIMULATING PROGRESS

CIP's Vision Statement

October 2003

International Potato Center (CIP)

The CIP Vision Exercise is dedicated to the memory of David MacKenzie

Contents

Introduction

Preserving the core, stimulating progress[1]

Pamela Anderson

The Consultative Group on International Agricultural Research (CGIAR) is an association of 58 public and private members that supports a system of 16 International Agricultural Research Centers. The Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), the United Nations Development Programme (UNDP), and the World Bank cosponsor the CGIAR. The Research Centers generate public goods for the benefit of developing countries. More than 8500 CGIAR scientists and scientific staff work in 100 countries around the world, harnessing the best of cutting-edge science to increase food security, reduce poverty, and protect the global environment (Box 1).

Box 1. CGIAR Mission Statement

To contribute to food security and poverty eradication in developing countries through research, partnerships, capacity building, and policy support, promoting sustainable agricultural development based on the environmentally sound management of natural resources (http://www.cgiar.org/who/index.html).

The CGIAR system is undergoing redesign to refocus its efforts in a rapidly changing world and to make it more effective and visible in the future. This has led to a restructuring of the management of the system, a new focus on raising external funds from unconventional sources, and a new strategy for the future.

The CGIAR vision is based on a two-pronged approach: reducing poverty and improving food security[2]. This will entail research on agriculture and natural resources to address the needs of the poor in the more favored environments, while at the same time tackling the more complex problems of poverty in the marginal and less-favored areas.

An important consequence of the new perspective is a change in the way priorities are established for the system. In an earlier era, the Technical Advisory Committee (TAC) generated system-level priorities based on rigorous analysis of commodity developments and poverty weighting. Considerable effort went into this analysis, with the results and recommendations debated and approved by the donors. The decline in core (unrestricted) budget support for the system weakened the process of setting priorities because it was accompanied by a relative increase in funding earmarked for specific activities or special projects, from both traditional and unconventional donors. This had the effect of creating a parallel set of priorities, making the commodity-based priority setting process less relevant.

The new strategy for the CGIAR system is based on seven propositions.

1 The title of the CIP Vision Exercise was taken from Collins JC and Porras JI. 1994. *Built to Last: Successful Habits of Visionary Companies*. Harper Business, NY. "A visionary company carefully preserves and protects its core, yet all the specific manifestations of its core must be open for change and evolution."

2 Technical Advisory Committee. 2000. *A Food Secure World for All: Toward a New Vision and Strategy for the CGIAR*. Technical Advisory Committee of the CGIAR. Document No. SDR/TAC:IAR/00/14.1. TAC Secretariat, FAO, Rome.

- The goal of sustainably reducing poverty, hunger, and malnutrition is reaffirmed.
- New developments in social, biological, and physical sciences are to be mobilized so as to bring modern science to bear on the often difficult-to-assess causes of poverty and food security.
- Highest priorities are to be given to determining relative geographic priorities to address the needs of people in Sub-Saharan Africa and South Asia.
- A regional approach to research planning and implementation is to be adopted to address the heterogeneous nature of poverty and food insecurity and integrate regional priorities with global priorities.
- Increased emphasis is to be given to seeking new types of partners and using new forms of partnership to improve efficiency and effectiveness.
- A task force approach is to be adopted to address major, clearly identifiable problems where there is an opportunity for an impact to be made or to address intractable problems.
- The role of the CGIAR as a catalyst, integrator, and disseminator of knowledge within the overall global agricultural research system is to be strengthened.

The International Potato Center

The International Potato Center (CIP, the Spanish acronym for Centro International de la Papa) was formally established in 1971. CIP was funded and accepted into the CGIAR in 1972, the first year of the CGIAR's operation. As of the year 2000, CIP functions as an international organization created by a charter that has been signed and ratified by 10 countries and two United Nations agencies.

Originally, CIP was conceived and operated as a single commodity center; its operational mandate included potato alone. In 1985, CIP's Board of Trustees added sweetpotato to the Center's research agenda. And in 1992, the mandate was extended further to include lesser known Andean root and tuber crops (ARTCs).

CIP is one of the CGIAR's in-trust germplasm banks. Over the past 30 years, CIP and its partners have collected potato, sweetpotato, and ARTC germplasm. The Center currently holds in trust for future generations: 4732 accessions of potato cultivated landraces, 1917 accessions of 140 wild potatoes, and 1146 accessions of advanced breeding lines; 3201 accessions of sweetpotato cultivated landraces, 1087 accessions of 107 species of wild sweetpotatoes, and 2073 accessions of advanced breeding lines; and 1495 accessions of eight species of other wild and cultivated Andean roots and tubers. Through CIP's breeding program, 107 varieties that have used CIP's genetic materials have been released in 26 countries in the developing world.

As a Center within the CGIAR, CIP's mission (Box 2) contributes to the overall mission of the CGIAR, in research areas defined by commodities (potato, sweetpotato, and ARTCs) and ecoregions (the Andes). In 1992 a strategy was developed to include natural resource management, with specific attention to highland or mountain environments. CIP also serves the CGIAR system as the convening center for the Strategic Initiative on Urban and Peri-Urban Agriculture (now known as Urban Harvest), the Global Mountain Program (GMP), and the CONDESAN (Consortium for the Sustainable Development of the Andean Ecoregion) Ecoregional Program. An overview of CIP's program is available at: www.cipotato.org

Box 2. CIP Mission Statement

The International Potato Center (CIP) seeks to reduce poverty and achieve food security on a sustained basis in developing countries through scientific research and related activities on potato, sweetpotato, and other root and tuber crops and on the improved management of natural resources in the Andes and other mountain areas (http://www.cipotato.org).

The Need for a Vision Exercise

The International Agricultural Research Centers must take a longer term perspective on research. Longer term research planning by a center can only be done effectively if there is a vision for the center. In times of change, a well-articulated vision is also critical in order to provide guidelines for decision making and to avoid compromising long-term strategic needs and responsibilities in the face of immediate, external pressures.

In June 2002, with the endorsement of the Board of Trustees, CIP's Director General mandated the Office of Research to carry out a CIP Vision Exercise. The CIP Vision Exercise was designed to take an extended look at the future and map out the programmatic content of the Center's research and development activities in relation to the Center's mission and the broader international development context in which it operates.

The outcome of the Vision Exercise is this Vision Statement, i.e. a roadmap of what development challenges CIP's research should address. The Vision Statement will be utilized as the foundation for a strategic plan to tackle the questions of: *where* CIP's research has the most potential to impact development; *what* specific research needs and opportunities exist in those target areas and populations; and *how* the research should be done, i.e. the articulation of conceptual, or theoretical, frameworks within which to conduct the research as well as how we organize ourselves to create and capture synergies that increase our research and development impact. These considerations extend to identifying core values and guiding principles for how we conduct our research. For example, the working group for integration of CGIAR and partner activities in Eastern and Southern Africa[3] endorsed a set of core values as the basis for collaborative research efforts: commitment to farmers and other ultimate beneficiaries; multiple pathways to excellence accepted and recognized; commitment to capacity building for all scientists, irrespective of their institutional affiliation; cooperation amongst all partners; and shared credit and recognition. They proposed that guiding principles should include building incentives for enhanced cooperation, placing competence before resources, forging strategic alliances in full knowledge of what each partner does well and does not do well, and defining clear roles, responsibilities, timeframes and expectations among partners.

3 Hagmann J and Izac AM. 2001. *Integration of CGIAR in Eastern and Southern Africa: Synthesis Report of the Second Meeting, 18–20 September 2001*. ICRAF, Nairobi, Kenya.

Framework for the CIP Vision Exercise: The Millennium Development Goals

CIP is a center within the CGIAR system, which belongs to the broader international development community (Figure 1). In 2000, under the leadership of the United Nations, the international community articulated well-defined development goals: the Millennium Development Goals (MDGs). Each of these eight goals pinpoints specific targets (Box 3).

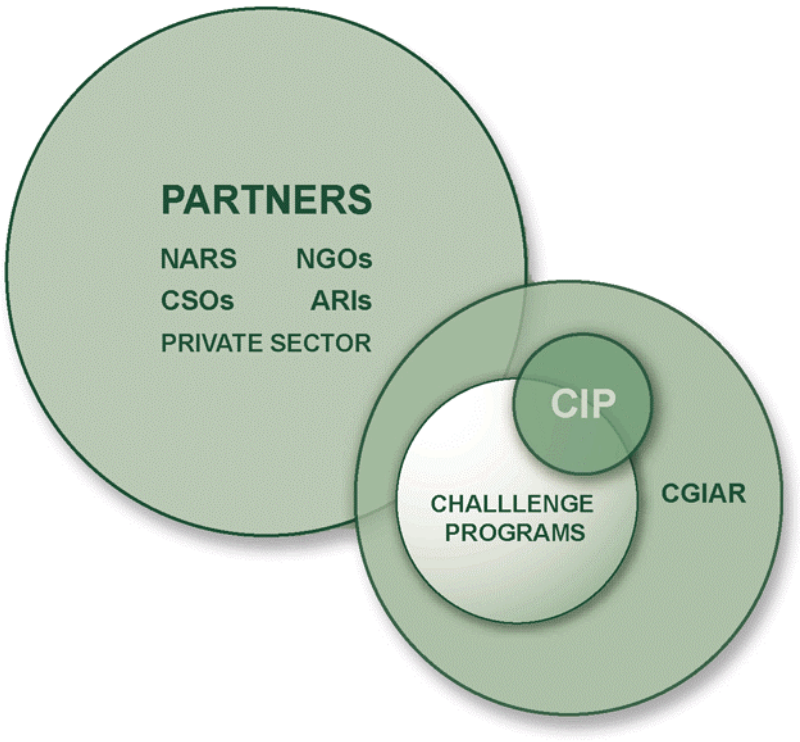

Figure 1. The international development community. (NARS = national agricultural research systems; NGOs = nongovernmental organizations; CSOs = civil society organizations; ARIs = advanced research institutes.)

It is clear in reviewing the MDGs and Millennium Development Targets (MDTs) that agricultural research is a valid and significant vehicle to contribute to international development. Agriculture is central to poverty reduction, food security, broad-based economic development, and environmental stability. Agriculture is one of the five sectors chosen by UN General Secretary Kofi Annan as most important to poverty eradication and achievement of the MDGs. Thus, the MDGs were proposed as the boundaries for the CIP Vision Exercise.

Box 3. Millennium Development Goals

Goal 1. Eradicate extreme poverty and hunger
Target 1. To halve the proportion of the population in extreme poverty between 1990 and 2015—that the population living in poverty be less than 15% by 2015
Target 2. Halve, between 1990 and 2015, the proportion of people who suffer from hunger

Goal 2. Achieve universal primary education
Target 3. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling

Goal 3. Promote gender equality and empower women
Target 4. Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015

Goal 4. Reduce child mortality
Target 5. Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate

Goal 5. Improve maternal health
Target 6. Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio

Goal 6. Combat HIV/AIDS, malaria, and other diseases
Target 7. Have halted by 2015 and begun to reverse the spread of HIV/AIDS
Target 8. Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases

Goal 7. Ensure environmental sustainability
Target 9. Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources
Target 10. Halve by 2015 the proportion of people without sustainable access to safe drinking water
Target 11. By 2020 to have achieved a significant improvement in the lives of at least 100 million slum dwellers

Goal 8. Develop a Global Partnership for Development
Target 12. Develop further an open, rule-based, predictable non-discriminatory trading and financial system
Target 13. Address the special needs of the least developed countries
Target 14. Address the special needs of the landlocked countries and small island developing states
Target 15. Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term
Target 16. In cooperation with developing countries, develop and implement strategies for decent and productive work for youth
Target 17. In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries
Target 18. In cooperation with the private sector, make available the benefits of new technologies, especially information and communications technologies

CIP Vision Process

The CIP Vision Exercise was chaired by CIP's Deputy Director General for Research, and cochaired by CIP's Board of Trustees' Program Committee Chair. The process for the CIP Vision Exercise was influenced by the discussions on science and technology roadmapping[4,5,6]. The process to arrive at the CIP Vision Statement was divided into seven steps.

1. First Plenary Consultation
2. Definition of Challenges
3. Formation of Challenge Teams and Task Force
4. Development of Challenge Essays
5. Second Plenary Consultation
6. Finalization of the CIP Vision Statement
7. Report to Plenary

Step 1. First Plenary Consultation

The CIP Vision was defined through a participatory consultation process with a Stakeholder Plenary. The Stakeholder Plenary was made up of CIP's Board of Trustees, CIP scientific and administrative staff, donor organizations, international agricultural organizations, advanced research organizations, regional research networks and organizations, national agricultural research organizations, and nongovernmental organizations.

The First Plenary Consultation took place, via e-mail, during October and November 2002. The specific objectives of the First Consultation were: (a) to propose the MDGs as boundaries for the CIP Vision Exercise and, if accepted by the Plenary, then; (b) within the MDG boundaries, to identify the areas where CIP research could contribute most significantly to achieving the MDGs.

A background document explaining the MDGs and a questionnaire (Appendix 1) were sent out to 286 Plenary members. The questionnaire was completed by 158 (= 55%) of the Plenary members.

The questionnaire first asked the Plenary participants if they accepted the MDGs as the boundaries for the CIP Vision Exercise. Of the 158 respondents, 89% said that they did accept the MDGs as the boundaries for the CIP Vision Exercise. Thus, the MDGs were adopted as the boundaries for the visioning.

The questionnaire then asked the Plenary participants to indicate if CIP research could contribute to impact on each of the 18 MDTs. The results are presented in Table 1.

4 Galvin R. 1998. Science roadmaps. *Science* 280(5365): 803.
5 National Association of State Universities and Land-Grant Colleges (NASUL). 2001. *A Science Roadmap for Agriculture*. www.nasulgc.org/comm_food.htm
6 MacKenzie DR, Donald S, Harrington M, Heil R, Helms TJ, and Lund D. 2002. *Methods in Science Roadmapping: How To Plan Research Priorities*. NERA, Mayland, USA.

Table 1. CIP Vision First Plenary Consultation results: answers to "Can CIP research contribute to the achievement of this MDG target?" (total responses = 158)

Target No.	Target	Yes (#)	Yes (%)	No (#)	No (%)	No response (#)
2	Hunger	151	96%	5	3%	2
1	Poverty	147	93%	10	6%	1
9	Sustainable environment	145	92%	12	8%	1
18	New technologies	134	85%	24	15%	0
5	Under-5 mortality	119	75%	39	25%	0
13	Needs of least developed countries	110	70%	43	27%	5
11	Slum dwellers	105	66%	53	34%	0
6	Maternal mortality	83	53%	75	47%	0
10	Safe drinking water	76	48%	82	52%	0
16	Productive work for youth	73	46%	83	53%	2
14	Landlocked countries and small island	62	39%	90	57%	6
3	Primary schooling	52	33%	106	67%	0
4	Gender disparity in primary schooling	50	32%	108	68%	0
8	Malaria and other diseases	45	28%	113	72%	0
17	Affordable drugs	41	26%	116	73%	1
7	Spread of HIV/AIDS	33	21%	122	77%	3
12	Non-discriminatory trade	33	21%	125	79%	0
15	Debt problems	23	15%	134	85%	1

Step 2. Definition of Challenges

Using a simple majority cut-off, i.e. where 50% or more of the respondents answered yes (Table 1), the CIP Vision Plenary considered that CIP research could contribute to eight of the MDTs. These Targets were then converted into CIP Vision Challenges (Box 4) that can be broadly characterized as: reduction of poverty and hunger; improvement of human health; sustainable rural and urban development; and improving availability of new technologies.

Box 4. The Challenges to CIP

CIP can contribute to halving the proportion of the population in extreme poverty between 1990 and 2015—that the population living in **poverty** be less than 15% by 2015 (Target 1).

CIP can contribute to halving, between 1990 and 2015, the proportion of people who suffer from **hunger** (Target 2).

CIP can contribute to reducing by two-thirds, between 1990 and 2015, the **under-five mortality rate** (Target 5).

CIP can contribute to reducing by three-quarters, between 1990 and 2015, the **maternal mortality ratio** (Target 6).

CIP can contribute to integrating the principles of **sustainable development** into country policies and programs and to reversing the loss of environmental resources (Target 9).

CIP can contribute, by 2020, to achieving a significant improvement in the lives of at least 100 million **slum dwellers** (Target 11).

CIP can contribute to addressing the **special needs of the least developed countries** (Target 13).

CIP can contribute, in cooperation with the private sector, to making available the benefits of **new technologies**, especially information and communications technologies (Target 18).

Step 3. Formation of Challenge Teams and Task Force

The CIP Vision Chair requested eight CIP scientists to serve as Challenge Team Leaders. The CIP Vision Chair and Cochair, plus CIP's Director General and the Challenge Team Leaders, make up the Task Force for the CIP Vision Exercise (Table 2).

Table 2. CIP Vision Task Force

Name	Responsibilities
Pamela Anderson	Chair
Eija Peju	Co-chair
Hubert Zandstra	CIP Management
Keith Fuglie	MDT 1 (Challenge 1)
Dindo Campilan	MDT 2 (Challenge 2)
Donald Cole*	MDT 4 and 5 (Challenge 3)
Charles Crissman	MDT 9 (Challenge 4)
Gordon Prain	MDT 11 (Challenge 5)
Coen Bussink	MDT 13 (Challenge 6)
Marc Ghislain/Roberto Quiroz	MDT 18 (Challenge 7)

*Donald Cole MD is a CIP associate scientist.

Step 4. Development of Challenge Essays

CIP's Annual Meeting in November 2002 was dedicated to the CIP Vision Exercise, with the objective of developing a first draft of the Vision Statement. More than 100 of CIP's scientific and administrative staff, including outposted scientists, made up the CIP Plenary for the visioning discussions.

The first two days of the visioning work were organized to stimulate thinking and Center-wide exchange by inviting outside speakers to reflect with us on the role of agricultural research in poverty and hunger alleviation; improvement of human health; sustainable rural and urban development; and the development of new technologies. In Box 5 we acknowledge and thank those colleagues who shared their knowledge and insight with us.

Subsequently, the Challenge Team Leaders organized Challenge Essay Teams. Each Team developed a short (5–10 page) Challenge Essay on their particular Challenge topic. Targets 4 and 5, on infant and maternal mortality, were combined into one Challenge. Each Essay addresses the problem and background; specific objectives for CIP's program; and implications for CIP's Vision. The Challenge Team Leaders then presented the content of the Essay back to the CIP Plenary for further discussion and input. The collection of Challenge Essays constituted the first draft of the CIP Vision Statement.

Box 5. Keynote Participants in the CIP Plenary Discussions, November 2002

Dr Peter Hazell, a British economist with the International Food Policy Research Institute (IFRPI), who does policy analysis within the IFPRI 20/20 Vision Project

Dr Donald Cole, a Canadian physician with the University of Toronto Department of Public Health Sciences, who works on community and occupational medicine

Dr Richard Levins, a US biomathematician and population biologist with Harvard University, who works on understanding dynamic biological and social complexity in agriculture, human health, and the environment

Dr John Antle, a US economist with Montana State University, who works on integrated economic–health–environmental (tradeoff) analysis for decision-making in complex systems

Ms Sylvia Cadena, a Colombian with the International Center for Tropical Agriculture (CIAT), who works on information and communication technologies for social justice and development

Mr Manuel Ruiz, a Peruvian lawyer with the Peruvian Society for Environmental Law (SPDA), who works on access to genetic resources, intellectual property rights, biotechnology, agrobiodiversity, and indigenous peoples' rights

Step 5. Second Plenary Consultation

In March 2003, the draft Vision Statement was presented to the CIP Board of Trustees for review and discussion. With encouragement to proceed, the draft was then circulated back to the entire CIP Vision Plenary for commentary during April and May 2003. Plenary members were invited to review and provide feedback on any or all of the Challenge Essays. The Task Force members also solicited review and commentary from independent resource persons (as acknowledged in the individual Challenge Essays).

Step 6. Finalization of the CIP Vision Statement

The content review by the Board of Trustees, as well as commentary from the CIP Vision Plenary and comments from independent reviewers, were then incorporated into the relevant Challenge Essays by the Challenge Essay Leaders.

Step 7. Report to Plenary

This Vision Statement document represents the product of the CIP Vision Exercise and, as such, is submitted as final report to the CIP Vision Plenary.

We thank all who participated in the CIP Vision Exercise.

Box 6. CIP Vision Statement

The International Potato Center (CIP) will contribute to reducing poverty and hunger; improving human health; developing resilient, sustainable rural and urban livelihood systems; and improving access to the benefits of new and appropriate knowledge and technologies. CIP, a World Center, will address these challenges by convening and conducting research and supporting development partnerships on potato, sweetpotato, Andean root and tuber crops, and other commodities in mountain systems and the other less-favored areas where our mandate crops can contribute to the achievement of healthy, sustainable human development.

Appendix 1. CIP Vision 1st plenary consultation – Questionnaire (October 2002)

PART I PARTICIPANT INFORMATION

1 Name of plenary participant(s):

2 Key contact (name and e-mail):

3 Organization represented (one per questionnaire, please):

4 Location of organization (country, city):

PART II. BOUNDARIES FOR THE CIP VISION EXERCISE

5 CIP Vision boundaries

a. Do you accept the Millenium Development Goals (MDG) (see Background Document) as the boundary for the CIP Vision exercise? **YES** **NO**

PART III. PROGRAMMATIC CONTENT OF CIP'S RESEARCH

6 Target 1. To half the proportion of population in extreme poverty between 1990 and 2015—that the population living in poverty be less than 15% by 2015

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 6a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

7 Target 2. Halve, between 1990 and 2015, the proportion of people who suffer from hunger

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 7a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

8 Target 3. Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 8a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

9 Target 4. Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 9a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

10 Target 5. Reduce by two thirds, between 1990 and 2015, the under-five mortality rate

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 10a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

11 Target 6. Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 11a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

12 Target 7. Have halted by 2015 and begun to reverse the spread of HIV/AIDS

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 12a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

13 Target 8. Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 13a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

14 Target 9. Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 14a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

15 Target 10. Halve by 2015 the proportion of people without sustainable access to safe drinking water

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 15a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

16 Target 11. By 2020 to have achieved a significant improvement in the lives of at least 100 million slum dwellers

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 16a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

17 Target 12. Develop further an open, rule-based, predictable non-discriminatory trading and financial system

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 17a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

18 Target 13. Address the special needs of the least developed countries

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 18a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

19 Target 14. Address the special needs of the landlocked countries and small island developing states

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 19a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

20 Target 15. Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 20a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

21 Target 16. In cooperation with developing countries, develop and implement strategies for decent and productive work for youth

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 21a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

22 Target 17. In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 22a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

23 Target 18. In cooperation with the private sector, make available the benefits of new technologies, especially information and communications

a. Can CIP research contribute to the achievement of this MDG target? **YES** **NO**

b. If you answered YES to 23a, then please specify WHAT research should CIP be doing to contribute to this MDG target?

PART IV. RESEARCH TARGETS

24 a. Based on your knowledge of CIP's research, is there a need to re-align our geographical target populations to improve our impact on the MDG development goals **YES** **NO**

If you answered YES to 24a, then please specify:

b. Where is CIP currently working that you feel we should NOT be working?

c. Where is CIP currently NOT working, but you feel we should be working?

PART V. VISION PROCESS

25 Would you like to offer any observations, suggestions or advice on the process for the CIP Vision exercise?

Challenge 1

CIP can contribute to halving the proportion of the population in extreme poverty between 1990 and 2015—that the population living in poverty be less than 15% by 2015

Keith Fuglie, Thomas Bernet, Elske van de Fliert, Miguel Holle, Oscar Ortíz, Graham Thiele, and Mahesh Upadhya

Problem and background

Poverty alleviation is stated as the first priority of the International Agricultural Research Centers that make up the CGIAR. The extent to which CIP can marshal its scientific resources to contribute to poverty alleviation is a key measure of our success. In envisioning how CIP can strengthen its contribution to this goal, it is useful to first describe how we conceptualize poverty, and to assess how CIP-related technologies have contributed in the past to the various dimensions of poverty.

Concepts of poverty

The Millennium Development Target uses the commonly quoted "$1/day/capita" threshold to measure the number of individuals classified as extremely poor. People at or below this threshold are considered to have insufficient resources to meet their basic needs, especially for sufficient food to sustain a healthy livelihood. The World Bank has developed measures of rural and urban poverty based on this threshold for every country in the world.

Poverty has to be defined at a population level as well as for individuals. At the population level, poverty can be assessed according to parameters that are not strictly based on income. A poor population is one that lacks access to collective facilities such as medical care, schools, communications with the outside, enough literate people for contact with outside events, and an equitable sharing of resources, with systems of redistribution and mutual aid that can be sustained. Nobel laureate Amartya Sen described poverty in terms of a lack of "capabilities", especially the capability of individuals to become agents of change and masters of their own destiny. In addition to material well-being, Sen argued that poverty also means lack of political freedom, social opportunities, transparency of how governments make and implement policy, and protective security.

Poverty changes over time with fluctuating conditions. Episodes of drought, crop pests, illness of family members, or price instability can push a household into poverty such that they begin to sell off assets and productive capacity, endangering their ability to recover in the future. Global climate change may increase the frequency and severity of environmental shocks in the future, and potato-based livelihood systems may be especially vulnerable to climate change.

Gender is another critical dimension of poverty. Among the most vulnerable of the poor are women and children, and households headed by them. Gender has particular relevance for potato and sweetpotato. Root and tuber crops are generally women's crops due to their prominent role in household garden systems and to the increasing "feminization" of agriculture.

Given the multidimensional and dynamic nature of poverty, it is preferable to consider several aspects of poverty in designing our vision and strategies for contributing to this Millennium

Development Target. Using a livelihood systems framework, Niehof and Price[1] show how various dimensions of poverty—capabilities, assets, resources, strategies, livelihood portfolios, and diversification—can be incorporated into assessments of poverty and decision making by poor households. One implication of the livelihood systems framework is that reducing poverty needs more than just improved technology; it may also require institutional and policy innovations and partnership strengthening.

CIP's contribution to poverty reduction

Historically, CIP has made an explicit effort in its research planning to target countries and regions where poverty is most widespread. In this way the likelihood increases that the poor will benefit from CIP-related technologies. In its last major priority-setting exercise,[2] CIP overlaid income-based poverty headcounts with the geographic distribution of potato and sweetpotato to evaluate where and what types of technologies would most likely benefit the poor. What was revealed in this exercise was that CIP-related technologies were likely to have a high "poverty content", meaning that a large share of the benefits of improving potato and sweetpotato technology were likely to be enjoyed by poor households. This is because the areas where potato and sweetpotato are major crops also tend to be areas where rural poverty rates are high, such as northeast India, Bangladesh, interior provinces of China, and central Africa. We assumed that by focusing on regions where CIP-related technology was likely to generate the highest total economic benefits, CIP could achieve the greatest impact on poverty reduction.

Over the past decade CIP has conducted a number of studies to evaluate the economic and poverty impacts of the work it has done in cooperation with national agricultural research systems. Scientific and technical improvements introduced into potato and sweetpotato production systems have made significant improvements to farm productivity throughout the world, especially in China, India, the Andean highlands, and central Africa (Table 1). The "poverty content" of the benefits from these technologies is measured by the share of extremely poor people living in the regions where technology adoption occurred. This measure assumes that the benefits were reasonably evenly distributed across households within these regions. In some cases benefits may have favored relatively well-off households, but in other cases benefits may have been weighted in favor of the poor. The diffusion of virus-free sweetpotato planting material in Shandong, China, for example, tended to benefit poorer households more because these households had a larger crop area under sweetpotato compared to the average farm household in Shandong.[3]

CIP has also begun some initial attempts to incorporate multidimensional characteristics of poverty into its impact assessments. Walker developed a simple scoring technique to appraise the case studies listed in Table 1 according to a number of poverty-related critera, such as whether farm households adopting the technologies were more or less likely to be poor, whether consumers benefiting from increased supply (at lower prices) of the commodity were likely to be poor, and whether the technologies were likely to generate significant employment or health benefits within the affected regions.[4] Other studies have attempted to evaluate impacts of interventions on general household and institutional capacities. For example, an assessment of farmer field schools (FFS) for sweetpotato integrated crop management in Indonesia showed how practitioners trained in FFS

1 Niehof A and Price L. 2001. *Rural Livelihood Systems: A Conceptual Framework*. UPWARD Working Paper No. 5. Wageningen-UPWARD Series on Rural Livelihoods No. 1.

2 Walker TS and Collion M-H. 1997. *Priority Setting at CIP for the 1998–2000 Medium-Term Plan*. CIP, Lima, Peru.

3 Fuglie KO, Zhang L, Salazar L, and Walker TS. 1999. *Economic Impact of Virus-free Sweetpotato Planting Material in Shandong Province, China*. CIP, Lima Peru.

4 Walker TS. 2000. Reasonable expectations on the prospects for documenting the impact of agricultural research on poverty in ex-post case studies. *Food Policy* 25: 515–530.

methods extended the use of the approach to other crops and farming systems under their responsibility in order to enhance the capacities of additional farmers.[5]

Table 1. Impact case studies of CIP-related technologies[a]

Technology		Country	Time span for project appraisal	Returns on investment [b]		
General	**Specific**			**Internal rate of return (%)**	**Net present value (million $)**	**Poverty content (%)**
Varietal	Late blight resistance and improved seed	Rwanda, Burundi, eastern Zaire	1978–1993	92	27.0	85
	Resistance to drought and viruses	China	1978–2000	106	11.9	71
	Late blight resistance	Peru	1979–2020	27	5.4	31
Integrated pest management	Potato tuber moth	Tunisia	1976–2000	64	6.4	18
	Sweetpotato weevil	Dominican Repblic	1989–2019	29	1.1	55
	Sweetpotato weevil	Cuba	1993–2020	65	21.7	32
	Andean potato weevil	Peru	1988–2018	32	1.8	31
Seed	Rapid multiplication and late blight resistant varieties	Vietnam	1978–1993	81	2.1	52
	True potato seed	India	1978–2015	29	18	60
	Sweetpotato virus free planting material	China	1978–2015	202	550	20
	True potato seed	Egypt	1979–2015	28	2.9	23
	True potato seed	Vietnam	1990–2010	39	1.8	52

[a] This is not an exhaustive list of where impacts of CIP-related technologies have occurred. Rather, these are selected cases where CIP has been able to conduct formal benefit–cost analysis of technologies known to have been widely adopted. It is part of an ongoing effort to assess and document impacts of CIP in developing countries.

[b] Net present value estimated using a 10% discount rate. Poverty content is the estimated share of total benefits going to poor households (based on the percentage of the population in impacted areas living below $1/day). Benefits of technology adoption are projected into the future based on estimates of the probable adoption patterns and "life span" of the technology. See Walker TS and Fuglie KO. 2000. Impact assessment at the International Potato Center (CIP) in the 1990s. Paper presented at the CGIAR Impact Assessment Workshop, 3–5 May 2000, FAO, Rome, and the papers cited therein for more detailed results and sensitivity analysis of the estimated rates of return to research investments.

5 Van de Fliert E, Johnson N, Asmunati R, and Wiyanto. 2001. Beyond higher yields: The impact of sweetpotato integrated crop management and Farmer Field Schools in Indonesia. *Scientist and Farmer: Partners in Research for the 21st Century. Program Report 1999–2000*, pp. 331–42. CIP, Lima, Peru.

Specific objectives for CIP's research program

The pro-poor Research and Development cycle

Enhancing pro-poor impacts on income, health, and sustainability will require a significant realignment in CIP's Research and Development (R&D) framework. We propose the elaboration of a pro-poor R&D cycle and sketch out here its most important components. This planning process will be part of an ongoing mechanism and will be used to introduce modifications in the research agenda. Figure 1 shows the complete cycle. This cycle iteratively targets at different scales. As the cycle moves from macro- to micro-interactions with stakeholders and enhanced understanding of needs and opportunities, it may generate modifications at the higher scale:

- macro-scale: geographical impact targeting identifies the most promising macro-areas for pro-poor impacts given CIP's comparative advantage
- meso-scale: participatory needs and opportunity assessment (PNOA) is a finer matching of needs and opportunities within the macro-areas
- micro-scale: poverty matrix builds on the PNOA to identify and prioritize specific R&D interventions for the pro-poor impacts

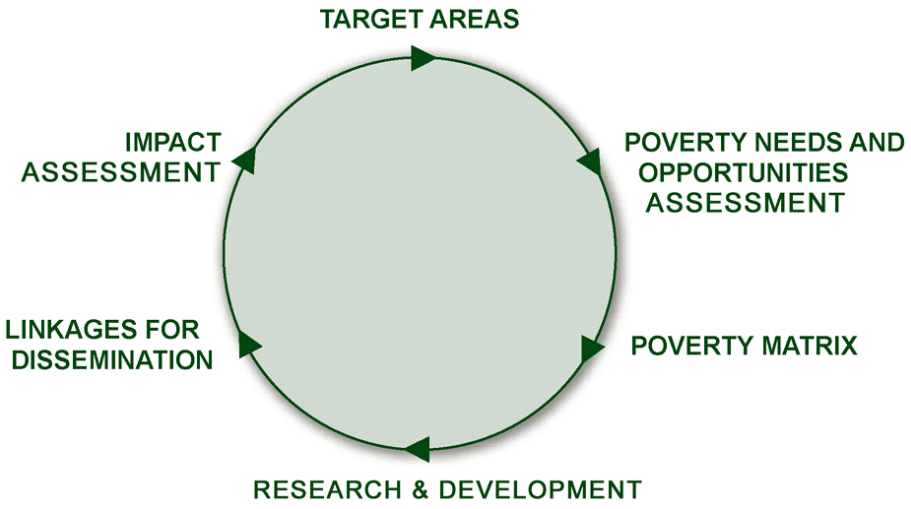

Figure 1. Pro-poor R&D cycle.

Impact targeting will be followed by implementation of R&D activities, linkages for dissemination, and impact assessment. Impacting poverty may require linkages with policy makers at the dissemination stage. Previous targeting exercises in CIP were largely scientist-driven with limited stakeholder consultation and a one-dimensional criterion for targeting (net present value). The pro-poor R&D cycle uses multidimensional criteria for targeting and will require more integral coordination with a wider range of stakeholders. Strengthening existing partnerships and building new partnerships will be important as many of the interventions envisaged require a broader set of skills and resources then those available at CIP.

Geographical targeting

Geographical targeting is conceptually an overlaying of a *poverty map* with a *crop map*—referring to CIP's crop mandates (i.e. potato, sweetpotato, and Andean root and tuber crops)—and an *environmental vulnerability* map—referring to vulnerable ecological systems related to CIP's mandate (i.e. hillsides, mountains, and urban agricultural systems) in developing countries. Three different areas should be noted (Figure 2):

A—areas where poverty, CIP's crop mandates, and environmental vulnerability overlap

B—areas where poverty and CIP's crop mandate are overlap

C—areas where poverty and environmental vulnerability overlap

Areas where poverty geographically overlays with CIP's crops and environmental vulnerability will be prioritized. The gray shading in the poverty map circle represents increasing poverty from periphery to center, with the white dotted line representing the border of some poverty threshold (such as $1/day/capita or other dimension of poverty). A1, B1, and C1 represent areas with a high concentration of households living in extreme poverty, whereas A2, B2, and C2 are poor areas albeit with less extreme poverty.

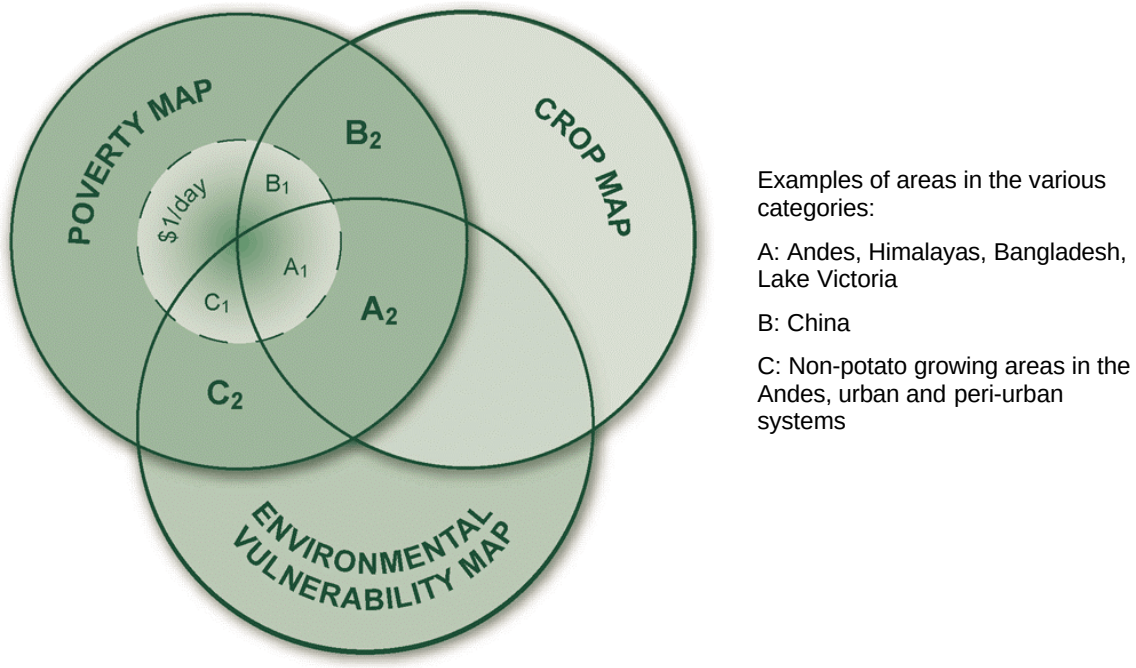

Figure 2. Conceptual geographical priority-setting framework.

Intersections A1, B1, C1 and A2 will receive highest priority. In practical terms, the prioritization of the impact areas takes explicitly into account the degree of poverty, crop diffusion, and vulnerability in each area. Based on these three criteria together with the probability of achieving impact, potential geographical areas can be ranked using a simple qualitative scoring exercise (Table 2).

Table 2. Example of scoring exercise using impact criteria to prioritize potential target areas

Criterion[a]	Andes	Lake Victoria	Bangladesh	South China
Degree of poverty	1	3	5	5
Importance of the mandate crop	5	5	2	4
Environmental vulnerability	3	4	5	3
Probability of impact[b]	5	3	2	4
Total Score	**14**	**15**	**14**	**16**

[a] Scoring from 0 (not important) to 5 (very important).

[b] Based on the likelihood that a research endeavor will be successful and on the ease with which technology can be adapted and disseminated in an area. Probability of impact is influenced by the human and scientific capital, institutional capacity, and political will of CIP partners in the target area. Though based largely on subjective judgment and prior experiences, external indicators of institutional capacity can also be assessed. For example, CIP conducted surveys of potato research capacity in developing countries in 1990 and 2000, information that can help assess the probability of impact.

Available poverty statistics across countries often fail to detect local and temporal poverty within countries. In order to sense these "poverty pockets" and crises-affected areas, an additional approach is needed. CIP's contribution to such areas is strongly linked to its crop-related activities. Hence these areas are found within the area of the crop map circle, but outside the poverty map circle, as shown in Figure 2. The prioritization and targeting of these areas involves different criteria than those used in the general geographical targeting approach, where CIP seeks long-term investments to reach its impact. Specific geographic targeting for poverty is strongly related to "temporary hunger targeting", while areas with chronic hunger can more easily be detected by general geographic targeting procedures.

Area-specific needs and opportunity assessment with poverty focus

After defining the potential geographical regions for intervention, a specific participatory process for assessing needs and opportunities, focusing on poverty-related aspects, will be conducted at a meso-scale. The result of this process will be a list of priority needs of resource-poor people and the identification of those that CIP-related interventions could address. In addition to our traditional partners, this process should involve key stakeholders with experience in poverty-related aspects and should consider factors that might limit the potential of interventions to generate impact. An example of this is gender analysis since access to technologies, knowledge, and information is often a gendered affair (meaning that women have less of it). Some technologies might be suitable for men but not for women. Women are often faced with enormous time constraints, having to combine reproductive work and productive work. Hence new technologies and technology dissemination strategies need to be compatible with women's time constraints.

In addition, partners who participate in the needs assessment process should take into consideration the existence of facilitating factors for potential interventions in specific areas. For example, institutional capabilities, potential for partnership, or policy support for the intervention can influence the potential success of the intervention. This type of analysis will help stakeholders to assess the probabilities of success of a particular project, and therefore will support the selection of the appropriate type of intervention needed in a particular country (focusing on technology dissemination, training, research for specific types of technologies, or institutional capacity building). CIP will facilitate the process of analysis in some cases and act as a partner in other

cases, where wider regional efforts oriented to needs assessment are being implemented (for example, the CGIAR Challenge Program for Sub-Saharan Africa).

Poverty impact matrix

The next step is to go down to micro-level and develop a matrix to identify pro-poor R&D activities for the selected geographical targets, including both continuing and new activities. Table 3 presents the matrix with a list of selected examples of specific R&D activities currently conducted by CIP (in normal font) and desired activities for better poverty targeting (in italic font) for two selected geographical areas. The rows of the matrix are represented by types of pro-poor impacts adapted from Hazell and Haddad,[6] including technology-based impacts in rows 1–5, and process-based impacts that cut across the technology-based impacts in rows 6 and 7. It should be noted that some activities have multiple impacts and appear in several cells.

Table 3. Poverty impact matrix with examples for selected geographical areas

Strategies for pro-poor R&D [a]	**Examples of research topics in selected geographical areas**	
	Andes	**Lake Victoria**
1. Productivity and production increase in countries where food price effects are important 2. Improved farming productivity for small-scale farmers in less-favored, heavily populated areas	Potato IPM Late blight resistance *Conservation farming and soil health*	Sweetpotato IPPM through Farmer Field Schools *Conservation farming and soil health*
3. Improved income through access to higher-value crops with potential in the domestic and export market 4. Increased employment and income-earning opportunities in labor-surplus regions	Platforms to link farmers to process potato markets *Quinoa and ARTC production, processing, marketing*	Sweetpotato postharvest utilization and product development
5. More nutritious and safer foods to enhance the diet of poor people	*Use of native potatoes and animal products*	Sweetpotato breeding for beta-carotene/vitamin A
6. Undertake research and learning activities in ways to empower the poor	Potato IDM Farmer Field Schools *Participatory poverty, needs, and opportunity assessment* *Poverty-oriented impact assessment*	Sweetpotato IPPM Farmer Field Schools *Participatory poverty, needs, and opportunity assessment* *Poverty-oriented impact assessment*
7. Building platforms for collecting decision making and action	CONDESAN Internalizing externalities	Sweetpotato IPPM Farmer Field Schools

[a] Pro-poor strategies 1–6 are from Hazell and Haddad (2001). Strategy 7 is an offshoot of strategy 6 (empowerment) that is directed at the community or regional level.

Italics indicate activities which are not currently being undertaken as a priority by CIP but would have to be addressed to be able to contribute to the specific pro-poor strategies indicated in the first column.

ARTC = Andean root and tuber crops, CONDESAN = Consortium for the Sustainable Development of the Andean Ecoregion, IDM = integrated disease management, IPM = integrated pest management, IPPM = integrated production and pest management.

6 Hazell P and Haddad L. 2001. *Agricultural Research and Poverty Reduction*. Food, Agriculture, and the Environment Discussion Paper 34. IFPRI, Washington, DC.

Impact assessment

The results of the impact assessments reported in Table 1 focused on a single, important question: has the investment in CIP by its donors paid off? The answer to this question, using standard tools of benefit–cost analysis, is a clear yes. The monetary value of benefits to farmers from the technology generated by CIP in collaboration with national partners has been large relative to the size of the investment, appropriately discounted over time. A more in-depth assessment of the implications of technological, institutional, and policy innovations for poverty reduction, income redistribution, and enhancing "capacities" will require a different set of methodological tools, including social, anthropological, and health sciences approaches in addition to economic criterion. Some considerations follow.

Ex-ante and ex-post assessment. Impact assessment needs to be conducted *ex-ante* (before the research is undertaken) as part of research priority setting and planning, as well as *ex-post* (after the technology is adopted by farmers) to monitor and evaluate actual effects on families and communities. *Ex-ante* assessment needs to explore pathways of how benefits can address the needs of poor families and communities and anticipate possible unintended negative effects of the new technology in order to design ways to avoid or mitigate possible harm. *Ex-post* assessment establishes "truth-on-the-ground", informs future research priorities, and identifies need for policy changes.

Benefit and risk assessment. A description of six pathways developed by Hazell and Haddad through which new technology can benefit the poor is given in Table 4. However, for each pathway, there are also risks that could cause potential harm. For example, one way in which agricultural research can benefit poor families is by increasing food production. In subsistence farming, farm families benefit directly through increased food supply. In commercial production, some of the productivity benefits may be passed on to poor consumers in the form of lower food prices. However, an increase in crop productivity may increase specialization, reducing diversity in food production, subjecting farm families to greater risk, or increasing use of pesticides with health and environmental consequences. Lower food prices for consumers also implies lower crop prices, without commensurate reduction in costs, for farmers who have not adopted the new technology. Impact assessment should critically evaluate both the positive and negative consequences of new technologies.

Further, these benefits do not materialize exclusively for the poor. Many factors, especially the existing structure of land distribution and tenure, will influenced the share of the total benefits that are captured by poor households. The effects of agricultural research on poverty are also influence by gender participation and patterns of food and resource allocation within a household. Technological improvements in crops that are traditionally farmed by women and which increase the earnings of women may be more likely to enhance the welfare of poorer members of the household, such as young children who are under the women's care. Some innovations, such as crops with improved nutrition, can impart substantial benefits in household welfare, including reduced mortality rates, even though these benefits may not be reflected in changes in income.

Table 4. Impact assessment of new agricultural technology.

Potential benefit	Potential harm
1. Increased yield of improved crop	Specialization and displacement of other crops, reducing diversity. Use of pesticides and other health impacts. Clearing of forest, erosion. Increased area sown to a crop can lead to more kinds of pests.
2. Employment opportunities	Replaces home production, increases vulnerability to employment cycles. Who gets the jobs?
3. Growth of rural and nonfarm economy	Invasion by commercial suppliers destroys local economy. Land market results in growing concentration of wealth.
4. Lower food prices	Dependence on purchased food other than the main market crop. Lower prices for farmers.
5. Access to high-nutrient foods	Specialization, lower diversity, and more seasonality of food supply.
6. Research can empower	But only if empowerment includes teaching people how to challenge land tenure and other inequities.

The six pathways listed in the table of how new agricultural technology may benefit the poor are from Hazell and Haddad (2001). Examples of potential harms that may result through each of these pathways were kindly provided by Richard Levins.

Multiple dimensions of benefits. The mechanisms by which agricultural technology affects poverty suggest multiple dimensions at which poverty impacts need to be measured and assessed. One dimension is how the benefits of new technology are distributed among the different levels of the food systems chain, including farmers, processors, and consumers. This analysis requires in-depth understanding of the market system and how supply changes affect prices. A second assessment is at the level of the household. By studying patterns of technology adoption at the farm level and patterns of food consumption for different classes of households, we can estimate the distribution of research benefits going to poor and nonpoor households, distribution of consumption within households, and how this distribution may change over time. This analysis requires greater attention to relatively large and detailed farm and household surveys. Market and household analysis can also provide assessments of impacts on the stability of market and food supply, and the dynamics of poverty. Still a third dimension of impact is human health. While improvements in the health and lifespan of household members may be measurable in terms of the effects of improved health on productivity and income, health benefits also have intrinsic value. An example of a non-monetary indicator of health impact is changes in Disability Adjusted Life Years (DALY). Finally, a fourth level of impact assessment needs to consider a wider set of measures of individual and community well-being, including impacts of individual capacities in decision making and access to decision-making processes, and at the community level, enhanced capacity for taking collective action. This multidimensional approach to impact assessment will require inputs from several scientific disciplines, including economics, anthropology, and political and health sciences. One important source of new methodologies for conducting impact assessment is the CGIAR's Strategic Program for Impact Assessment (SPIA).

Implications for CIP's Vision

Enhancing impact on poverty alleviation through a pro-poor R&D cycle implies a realignment in the structure of CIP's research program and the way the Center operates.

Resources allocated to enhancing impact on poverty will prioritize geographical areas where poverty, CIP's mandate crops and environmental vulnerability overlap. High priority will be given to areas where potato, sweetpotato, and Andean root and tuber crops serve as vehicles to reach a high concentration of households living in extreme poverty in vulnerable environments.

In previous targeting exercises research needs have been scientist-driven and constraint-focused (e.g. potato late blight), with ranking for quantitative (economic) impact. In the new vision, a wider range of pro-poor impacts (e.g. economic growth, empowerment) will be sought with needs and opportunities identified through more participatory processes. Thus, we cannot say a priori which R&D activities CIP will engage in. These activities will emerge through the iterative targeting procedures. In practice we anticipate many of the current activities will continue to be relevant. But as priorities are redefined with more local collaboration we envisage a more diverse portfolio of R&D activities, requiring increasingly diverse partnerships.

Challenge 2

CIP can contribute to halving, between 1990 and 2015, the proportion of people who suffer from hunger

Dindo Campilan, Juan Landeo, Berga Lemaga, Kurt Manrique, Elías Mujica, Sylvie Priou, and Willy Roca

Problem and background

In the last 50 years, the production of foodstuffs worldwide has tripled.[1] The daily per capita dietary intake in developing countries rose from 2140 calories in 1970 to 2716 in 1996–98, and the number of malnourished people declined from 1 billion in 1970 to 800 million in 1996–98. As a percentage of total population, the decline was even faster, from 37% to 18%.[1] During the second half of the twentieth century, remarkable progress has been made in increasing the quantity and quality of global food supplies and in improving the nutritional status of populations.[2]

In spite of this progress, over 800 million people still suffer from hunger, representing one-seventh of the world's population. Statistics from the World Food Programme (WFP) and the Food and Agriculture Organization of the UN (FAO) reveal that each day 24 000 people die from hunger with children being the most vulnerable. One child dies every seven seconds due to insufficient food, undernourishment, and associated diseases.[3]

Concepts of hunger

Three interrelated concepts are commonly used to analyze the global food situation and to estimate the number of people affected by hunger. *Food shortage* occurs when total food supplies within a designated area are insufficient to meet the needs of the population. *Food poverty* refers to the situation where households cannot obtain enough food to meet the needs of all their members. *Food deprivation* refers to inadequate individual consumption of food or of specific nutrients, otherwise known as undernutrition.[4]

While hunger can be viewed at different levels, as illustrated in Table 1, it also has an important temporal dimension. Hunger can result from temporary, seasonal, or chronic underconsumption of food (Table 2). Temporary hunger emanates from crisis situations, while seasonal hunger is a recurrent state, and chronic hunger persists over longer periods of time.

1 International Food Policy Research Institute. 2002. *Sustainable Food Security for All by 2020: Proceedings of an International Conference, September 4–6, 2001, Bonn, Germany*. IFPRI, Washington, DC.
2 Lupien JR and Menza V. 1999. *Assessing Prospects for Improving Food Security and Nutrition*. Food, Nutrition and Agriculture No. 25. FAO, Rome.
3 Food and Agriculture Organization. 2000. *The State of Food Insecurity in the World*. FAO, Rome.
4 Uvin P (ed.). 1994. *The Hunger Report 1993*. Gordon and Breach, Yverdon, Switzerland.

Table 1. Forms of hunger[5]

Form	Characteristic
Food shortage	Large-scale famine and supply shortfalls that afflict regions and nations
Food poverty	Affected households go hungry even though food may be available
Food deprivation	Individuals may be denied food by custom, abuse, self-denial, or disease

Beyond a problem of quantity, hunger also has an important qualitative dimension, e.g. obtaining a nutritionally adequate diet. *Food security* is characterized by the availability of a safe and nutritionally adequate food supply, a reasonable degree of stability in food supply, and access to enough food for meeting basic human needs.[6]

Hunger was traditionally viewed as primarily physiological in origin. It is now widely accepted that the causes of hunger are both natural and social in origin, with the causes of hunger ranging from natural disasters and crop disease epidemics to armed conflicts and limited financial and human capital (Table 2).

Table 2. Common natural and social causes of hunger

Temporary (crisis)	Seasonal (recurrent)	Chronic (persistent)
Natural disasters	Natural disasters	Limited income-earning opportunities
War/violence	Disease epidemics	Limited skills and capacity
Disease epidemics		Inappropriate land use and management
		Migration
		Rapid population growth
		Gender discrimination
		Political and religious exclusion

Indicators of hunger

The Millennium Development Target calls for reducing the number of hungry people around the world, and specifically, halving the proportion of people who suffer from hunger between 1990 and 2015. The two key indicators adopted to measure progress towards achieving this target of hunger alleviation are: (1) prevalence of underweight children under five years of age; and (2) proportion of the population below a minimum level of dietary energy consumption (Table 3).

5 The Alan Shawn Feinstein World Hunger Program. 1995. *Hunger Report 1995*. Brown University, Providence, Rhode Island, USA.

6 Food and Agriculture Organization. 1992. International Conference on Nutrition, Plan of Action.

Table 3. Goal, target, and indicators for hunger alleviation in the UN Millennium Declaration

Goal	Target	Indicators
Eradicate extreme poverty and hunger	Halve, between 1990 and 2015, the proportion of people who suffer from hunger	Prevalence of underweight children (under five years of age) Proportion of population below minimum dietary energy consumption

The challenge of hunger alleviation primarily focuses on developing regions, where the world's hunger problem is most widespread and serious (Table 4). On the whole, 32% of children under five years in developing regions are underweight, while 20% of the population is below the minimum level of dietary energy consumption. South-central Asia tops the list of regions with the highest proportion of underweight children (55%), while Sub-Saharan Africa has the highest proportion of population unable to meet basic energy requirements (35%).

Table 4. Benchmark data on world hunger, 1990[7]

Region	Prevalence (%) of underweight children under five years of age	Population (%) below minimum level of dietary energy consumption
Developing regions	32	20
Africa	28	29
Northern Africa	10	4
Sub-Saharan Africa	32	35
Latin America and Caribbean	11	13
Asia	37	19
Eastern Asia	19	6
South-central Asia	55	25
South-eastern Asia	38	17
Western Asia	14	6

Based on a recent assessment of the Millennium Development Goals by the World Bank,[8] most regions of the world have made dramatic progress in reducing the proportion of underweight children. But progress has been slow, leaving the prospect of reaching the Targets in doubt. Similarly, malnutrition rates among children under five in the developing world fell from 46.5% in 1970 to 27% in 2000. Even so, 150 million children in low- and middle-income economies are still undernourished, and at current rates of improvement 140 million children will be underweight in 2020. Finally, the number of undernourished people in the developing world fell from 840 million in 1990 to about 777 million in 1997–99 and is expected to decrease by 200 million more by 2015. However, greater reductions will be needed to reach the Millennium Development Target of cutting the number of undernourished people in half by 2015.

7 Data available from the United Nations Statistics Division.
8 The World Bank. 2002. Millennium Development Goals. The World Bank Group, Washington, DC.

CIP's contribution to hunger alleviation

With respect to temporary (crisis) and seasonal (recurrent) hunger, roots and tubers are highly effective as a relief crop. CIP has responded to food shortages caused by war or natural disasters in East Timor; in Honduras and Nicaragua after Hurricane Mitch; in the Democratic People's Republic of Korea after a four-year famine; in Chayabamba, Peru after especially severe effects of an El Niño event; and in Mozambique after civil war. In addition, CIP is currently participating in consortia attempting to bring postconflict relief through staple food production in Afghanistan, Angola, Congo, and Iraq.

With respect to chronic hunger, FAO data reveal that countries which managed to decrease their level of undernourishment were generally those that achieved a positive growth rate in agricultural production per capita. Conversely, countries with a negative growth rate generally suffered from increased level of undernourishment (Tables 5 and 6). Challenge 1 addresses the ways in which CIP research has contributed to poverty alleviation, productivity, and growth.

Table 5. Key indicators for 13 countries with a decreasing level of undernourishment [9]

Country	Undernourished 1980/1997 (%)	Change (% points)	Real GDP per capita growth rate (%)	Agricultural production per capita growth rate (%)
Benin	37/14	–23	0.9	2.9
Burkina Faso	64/32	–32	1.2	2.2
Cambodia	61/33	–28	2.0	4.5
Chad	69/38	–31	0.1	1.5
China	30/11	–19	8.2	4.2
Gambia	58/16	–42	–0.4	–2.5
Ghana	62/10	–52	–0.2	2.1
India	38/21	–17	3.2	1.0
Indonesia	26/6	–20	4.0	1.9
Mali	60/32	–28	–0.4	1.0
Mauritania	35/13	–22	–0.6	–1.4
Nepal	47/28	–19	1.7	0.8
Nigeria	44/8	–36	–0.7	2.4

9 Food and Agriculture Organization. 2000. *The State of Food Insecurity in the World*. FAO, Rome.

Table 6. Key indicators for 11 countries with an increasing level of undernourishment [9]

Country	Undernourished 1980/1997 (%)	Change (% points)	Real GDP per capita growth rate (%)	Agricultural production per capita growth rate (%)
Afghanistan	34/70	+36	n.a.	0.0
Burundi	39/58	+29	–0.9	–1.6
Central African Rep.	22/41	+19	–1.5	0.5
DR Congo	38/61	+23	–4.5	–1.6
Cuba	4/19	+15	n.a.	–2.4
DPR Korea	19/57	+38	n.a.	–0.4
Liberia	22/46	+24	n.a.	–1.4
Madagascar	18/40	+22	–1.5	–1.7
Mongolia	16/45	+29	0.0	–2.3
Somalia	55/75	+20	n.a.	–1.8
Tanzania	23/41	+18	0.3	–1.4

More specifically, root and tuber crops play a significant role in helping developing countries achieve improved food security, serving as a major part of the diet among the poorest households. These high-energy crops are a contributing, if not principal, source of food and nutrition among the most undernourished households in the developing world.[10]

In many parts of Sub-Saharan Africa, roots and tubers, including sweetpotato, are a major source of sustenance. In the late 1990s, they accounted for 20% of calories consumed in the region, and even more in the diets of the poor. In much of Asia and Latin America, roots and tubers are an important supplementary source of carbohydrates, vitamins, and amino acids in food systems dominated by other commodities.[11]

Specific objectives for CIP's research program

In conflict and natural disaster situations, chronic food shortages can result in hunger, malnourishment, and even starvation. Tragically, there are 44 nations currently in the state of conflict or postconflict. And, trends indicate that many of these nations are not progressing from conflict to postconflict relief, construction, and development, but rather slipping back into states of conflict. Simultaneously, evidence indicates that natural disasters and severe weather events are becoming more frequent and more severe. Combined, these trends suggest that it will be increasingly important to develop a rapid response capacity to hunger crises arising from human conflict and natural disasters.

Risk assessment of food shortages due to human conflict and natural disasters, and a program of institutional preparedness for response, will be required. For high-risk countries it will be necessary to acquire knowledge of the most appropriate sweetpotato and potato varieties and

10 Alexandros N. 1995. *World Agriculture: Towards 2010*. FAO and John Wiley, New York.

11 Rosegrant MW, Paisner MS, Meijer S, and Witcover J. 2001. *2002 Global Food Outlook: Trends, Alternatives and Choices*. IFPRI, Washington, DC.

develop systems for reproduction and storage of planting material. Designs for implementing rapid multiplication and decentralized distribution systems for planting material in target countries will also be needed. CIP's previous investment in true potato seed systems will be a valuable asset in this endeavor.

Related to alleviation of chronic hunger, root and tuber crops will become more important food crops in succeeding decades. Projections by the International Food Policy Research Institute (IFPRI)[11] point to surging consumption of root and tuber crops. To address the Millennium Development Target of reducing the proportion of populations suffering from undernourishment, a useful starting point is the WFP map and accompanying statistics (Figure 1, Table 7).

Targeting chronic hunger

Existing hunger maps are useful in identifying hunger hot spots. However, these need to be used with caution because they are often based on: (1) a single hunger indicator or criterion; (2) country-level statistics that present nationally aggregated information, disregarding variability across the country and the existence of pockets of hunger in specific communities; and (3) data that have not been updated to reflect rapid changes in global or local situations.

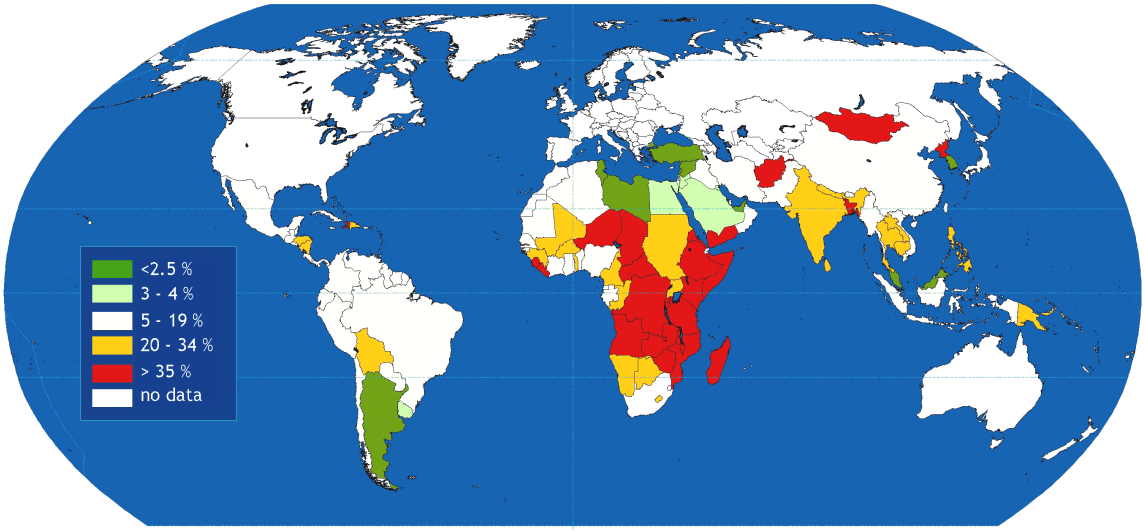

Figure 1. Hunger map based on percentage of population suffering from undernourishment[12]

In general, available data point to South Asia and Sub-Saharan Africa as key hunger regions, in terms of proportion of hungry people in the regional/national population. Because of its large population, Southeast and East Asia ranks high in terms of the actual number of hungry people.

12 World Food Programme. 2001. Hunger Map. FAO, Rome.

Table 7. Top five countries per region with the highest number of undernourished people, 1995–97[12]

Region	Country	No. of malnourished people (millions)	% of population
Asia-Pacific	India	204.4	22
	China	164.4	13
	Bangladesh	44.0	37
	Pakistan	26.3	19
	Philippines	15.6	22
Africa	Ethiopia	28.7	51
	Congo	25.8	55
	Tanzania	12.3	40
	Kenya	11.4	41
	Nigeria	8.3	8
Latin American and Caribbean	Brazil	16.2	10
	Mexico	5.1	6
	Haiti	4.7	61
	Peru	4.6	19
	Bolivia	1.8	23

Asia-Pacific is home to the greatest number of undernourished people, with India and China heading the list. However if hunger is viewed in terms of percentage of hungry people of a country's population, the geography of world hunger shifts toward smaller countries beset by economic underdevelopment.[3] For instance in East Asia, topping the list are DPR Korea (48%), Mongolia (48%), Cambodia (33%), and PDR Lao (33%). Similarly, Africa is home to 25 of the countries with the highest percentage of undernourished people, led by Somalia (73%), Eritrea (67%), Burundi (63%), and Mozambique (63%). More specific targeting will be necessary to identify hunger pockets within a country or widespread hunger conditions across national frontiers.

The value of CIP's mandate crops to the world's hungry is a major determinant of the Center's potential contribution to the Millennium Development Target on hunger alleviation. This entails overlaying the hunger map with a potato and sweetpotato map, to determine the capacity to alleviate hunger through increased potato or sweetpotato production.

It is generally accepted that one answer to hunger is raising incomes and reducing poverty. As average incomes grow, extreme poverty declines and children become better nourished. Very few upper-middle-income countries report significant numbers of underweight children. And even in countries with relatively low average rates of malnutrition, poor people suffer disproportionately.[8] As Figures 2 and 3 show, malnutrition falls as average income rises; and within countries, malnutrition also follows income.

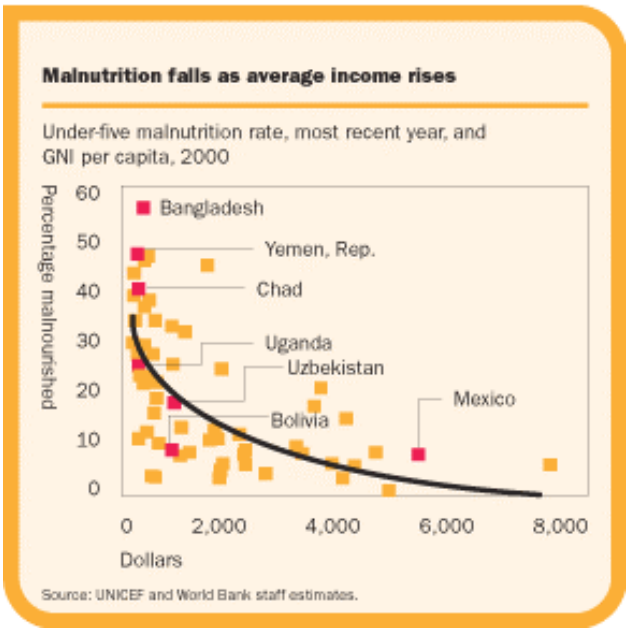

Figure 2. Inverse relationship between child malnutrition and income

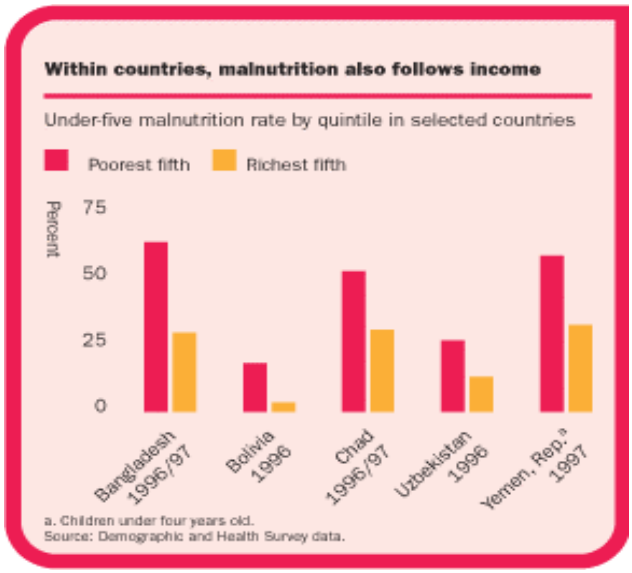

Figure 3. Malnutrition and income trends for selected countries

CIP's current research program consists of a portfolio of constraints-driven projects aimed at enhancing crop productivity, adding value to mandate crops, and managing natural resources. Although links to the hunger agenda have not been as clearly articulated as need be, with some realignment the existing research agenda can effectively increase CIP's contribution to hunger alleviation (Figure 4). To realize this potential, it will be critical to integrate hunger indicators into impact monitoring and assessment research.

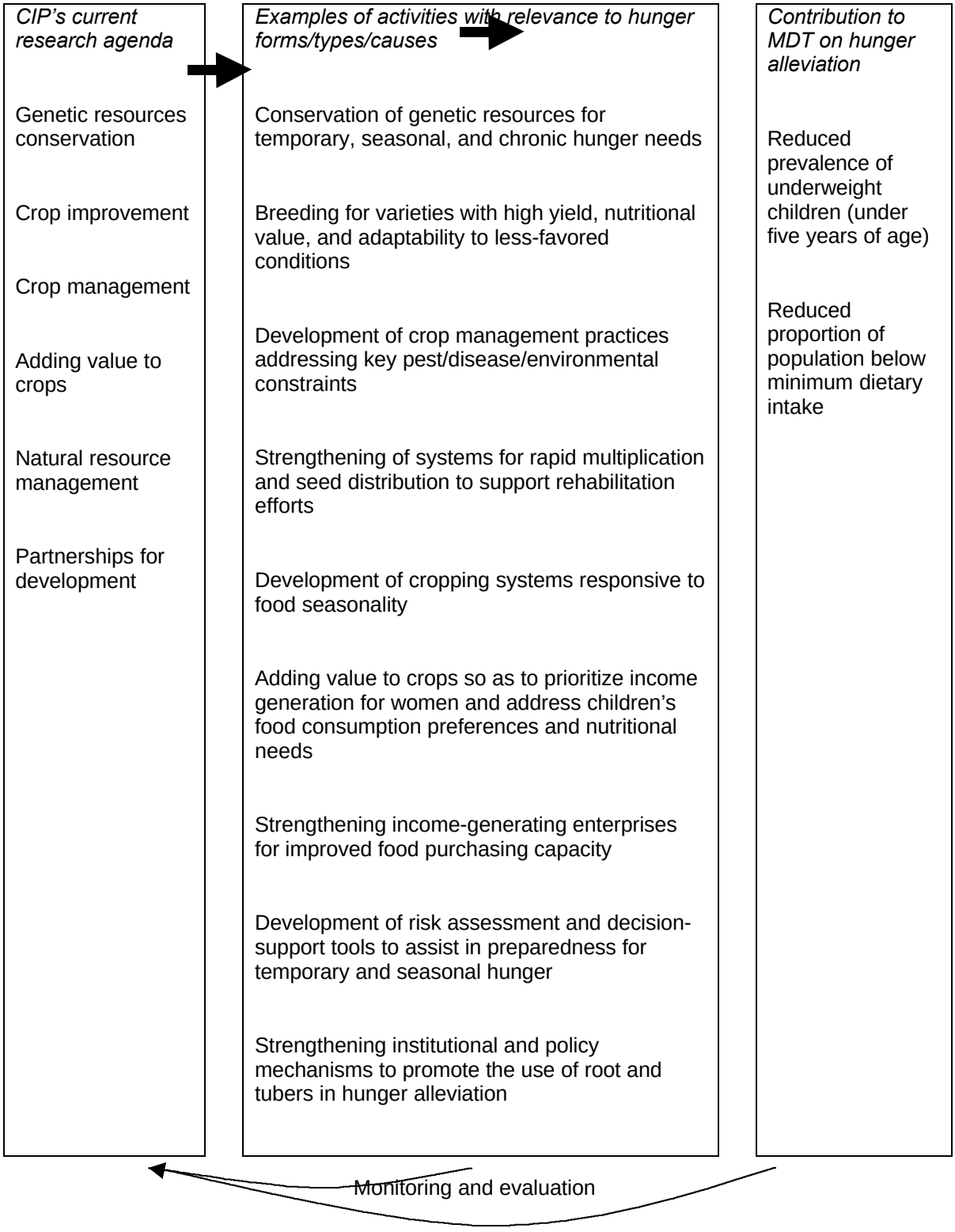

Figure 4. Orienting CIP research to hunger alleviation

The hunger–poverty link reinforces the need to consider poverty alleviation as a simultaneous strategy for chronic hunger alleviation. However, poverty should not be taken as a strict proxy for hunger. Hunger targeting, establishment of hunger indicators, research activities directed at hunger alleviation, and monitoring and impact assessment will be tracked independently.

Implications for CIP's Vision

To date, research targeting and impact assessment at CIP have focused primarily on contributions to poverty alleviation. Ex-ante analyses and ex-post studies have shown high returns on investments for CIP's agricultural research efforts[13,14], particularly among poor countries where root and tuber crops are widely grown.[15] In CIP's 1998–2000 Medium-Term Plan, poverty measures were likewise incorporated into the formulation of the research agenda and priority setting.[16]

In this Visioning Exercise, the CIP Vision Plenary has ranked hunger alleviation as the most important Millennium Development Target to which the Center can contribute. Thus, CIP's impact targeting, needs and opportunities assessment, research agenda, and impact assessment will be realigned to enhance impact on hunger alleviation.

13 Walker TS and Fuglie KO. 2000. Impact assessment at the International Potato Center (CIP) in the 1990s. Paper presented at the CGIAR Impact Assessment Workshop, 3–5 May 2000, FAO, Rome.

14 Walker TS and Crissman CC. 1996. *Case Studies of the Economic Impact of CIP-related Technologies*. CIP, Lima, Peru.

15 Walker TS. 2000. Reasonable expectations on the prospects for documenting the impact of agricultural research on poverty in ex-post case studies. *Food Policy (UK)* 25(4): 515–530.

16 Walker TS and Collion M. 1999. Incorporating Poverty in Priority Setting: CIP's 1998–2000 Medium-Term Plan. In: *CIP Program Report 1997–98.* CIP, Lima, Peru.

Challenge 3

CIP can contribute to reducing by two-thirds, between 1990 and 2015, the under-five mortality rate, and to reducing by three-quarters, between 1990 and 2015, the maternal mortality ratio

Donald Cole, Regina Kapinga, Nelly Espinola, Dapeng Zhang, and Sarath Ilangantileke

Problem and background

Under-five mortality (Figure 1) is the proportion of child deaths before the age of five per 1000 live births. Maternal mortality (Figure 2) is the number of deaths of childbearing women during pregnancy, around delivery, or arising out of the complications of pregnancy and delivery per 100 000 live births. For both kinds of mortality, there are issues of under-registration in vital statistics in many poorer countries. Hence periodic surveys are desirable in order to update and improve mortality statistics.

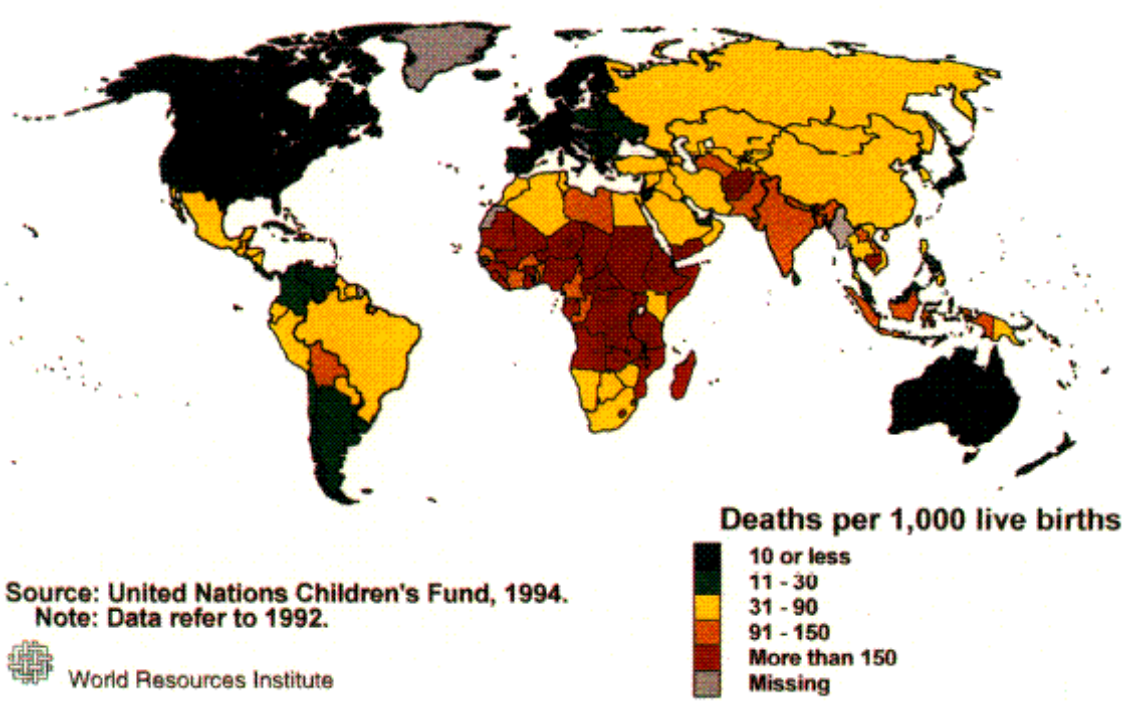

Figure 1. Child mortality rate

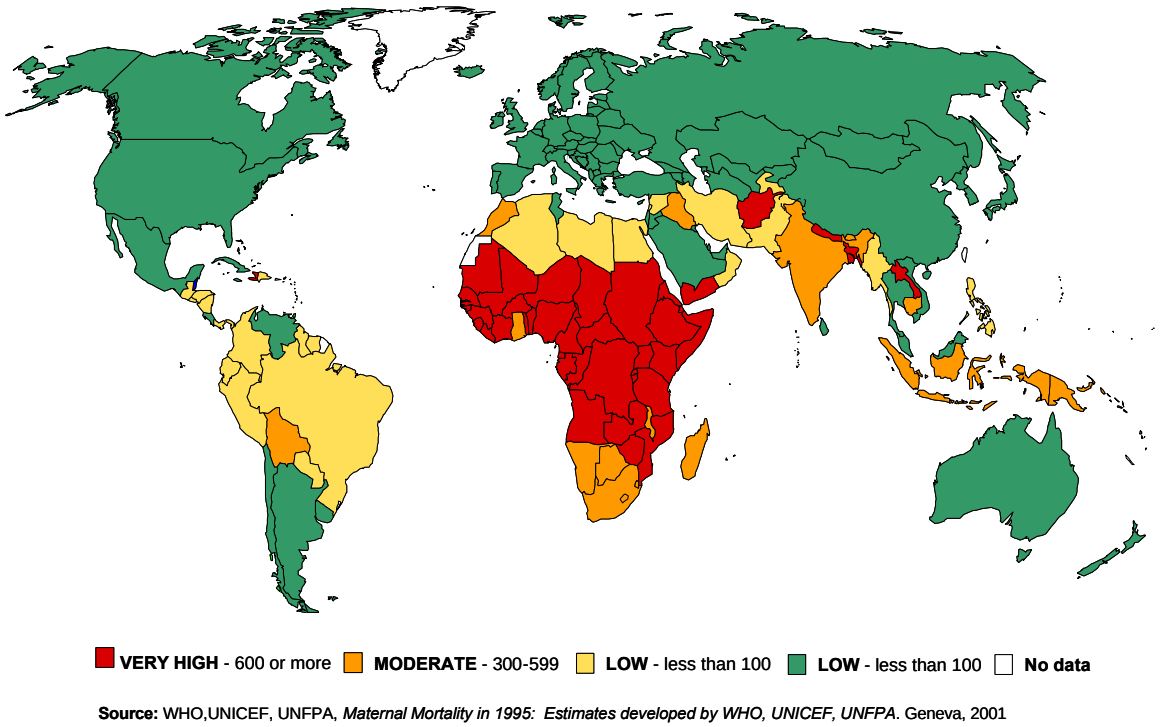

Figure 2. Maternal mortality (per 100 000 live births)

Distribution of under-five mortality is presented in Figure 1 and Table 1. According to FAO statistics, of the 24 000 people who die every day from the consequences of hunger, three-quarters are children under five. That is, 18 000 children under five years of age starve to death every day.[1]

Table 1. Under-five mortality rate (per 1000 live births).[2]

	East Asia	Latin America and Caribbean	Near East/North Africa	South Asia	Sub-Saharan Africa	Developing world
1990–92	55	49	71	121	155	91
1996–98	44	39	56	94	152	81

According to the World Health Organization,[3] the causes of under-five mortality worldwide, ranked by order of importance, are: malnutrition, perinatal causes, acute respiratory infections, diarrhea, malaria, measles, HIV/AIDS, and other non-specific causes. Malnutrition is responsible for over half (54%) of the under-five mortality.

Malnutrition contributes to infant morbidity (illnesses) and mortality, both directly through inadequate intake of calories, protein, and micronutrients and indirectly in synergies with

1 International Food Policy Research Institute. 2002. *Sustainable Food Security for All by 2020: Proceedings of an International Conference, September 4–6, 2001, Bonn, Germany*. IFPRI, Washington, DC.
2 Food and Agriculture Organization. 2000. *The State of Food Insecurity in the World*. FAO, Rome.
3 EPI/WHO 2000.

infections. In 2000, there were 181.9 million stunted (low height for age) preschool children in the developing world, representing 32.5% of all preschool children.[4] Sub-Saharan Africa is the only region where both the numbers and the proportion of malnourished children have been consistently on the rise in recent years.[5] In a study from nine low-income countries in Asia, Gillespie and Haddad[6] concluded that nearly 3 million preschool children in these nine countries die every year, and over half of the deaths are due to malnutrition.

Rosegrant et al.[5] provide three scenarios for estimated child malnutrition in 2020, depending upon the policies and investments that are pursued. The baseline calculation projects 132 million malnourished children in 2020. An "optimistic" calculation would imply 94 million malnourished children; a "pessimistic" scenario increases the number of malnourished children to 175 million. According to the authors, agricultural research is one of the five key areas where investment is necessary if the optimistic scenario is to be achieved.[5]

According to a World Bank consultation,[7] numerous interventions could be effective in reducing child mortality. Household- and community-level interventions would include breastfeeding and complementary feeding of young children, immunization, malaria prevention, and case management for respiratory infections, diarrhea, and malaria. Health-system level interventions would include improved infant and child nutrition, breastfeeding, immunization, and use of bednets (against mosquitoes). Policy-level interventions would include ensuring the availability of essential drugs, and financing mechanisms that help the poor.

In the case of maternal mortality, worldwide more than 500 000 women between the ages of 15 and 49 die every year as a result of complications related to pregnancy and childbirth.[6] Almost all these deaths occur in the developing world, with Africa having the highest maternal mortality (Figure 2). The three main strategies for reducing maternal mortality are: (1) preventing pregnancy; (2) preventing complications from pregnancy; and (3) preventing death when complications arise.

CIP's contribution to reduction of under-five and maternal mortality

Of the possible interventions to reduce under-five mortality, improving infant and child nutrition is the most plausible pathway for CIP to contribute to reduction in child mortality. Among a suite of interventions to reduce childhood malnutrition, a working group on Macroeconomics and Health highlighted the importance of vitamin A supplementation,[8] as did the World Bank's Child Mortality Working Group.[8] Severe vitamin A deficiency has high fatality rates (60%) but even subclinical deficiency is associated with a 23% increase in preschooler mortality in areas with endemic vitamin A deficiency.[6,9]

Worldwide, an estimated 250 million preschoolers are thought to be deficient in vitamin A. This deficiency is one of the most prevalent malnutrition problems in Sub-Saharan Africa, South Asia,

4 DeOnis M, Frongillo EA, and Blossner M. 2000. Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980. *Bulletin of the World Health Organization* 78(1): 1222–1233.

5 Rosengrant MW, Paisner MS, Meijer S, and Witcover J. 2001. *2020 Global Food Outlook: Trends, Alternatives, and Choices*. IFPRI, Washington, DC.

6 Gillespie S and Haddad L. 2001. *Attacking the Double Burden of Malnutrition in Asia and the Pacific*. Asian Development Bank, Manila, The Philippines and IFPRI, Washington, DC.

7 World Bank 2002. Health, Nutrition and Population Development Goals http://www1.worldbank.org/hnp/mdg.asp

8 Nemer L, Gelband H, and Jhan P. 2001. The evidence base for interventions to reduce malnutrition in children under 5 and school-age children in low and middle-income countries. Commission on Macro-economics and Health. Working Group 5, Working Paper 11 htttp://www.cmhealth.org/docs/wg5_paper11.pdf

9 McGuire, 1993. Addressing micronutrient malnutrition. SCN News No. A. Administrative Committee on Coordination; Sub-committee on Nutrition (ACC/SCN), Geneva, Switzerland.

and Southeast Asia. In Sub-Saharan Africa alone 3 million children under the age of five suffer from vitamin A related blindness, a disease known as xerophthalmia or dry eye. Two-thirds of affected children die within months of going blind, mainly because of increased susceptibility to infection associated with insufficient intake of vitamin A. Addressing vitamin A deficiency alone should reduce overall mortality among children under six by nearly 23%.

In the case of maternal mortality, one of the measures to reduce complications from pregnancy is ensuring adequate nutrition among reproductive-age women. Among the micronutrients, plausible biomedical pathways can be drawn between deficiencies in vitamin A and anemia and hypertension in pregnancy, pregnancy-related infections, and obstetric hemorrhage (or bleeding). A number of well-designed intervention trials have shown dramatic reductions in maternal mortality through vitamin A/beta-carotene supplementation. Preliminary studies also suggest a correlation between maternal vitamin A deficiency and elevated risk of mother-to-child transmission of HIV.

Over the last 10 years, the international public health community has made significant strides in combating vitamin A deficiency through supplementation and fortification programs. However, in spite of these efforts, vitamin A deficiency still plagues developing countries. One reason is that these programs cannot easily reach all of the poor households. These households are often in remote areas that are isolated because of inadequate infrastructure and frequent severe weather events that make roads impassable and supplement distribution unsustainable.

Food-based approaches to improving diets and nutrition are particularly relevant for poor households in such marginal environments. They are also more sustainable in the long term as they require far less investment, an important consideration for financially limited health services. Another key to sustainability is that food-based approaches are particularly suited to the target populations (children and women in poor households) in these environments. Family- and community-based approaches provide a sustainable way of ensuring nutritional well-being of mothers, children, and other family members over the longer term[7] because they build on the capacity of women as key agents for converting agricultural production into income and nutritional benefits, and the capacity of men as economic actors and producers.

Sweetpotatoes are widely grown in Eastern and Southern Africa as a food security crop. Approximately 900 000 hectares are planted in Kenya, Uganda, and Tanzania. Most production, however, is derived from white- or cream-colored landraces that are adapted to local growing conditions and meet consumer preferences for taste and texture.

Beta-carotene-rich varieties of sweetpotatoes can provide an inexpensive, year-round dietary source of vitamin A for communities at risk for micronutrient deficiency. Because of the high content of beta-carotene in orange-fleshed sweetpotato, the recommended daily allowance of vitamin A for any age group (>600 µg retinol equivalents) can be readily acquired by consuming 100 g of these sweetpotato roots, either freshly cooked or as processed food products. Moreover, vitamin A can be stored in the liver, which enables consumers to build reserves that tide them over in periods when they are unable to eat carotene-rich food.

Experience has shown that African sweetpotato farmers, most of whom are women, will adopt orange-fleshed varieties if they are convinced that they are good for their children and if the cultivars perform well in the field and have acceptable taste. Studies have further shown that consumers are primarily concerned with taste, texture, and dry-matter content, and not with color per se. Sweetpotato cultivars that are acceptable to African consumers, especially children, have been identified.[10]

10 Low J, Kinyae PK, Gichuki S, Hagenimana V, Oyunga MA, and Kabira J. 1996. Combating Vitamin A Deficiency through the Use of ß-carotene-rich Sweetpotato Varieties: Results from Phase I of an Action Research Project in South Nyanza, Kenya. CIP, Lima, Peru.

In May 2001, CIP launched the Vitamin A for Africa (VITAA) Partnership in collaboration with the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) and South African Center for Cooperation in Agricultural Research and Natural Resources (SACCAR). VITAA is coordinated by CIP and governed by a Steering Committee that includes experts in the areas of agriculture, nutrition, health, and gender.

VITAA's agenda consists of a coordinated set of activities in the major sweetpotato-producing countries of Eastern and Southern Africa. Its principal objective is to promote wide-scale production and consumption of orange-fleshed sweetpotatoes, and to create a platform for complementary use of other micronutrient-rich foods, e.g. mineral-rich beans and yellow-fleshed cassava, as they become available.

Specific objectives for CIP's research program

Further research is needed in order to maximize CIP's contribution to reducing under-five and maternal mortality through the wide-scale production and consumption of orange-fleshed sweetpotato. The objectives for CIP's research and development program should include: (1) improving the understanding of the genetic diversity of sweetpotato held in trust in CIP's genebank; (2) continuing development of new orange-fleshed sweetpotato varieties, with enhanced nutritional qualities, pest (sweetpotato weevil) and disease (sweetpotato virus) resistance, and traits that will meet quality/preference standards; (3) conducting bioefficiency studies with target populations; (4) expanding field trials with producers in target areas, using participatory evaluation and selection; and (5) developing integrated public awareness, nutrition education, and seed distribution strategies.

An ex-ante impact assessment[11] has indicated that orange-fleshed sweetpotato can make a major contribution to alleviating vitamin A malnutrition in Sub-Saharan Africa. Replacing the white-fleshed sweetpotato varieties now grown by farmers with new high-beta-carotene varieties that meet local preferences would benefit the estimated 50 million children under the age of six currently at risk in sub-Saharan Africa alone (Figure 3). Additional benefits would accrue to pregnant and lactating women in these areas. Impact indicators need to be established, with monitoring and evaluation in the Sub-Saharan target countries. Ex-ante studies in South Asia and Southeast Asia would determine if this work should be expanded to other regions, building on the model and experience of the VITAA partnership.

Implications for CIP's Vision

Research and development activities in the areas of agriculture and human health have been compartmentalized for far too long. CIP has been conducting research on the potential contributions of agricultural production to human health (e.g. alleviation of vitamin A deficiency through the use of orange-fleshed sweetpotato and development of weaning foods) as well as research to understand the risks of agricultural production on human health (e.g. pesticide abuse) and searching for solutions to the risks (integrated pest management). The TradeOff Analysis research partnership, in which CIP has participated, has focused on modeling and elucidating the linkages among agricultural production, human health, and ecosystem (environmental) health.

The CIP Vision Plenary, in challenging the Center to contribute to the reduction of child and maternal mortality, is also challenging the Center to explicitly place "health and agriculture" on the

11 Low J, Walker T, and Hjimans R. 2001. The potential impact of orange-fleshed sweetpotato on vitamin A intake in Sub-Saharan Africa. Paper presented at VITAA Stakeholders' Meeting, May 9–11.

research and development agenda to better understand how agricultural production activities can directly contribute to improved human health and well-being.

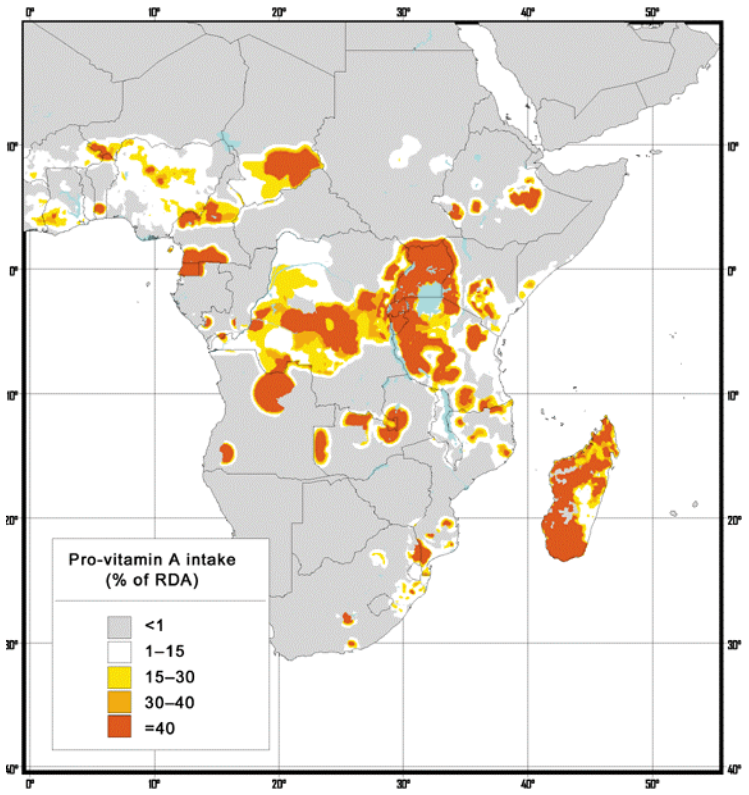

Figure 3. Potential impact of replacing white-fleshed sweetpotato with orange-fleshed varieties on pro-vitamin A intake in Sub-Saharan Africa

Challenge 4

CIP can contribute to integrating the principles of sustainable development into country policies and programs and to reversing the loss of environmental resources

Charles Crissman, Roberto Quiroz, Héctor Cisneros, Carlos León Velarde, Hugo Li-Pun, and David Yanggen

Problem and background

Sustainable agricultural development is at the core of the CGIAR mission. The research programs of the Centers have historically emphasized their contribution to this objective through increased crop yields, which has had tremendous impact through increases in food supplies and reductions in the rate of expansion of the agricultural frontier, especially in Asia and to some extent in Latin America. Nonetheless, focusing only on increased food supply could produce a net negative impact in the long run. It is important therefore to consider, in this light, the compatibility of agricultural growth with conservation of the natural resource base in specific ecological zones and countries.[1] The biggest problem appears to be land and water degradation, which decrease crop yields and increase food costs, pushing many into poverty. This presents a major challenge of developing policies, institutions, and technologies that can make the goals of agricultural growth, poverty alleviation, and sustainable natural resource use compatible.

Concepts of sustainability

The Brundtland Commission[2] formulated the concept of sustainable development more than 10 years ago. They defined it as development that meets the needs of present generations without compromising the ability of future generations to meet their needs. The major obstacles to sustainable development can be reduced to three basic categories: willingness, understanding, and capacity. A lack of political will to implement the changes needed is the first obstacle. But even if there is political will, a lack of understanding of the behavior of complex systems constitutes a second obstacle. The third obstacle—insufficient capacity to implement the changes needed—is of particular importance particularly in poor areas.

Sustainable systems need to be resilient. Resilience refers to a system's capacity to buffer perturbations, self-organize, learn, and adapt.[3] A resilient agro-ecosystem is one that can cope with disturbances such as droughts, floods, frosts, and pollution without shifting into a qualitatively different state. A resilient system has the capacity to absorb shocks and adapt to change while maintaining function.[3] Resilience of people's livelihoods depends on their capability to adapt to internal and external shocks and stresses.[4] Diversified livelihood strategies contribute to the capacity to withstand shocks in less-favored environments. Factors that contribute to the resilience

1 Vosti SA and Reardon T. 1997. Introduction: The critical triangle of links among sustainability, growth, and poverty alleviation. In *Sustainable, Growth, and Poverty Alleviation. A Policy and Agroecological Perspective*, edited by SA Vosti and T Reardon, pp. 1–15. IFPRI/The Johns Hopkins University Press.

2 World Commission on Resilience Alliance. 2003. Sustainability. http://www.resalliance.org

3 Folke C, Carpenter S, Elmqvist T, et al. 2002. Resilience and sustainable development: building adaptive capacity in a world of transformations. Scientific Background Paper on Resilience for the Process of The World Summit on Sustainable Development on behalf of The Environmental Advisory Council to the Swedish Government.

4 Chambers R and Conway GR. 1992. *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*. Discussion Paper 296. Institute of Development Studies, London.

of the people living in these areas are the control of assets, as well as the capacity for collective action and for negotiating with markets in order to capture the stream of benefits from capital and labor.[5] These capabilities are shaped or mediated by culture, society, policies, resource endowments, environment, and global markets.

Because management of a system can either diminish or increase resilience, managing complex social–ecological systems for sustainability requires an approach other than "informed trial and error". Adaptive Management—an approach to environmental management that identifies uncertainties and establishes methodologies to test hypotheses concerning these uncertainties—is called for. Adaptive Management is not only a tool to change the system, but also to learn about the system.[2]

CIP's contribution to sustainable development

CIP's research on roots, tubers, and related natural resources management has contributed positively towards sustainable development in rural areas through development and provision of improved root and tuber crops, crop management practices, ecosystem management options, and institutional frameworks and policies.

Better roots and tubers

CIP has introduced new potatoes and sweetpotatoes and other root and tuber crops to farmers in cropping systems around the world. This contributes to sustainable development by: broadening the genetic base of root and tuber crops and stimulating the utilization of the genetic resources of these crops; improving resistance and tolerance to pests and diseases, resulting in enhanced resilience and reduced use of agrochemicals; raising yields, thereby allowing the sustainable intensification of agriculture by reducing expansion into marginal areas, and increasing overall farm productivity; and providing for the return of root and tuber varieties to places where these have been lost to political, social, and natural disturbances.

Better crop management

CIP's work in crop management stimulates the transition from labor- or capital-intensive farming to knowledge-based systems. For example, by integrating biological control mechanisms with traditional chemical control through integrated pest/crop management, reductions in the use of chemical inputs are achieved, while farm productivity is increased. This results in reduced toxicity risks in association with crop production and thereby, improved human and ecosystems health.

Better ecosystem management

Natural resources management research at CIP focuses on studying the interrelations of soil, water, plants, and animals with decision making in and for mountain environments, so as to obtain a better understanding of the biophysical and socio-economic processes directly impinging on the livelihoods of mountain dwellers. It also identifies constraints to and low-risk innovations for improving sustainable crop–livestock production systems. Decision-support tools and methods that allow for the integration of biophysical and socio-economic information have been developed,

5 Valdivia C and Gilles JL. 2001. Gender and resource management: Households and groups, strategies and transitions. *Agriculture and Human Values* 18(1): 5–9.

tested, and used in various development projects. Management practices and policy recommendations for alleviating poverty and making mountain production systems more sustainable have also been tested and made accessible to national agricultural research systems and other partners.

Mountain farmers cope with extreme climatic and market uncertainties. CIP has documented these, and has devised risk-reducing technological alternatives and validated them at the farm level. These technological alternatives—including drought- and frost-tolerant potato and quinoa varieties, improved pasture and dairy-herd management methods, and transformation of crop and livestock products—have helped to create employment opportunities and reduce poverty. Furthermore, multimedia technology for collaborative research, distance learning, and for decision-making support through modeling of integrated watershed management options have been developed and tested.

Better institutions

CIP's research and training activities and the convening role carried out in various initiatives have resulted in stronger rural institutions, improved conditions for investment, and empowered individuals and communities. In the process, synergies have been built, linkages have been established with development projects and, as a result, better targeting and returns to investments have been achieved.

Specific objectives for CIP's research program

Targeting environmentally vulnerable areas

The geographical targeting described in Challenge 1, as relevant to sustainable development, implies targeting systems in less-favored areas. As stated by Pender and Hazell,[6] less-favored areas include lands that have low agricultural potential because of limited and uncertain rainfall, poor soils, steep slopes, or other biophysical constraints, as well as areas that may have high agricultural potential but have limited access to infrastructure and markets, low population density, or other socio-economic constraints (Figure 1). A rough definition of less-favored areas will be used to start CIP's targeting exercise (Figure 2). The use of new climate-interpolation process-based models developed by CIP and its partners as well as new tools and methods to downscale soil maps are a few innovations that will help to fine-tune the targeting of less-favored areas as we move forward.

Priority setting will be aided by a better assessment of the vulnerability of the social–ecological systems related to CIP's mandate. Environmental threats assume diverse forms across agro-ecological zones. In general, agro-ecological zones are characterized according to rainfall and solar radiation patterns during the cropping season. Other layers, such as soil erosion, biodiversity loss, and agricultural pollution, can be added. The current ability to simulate crop production under climate change scenarios, as well as the concomitant impact on environmental variables such as soil erosion, will greatly improve our capacity to map the vulnerability of systems.

6 Pender J and Hazell P, 2000. *Promoting Sustainable Development in Less-favored Areas. A 2020 vision for Food, Agriculture, and the Environment*. IFPRI, Washington, DC.

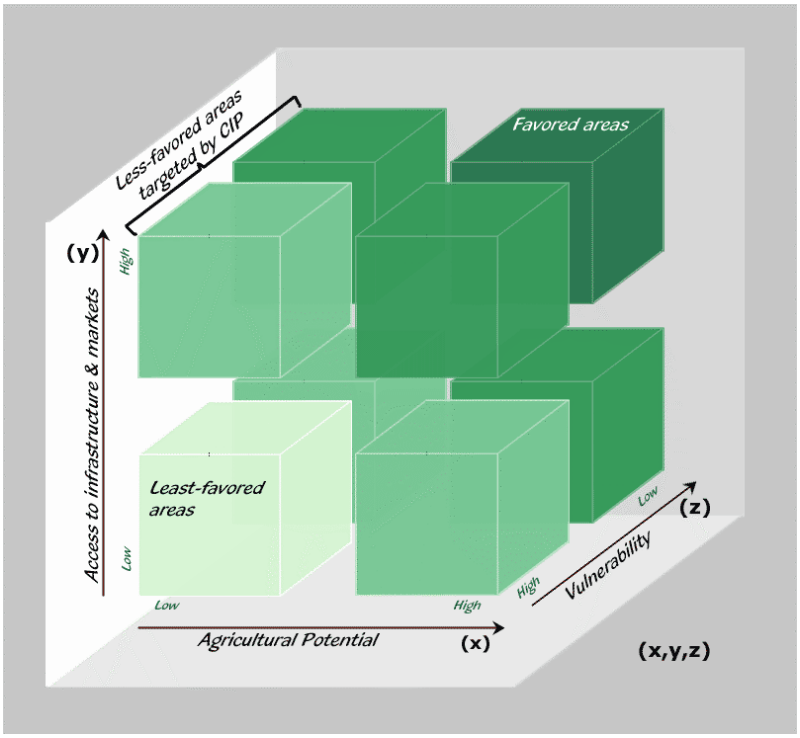

Figure 1. Classification of favored and less-favored areas (modified from Pender and Hazell, 2000).[6]

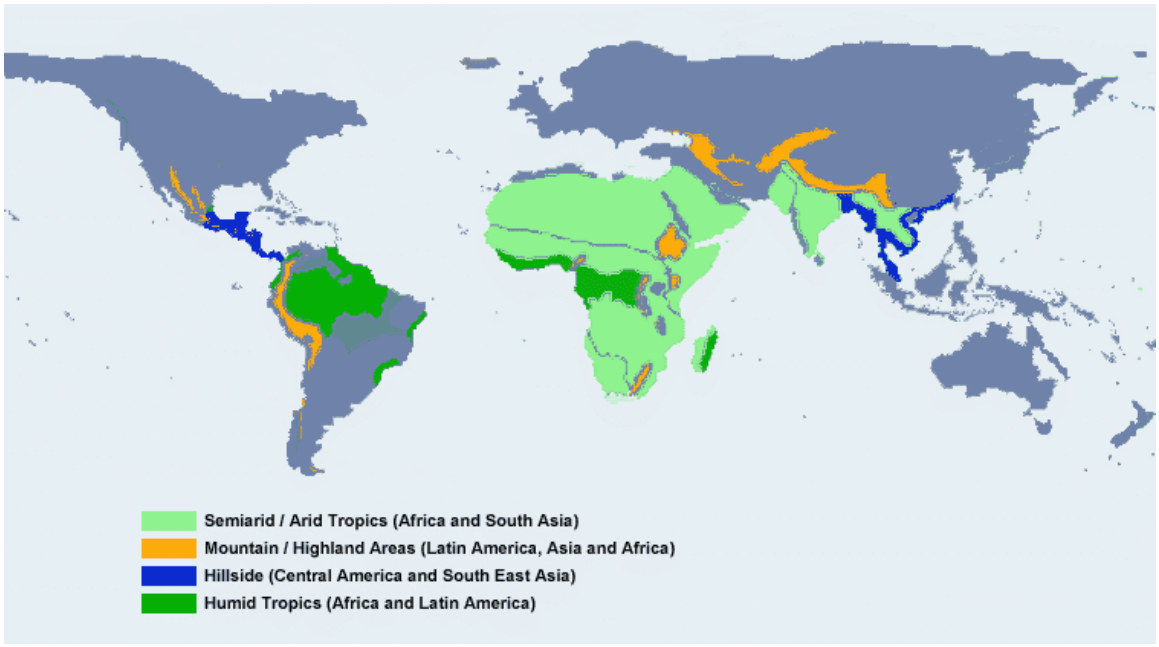

Figure 2. Less-favored areas of the world.

Building resilient systems

Until quite recently, research aimed at improving the circumstances of the poor who depend on agriculture focused mostly on the ecological, economic, or social determinants of poverty. When social determinants were studied, humans were regarded as managers of, but not a part of the subject system per se. More recent inquiry has shown that the interaction among these determinants is as important as, or even more important than the individual determinants per se. CIP will focus attention on the interactions among ecological, economic, and social factors to develop livelihood strategies for the poor living in environmentally vulnerable areas. The identification and assessment of the processes and drivers determining the dynamics of targeted systems, and the development of resilience-building management strategies, will help to build the adaptive capacity in these systems to sustain livelihoods and respond to change.

Adaptive capacity

The ability of a socio-ecological system to cope with novel situations without losing options for the future is key to the sustainability of the system. Baseline adaptation analyses will be conducted for CIP's targeted systems, including: identifying the shocks, vulnerabilities, and extreme outcomes within the system; understanding the frequency and variation of these disturbance events; determining capacity to innovate to cope with changes; and determining the capacity of institutions to implement favorable policies and adaptive management.

Implications for CIP's Vision

Impact targeting will be improved by adding environmental vulnerability to the development challenges (poverty, hunger, child/maternal mortality) and crops layers. The definition of particular target systems and disturbances, and of the ways in which each system can adapt better to these disturbances and surprises, will facilitate the definition of the technologies, policies, and institutions required to build resilience.

Modeling resilience and the adaptive capacity of complex systems will facilitate prototyping the technologies required for each system. This will increase the cost-effectiveness of the research process. Modeling across spatial and temporal scales will also facilitate the extrapolation of technologies as well as the assessment of the impact that disturbances such as climate change are expected to have, on crops in particular and on systems in general.

In the interpretation of this Millennium Development Target, we take into consideration both the need to influence country policy and programs and to reverse the degradation of the environment. Thus achievement of the target implies that CIP should work for both direct impacts through technology and management improvements and indirectly through influencing policies and programs that affect sustainable development. We choose to adopt a broader vision of sustainability to include both economic and social aspects in addition to environmental aspects. There will be a need to strengthen policy research and advocacy. In policy we perceive that CIP and its partners can influence policy and programs at various levels including national, regional, community, and even farm.

Challenge 5

CIP can contribute to achieving a significant improvement in the lives of at least 100 million slum dwellers by 2020

Gordon Prain, Michael Hermann, Diana Lee-Smith, and María Scurrah

Problem and background

Nearly half the world's population is now urban, and another 1.5 billion people will be living in cities by 2020 (Figures 1 and 2). During the post-World War II "development decades", economists considered poverty to be a largely rural phenomenon, with city dwellers benefiting from an "urban bias" in the distribution of resources.[1] However, population growth and migration over the past 30 years, as well as structural adjustment policies introduced in the 1980s, have undermined whatever urban bias had existed.[2]

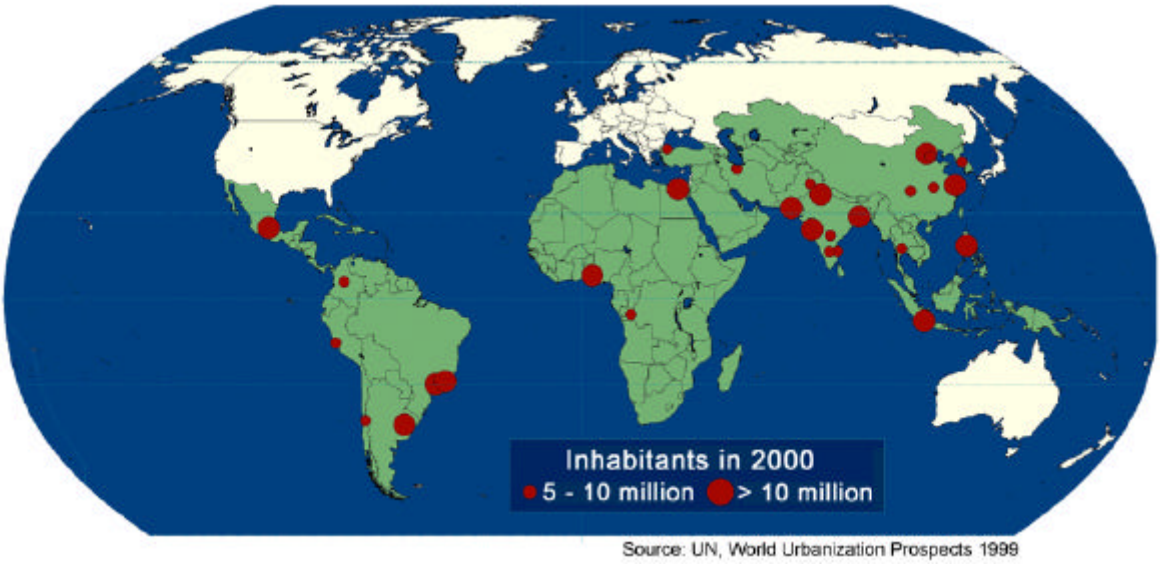

Figure 1. Megacities in the developing world.

1 Lipman M. 1977. *Why Poor People Stay Poor*. Harvard University Press, Cambridge, MA.
2 Maxwell D. 1998. *The Political Economy of Urban Food Security in Sub-Saharan Africa*. FCND Discussion Paper No. 41. IFPRI, Washington, DC.

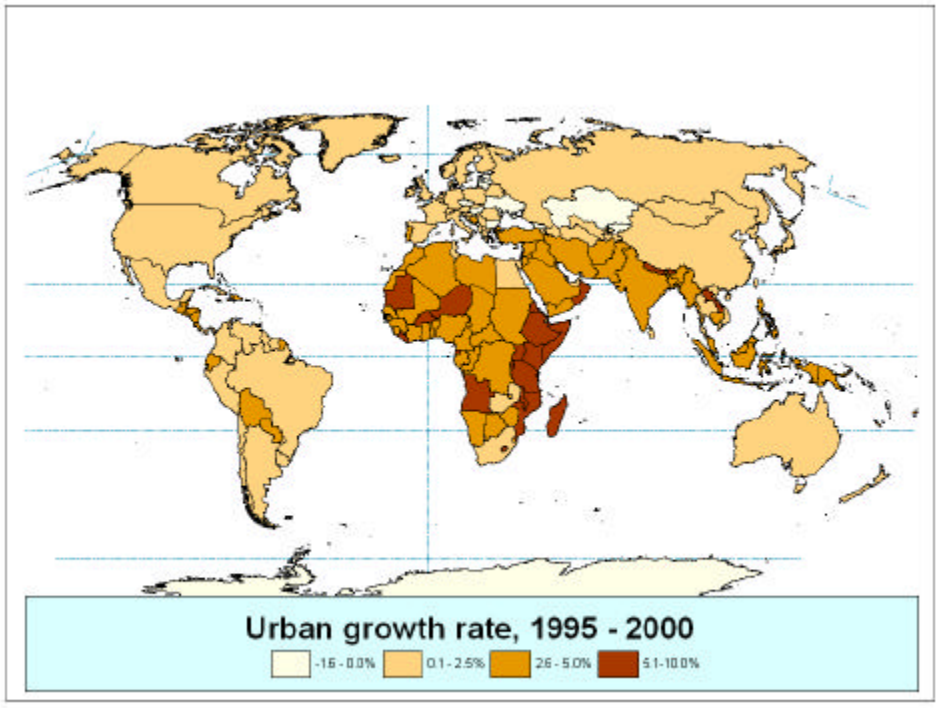

Figure 2. Urban growth rate, 1995–2000.

Today, in absolute global terms, the majority of developing-country poor people continue to be rural. However, this no longer holds true for Latin America, where the urban share of poverty has dramatically increased, from 37% in 1970 to 62% in 1997.[3] Similar changes are occurring in Africa and Asia. In Africa, approximately 40% of the poor are now urban, although there is considerable variation among countries.[4] In Asia, rapid urbanization in populous countries such as Bangladesh has led to 15 million poor people, almost 24% of the total poor, living in urban areas.[5]

Despite the limited availability of poverty data disaggregated for urban populations[6] and the even fewer datasets that permit analysis of trends, it is still clear that urban poverty is growing steadily and significantly. In a recent analysis of newly assembled data, IFPRI showed that in seven out of eight countries where longitudinal data exist, there is an increase in the proportion of poor people in urban areas. The countries where urban poverty is increasing are home to two-thirds of developing-world people.[7] Even these dramatic trends understate the growth in urban poverty because of the way national statistics on poverty are calculated, failing to take into consideration the higher costs of nonfood items such as transportation, education, health care, water, and sanitation in and around cities.

3 Comisión Económica para América Latina y el Caribe (CEPAL). 1999. Panorama Social de América Latina, LC/G.2050-P. Santiago de Chile.
4 United Nations Centre for Human Settlements. 2001. *The State of the World's Cities*. UN, New York.
5 World Bank. 2002. World development indicators. http://www.worldbank.org/data/onlinedatabases/onlinedatabases.html; Asian Development Bank. 2002. Indicators of developing Asian and Pacific countries. http://www.adb.org/Documents/Books/Key_Indicators/2002/rt01.xls
6 The WDR 2000/01 on Poverty provided very little disaggregated data (World Bank 2000).
7 Haddad L, Ruel M, and Garrett J. 1999. Are urban poverty and undernutrition growing? Some newly assembled evidence. *World Development* 27(11).

By 2020, 4.3 billion people will need shelter, food, and employment in urban areas. There is a correlation between urban poverty and vulnerability to environmental problems such as lack of water, poor sanitary conditions, waste disposal, and exposure to contaminants.[8] There is also evidence that the urban poor and those living around cities are exposed to a "double health burden", i.e. the communicable diseases typical of rural areas and the noncommunicable "lifestyle" diseases typical of the urban transition.[9] Of particular concern are the megacities in the South, each with a population exceeding 10 million (Figure 1). Congestion and overcrowding in these cities contribute to problems associated with access to food, poor air quality, and worsening psychosocial health. Urban poverty is linked to individual human health, community health, and the health and sustainability of the environment.

Yet while most urban areas in the developing world suffer problems of growing poverty and a deteriorating environment, cities are also experiencing new concentrations of wealth, a phenomenon that brings with it increased demand for a wide range of crops and fruits, flowers, shrubs and ornamental trees, livestock products, and processed products.[10] Some of these products are highly perishable or are easily damaged in transport, giving urban production an advantage over rural production. Poor urban residents with access to small amounts of land can take advantage of emerging markets, to increase their own income and food security.

The fundamental challenge to improving the lives of slum dwellers consists of developing healthy, resilient urban ecosystems where slum dwellers are able to capture the opportunities of emerging urban markets while minimizing the risks associated with urban and peri-urban production.

CIP's contribution to the improvement in the lives of slum dwellers

In 1999, to begin addressing this challenge, and based on social science evidence that increasing numbers of the urban poor are engaging in agriculture as a poverty alleviation strategy, the CGIAR established the Strategic Initiative on Urban and Peri-urban Agriculture (SIUPA). This CGIAR Systemwide Program, now known as Urban Harvest, is led by CIP.

Since 1999, Urban Harvest has initiated research and development projects in Manila, Hanoi, Nairobi, Kampala, Yaounde, and Lima, through partnerships with four other International Research Centers (the Asian Vegetable Research and Development Center, the International Center for Tropical Agriculture, the International Livestock Research Institute, and the International Institute of Tropical Agriculture), four donor partners (the World Bank, Canada's International Development Research Centre, the Canadian International Development Agency, and Spain), nongovernmental organizations (NGOs), and six municipal governments.

Specific objectives for CIP's research program

CIP will continue to provide leadership to research and development activities that affect the well-being of urban and peri-urban slum dwellers through the global Urban Harvest program. Enhanced contribution to impact will be achieved through improved targeting, based on several priority criteria.

8 Hardoy JE and Satterthwaite D. 1989. Environmental Problems of Third World Cities: A Global Issue Ignored. IIED, London.

9 HABITAT 2001. Cities in a Globalizing World: Global Report on Human Settlements. Earthscan, London. Also Birley M and Lock K. 1999. Health Impacts of Peri-urban Natural Resource Development. Liverpool School of Tropical Medicine, Liverpool.

10 Moustier P. 1998. Definitions et contours de l'agriculture périurbaine en Afrique subsaharienne. In *Agriculture périurbaine en Afrique subsaharienne*. CIRAD, Montpellier.

Urban and peri-urban areas with large numbers of slum dwellers. The urban poor account for 62%, 40%, and 24% of the share of poverty in Latin America, Africa, and Asia, respectively. Figure 1 shows the global distribution of megacities (5–10 million inhabitants, and more than 10 million inhabitants).

Countries with high rates of urbanization. Beyond absolute numbers (i.e. the megacites), urban areas with high rates of urbanization will be prioritized for study and intervention. In this respect, Africa stands out as meriting high priority (Figure 2). With current and projected urbanization rates, food security and environmental problems are likely to worsen on the African continent.

Women and young children as populations heavily engaged in urban and peri-urban agriculture. Women and young children will be key target populations. Women are frequently the major actors in urban and peri-urban systems. Women and children are also the most vulnerable groups in slum settings, frequently exposed to negative health impacts from both the agricultural and nonagricultural environment. The under-five mortality rate is a widely accepted indicator for urban poverty and slum conditions. Based on under-five mortality, priority would be given to the African and South Asian regions, and to a lesser extent to Southeast Asia.

Crop-specific impacts. For CIP, impacts on urban and peri-urban agriculture which could be made through sweetpotato or potato production would be prioritized. Sweetpotato will be an increasingly important crop for urban and peri-urban agriculture in Africa. Sweetpotato is a vehicle for delivering micronutrients, especially beta-carotene, and is appropriate as a low-labor and low-input crop for orphan-headed households and for households with multiple livelihood activities.

South Asia, an area with high levels of poverty, high rates of urbanization and where potato is already a high value vegetable, will be increasingly targeted for potato production. Potato is a viable cool season urban and peri-urban crop around cities such as Dhaka, but early maturing varieties, pest resistance, and innovative seed systems will be vital. A secondary target will be Eastern Europe and Central Asia, where urban and peri-urban production of potato as a staple food is well established, but where several constraints exist.

In addition to targeting specific cities and populations, research on urban and peri-urban agriculture will need to address several specific themes, to increase understanding and impact.

Understanding rural–urban linkages. Attempts to provide greater analytical clarity to the distinction between rural and urban areas have used both spatial and sectoral definitions. It is difficult to provide unambiguous, analytical distinctions between the rural and the urban; there are flows of people, goods, knowledge, and information between the two that suggest that it is more important to look at their interdependence rather than their separation. An obvious and important set of flows involves agricultural produce in rural areas moving to urban markets, and the converse flow of agricultural inputs such as fertilizers, pesticides, and some types of seed from urban centers to markets in rural areas. But flows are also related to household livelihood strategies, including the existence of multi-household families exchanging food, remittances, information, and other resources between rural and urban residences, sometimes with agriculture practiced in both locations. Analysis of rural–urban linkages can help us to understand where improvements in rural-to-urban food flows can best contribute to better food security among the urban poor and where opportunities exist for urban food production to make a complementary contribution—either directly or via income opportunities—to household food security.

Development of "models" of non-crop-specific interventions that can be widely applied across regions and systems. Impact on the well-being of slum dwellers will not be achieved through an aggregate of small projects in distinct locations. In addition to targeting specific urban centers and priority populations, it will be necessary to develop process models for how to study, understand,

and intervene in urban environments. Modeling of agro-processing clusters as systems for urban and peri-urban income generation will be one way of doing this.

Identification of enabling policy environments. It will be essential to identify and foster enabling policy environments at the local and national levels in order to promote sustainable local food production, transformation and marketing. Impact on policies will be fostered through analyses of policies and regulations affecting urban and peri-urban agriculture, the promotion of dialog with stakeholders around the results of these analyses, and the active development of policies options with those stakeholders.

Identification of the necessary partnership framework. Identification of the critical composition of urban partnerships (e.g. local municipal authorities, women leaders, community leaders, youth groups, child advocacy groups, NGOs, technical colleagues, etc.) will assist in achieving desired, sustainable impact on the well-being of slum dwellers and in particular the prioritized target populations.

Strategic and targeted capacity building to strengthen the potential for scaling out of experiences. A strategy for sharing and scaling out successful process models, policy lessons, and partnership structures will expedite and enhance impacts through other urban partnership projects (e.g. Cities Feeding People, Resource Centre on Urban Agriculture and Forestry, UNDP Habitat).

Implications for CIP's Vision

Poverty alleviation, hunger alleviation, human health, and sustainable development are issues that can no longer only be addressed in the rural sector. These development challenges also apply to the urban environment, where poverty is expected to increase significantly in the coming decades. Through novel partnerships, research and development must take on the challenge of agricultural production in urban and peri-urban environments.

Challenge 6

CIP can contribute to addressing the special needs of the least developed countries

Coen Bussink, Nicole Adler, Enrique Chujoy, Andre Devaux, Stef de Haan, Ramzy El-Bedewy, and Ednar Wulff

Problem and background

The least developed countries (LDCs) are a group of countries that have been identified by the United Nations as "least developed" in terms of their low gross domestic product (GDP) per capita, their weak human assets and their high degree of economic vulnerability. Most of these countries show persuasive and persistent extreme poverty rates.[1] The incidence of poverty is so high because most of the LDCs are caught in an international poverty trap. International trade and finance relationships reinforce the cycle of economic stagnation and poverty.

At this moment there are 49 countries identified as LDCs, which are mainly located in Africa and South/Southeast Asia. In Latin America only Haiti is a LDC (Figure 1 and Table 1).

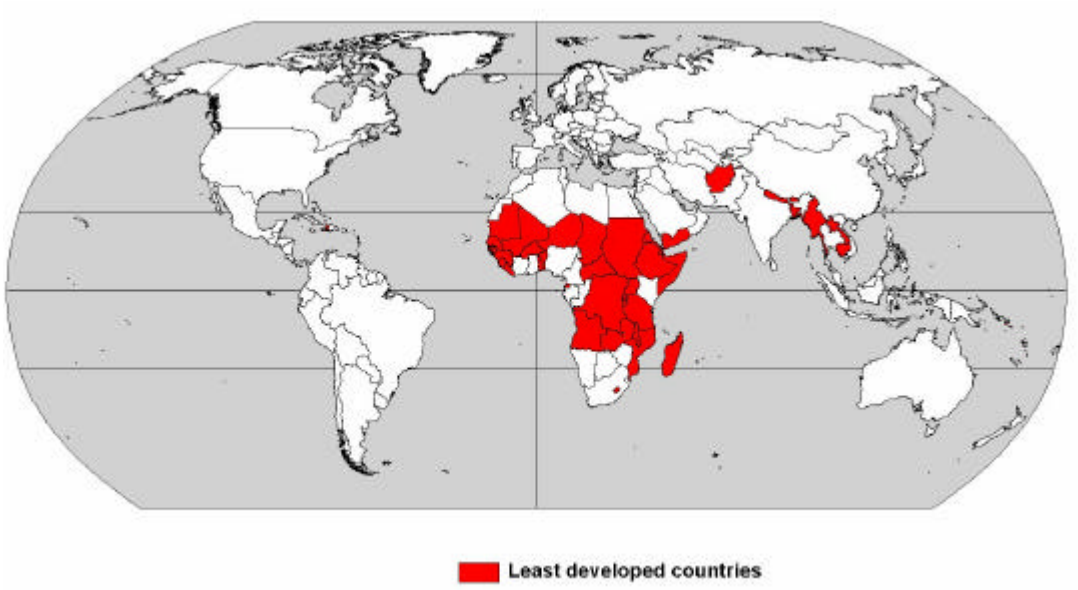

Figure 1. The least developed countries in the world.

1 UNCTAD. 2002. *The Least Developed Countries, 2002 Report—Escaping the Poverty Trap*. www.unctad.org.

Table 1. The least developed countries

Afghanistan	Gambia	Rwanda
Angola	Guinea	Samoa
Bangladesh	Guinea Bissau	Sao Tome and Principe
Benin	Haiti	Senegal
Bhutan	Kiribati	Sierra Leone
Burkina Faso	Lao People's DR	Solomon Islands
Burundi	Lesotho	Somalia
Cambodia	Liberia	Sudan
Cape Verde	Madagascar	Togo
Central African Rep.	Malawi	Tuvalu
Chad	Maldives	Uganda
Comoros	Mali	United Rep. of Tanzania
DR of Congo	Mauritania	Vanuatu
Djibouti	Mozambique	Yemen
Equatorial Guinea	Myanmar	Zambia
Eritrea	Nepal	
Ethiopia	Niger	

In its latest triennial review of the list of LDCs in 2000, the Economic and Social Council of the UN used the following three criteria for determining the new list, as proposed by the Committee for Development Policy:

1. *a low-income criterion*, based on a three-year average estimate of the GDP per capita (under $900 for inclusion, above $1035 for graduation)
2. *a human resource weakness criterion*, involving a composite *augmented physical quality of life index* (APQLI) based on indicators of: (a) nutrition; (b) health; (c) education; and (d) adult literacy
3. *an economic vulnerability criterion*, involving a composite *economic vulnerability index* (EVI) based on indicators of: (a) the instability of agricultural production; (b) the instability of exports of goods and services; (c) the economic importance of non-traditional activities, e.g. share of manufacturing and modern services in GDP; (d) merchandise export concentration; and (e) the handicap of economic smallness as measured through the population in logarithm

The UN has identified the needs that require more international support to LDCs. According to the UN these special needs are:

1. tariff- and quota-free access for LCD exports
2. an enhanced program of debt relief for highly indebted poor countries, and cancellation of official bilateral debt; and
3. more generous development aid for countries committed to poverty reduction.

CIP's contributions to the LDCs

The presence of CIP in the world is illustrated in Figure 2 and presented in Table 2. These are the countries where CIP has research activities and/or partnership projects, e.g. Urban Harvest, CONDESAN, VITAA, UPWARD, PRAPACE, SARRNET, PRECODEPA, and PapaAndina. Of the 48 countries where CIP research and partnership projects are active (Table 2), 18 are LDC countries.

Characterization as an LDC is based primarily on poverty indicators and, as such, this Millennium Development Target represents a special case of poverty alleviation. CIP's contribution to poverty alleviation has been addressed in Challenge 1.

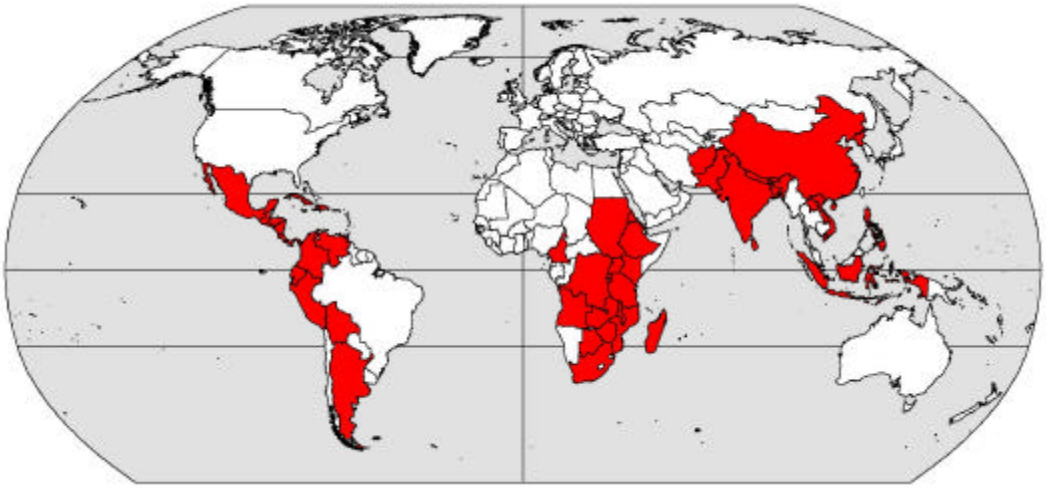

Figure 2. Countries where CIP participates in research activities and partnership projects.

Table 2. Countries where CIP participates in research activities and partnership projects (LDCs in bold).

Afganistán	**Eritrea**	Panama
Angola	**Ethiopia**	Peru
Argentina	Guatemala	Philippines
Bangladesh	**Haiti**	**Rwanda**
Bhutan	Honduras	South Africa
Bolivia	India	Sri Lanka
Botswana	Indonesia	**Sudan**
Burundi	Kenya	**Tanzania**
Cameroon	**PDR Lao**	**Uganda**
China	**Madagascar**	Venezuela
Colombia	**Malawi**	Vietnam
DRC Congo	Mexico	**Zambia**
Costa Rica	**Mozambique**	Zimbabwe
Cuba	**Nepal**	Pakistan
Dominican Republic	Nicaragua	Panama
Ecuador	North Korea	
El Salvador	Pakistan	

Specific objectives for CIP's research program

Comparison of Tables 1 and 2 indicates that there are 30 LDCs where CIP is currently not active: Benin, Burkina Faso, Cambodia, Cape Verde, Central African Republic, Chad, Comoros, Djibouti, Equatorial Guinea, Gambia, Guinea, Guinea Bissau, Kiribati, Lesotho, Liberia, Maldives, Mali, Mauritania, Myanmar, Niger, Samoa, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, Togo, Tuvalu, Vanuatu, and Yemen. These countries are predominantly in Africa and Southeast Asia-Oceania.

If further analysis indicates that CIP's mandate crops could serve as vehicles to impact on Development Targets (e.g. poverty, hunger, child/maternal mortality), then at least two strategies could be contemplated. Partnership projects, which are coordinated by CIP or in which CIP actively participates, could be encouraged to broaden their networks to include the geographically relevant LDC countries. Another alternative for working with LDCs would be the implementation of special country projects with restricted (bilateral) funding for responding to specific needs.

There has been a notable decrease of the proportion of development aid allocated to external assistance to agriculture in LDCs (Table 3). Where appropriate, CIP could lobby with LDCs to increase development aid commitment to research and development for poverty reduction, hunger alleviation, and mortality reduction.

Table 3. External assistance to agriculture (EAA) in LDCs, 1981–1999[2]

Period	EAA (current $, million)	Share of EAA in total assistance (%)
1981–1990	2518	19.6
1991–1999	2014	13.1

Implications for CIP's Vision

The LDCs have been defined primarily based on poverty indicators. As such, the contributions to address the special needs of the LDCs should be considered as a special case of poverty alleviation (Challenge 1).

CIP does not have a comparative advantage to address the first two special needs that were identified by the UN for more international support to the LDCs, i.e. through tariff- and quota-free access for exports, and debt relief. However, CIP is in a position to lobby to either bring LDCs into existing partnership projects and/or jointly lobby with LDCs to increase aid commitment to research and development for poverty reduction, hunger alleviation, and mortality reduction. The latter is consistent with CIP's Vision and with Special Need 3, more generous development aid for LDCs, set out by the United Nations.

2 UNCTAD. 2002. The Least Developed Countries, 2002 Report—Escaping the Poverty Trap, Part 2 Ch. 6. www.unctad.org.

Challenge 7

CIP can contribute, in cooperation with the private sector, to making available the benefits of new technologies, especially information and communications technologies

Marc Ghislain, Roberto Quiroz, Carlos Alonso, Merideth Bonierbale, Anthony Collins, Fernando Ezeta, Christine Graves, Greg Forbes, Aziz Lagnaoui, Charlotte Lizarraga, Patricio Malagamba, Ana Maria Ponce, Reinhard Simon, and Regula Zuger

Problem and background

Technology is understood here as any combination of techniques, protocols, or procedures used to achieve one's goals. Generally, technologies developed through agricultural research have included tangible products and processes that include crop varieties, diagnostic kits, pest and disease management methods, crop management systems, or postharvest products and processes. In a somewhat different manner, information and communications technologies (ICTs) have been developed and employed as vehicles for enhancing efficient and wide exchange of knowledge.

Technology has played a primordial role in agricultural development over the past century and is expected to continue to deliver solutions to problems associated with crop production, natural resource management and postharvest systems. Technological solutions have been developed for production constraints associated with crop yields, pests and diseases, climatic fluctuations, soil degradation, and production on marginal lands that, either in combination or alone, affect productivity.

However, the increased use of technology has not been without negative impacts. Extensive use of agrochemicals has led to environmental contamination and loss of ecosystem resilience, of particular concern in habitats that are centers of genetic diversity. Agrochemicals have also threatened the health of farmers, their families, and consumers. Overworking the soil has resulted in degradation through erosion. And, specific communities have been placed at a disadvantage due to factors that favor technology-induced benefits, including unbalanced regional development resulting from the introduction of technologies that are not scale-neutral, unbalanced policies on technologies (national and international), and creation of subsidies for a range of agricultural inputs (e.g. pesticides, fertilizers).

Access to and delivery of new technologies is also changing as a result of the growing involvement of the private sector in agriculture. Indeed, the ability to protect one's ownership of technology outputs (e.g. genes, plant varieties, diagnostic kits, and databases) has promoted private-sector investment in agricultural products. Interaction with the private sector, however, is bound to become controversial if there is no clear definition of how to share the benefits derived from new technologies.

CIP's contribution to technology development and dissemination

CIP has been successful in acquiring and generating a range of technologies pertinent to its mandate crops in areas such as biodiversity conservation, genetic improvement, production, and postharvest utilization (Table 1). The documented impact of CIP-related technologies has shown a high rate of return with a large share of the benefits accruing to the poor (see Challenge 1). Most of these technologies were developed based on publicly available information, knowledge, and materials. Access to know-how and materials has rarely been restricted by the original developers.

A limited number of proprietary technologies, however, have been accessed and utilized for deployment to resource-poor farmers. These include pheromones for potato pest control and genes for pest and disease resistance.

During the past 10 years CIP has also developed a fairly comprehensive set of information and communication assets, generically grouped into methodologies, publications, databases, and software. These assets have reached diverse user groups, including scientists, knowledge-exchange agents, decision makers, and farmers (Table 2).

CIP information assets are available in a variety of formats, according to intended user groups (Figure 1). The most prolific category across user groups has been publications. These products are also estimated to have reached the largest number of target groups. The next most prolific category is databases, reaching scientists, transfer agents, and decision makers. The software category has mainly been used by scientists, but also reaches—depending on the particular product—decision makers and exchange agents. This software category also represents the most diverse and advanced set of tools that has been developed by scientists at CIP, to study complex, dynamic, and spatially heterogeneous systems. A major challenge is to effectively process and channel the knowledge generated through these analytical tools to a more diverse group of end users.

Specific objectives for CIP's research program

After defining the prioritized target areas for optimum realization of CIP's contribution to the Millenium Development Targets, as outlined in the previous chapters, assessments will be made of needs and opportunities. Decisions on technology development and dissemination will then undergo further analysis.

A detailed description of the technologies needed will include: definition of existing technology options; whether these technologies exist and need to be adapted or need to be newly generated; CIP's role in adaptation, generation, and/or facilitation of access to new technologies; and the respective roles of CIP's public- and private-sector partners.

Benefit and risk assessment (see Challenge 1) will result in an overview of the expected development impacts as well as issues, concerns, risks, and assumptions associated with the technology in question. It will be critical to review the lessons learned from similar technology development, acquisition, and delivery in other public goods research institutions. The level of investment and the special needs associated with the development of new technologies will be assessed, including staffing (quantitative and qualitative), capital investment, and timeframe for output.

Within CIP, a new Research Informatics Unit will lead the development of integrated, center-wide platforms for transformation of knowledge (acquired, developed, and held by individuals) into global public goods (databases, publications, software, interactive and multimedia products, videos, training protocols, etc.). CIP will apply its expertise in Information Technology and Communications to select the ICTs that will most effectively contribute to addressing the specific stakeholders' prioritized needs and opportunities.

The use of ICTs will have a prominent role in improving the diffusion of technologies relevant to agricultural production, crop utilization, and natural resource management. CIP has four generic target groups: scientists, knowledge exchange agents, decision makers, and farmers. Scientists are the primary users of CIP ICTs for the achievement of priority objectives and goals and the development of technologies. Knowledge exchange agents use selected ICTs for adaptation and scaling up of technologies. Decision makers are seen as empowered users of specially developed

ICTs and the information products provided by these. And farmers are largely seen as beneficiaries of ICTs but also participate in the development and ground truthing of ICTs at benchmark sites.

The approaches to developing information products and communication processes for and with the various target groups are complementary and diverse rather than exclusive or unique. They are process-based approaches that will rely heavily on feedback for the optimum, dynamic, and flexible development of tools and their application.

CIP's role in making available the benefits of ICTs involves a responsibility to: (a) choose ICTs that will permit the effective and efficient development of priority products in the most useable and flexible format possible, according to target groups; (b) use ICTs to systematize input-based and information-based agricultural technologies according to the needs of the target groups; (c) use ICTs to disseminate efficient and effective agricultural technologies among our target groups; and (d) empower selected target groups in the use of appropriate ICTs.

CIP will give special attention to technologies that are currently not used or underused and that could be acquired/used in cooperation with the private sector to benefit CIP's target groups. At the same, comparative advantages of the private sector to deliver new technologies generated by CIP and to increase the Center's impact on development targets will be explored.

The private sector can be a recipient as well as a provider of technologies developed by CIP and its partners either by assisting in providing access to new private-sector technological developments for our intermediate technology, or by adapting our technologies to private-sector needs for more efficient diffusion to target systems and populations. Public–private-sector cooperation will require definition of ownership and intellectual property rights for both sectors, including patents, trade secrets, breeder's rights, copyrights, and licenses. Benefit sharing will also have to be addressed.

In the case of ICTs, CIP will develop its own in-house capacity, promote teambuilding to integrate products developed by its various programs, and explore key strategic alliances. CIP will provide content and utilize diverse applications, packaging, and presentations of ICT protocols according to the existing capacities and connectivity level inside each region. User-friendly applications will include participatory feedback channels to evaluate adoption of ICT-facilitated technologies.

Implications for CIP's Vision

CIP has a mission and ethical responsibility to develop and disseminate global public goods that will in turn empower target groups to develop sustainable agricultural practices that improve the livelihoods and well being of the resource-poor.

The Center's research and development program sees technology as a pillar of agricultural development that will bring welfare to smallholder farmers and their communities. Some of the agricultural technologies developed at CIP enjoy less than optimal use and implementation by the users they are intended to aid. New and traditional technologies can be made more efficient and/or appropriate.

In addition, many new technologies that have been developed elsewhere, including technologies in the private sector, have not been used at CIP, or made available to the beneficiaries we target, although significant benefit might accrue from their use in target populations. To this end, increased linkages must be developed with the private sector to acquire, generate, utilize, transfer, and diffuse appropriate technologies, making the best use possible of ICTs to ensure that the benefits they offer reach CIP's target groups.

Table 1. Examples of technology assets and projected future needs to achieve development goals through CIP-technology interventions.

Crop life cycle	Current technology assets	Projected technology needs
Biodiversity conservation and utilization	In vitro conservation Cryopreservation of germplasm	High-throughput genotyping of germplasm collection Variety identification/fingerprinting for tracking in exchange and breeding programs
Genetic improvement of crops	Improved breeding clones as potential varieties Genetically engineered potatoes with resistance to tuber moth and viruses	Gene technology to engineer resistance to pests, diseases, and abiotic stresses Nutritional and health factor production in engineered root and tuber crops Carbohydrate quantity and quality and partitioning modification by genetic engineering Frontier science technology for gene discovery for resistance and health traits, and better utilization of gene banks Genomics for host–pathogen/pest interactions
Crop management	Seed technologies appropriate for use by resource-poor farmers Diagnostic technologies for most widespread pathogens and pests Low input or ecologically based pest and pathogen management technologies Potato and sweetpotato production systems analysis (environment, markets) relevant to developing country situations Technology transfer methodologies (manuals, CDs, courses, workshops, farmer field schools)	Conservation agriculture technologies Hydroponics for potato seed multiplication Apomictic botanical seeds Geospatial tools for ex-ante impact assessment and enhanced natural resource management Biorational (pheromones, biorepellants, biopesticides, botanical pesticides) as pest control tools and strategies Effective diagnostic tools for pests and pathogen (detection strips, DNA or peptide chips) Tools and methods for understanding problems in targeted systems and decision-making tools for technology deployment and policy decisions Internet-mediated technology diffusion (distance learning, helpdesks, video conferences)
Postharvest utilization	Diffuse light storage important for challenging tropical environments Postharvest processing technologies (new products as such yacon syrup, sweetpotato-based baby food)	Postharvest processing technologies for adding value, minimizing loss, and stabilizing prices Low input storage technologies Methodological approaches to product development and marketing of small farmers' produce

Table 2. Summary of current CIP information and communication assets.

	Target Population			
	Scientists	**Knowledge exchange agents**	**Decision makers**	**Farmers**
Publications	CD-ROMs Electronic publications E-newsletters and lists Web pages Slide sets Media (TV, radio, newspapers)	E-newsletters & lists Electronic publications Web-based instruction and Web pages CD-ROMs	E-newsletters and lists Web pages CD-ROMs Videos Media (TV, radio, newspapers)	Flyers Manuals (FFS) Videos Radio
Databases	CD-ROMs Geo-referenced data Climatic data Germplasm data Bioinformatic data	CD-ROMs Geo-referenced data Climatic data	CD-ROMs Geo-referenced data	
Software	Mapping genetic resources Workflow genetic resources Breeding related software Bioinformatics software Visualizing genomic maps Climate interpolation Meta data base software CIP administration software Simulation models (crops, late blight, entomology, livestock, econometric, risk) Scaling software Expert systems 3-D visualizing software	Mapping genetic resources Climate interpolation Meta data base Simulation models (crops, late blight, livestock, econometric, risk) Expert systems 3-D visualizing software	Climate interpolation Meta database Simulation models (crops, late blight, livestock, econometric, risk) Expert systems 3-D visualizing software	Expert systems: potential

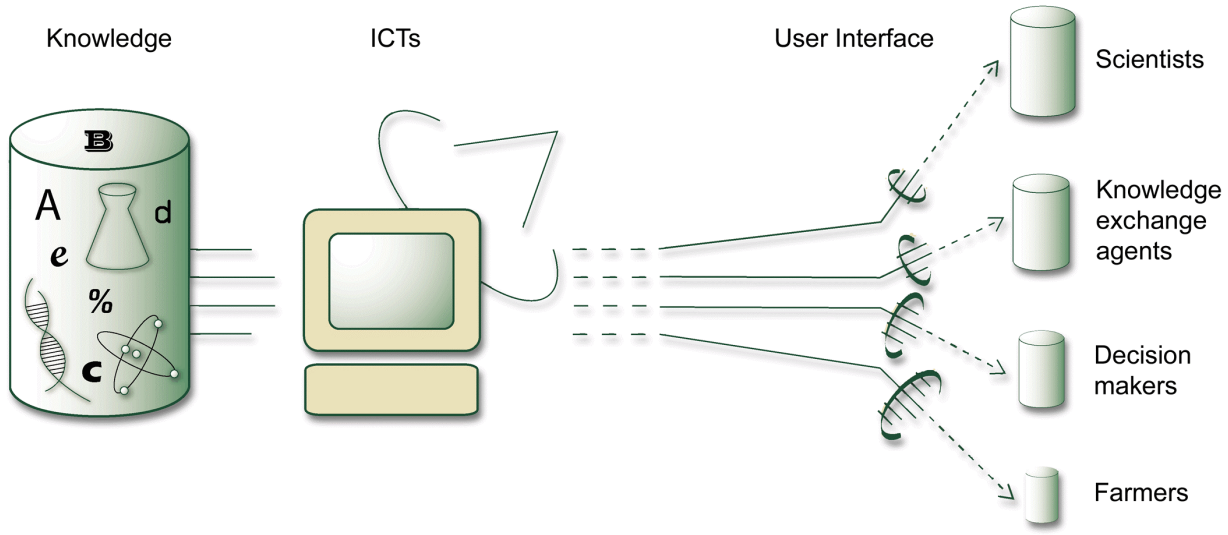

Figure 1. ICT-facilitated flow of knowledge to CIP target groups.