1 UNDERSTANDING AND RATIONALIZING CIP´S MODEL OF INTERVENTION FOR THE PURPOSE OF THE EPMR

1.1 Introduction

Each CGIAR Center's own particularities in terms of its fundamental mandate, available inputs (staff, information, facilities and finance), vision, mission, strategic plan, and governance result in a "unique" model of intervention. The final success of each Center's model of intervention depends on how the Centre delivers outputs (International Public Goods (IPGs) as new technologies, trained manpower and policy recommendations) that are transformed into outcomes (changed farming practices, policies and institutions), and finally into impacts (food security and poverty reduction). Several factors specific to potato and sweet potato, and Andean roots and tubers, contribute significantly to the uniqueness of CIP's model of intervention.

First, the geography of potato and sweet potato production is closely and positively correlated with high poverty areas. Thus, focusing CIP's research on regions with large areas sown to these crops will naturally contribute to improving the livelihood of the poorest. The map in CIP´s Vision Exercise, overlaying hunger, poverty, and child and maternal mortality areas with those of potato and sweet potato production areas, has sharpened Centre targeting to rationalize needed additional investments.

Second, when per-capita incomes rise, per-capita potato and sweet potato consumption tends to decline in favor of other staples. This pattern is evident with sweet potato in much of Asia and Africa, and with potato in the Andes. Therefore, there is growing interest in breeding both crops for new uses and markets in the processed foods and feed sectors.

Third, again due in part to the inverse relationship between consumption and incomes, technology generation and dissemination systems for potato and sweet potato in poor countries tend to be weak or non-existent. A particularly important constraint is the weak seed systems, essential to adoption of new varieties. The importance of functional seed systems is demonstrated by the cases of wheat, maize and rice. In these three crops, relatively effective seed delivery mechanisms facilitated the wide adoption of the seed-based technologies that made the Green Revolution possible. It is no surprise that CIP´s scientists have devoted important efforts to devise ways to strengthen local partnerships with both government and non-government organizations to enable potato and sweet potato technologies to reach poor farmers.

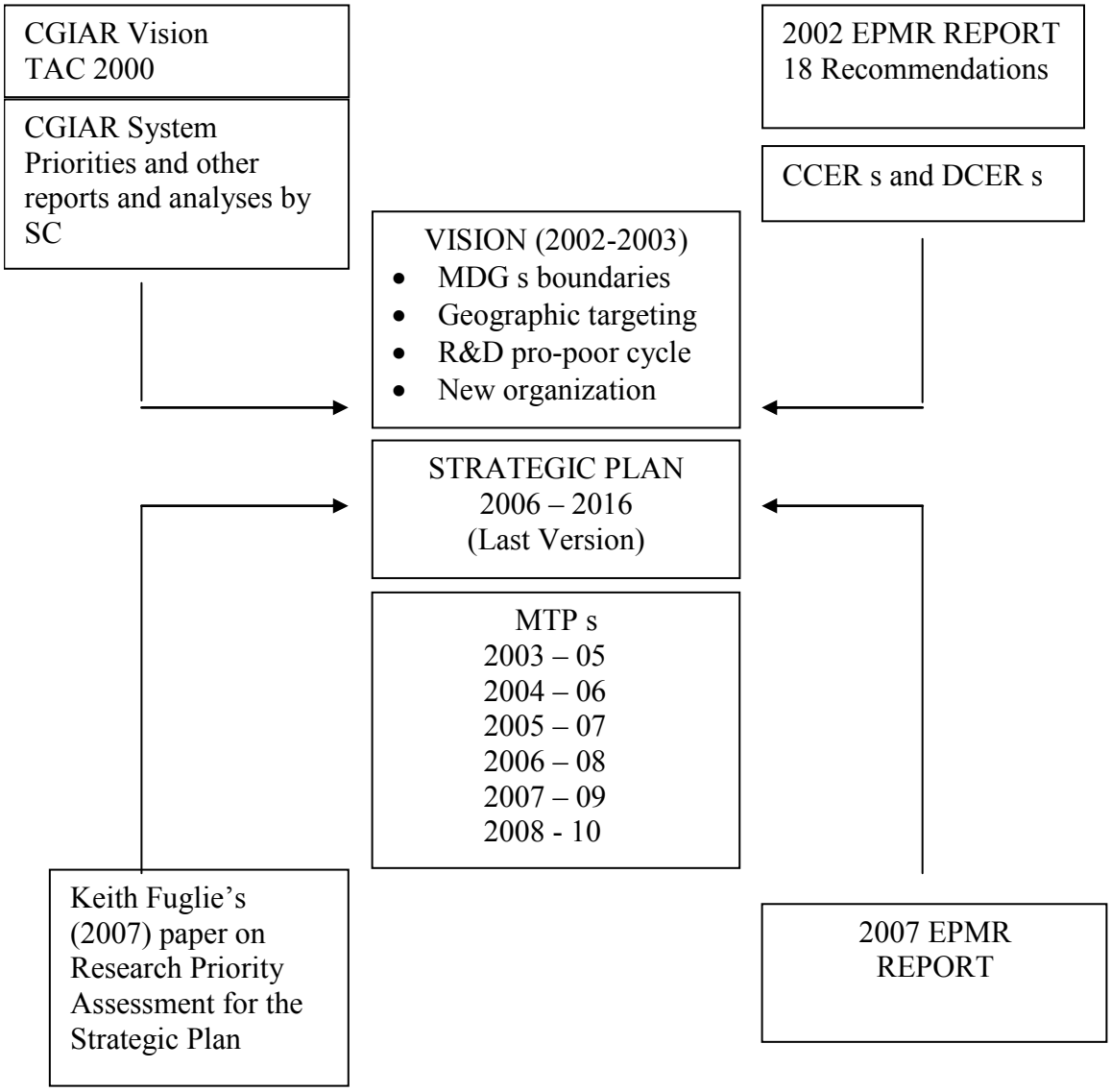
1.2 Centre Performance and Drivers

In order for a Centre to attain the desired outcomes and impacts, it must take care of two fundamental dimensions: First, under the leadership of the Center's Director General, it must produce quality and relevant research, and have good research management (including the quality and quantity of inputs, research processes developed, outputs responding to user needs, and management quality and efficiency); and second, it must have the right policies, vision, mission and strategic directions (aka "governance"), with the apt participation of the Board, charged with the fiduciary responsibility of the Center's work.

As a CGIAR Centre, CIP is autonomous, with its own charter, and an international Board, Director General and staff. CIP ´s Board members are elected from a list of nominees suggested by the CGIAR, the host country, and CIP's own Board. In addition, the Board has the

responsibility to balance the power between those who direct and manage the Centre, and those who invest in it.

Figure 1.1 CIP´s External and Internal Drivers



Source: 6th EPMR Panel, adapted from CIP.

Figure 1.1 shows CIP´s main steps since the 2002 EPMR: A Visioning exercise "Preserving the Core, Stimulating Progress", a strategic planning process, and six Medium Term Plans (MTP s), whose output targets are compared against achieved outputs to monitor the Center's performance. One important result of the Visioning exercise has been that CIP has assessed and realigned its research agenda to meet the Millennium Development Goals (MDGs).

Figure 1.1 also illustrates the plethora of external and internal influences that have driven CIP's programs and priorities in the period being evaluated by the Panel, namely: (1) The diverse groups of CIP stakeholders that participated in the Visioning and Strategic Planning exercises; (2) CGIAR orientations, mainly through the Group's vision/mission planks, and the 20 CG System Priorities; (3) the 18 approved recommendations from the 2002 EPMR that have been gradually implemented through that period; (4) the recommendations from Board and Donor -

commissioned external reviews (Conservation and Characterization of Root and Tuber Crop Genetic Resources (2003, Donor-Commissioned), Papa Andina (2005, Donor-Commissioned), Strategies on Development and Deployment of Genetically Engineered Potatoes and Sweet potatoes (2005, Board-Commissioned), and the Review of the NRM Program of CIP (2007, Board-Commissioned); (5) the internal studies and analyses produced by the Centre for the assessment of certain sections of CIP programs, (e.g. the Report on Research Priority Assessment for the CIP 2005-2015 Strategic Plan); (6) advances in the frontier of scientific knowledge; and (7) CG System partnerships (Challenge Programs, SWEPs, and other collective CG System initiatives), and other associations with regional organizations and consortia.

A final, significant consideration shaping the CIP agenda is its leadership. A new Director General, appointed in 2005, has also influenced CIP's performance during the period under review, although the fourteen years of the previous DG still count a lot.

1.3 CIP's Internal Structure and Organization

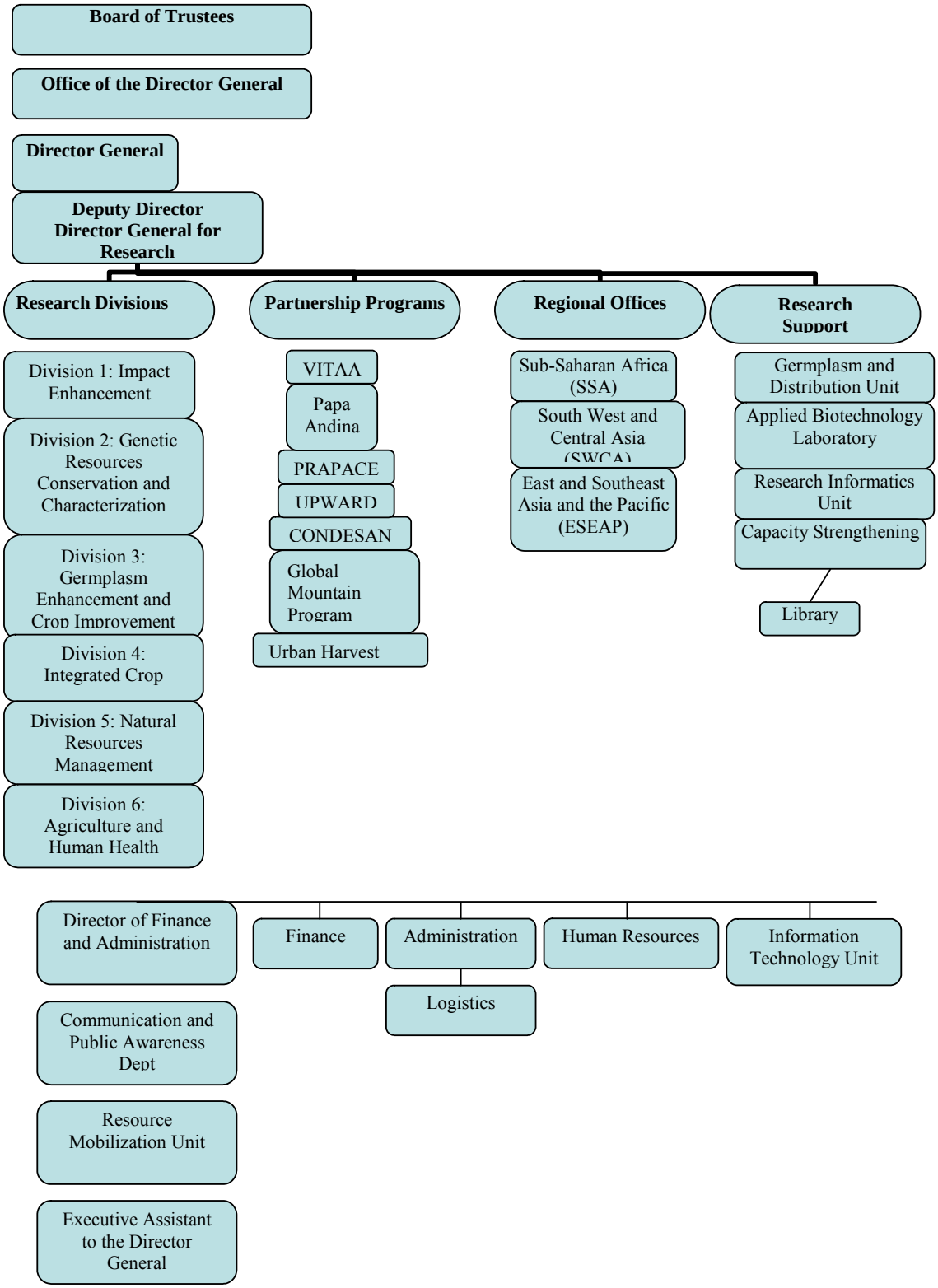
CIP´s different units under the responsibility of the Director General are organized into two major blocs: Research and Finance/Administration. In 2004, in place of its previous "constraint project" model, CIP implemented a new organizational structure, now in operation, consisting of six Research Divisions and seven Partnership Programs. The new structure (as of June 2007) is illustrated in Figure 1.2.

Three Research Divisions -- Genetic Resources Conservation and Characterization, Germplasm Enhancement and Crop Improvement, and Integrated Crop Management -- encompass the Center's main "technology supply chain". Research in these three Divisions is geared to have the greatest impact on poor farmers, making use of the Center's unrivalled genetic resources collection, and moving from genes to products via plant breeding and/or biotechnological routes, complemented by disease free planting material and management strategies for other biotic and abiotic yield constraints. CIP´s true, core identity lies in its technology supply chain, a unique capability giving the Centre a tangible comparative advantage and myriad opportunities to produce IPGs.

According to CIP, the Natural Resource Management (NRM) Division focuses on deciphering and understanding the complexities of the socio-ecological systems in potato/sweet potato areas. It aims to facilitate turning potato and sweet potato systems into resilient agro-ecosystems by introducing new technologies as well as by improving local institutions and policies. Until now this Division has been somewhat biased toward process-oriented and crosscutting issues, though recent indications suggest a better balance between process and applications orientation.

According to CIP, the Impact Enhancement (IE) Division addresses the problem of where and how the Centre should deploy its limited resources to maximize impacts on potential beneficiaries, and to contribute to meeting the MDG targets selected through the Visioning exercise. Keith Fuglie's "Projecting Impacts on Poverty, Employment, Health and Environment" is an important IE ex-ante impact assessment exercise, carried out to contribute the CIP 2005-2015 Strategic Plan, and just published by CIP in 2007. The study assesses the potential contributions of CIP's research outputs to the MDGs, and implications for resource allocation among regions, current research areas and technologies.

Figure 1.2 New Research Divisions and Partnership Programs Structure[3]



Finally, the Agricultural and Human Health (AHH) Division, created as a result of CIP's

[3] Source: CIP

Visioning exercise, seeks to promote the agricultural-health interface through activities such as crop breeding for bio-fortification and pesticide reduction. CIP created the AHH Division based on the premise that some new agricultural technologies and agricultural interventions can both enhance human health and decrease human health risks. Historically, agriculture and human health have been compartmentalized both in research and development efforts. New and appropriate technologies bring opportunities to enhance human health on the one hand, and to minimize the risks to human health of agricultural interventions on the other hand. As the Panel will discuss later in this report, if the premise under which the AHH Division was created is to become a reality a "decompartmentalization" is needed.

1.4 Partnership Programs

Partnership Programs complement CIP Research Divisions with their own regional or global mandates. Whether they are public or private entities, CIP partners have the common purpose of improving agricultural productivity to ensure food security and poverty reduction.

According to CIP, some of its Partnership Programs are meant to be research or output-partnerships that aim to produce research outputs to complement outputs generated by CIP´s Research Divisions. Examples of such Partnership Programs are CONDESAN -- an eco-regional program for the Andes -- the Global Mountain Program, and the Urban Harvest Program, all of which are System Wide Programs sponsored by the CGIAR. However, in reality, as will the Panel will discuss later in this report, the research outputs from these Programs are have little or no relation to CIP´s main technology supply chain.

Historically, CIP has invested heavily in collaborative partnerships with a "research partner for development" perspective, in order to build coalitions and platforms that link scientific research to technology development and to dissemination. In CIP's early years, it stationed a sizeable share of its research staff regionally and in country initiatives. Although the share of staff in regional and country offices is smaller today, CIP has been able to develop partnerships and collaborative projects as pathways to mobilize the Center's IPG outputs into outcomes and impacts. A notable example, applied by CIP in many regions, is the Farmer Fields Schools (FFS) model, an approach to technology diffusion at the farmer level, involving interactive learning and experimentation in farmers' fields, which has made farmers less dependent on traditional extension services, often weak or non-existent in many countries.

Local capacities for technology adaptation and dissemination are variable among the countries and regions where CIP has established its programs, from China to SSA. Developing partnerships with targeted constituencies to ensure that CIP ´s research outputs finally find their way to farmer fields (outcomes) is a challenge involving more than the design of good partnership projects. The challenge lies also in finding investors/donors willing to reach a compromise between their own goals focused on development activities to attain impact, and those of the Centre, which should focus on producing research outputs of an IPG nature and to design partnerships to help transform those outputs into outcomes. Indeed, most of CIP´s impact success stories have required significant funds for scaling-up technology dissemination, usually in the form of special donor projects to disseminate a particular technology in a country or region.

CIP ´s IPG outputs can be thought of as "intermediate goods" that require various degrees of development, adaptation, validation and, finally, dissemination before they become "final

goods", ready to be adopted by farmers, and eventually attain wide-scale adoption and have tangible, sustainable impacts on the welfare of the poor. Furthermore, not every output links forward immediately to outcomes. Some outputs cycle back into CIP´s technology supply chain to produce new outputs. For example, the main users of outputs from the Genetic Resource Conservation and Utilization Division are scientists in the Genetic Enhancement and Crop Improvement Division. The more "global" outputs of CIP's research are intermediate research outputs produced at CIP´s headquarters, while CIP's regions do the bulk of adaptation and validation to produce final outputs.

1.5 Attribution

As a Centre moves from producing IPG outputs, to producing outcomes (changes in behavior such as adoption of a new technology), and finally to impacts (changes in the state variables such as those built in the MDGs), the problem of attribution shows up.

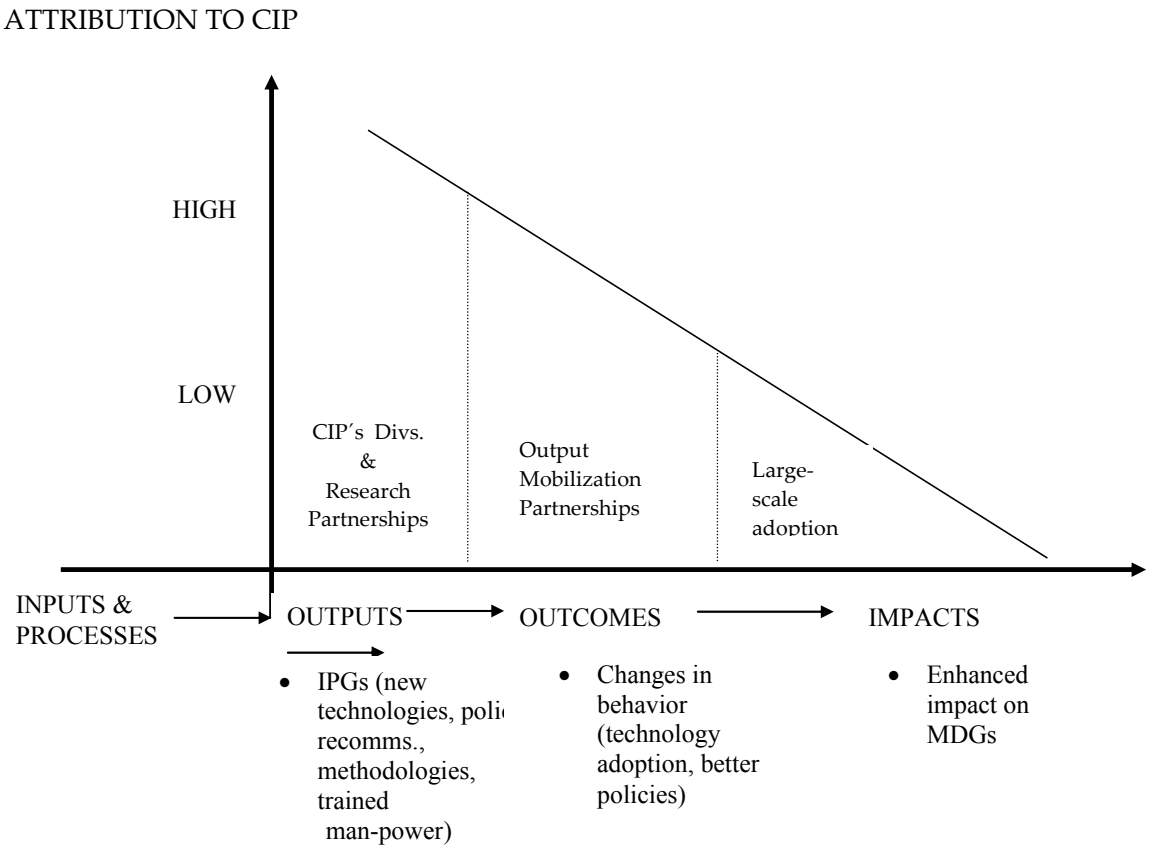
Figure 1.3 illustrates that problem. The process can be seen as one of diminishing control by the Centre, as local ownership, number of actors, and number of exogenous factors (e.g. culture, markets, policy, weather, wars) become preponderant as one moves to the right, along the horizontal axis, from outputs, to outcomes to impact. CIP can take credit, claim attribution, and be made accountable for the "output step" of the process, and even at this "output step", credit, attribution and accountability are limited, since the Centre borrows from and contributes to a global pool of knowledge. As CIP's activities move from outputs to outcomes to impact, attribution to CIP and accountability from CIP diminishes.

Inevitably, attribution becomes a problem when, in measuring Centre performance, development and donor organizations focus on impact indicators. CIP has little control over the changes in behavior in the Centre ´s clients, associated with outcomes, and even less control over impacts.

A clear concert for CIP is that, unless it attains outcomes, its outputs will be useless. For this reason, developing and strengthening partnerships with the groups and organizations with which CIP anticipates opportunities for influencing changes in behavior (adoption of new technologies and farming practices, new policies and stronger institutions for example), is the only avenue open to the Centre to exercise such an influence. These partners are defined as "boundary partners" (in the IDRC jargon) and refer to those who control change and with whom the Centre-sponsored partnership programs interact directly. A careful selection and cultivation of these boundary partners constitutes a strategic step for CIP as an ex-ante activity to ensure the successful mobilization of Centre outputs. Depending on the nature of the output (technology, policy, institutional), each output or set of outputs will require specific partners, (government and non-government organizations) in each region or country.

Therefore, an important question here is whether CIP has in place the right set of partnership programs, for both the effective production of outputs, and the effective mobilization of outputs into outcomes. Firstly, it is desirable that research outputs produced by CIP's partnership programs are in fact complementary to CIP, which is, closely related to the Center's main comparative advantages. Otherwise, such program will only divert the Centre from its core business. Secondly, it is important that CIP's regional and country programs working in the research for development interface (i.e. on efforts geared to achieving outcomes) pick the right partners for effective output mobilization.

Figure 1.3 Dimensions of CIP Performance Addressed by the Panel, and the Problem of Attribution



1.6 CIP´s Regional Offices

An additional consideration regards CIP's work in the Regions, where most of the output mobilization work is done, including the implementation of the "research for development approach" work of the country and regional Partnership Programs. As the Panel discusses later in this report, CIP's Regional Offices (see Figure 1.2) – of which LAC has none -- are just that, and not true Regional Programs. No place for the Regions is contemplated in the structure of CIP's research Divisions and Partnerships Programs. Although since 2006 CIP's country development projects report directly to their appropriated regional leader, the Panel strongly questions whether this organizational structure with Regional Offices is the best for CIP´s research and output mobilization work.

The regions that CIP has defined are: Latin America and the Caribbean, Sub-Saharan Africa, South, West and Central Asia, and East and Southeast Asia and the Pacific. Currently, the Centre is in the process of developing an ambitious program with China that will help to create partnerships among the host country, CIP and third countries in different regions. (See Annex 9)

Normally a common set of research themes is pursued in each region. However, each region has different requirements and priorities that are laid out in a series of regional strategies. For example, combating late blight through resistance breeding and integrated management is a common activity across regions, but in Latin America and the Caribbean, the focus is on improving nutrition of Andean inhabitants and conserving the rich agro-biodiversity in native potatoes. The strategy for Sub-Saharan Africa takes into account the needs of two broad regional

groups: eastern and southern Africa and West Africa. Specific activities include for example cost-effective strategies for scaling-out orange-fleshed to combat vitamin A deficiency and improve diet quality. The strategy for South, West and Central Asia include sustainable production in the small hillside farms and innovative technology in multiple cropping systems, while in East, Southeast Asia and the Pacific emphasis is on simple and affordable ways to extend the storage life of sweet potato.

1.7 EPMR Road Map

The EPMR has followed the steps outlined above in an attempt to analyze the Center's program and management. And based on the Panel's individual and collective judgment plus the information obtained through the different readings, presentations and interviews from and with scientists and field trips, has produced a set of suggestions and recommendations aimed at improving the effectiveness and efficiency of the CIP´s model of intervention towards the future.

2 CIP'S VISION EXERCISE AND STRATEGIC PLAN

2.1 Introduction

International Research Centres generally take long-term perspectives in research. A well-articulated Vision is critical to decision making guidelines, and to avoid compromising long-term strategic goals and opportunities.

The 2002 EPMR made two recommendations in this regard, namely that CIP develop a Vision and Strategic Plan, and that CIP connect Vision and Plan, establishing a robust set of priorities for the future. CIP reports that it has implemented both recommendations.

In June 2002, with the endorsement of the Board, CIP's DG decided to carry out a Centre Vision Exercise, in order to produce a roadmap of CIP's "development challenges". According to CIP, the Vision, which would be the basis for CIP´s Strategic Plan, would pinpoint:

- where CIP research has most potential to impact development;
- what specific research needs and opportunities exist in CIP target areas and respective populations; and
- How CIP's research should be performed.

As next steps, the Panel expected CIP to carry out the following actions: (1) that based on the Strategic Plan, a Corporate Plan would be developed to realign financial, human and economic resources across CIP research units and target regions; and (2) that the priorities defined in the Strategic Plan would first be expanded into Business Plans (specifically addressing how a particular goal is to be achieved, for example, on the issue of critical mass), then into Operational Plans (the MTPs), and finally into resource mobilization toward achieving CIP's Vision.

The logic of this rather long process (the Vision in 2002-2003 and the Strategic Plan in 2006-2016, the final version of which has not been completed) is supposedly a progressive one, running from vision-goals-mission to priorities, then to tactics and activities designed to achieve the goals, then to resource allocation, and finally to the evaluation of outputs.

2.2 CIP's New Vision

Changing Boundaries from Commodities to MDGs

The process of shaping the new CIP Vision was well conceived and highly inclusive, with the participation of diverse groups of Centre stakeholders. A comprehensive questionnaire was sent to the Plenary Members probing two specific issues:

- MDGs as the boundaries for the CIP Vision Exercise; and
- CIP research impact potential in the eighteen identified MDG target areas.

Of the 158 respondents, 89% agreed to the first inquiry. Thus the MDGs were adopted as the boundaries of CIP's visioning exercise. The results of the second inquiry are shown in Table 2.1, below.

The first comment of the Panel regarding this first part of the visioning exercise relates to the scope of the MDGs. Clearly, many of the targets associated with the MDGs are totally outside CIP's mandate as an agricultural research organization. This suggests that CIP´s research potential and comparative advantage to produce and deliver the specific IPGs implied by many

Table 2.1 MDGs and CIP Vision First Plenary Consultation Results (Total Responses= 158)

No.	MDG target areas	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	Available new information & communication 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	45	1

Source: CIP

of the MDG targets areas did not receive appropriate attention in the visioning exercise. It certainly would have been more appropriate to define the most relevant MDGs for the Centre before asking stakeholders about CIP's potential contribution. This would have prevented results such as the one on "safe drinking water", a doubtful goal for an agricultural research organization such as CIP, but a target area where 48% of respondents considered that CIP research could contribute to impact.

This Panel's second comment pertains to CIP's choice of a simple majority (more than 50%) as criteria to select CIP's Vision challenges. The Panel considers that a higher cut-off, for example 70-75%, would have been more appropriate, directing CIP's efforts to challenges with the greatest support among Centre stakeholders. For example by selecting a 75% majority, the four basic goals to which agricultural research has proven to contribute significantly are related to combating hunger (96% vote), poverty (93% vote), sustainable environment (92% vote), and under-5 mortality (75% vote), would have been selected as the core challenges in CIP's Vision Exercise. Furthermore, because MDG targets are highly correlated, the same research outputs

that impact these four MDGs are indirect fixes (technological solutions) for other related developmental issues. For example, it is well known that poor urban consumers, which include slum dwellers (goal #11), have been the main beneficiaries of price drops derived from higher agricultural productivity because they spent a relatively large share of their income on food.

This Panel's third comment relates to the inclusion of Target 18— to improve access to new Knowledge and Technologies —as a Vision challenge. The problem here is that making communication and dissemination technologies available to less developed countries constitutes a basic instrument for CIP, and all CGIAR Centres for that matter, if they are to achieve effective output mobilization for the poor. In other words, even if Target 18 had received little or no support from survey respondents, CIP had no alternative but to include it as a goal. Therefore, in the Panel's opinion, Target 18, being a required means to achieve all ends, seems inappropriate as a Vision challenge.

Challenge teams and task forces were created around the 8 Vision Challenges selected, in order to develop individual Challenge Essays. These Essays focused on specific CIP program objectives and their implications for the CIP Vision. Outside experts were invited to present their views about the role of agricultural research vis-à-vis the 8 selected MDG target areas. In addition, Plenary Members and independent resource persons were consulted.

On March 2003, a draft Vision was presented to CIP's Board for review, and management was encouraged to proceed. The Vision Document was submitted as a final report to the CIP Vision Plenary, with the following vision statement:

> "The International Potato Centre (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 will address these challenges by convening and conducting research and supporting partnerships on root and tuber crops and on natural resources management in mountain systems and other less-favored areas where CIP can contribute to the achievement of healthy and sustainable human development."

The previous CIP Vision Statement was closely aligned with that of the CGIAR, stressing the Institute's character as an agricultural research Centre dedicated to:

i. helping the poor;
ii. the achievement of food security and its focus in scientific research on mandated crops as the Mission boundaries; and
iii. NRM in the Andean and other mountain areas.

Although this focus remains unchanged, CIP's new vision statement based on its contributions to the 8 selected MDG target areas, expanded considerably on the previous one, adding three new dimensions:

i. improving human health;
ii. developing resilient, sustainable, rural and urban livelihood systems; and
iii. Improving access to appropriate new knowledge and technologies.

This Panel has questions about what were the real forces that drove CIP to expand its boundaries into such new targets and directions, and about the implications of this expansion of boundaries

for the quality and relevance of the Center's core areas of research. Following are further considerations in this respect:

CIP scientists anticipate that the Center's potato and sweet potato research will deliver significant economic, employment, health and other benefits over the coming decades, and because these crops are important for the poor, particularly in rural areas, a large share of the anticipated benefits will go directly to poverty reduction.

However, CIP's claimed contribution to "sustainable rural and urban livelihood systems" is far more difficult to achieve. The Sustainable Livelihood (SL) approach (as articulated by the UK's DFID) which is generally considered a better alternative than the Integrated Rural Development of the 70´s (popularized by the World Bank) is "centered on people's assets, their ability to withstand shocks and the policies and priorities reflecting the needs of the poor." SL principles state that poverty-focused development activity should aim to be holistic, though holistic analysis and planning need not necessarily result in holistic interventions.

CIP research outputs do not operate in a vacuum. If disseminated, research outputs integrate into farming systems, which in turn are part of livelihood systems. While research outputs can add to the IPG pool, farming and livelihood systems are always local, highly specific arrangements, and their success is subject to a great number of conditions over which CIP and its partners have little or no control (see discussion on the problem attribution in Chapter 1). Extending CIP's research to urban livelihood systems is likely to complicate that panorama even further.

CIP's claimed contribution to human health is seen as a natural extension to the goal of nutrition improvement through foods fortified with vitamins and minerals. By facilitating breeding for specific traits to improve human health, as in the case of golden rice, biotechnology has opened up new frontiers. The case of the orange-fleshed sweet potato that CIP is promoting in SSA through the VITAA program is a key example of CIP's work in this area. The field of "nutraceuticals" suggests the importance of this CIP-claimed contribution.

CIP work on reduction of pesticide use over the past years has contributed reductions in pesticide, and therefore to improvements in human health. There is no doubt that CIP´s integrated crop management (ICM) and breeding research, looking at all ramifications of any new chemical related to potato and sweet potato production is the appropriate way to go. However, the Panel questions whether CIP's comparative advantage lies in the area of pesticide use *vis-à-vis* human health generally, and is of the opinion that all health issues relevant for the poor which cannot be tackled through better potato and sweet potato technologies should not attract CIP´s resources. Otherwise, CIP's resources could be "diluted to infinity". (Further discussion about this issue is provided in the analysis of the Agriculture and Health Division in Chapter III).

The Panel's basic concern is to what extent CIP's work on the new targets related to human health and urban dwellers might dilute the human and scientific assets responsible for CIP's long achievement record. Management has stressed very clearly that CIP must preserve and consolidate activities for which the Centre has achieved world renown. However, the new Vision calls for CIP to ensure that its outputs improve the livelihoods of the poor by contributing to the eight identified MDG target areas. This implies that CIP move beyond the commodity boundaries that have characterized its work in the last ten years.

Thus, the Panel asks what forces are driving CIP into new directions. This Panel can think of four grounds most likely to prompt pursuit of new opportunities:

i. That the prospects for additional gains in CIP′s traditional core are declining. But Fuglie's (2007) 1996-2006 ex-ante comparison of expected benefits across major CIP research programs does not seem to indicate such a decline; to the contrary, some are rising due to new CIP target regions and countries.
ii. That alternative businesses promise larger benefits than the original core ones. But the Panel sees no evidence of this, and, in any case CIP would need to show evidence of greener pastures in the new roads.
iii. That the donor community is reducing support to CIP′s core activities due to "donor fatigue" or other reasons, such as fluctuating donor interests. This Panel suspects that CIP may be suffering from this to some extent.
iv. That alternative source of supply of CIP's core work have appeared, from the public or private sectors, or that CIP has lost its comparative advantage in some of its core areas of endeavor. In the Panel's opinion, CIP may have some specific research endeavors where stronger NARS or the private sector could perform more efficient work.

With the intention of providing a retrospective dimension to its review, the Panel interviewed Dr. D. L. Sawyer, CIP's founding Director General Emeritus. Dr. Sawyer's historical highlights as well as his views on the Center's most important changes and challenges helped the Panel understand CIP and its circumstances better. Dr. Sawyer's insights were particularly helpful to the Panel while analyzing CIP′s Vision and Strategic Plan. (See Annex 10 for the complete interview.)

Other Relevant Themes of the Visioning Exercise

An interesting feature of the Vision Exercise is the introduction of the "pro-poor R and D cycle" as a planning tool to alter CIP's research portfolio.

As Figure 2.1 illustrates, the Cycle moves from the macro-scale (targeting the most promising geographic areas for pro-poor impacts) to the meso-scale (research and opportunities within the macro areas), and then to the micro-scale (prioritizing specific R and D interventions). Each step within the Cycle introduces methods sensitive to the goal of alleviating poverty.

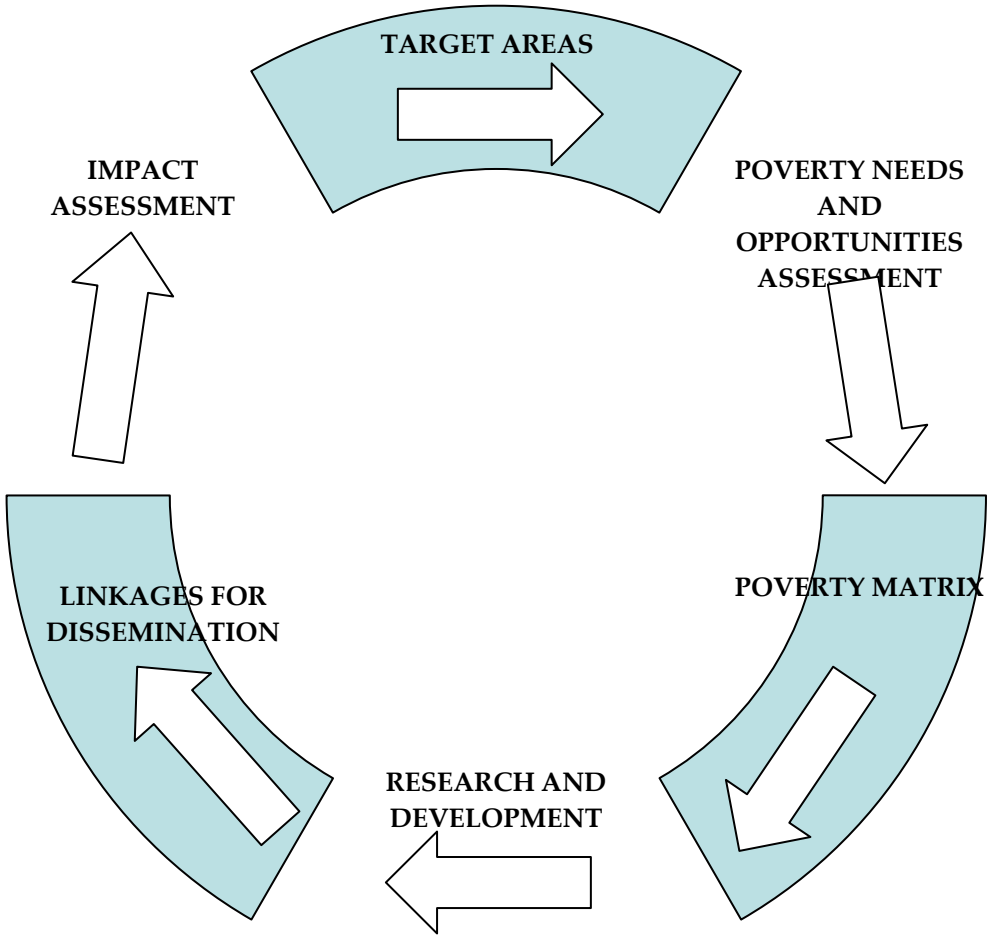
Based on this tool, the Vision Exercise involved two first steps toward developing a Strategy:

i. A geographic targeting exercise identified eight regional groups in 36 countries that ranked high in production of potatoes or sweet potatoes, and in the prevalence of poverty; and
ii. A new organizational structure based on Research Divisions and Partnership Programs was set up.

The Panel would like to commend CIP for the quality and relevance of the new geographic targeting. CIP has long felt that CGIAR investment in roots and tubers based on value of production and a poverty–weighted congruence analysis tends to underestimate the contributions of those crops to poverty and hunger alleviation. The new mapping exercise -- based on overlaying hunger, poverty and child and maternal mortality data with potato/sweet potato production areas -- is a major step toward justifying additional investment and improving targeting.

This Panel would like to note that a major conclusion of CIP's geographic targeting exercise was that adding livelihood targets does not significantly alter "highest priority" geographic targets for CIP commodity research. Countries with high rates of malnutrition and mother and child mortality also have the highest levels of income poverty. This is usually the case with hierarchical goals, where targets can be nested into others higher-up the ladder. In this case, high rates of malnutrition and mother and child mortality can be nested into income poverty.

Figure 2.1 The Pro-Poor Research and Development Cycle



Source: CIP

The second step taken by CIP toward developing a strategy was to realign its research programs into a new structure consisting of six Research Divisions and eight Partnership Programs (See Chapter 1 on CIP's Model of Intervention). According to CIP, "the revised structure should achieve a more streamlined research management and be robust enough to persevere and maintain its relevance in the face of a dynamic external environment".

The new structure, which became operational in 2004, substituted the "constraint project" model that CIP had applied for many years. It contemplates a Genetic Enhancement and Crop Improvement Division, which puts CIP's breeding efforts for all commodities under a single leadership, as recommended by the 2002 EPMR.

The only Division that houses projects previously considered "orphan" seems to be Agricultural and Human Health, which houses CIP's claimed contribution to human health according to the new Vision. Currently focused on pesticide risk reduction in Andean communities, the Science Council has noted that this area of work is relatively absent of IPGs, and has questioned whether CIP has a comparative advantage in this kind of research. This Panel agrees with the Science Council's comments in this respect.

It is important to point out that, in spite of the reorganization of CIP's research programs, the new Research Divisions retain the same budget imbalances reflected in the previous "constraint project" model. For example, while under the former "constraint project" structure, three out of eleven projects accounted for almost 50% of the CIP 2001 budget, today two out of six Divisions (Genetic Enhancement and Crop Improvement, and Integrated Crop Management) accounted for 55% of CIP's 2005 budget. Although it may be absolutely justifiable for breeding and agronomy research to account for nearly two thirds of CIP´s budget, the Panel sees the imbalance in resource allocation among the Research Divisions as a potential managerial problem. For example, the role of Division leaders is likely to vary significantly across Research Divisions.

The rationale of the new structure is clear in terms of supply and demand, both propelling Division research and driving Division/Partnership interaction. CIP Divisions supply OUTPUTS, to be locally adapted and disseminated for up-take and utilization, while Partners´ demand for specific OUTPUTS result in contract research.

Besides creating the research Divisions, the new structure provides an identifiable space for partners, something welcomed by the Panel. The Regions are, however, the big absents in the new structure. It is certainly not clear to the Panel where and how CIP's Regions fit in the new structure.

2.3 An Alternative Program Structure for CIP

In the past CIP had Outreach Programs, with CIP scientists stationed regionally to collaborate with NARS, to train NARS personnel, and to adapt and promote the dissemination and utilization of new CIP technologies. CIP abandoned this structure, apparently due to the tendency of Outreach Programs to become independent of the Center's research "thrusts"/ projects/Divisions. Today, CIP has replaced its Outreach Programs by Regional Offices, at least in three of the four regions, which operate in unified manner, around the six Research Divisions.

The Panel sees two problems with this new arrangement. First, the Regions have lost stimulus to pursue their research work, and have developed a greater dependence on Lima, both technically and bureaucratically. Second, Research Divisions today house (and sometimes even coordinate) regional and country program partnerships oriented toward output mobilization. For example, the MTP shows that Papa Andina and UPWARD operate under the Impact Enhancement Division, and VITAA operates under the Germplasm Enhancement and Crop Improvement Division. CIP's management has reminded the Panel that "it is important to distinguish between MTP reporting and the actual functioning of Research Divisions and Partnership Programs". In

the opinion of the Panel, on the one hand, there should be coherence between "functioning and reporting", precisely to avoid confusion to a casual CIP's stakeholder reader of the MTP. And on the other hand, actual functioning could be improved by clarifying the procedures through which Partners' demand specific outputs in contract research.

Most of the work related to development (technology adaptation and dissemination) is carried out in the Regions. And while some cases may justify that a researcher from a Research Division in Lima coordinate a project with R and D components, the Panel considers that in most cases Regional Leaders should coordinate regional and country projects in their respective domains, while using research outputs from Research Divisions in Lima as inputs.

A related problem lies perhaps in the Center's funding structure, where on the one hand restricted funds are significant, and on the other CGIAR guidelines require CIP to report its research projects in the MTPs in a certain way. For example, in the year 2006 contracts were signed for approximately US$ 11M, 50% for research and 50% "development type" activities. Some of the funds reported in the MTPs for development-type activities are just pass-through moneys, or resources linked to country-specific broader development activities, but allowed CIP to charge for over-head and some recovery of personnel costs.

CIP´s dilemma here is quite clear. Either, the Centre goes beyond the 20% limit for off-CGIAR Agenda activities or it reports development-type contracts as activities within its Research Divisions and/or the SWEPs. Since the latter is the Center's chosen reporting modality, Research Division budgets are artificially inflated as a result, and some planned outputs have only local relevance, and therefore are not IPGs. For the first time CIP, in its most recent MTP (2008-2010), reports development activities within the Research Divisions - reported as Projects in the MTP - making reporting more transparent.

This picture becomes clearer by looking at Table 1 of CIP´s 2007-2009 MTP which describes CIP's allocation of project costs to CGIAR System Priorities (See Annex 11). The table shows how all projects allocate considerable resources to System Priority Area 5 *Improving Policies and Facilitating Institutional Innovation to Support Sustainable Reduction of Poverty and Hunger* (CG System Priority 5) In fact, 37% CIP´s total budget is allocated to this System Priority (See Table 4.1 in Chapter 4). One might initially suspect that such concentration of resources on CG System Priority 5 reflects CIP's need to concentrate research on non-technical constraints in order to ensure proper dissemination and adoption of technological fixes. But on a closer look, this does not seem to be the case. The reality that the Panel perceives is that CIP has reported development activities as research OUTPUTS, linked to CG System Priority 5.

While this report argues that CIP needs to work on the promotion of OUTCOMES, at least in some countries with weaker NARS, and while it is clear for the Panel that without OUTCOMES the work of CIP is futile, the Panel is of the opinion that this is a situation that needs clarification and more transparency.

The geography of potato/sweet potato production areas correlates closely with high poverty areas in poor countries, or with important "poverty pockets", including countries like China. China has a strong NARS, in contrast with NARS in poor countries, which tend to be weak or non-existent. Potato seed production systems are also weak in most poor countries. Thus, CIP has the additional task of strengthening local partnerships with government and non-government

organizations, both to adapt technologies in collaboration with local researchers and to disseminate them among poor farmers.

But, notwithstanding this reality, CIP should introduce more transparency in budget reporting. This Panel suggests that CIP should start this by clarifying its agenda, by putting aside (not reporting) all restricted projects funds not directly related to CIP's research OUTPUTS or their deployment (OUTCOME partnerships). This may mean, for example, that restricted projects involving pass-through moneys will not be reported in the Center's MTP. Secondly, in case this is still needed, CIP should look for flexibility in the current 20% limit for off-agenda activities that the CGIAR has established across the board.

In addition, ***the Panel recommends*** two additional changes in CIP's program structure. First, that CIP create a new Division on Partnership and Research on Partnerships, with the double mission of: (i) to assist in the development of regional and country program partnerships - for OUTPUT mobilization - in close association with CIP's Regions, and (ii) to carry out research linked to System Priority 5C: Rural Institutions and their Governance, whose general goal is "to enhance the role that rural organizations and innovative institutional partnerships play in maximizing impact from agricultural research and in creating marketing platforms for smallholder producers".

Restricted project resources aimed at OUTPUT mobilization would be budgeted under this new Division. This Division would report its research OUTPUTS in the MTP. The budget for such research could come from a percentage of the "budget for research" that is usually included in the development-type restricted projects. Figure 2.2 illustrates the Panel's proposed program structure.

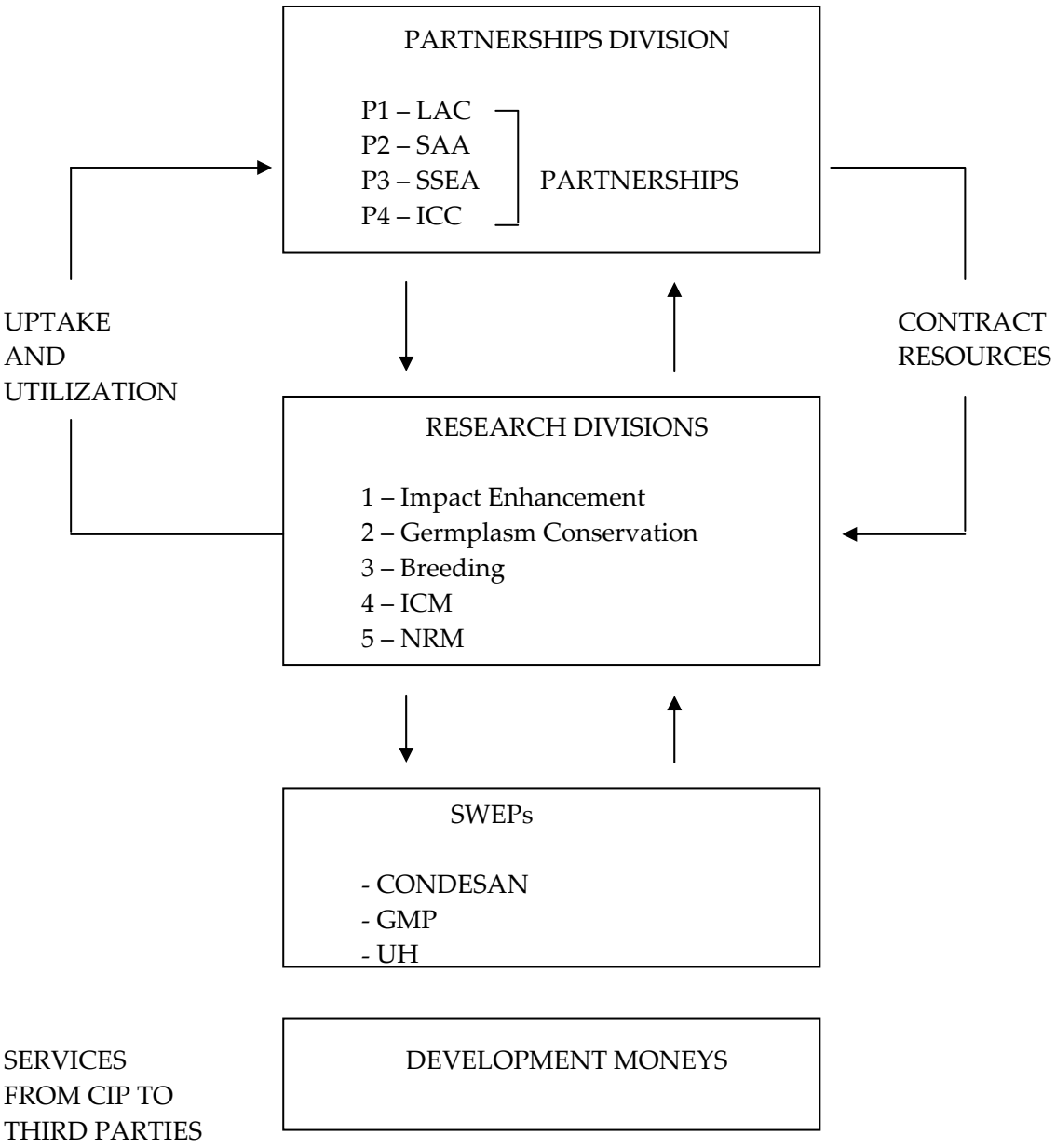
Recommendation #1

Because of the need to improve the effectiveness, transparency and visibility of the CIP program structure components, ***the Panel recommends*** that the current organizational structure be modified to include:

i. A Division on Partnership and Research on Partnerships, with the double mission of: (1) assisting CIP in the development of regional and country program partnerships specifically oriented to the mobilization of the Center's main OUTPUTS; and (2) conducting research of an international-public-goods nature in the field of CGIAR System Priority 5C, Rural Institutions and their Governance, whose goal is: "To enhance the role that rural organizations and innovative institutional partnerships play in maximizing impact from agricultural research and in creating marketing platforms for smallholder producers." The additional work needed to complete the implementation of the 2002 EPMR recommendation regarding the need to formulate a strategy for engaging in different types of partnerships (See Chapter IV, Crosscutting Issues), should be developed under this new Division.

ii. An identifiable space for CIP's Regions as Regional Programs - with true Regional Directors: (1) to design and implement regional and country partnerships, joint research activities in association with the Research Divisions, training programs and events; and (2) to realize the potential research spillovers among countries within and across Regions.

Figure 2.2 An Alternative Program Structure for CIP



2.4 CIP's Strategic Plan 2006-2016

The Plan's Particular Features

In 2005, CIP began to prepare a new Strategic Plan to guide the implementation of its Vision. This Panel reviewed the Plan, based on the following premises:

- Strategic planning is the process of defining a long-term action plan designed to achieve a strategic set of goals, in the light of an uncertain external environment.
- A Strategic Plan is a method of getting from one set of circumstances to another.
- A Goal is the desired outcome.

The first paragraph of CIP's Strategic Plan Executive Summary, reads as follows: "The strategy of the International Potato Centre (CIP) sets out a program of research for the next 10 years that is aimed squarely at contributing to the achievement of selected targets of the Millennium Development Goals".

The selected MDG targets are intended to guide CIP programs, ensuring that research outputs translate into improving the livelihoods of the poor (outcomes); thereby contributing to identified MDG targets (impact). CIP asserts that some of the selected MDG targets have a place in the Center's program agenda, in regard to some specific needs of the poor such as:

- Strengthening competence to empower local decision-making in innovation;
- a healthy diet for the family; and
- Secure and safe crop production for urban and suburban areas.

This Panel first notes the absence of any reference to the CGIAR System Priorities (SPs) in CIP's Strategic Plan. While the Panel concurs that CIP's agenda should not be limited to the CG System Priority s, CIP is expected to focus its work significantly on SPs, and this should be reflected in CIP's MTPs. Since a Strategic Plan should inspire CIP's MTPs, it is only logical that SPs constitute a key element in the Plan. This omission may cause setbacks in the planning process. For example, the Science Council does not recognize the Urban Harvest SWEP as aligned with SPs, and recommends that the program be funded by the Center's 20% budget allocation reserved for CIP's own research priorities. Furthermore, in reviewing CIP's 2006-08 and 2007-09 MTPs, the Science Council deemed inadequate CIP's progress in SP alignment.

The Panel commends CIP for the Plan's declaration that the Centre is a "research partner for development". According to CIP, CGIAR stakeholders have differing opinions about the role that CIP, and CGIAR Centres in general, should play in global agricultural innovation. These opinions can be summarized in the following two:

- The first views CIP as a provider of basic research of an IPG nature. This was a key criterion in defining the CGIAR System Priorities.
- The second views CIP as a partner in research for development, accompanying relevant stakeholders to ensure that research gets translated into outcomes and, in some cases, through to impact.

CIP's Strategic Plan aims to show that both views are vital, and indeed complementary, and the Panel agrees entirely with this position. The second view cannot be justified without the other. The rationale for the role that CIP has chosen, the two legs strategy, is based on an expanded interpretation of agricultural research as a "policy instrument", which covers three complementary dimensions:

i. Research capacity to generate technological fixes (TFs);
ii. coalitions and platforms to link scientific research to technology development and dissemination (CIP as a research partner for development); and
iii. Upstream and downstream linkages with policy makers and development partners, supported by lobbying and advocacy.

The problem perhaps is in the numbers. How funds, resources, and staff time should be shared among these three complementary dimensions. This Panel believes strongly that PRIMACY should be given to the first dimension, but current funding prospects seem to indicate that this, in fact, is not happening.

CIP's Technological Fixes (TFs)

TFs are the new knowledge and technologies that CIP produces to address major, specific constraints to productivity, typically faced by farmers in the developing world. They are "intermediate goods" in the technology supply chain because they require adjustment to fit particular farming systems. Indeed, it is their "intermediate good" attribute that in turn confers them their IPG nature.

The Plan, presented as the roadmap to CIP strategy, first describes the Center's core business as residing in four areas of global science: germplasm conservation, genetic improvement, crop protection and NRM management research. Each occupies one Division within the new organizational structure, and each is a research project in the MTP structure. A fifth area, Innovations Systems, is described as a CIP approach designed to demonstrate that a global Centre can deliberately affect impact locally, delivering tested models with potential international relevance.

The Strategic Plan includes reports about CIP's five areas of research. Each area follows a standard outline: global context, CIP context and outlook. In the areas of genetic resources and crop improvement –considered the heart of the CIP factory— priorities and specific objectives are organized around the main biotic and abiotic stresses. Biotic concerns (fungi, viruses and bacteria), plus abiotic stresses (drought, soil fertility, etc.), explain most of the yield gap faced by farmers. Improved classification of germplasm –i.e., resistant to priority pests and diseases— and subsequent crop improvement (including genomic research), are presented as essential steps in the CIP "technology supply chain". CIP's strategic plan asserts that potato and sweet potato constraints can be addressed with a combination of plant cultivars and management practices.

Disease-free planting material has been the farmer's main concern in potato and sweet potato production. In fact, a recent ex-ante impact assessment conducted by CIP (Fuglie's paper) identified the two technologies that have the most contribute most to rural poverty alleviation:

- planting material and viruses control in sweet potato; and
- Seed systems and viruses in potato.

CIP's Plan also tackles the complexity of Integrated Crop Management, and identifies the following four key research areas:

Evolution of insect and pest populations;
Crop modeling for analytical and predictive purposes;
Insects and pests in agro-ecosystems; and
Information and communications technologies.

The fourth research area, NRM, is presented less precisely. Innumerable issues and themes to be examined are described, with the general purpose of "conducting a complex system analysis to explore ways of developing robust seed systems." A CCER conducted in early 2007 recommended that this area define a "roadmap with a tool kit".

Possibly lacking in CIP's Strategic Plan and particularly regarding the Center's traditional core business (its main technology supply chain) are the long-term (2016) goals driving specific objectives. The Panel acknowledges that current scientific knowledge perhaps does not allow setting more explicit goals for all themes, which explains the specific, short-term objectives presented. The upshot is that the Plan does not envisage any significant breakthroughs, meaning that the kind of progress expected is incremental only, and along a perhaps too broad front of

issues in each area. The relatively high number of 2006 output targets contemplated by CIP (132) compared to a CGIAR Centre average of 75 is an indicator of this apparent lack of focus in CIP's research agenda.

This Panel is also concerned about the challenges and incentives driving CIP's scientists. Some of them claim that MDG targets do not spur the interest among scientists that long-term R&D challenges incite. In the Panel's view, setting long-term research goals need not imply sacrificing funding prospects. When knowledge and related technologies in a given research field set long-term goals attractive to stakeholders, a powerful magnet materializes, attracting additional resources.

The Plan presents CIP's fifth research area, Innovation Systems, as a method to tap into potential CIP opportunities. The narrative consists of a rather long list of themes and studies that CIP will address to ensure that technological fixes impact on farmers' livelihoods. Unfortunately, the narrative lacks a description of priorities in the form of a relevant, finite set of issues around which a research action plan could promptly be initiated.

In conclusion, the Panel would like to commend CIP for the breadth and depth of the reports on its five areas of research. However, though informative and thorough, they are not useful tools for developing operational plans (MTPs). Indeed, the 2007-2009 MTP, the first reflecting CIP's new Strategic Plan, includes a research portfolio with no significant changes compared to the 2006-2008 MTP.

A Business Plan for CIP

This Panel suggests that CIP develop a Business Plan as an integral part of its Strategic Plan. A Strategic Plan needs to be supported by funding expectations. A Business Plan would support the Strategic Plan by laying bare its two most relevant ensuing practical applications:

i. projecting how diverse financial scenarios might affect the plans to reach the Goals, prompting the Centre to either reduce or expand its research portfolio; and
ii. Working out the related issue of critical mass of human and financial resources required to achieve a particular set of Goals.

A Business Plan serves also to rationalize either resource allocation to new research opportunities, or its reallocation among current opportunities, based on under- or over-investments discovered through impact assessment studies. It is also fundamental to the application of the "the pro-poor cycle" framework, and should be revised whenever the Centre alters its research portfolio.

CIP's Proposed New Research Areas

CIP's Strategic Plan proposes three new research areas: (1) further work with other Solanaceous species as high-value vegetables, presumably within SP 3; (2) greater emphasis on agriculture-health linkages, such as crop breeding for bio-fortification with vitamins and minerals; and (3) healthful horticulture in and around cities.

This Panel strongly supports additional efforts on agricultural-health linkages through potato and sweet potato breeding for enhanced nutritive attributes. This is a research objective of great importance for CIP´s clientele in all regions.

This Panel does not think that CIP should engage in new areas (2) and (3). The spread, the likely impact, and ratio of resources to output should guide CIP to add on or shelve alternative species. Even if one takes into consideration CIP's expertise in *Solanacea*, each species has its own complexities, which require specific efforts in the germplasm-breeding-agronomy-post-harvest and marketing-storage continuum.

Furthermore, the Panel believes that the initiative on healthful horticulture in and around cities lies outside CIP's comparative advantage. In addition, although efforts in several cities that have started programs for urban and peri-urban home gardens are showing impacts in terms of income and nutrition for slum dwellers, the Panel sees no clear IPG research objectives. CIP's involvement in new area (3) would certainly drain CIP's scarce human and financial resources, and would diffuse its research agenda even further.

About CIP's Research Impact Pathways

In an attempt to better link research with the selected MD target areas (MDTs), CIP has defined seven R&D themes, or research impact pathways, reflecting the most important needs of the poor, and identified based on external global trends and conceptual shifts. This is illustrated in Table 2.2. b.elow.

Table 2.2 Emerging Trends, Needs, Themes and MDTs

Global Trends	Needs of Poor	R&D Themes or Research Impact Pathways	MDT Challenges for CIP
Climate change Pandemics North-south inequalities A networked world Increased market penetration Conflicts and Security Urbanization	Access for stable and profitable markets	Link farmers to markets	Halve number of people suffering from extreme poverty
	Sufficient food all year	Reduce temporal and chronics hunger in vulnerable communities	Halve number of people suffering from hunger
	Healthy diet for the family	Improve access to safe and nutritious food	Reduce under five mortality rate Reduce maternal mortality rate
	Profitable and healthy farming	Sustainable intensification of potato and sweet potato based farming systems	Reverse the loss of environmental resources
	Diverse crops for multiple uses	Sustainable use of biodiversity	Reverse the loss of environmental resources
	Enhanced capacity for innovation	Institutional learning for pro-poor change	Integrate principles of sustainable development into country policies
	Secure and safe crop production	Sustainable and healthy horticulture in and around cities	Improved lives of slum dwellers

Source: CIP

With regard to the global trends referred to in CIP's Plan, the Panel suggests it include the "food for fuel *ad portas* revolution" that is profoundly affecting relative prices and crop patterns around

the world. The Plan presents two conceptual shifts: (1) "wider utilization of concepts of complex theory to address the multidimensional aspects of sustainable development"; and (2) "continuing evolution in the organization of international agricultural innovation systems".

Out of the seven "needs of the poor", two (enhancing capacity for innovation and access to stable and profitable markets are linked to conceptual shifts. The remaining five reflect the threats posed by global trends.

In its Strategic Plan, CIP claims to have adopted a paradigm that integrates the notions of innovation systems, agricultural knowledge systems, social organization of innovation and multiple sources of innovation. Given that innovation systems are absorbed by complex, existing systems –open systems within which large numbers of independent agents interact— CIP intends to use complex systems theory to introduce a method to conduct research at the multiple levels required to address the selected MDTs. Though conceptually appealing, and setting the rhetoric aside, the panorama for this undertaking is unclear to the Panel. How will this complex systems set –consisting of knowledge, community and innovation systems—be applied practically?

The Panel acknowledges that in this era of information technology, in which vast amounts of knowledge are disseminated, users tend to multiply, creating the need for interaction through partnerships and networks. At this point, the Panel notes CIP's efforts in this regard, and the fact that the Science Council has recognized them explicitly. (See Chapter 3 for an analysis and recommendations on this topic.)

Four of the research impact pathways (or R&D themes) listed in Table 2.2 relate to CIP's core business: (1) Reduce temporal and chronic hunger; (2) improve access to safe and nutritious food; (3) identify sustainable potato and sweet potato farming systems; and (4) identify sustainable uses of biodiversity. Two others are related to CIP as a "research partner for development": (1) link farmers to markets; and (2) institutional learning for pro-poor change, addressing CIP's commitment. And the seventh RIP responds to CIP's commitment to improve the lives of slum dwellers.

Apart from promoting a better conceptual understanding of the CIP Plan, the implementation of the approach (needs of the poor → R&D themes → MDGs) is unclear to the Panel. For example, how will CIP translate its set of R&D themes into the regional strategies? And if the R&D themes are to facilitate team formation and multidisciplinary work, should not some kind of a measurable goal be set for each theme, so that they can become *bona fide* instruments, promoting the specified outcome? In sum, the Strategic Plan should be strategic.

Research Priorities and Resource Mobilization

The last and most difficult step of any strategic planning process is that of setting robust priorities to aptly mobilize and allocate resources. CIP's Vision exercise has been completed, and a corresponding Strategic Plan has been drafted. However, while both efforts in this respect are commendable, in the Panel's view, the planning exercise is still unfinished. The 2002 EPMR recommended that CIP define a robust set of priorities, and this has not yet been done. Is CIP ready to tackle this last step to successfully complete the planning process?

CIP seems to offer two reasons for its delay in taking the final step:

1. Methods to tackle the multidimensionality of research priorities and impact assessment are not yet available; and

2. More participatory process and local collaboration is needed to decide priorities and mobilize resources.

While the Panel acknowledges the validity of these reasons, in its opinion CIP now possesses the relevant information to move ahead. The new quantitative and participatory methods will serve CIP in the final adjustment of its research portfolio.

Tables 2.3 and 2.4 below illustrate actual resource allocation and expected research impact for regions and selected technologies from Fuglie's (2007) ex-ante impact assessment study. Fuglie used two basic impact indicators:

1. The impact of CIP technologies on potato/sweet potato consumers and producers; and
2. The impact solely on poor rural potato/sweet potato farm households.

Figures presented are percentages, and logically, optimal resource allocation suggests that actual percentage resource allocation should lie between the respective percentages of the two indicators. Although these indicators are the product of an ex-ante analysis, and are thus speculative, they show ample space for reallocation both among regions and technologies and can rightly be taken as initial inputs to decide on an approximate set of priorities for CIP.

Table 2.3 Actual Regional Allocation of CIP Research Resources (2005) Relative to [Expected] Impact (In Percentages) (*)

REGION	RESOURCE ALLOCATION	AGGREGATE BENEFITS	RURAL POOR BENEFITS
LAC	51.0	2.5	4.1
SSA	21.3	12.8	44.0
SWCA	12.7	11.6	10.0
ESEAP - S	8.0	2.5	1.1
ESEAP -N	7.0	59.0	40.7
TOTAL	100	100	100

(*) Excludes research allocation to Global Impacts

Source: Fuglie, K. 2007.

Table 2.4 Resource Allocations and Research Impact for Selected CIP Technologies/Research Areas

Technology/ Research Area	Crop (*)	Resource Allocation US$ Million 2005	%	Aggregate Economic Surplus US$ Million/Year	%	Economic Benefits to Rural Poor US$ Million/Year	%
Late Blight	P	1,893	21.7	319	26.5	175	18.6
Breeding for Virus resist.	P	1,029	11.8	119	9.9	65	6.9
Seed Systems and Viruses	P	920	10.5	257	21.4	152	16.1
Enhancement Vitamin A	S	865	9.9	29	2.4	23	16.1
Integrated Pest Management	P	853	9.7	28	2.3	12	1.3
Utilization Animal Feed	S	617	7.0	30	2.5	30	3.2
Market Chain Enhancement	P	577	6.6	4	0.3	9	1.0
Bacterial Management Wilt	P	470	5.4	25	2.0	14	1.5
Increasing Dry Matter	S	464	5.3	92	7.7	80	8.5
True Potato Seed	P	421	4.8	12	1.0	6	0.6
Planting Mat. & Virus Control	S	406	4.6	284	23.6	253	27.0
Breeding for Processing	P	219	2.5	2	0.1	121	12.9
Total Potato	P	9925	72.0	773	62.0	558	57.0
Total Sweet potato	S	3860	28.0	474	38.0	428	43.0

(*) P stands for potato; S stands for sweet potato
Source: Fuglie, K. 2007.

At this point, the Panel would like to offer an approximation to a robust set of priorities for CIP, based on these indicators, plus information gathered in the interviews with CIP scientists and during the field visits, plus the Panel's detailed discussion of CIP's research projects provided in Chapter 3. According to the ex-ante impact assessment study Fuglie (2007), the above priority set includes five potato technologies standing high in terms of the size of their impact, and four sweet potato technologies showing the highest returns to poverty reduction. The robust set of priorities is as follows:

Potato Research Priorities

- Completing the evaluation of the potato germplasm, the constitution of core collections and cryo-conservation of accessions
- Breeding for combined resistance to late blight and viruses
- Breeding for regional requirements (including processing attributes and different nutritional traits)
- Integrated crop management including host resistance (for health and environment) specifically for Colorado potato beetle, bacterial wilt and late blight
- Support seed production program development in needed Regions

Sweet potato Priorities

- Breeding for combined quality (dry matter and nutritional traits including beta-carotene)
- Breeding for viruses resistance
- Developing and disseminating methods for disease-free planting material and virus control
- Integrated pest management specifically for sweet potato weevil

The proposed Business Plan to be integrated to the Center's Strategic Plan, should be able to set up different (realistic) funding scenarios (CIP´s Board has proposed a significant growth in the Centre resources over the next 10 years) with the critical masses of human resources allowing the development of variants within the suggested priorities. The aim should be to allocate 70-80% of total resources to that set of priorities and simultaneously to look for a better balance between potato and sweet potato as suggested by the referred-to ex-ante research priority assessment: 60% to potato and 40% to sweet potato.

Concluding Remarks on CIP´s Vision and Strategic Planning Exercises

CIP has done a commendable job in its Visioning and Strategic Planning exercises. The driving forces have been many and of different nature, aiming at consolidating and taking advantage of Center's past work on the one hand, and at attracting additional resources from Center's donors/investors on the other. In this process, CIP has ended up with activities that are too many for the human and financial resources available. In the view of the Panel, CIP should apply its resources to do real science work on a sure foot, for real life problems and challenges in the regions where the potato and sweet potato systems are dominant for food and income among poor peoples of developing countries.

Recommendation # 2

Because CIP must have in place a sound Strategic Plan to guide the Centre through global changes in the policy and science environments, and to make the Center's direction clearer in terms of research priorities in response to the needs of the poor potato and sweet potato producers in the identified target areas, ***the Panel recommends*** that CIP develop a completed version of its Strategic Plan, that includes the following considerations:

1. The relevant Millennium Development Goal targets to which CIP expects to make a contribution through its research of an international-public-goods nature should be clearly defined as "impact boundaries" in the typical sequence: inputs → outputs → outcomes → impacts.
2. The Centre "output boundaries" should be clearly recaptured as being new potato, sweet potato and Andean Roots & Tubers technologies, plus the policies and institutional innovations related to these commodities.
3. An analysis of the needs and opportunities in the target areas *vis-à-vis* the CGIAR Science System Priorities should be conducted for a better alignment of CIP's research portfolio.

4. Based on the needs and opportunities assessment of target areas (following CIP's Pro-Poor Research and Development cycle) plus the available scientific information and impact assessment analyses, a more robust, cohesive and internally complementary set of priorities should be developed together with a business plan.

3 QUALITY, RELEVANCE, AND IMPACTS OF CIP'S RESEARCH PROGRAM

The first section of this chapter presents a summary of the Panel's assessment of the productivity of CIP's research staff as one indicator of the quality of science at CIP. The sections that follow assess each of CIP's nine projects as reported in the Center's MTPs: The first six correspond to the work of CIP's Research Divisions (Impact Enhancement, Genetic Resources, Germplasm Enhancement and Crop Improvement, Integrated Crop Management, Natural Resources Management, and Agriculture and Health). The remaining three projects correspond to the work of three Partnership Programs (CONDESAN, the Global Mountain Program, and Urban Harvest).

3.1 Productivity of CIP's scientists

Scientific production is a good proxy of the quality of science. For this reason, the Panel requested CIP to provide information on scientific production of CIP's IRS research staff over the last five years. This information allowed the Panel to estimate values of indicators (students supervised, honors/prizes and publications) of CIP's staff productivity and to compare CIP's values with CGIAR averages. (Section on Research Performance in Chapter 6 reports the Science-Council's results of Centres' Performance Measurement for 2006.)

Over the last five years, CIP's researchers -- internationally-recruited staff directly involved in research (IRS-R) -- published around 570 publications, which means over 115 publications annually. Approximately 40% were journal articles, 82% of these peer reviewed. In addition, over three fourth of peer reviewed articles were published in ISI-indexed journals. These numbers suggest a highly prolific research community. But a closer look at values of a select set of indicators of staff productivity, provided in Table 3.1., suggests that CIP's performance is slightly below the average of CGIAR Centres for most indicators. This Panel's analysis also shows that in the last five years, between two thirds and 70% of researchers at CIP published less that the average CIP researcher, implying that the bulk of publishing can be credited to a few "stars".

Table 3.1 Scientists' productivity for the previous five years: CIP and the CGIAR (*)

Productivity indicator	CIP	CGIAR Average
1. % of IRS-R that have supervised degree students	52	56
2. average # of students supervised	5.5	4.9
3. % of IRS-R that have received honors and prizes	16	26
4. % of IRS-R that published peer reviewed publications (books, chapters, journal articles)	80	89
5. Number of peer reviewed publications (books, chapters, journal articles) per staff member per year	1.04	1.02
6. % of IRS-R that published peer reviewed journal articles	77	83
7. Number of peer reviewed journal articles per IRS-R per year	0.7	1.2
8. Number of peer reviewed journal articles per publishing IRS-R per year	0.9	1.5

(*) Considers only internationally-recruited staff devoted to research (IRS-R)
Source: 6th EPMR Panel, based on information provided by CIP.

3.2 Project 1 Impact Enhancement (IE)

Introduction

Impact Enhancement was created as one of the new six research Divisions at the time CIP developed a new research organizational structure during the Center's Vision exercise. The new Division was put together by grouping three projects of the previous research "project" structure: Impact assessment, Potato seed uptake and use, and Post Harvest. These three projects used to take 60% of total socioeconomic human resources at CIP. The creation in 2004 of the Impact Enhancement Division intended to provide a renewed framework for a more integrated social science research at CIP, while continuing the fruitful interaction of its social scientists with biological scientists, and while keeping social scientists in the other research Divisions, particularly in ICM and NRM.

Methodologies for impact targeting, a broader conceptual framework for impact assessment, impact indicators and methodologies for their measuring and monitoring, and strategies and tactics to add value to CIP commodity research, are mentioned as some of the themes for socio/economic research. Four projects were listed under this Division in the Vision document: (1) Characterizing user needs and opportunities for agricultural knowledge and technology; (2) Assessing dissemination strategies, adoption and impact; (3) Adding value to commodities through post harvest innovation; and (4) Institutional Innovation. This last project, Institutional Innovation, was later incorporated in the strategic plan as the area of Innovation Systems (see Chapter 2).

The 2002 EPMR, in essence, commended CIP for the quality and contributions in the field of social science, which at that time included analyzing research priorities; science and technology policy; studies on early acceptance and adoption; impact assessment; and strengthening capacity for social sciences research in national counterparts. But that EPMR recommended that CIP increase efforts in science and technology policy issues and in the development of frameworks for the collection and analysis of data on adoption and constraints. Simultaneously, that EPMR urged CIP to undertake, as soon as possible, a priority setting exercise (the last one had been conducted in 1996), and to incorporate the resulting priorities into the planning and budget of CIP.

Current Strategy and Overview

The current strategy, as reflected in the planned outputs for the Impact Enhancement Division (reported in the 07-09 and 08-10 MTPs) shows some changes and absences compared with the Social Science research agenda of some years ago. For example, the three outputs reported for the 08-10 period are: (1) The pro-poor R&D cycle validated (this tool was developed during the Vision exercise to guide the Centre with needed changes in its research portfolio); (2) strategies for linking farmers with markets and post-harvest innovations (this is one of the Papa Andina most important objectives); and (3) pro-poor policies for institutional learning and change (this is CIP's pathway to move from "enhanced capacity for innovation" to the MDG target of "integration of principles for sustainable development into country policies").

It is now quite clear for the Panel that the 2002 EPMR's main findings and recommendations for Social Sciences at CIP were not given enough consideration, either at the time the new Impact Enhancement Division was created, nor from there on. What the Panel sees instead in CIP's current strategy for Social Sciences -- at least from the perspective of the Impact Enhancement

Division -- is a research agenda that on the one hand is lacking of important themes such as adoption and research priorities, and on the other has been changing rather abruptly as its outputs for the periods 06-08, 07-09 and 08-10 indicate in the last two MTPs.

Resources

Because social science research at CIP includes impact enhancement and impact assessment associated with the mobilization of outputs from specific projects of other Divisions, the human and financial resources for this purpose are shared with other Divisions. Most of the IE Division's remaining funds correspond to the Papa Andina Partnership Program, which has its own management.

Table 3.2. Shows the evolution of the number of staff with social sciences training at CIP between 2002 and 2006. While total number of staff remained the same during the period, the disciplinary composition has changed. Two PhDs in Economics recently left the Centre, one in 2005 and the other in 2006; and one have been re-assigned as Deputy Director General for Research, which is mainly a research management position. In addition, not all staff members with socioeconomics background are involved in socioeconomic research. The human resources currently involved in social science research at CIP are scattered among Divisions and Projects, and their work covers a wide variety of topics that range from cost/benefit analysis of alternative technologies, to potential gains of disease controls, to ex-post impact assessment, to name a few. While professionals with other disciplinary backgrounds participate in social science research, it is hard to know how much of their time is dedicated to such work. The shift in disciplinary background of staff and the changes and absences pointed out in the current strategy; lead the Panel to conclude that the net allocation of human resources to produce socioeconomic research outputs has declined considerably since 2002.

Table 3.2 CIP, Disciplinary background of IRS in the social sciences, 2002 and 2006

Field	Degree	2002	2006
Economics or Ag. economics	PhD	6	3
Economics or Ag. economics	MSc	2	1
Anthropology	PhD	2	3
Anthropology	MSc	0	2
Extension/Communications	PhD	2	2
Extension/Communications	MSc	1	2
Total		**13**	**13**

Source: Information Provided by the IE Division

Main Achievements

As discussed in Chapter 2, Keith Fuglie's ex-ante impact assessment "Projecting Impacts on Poverty, Employment, Health and Environment" has been a major achievement of socioeconomics research at CIP. But ironically, this piece of research (recommended by the 2002 EPMR as priority) originally developed as a "Research Priority Assessment for the CIP Strategic Plan". Furthermore, this piece of research was neither used in the preparation of the Strategic Plan, nor by other social scientists at CIP to discuss eventual reallocation of resources among the different Centre research areas.

Socioeconomics research at CIP has also produced policy proposals and assessments of the potential value of potato genetic resources, which could be of interest to the countries of origin of potatoes, in light of trade liberalization and IPRs.

Regarding the Platforms and Consortia for processing and marketing of *tunta* in Puno to facilitate their entrance to higher income markets in Peru and Bolivia, the Panel wonders whether these could become models with more than local relevance. A User's Guide for Participatory Market Chain Approach (PMCA) has been produced, and published for use in Latin America and Africa. A recent appraisal in Asia assessed opportunities for Indonesia and Vietnam to become important suppliers of potatoes and sweet potatoes in global markets. Of particular IPG relevance is a study on asymmetric market information as a constraint to potato seed improvement.

Assessment

Whether the utilization of the Pro-poor R&D Cycle as a conceptual framework provides an opportunity for the integration of socioeconomics research work among Divisions and among Programs, is yet to be seen. But this opportunity will be missed unless CIP has a clear operational strategy and the necessary human resources are put in place.

The lack of attention and follow-up to Fuglie's paper, is another example of CIP moving away from areas of social science research, thought to be important to develop the kind of socio-economic information needed by biological and other scientists, as well as by managers and by donors and their advisers, in allocating funds to different research enterprises.

In spite of this lack of attention by CIP management, the Panel's assessment of CIP's IRS research staff productivity in terms of their publishing record during the last five years reveals that social scientists (including economists) have been highly prolific relative to CIP scientists with a different disciplinary background. CIP's social scientists produced 137 publications in the last five years, including peer-reviewed journal articles, books and book chapters, and conference papers. This represents nearly a fifth of all publications produced by CIP's IRS researchers. The average social scientist at CIP published 0.77 peer reviewed journal articles per year during the last five years, above CIP's average of 0.7, but still below the CGIAR the average of 1.2.

This Panel reviewed a number of social science publications, from peer reviewed journal articles to books and manuals, and notes their high quality with respect to methodology and analytical rigor. The findings are also interesting and relevant. This, notwithstanding, the Panel notes that a great majority of the key publications are produced in English only, which greatly limits their potential utilization.

The Impact Enhancement Division faces a major challenge in mainstreaming socioeconomic analysis throughout CIP's Divisions and Programs. The need for this was also evidenced by CIP staff in the workshop held in May 2007, which revealed eagerness of staff to participate in training and on the job initiatives for more socioeconomic research in each of their fields. Scientists were particularly concerned about the requirement that each project, regardless of its position in the research-innovation-development continuum, make a meaningful impact on specific MDTs.

Furthermore, the Panel perceives a generalized lack of awareness in CIP's scientists about the influence that policies and institutions, in short SP Area 5, have on their work. Hence,

mainstreaming socioeconomics at CIP will need to contemplate policy awareness. This Panel suggests that CIP undertake a consultation with Division and Program Leaders to assess their policy awareness and that of their work as a first step to designing appropriate training for CIP's staff.

Recommendation # 3

Because the Panel has observed that the work of the Impact Enhancement Division lacks a sound strategy on socio-economics at CIP and the appropriate human resource capacity to carry out quality research on the Division's stated goals, ***the Panel recommends*** that a CCER be commissioned immediately to review the Division's current goals, research agenda and human resources; that the CCER´s recommendations be acted-upon immediately after the review's completion; and that the CCER´s Terms of Reference:

1. require that the Review produce a well-defined strategy, research agenda and needed human resources; and
2. Consider the desirability of making this Division the integrator of social science research at CIP as a means to make further progress in the implementation of the 5th EPMR recommendations 6, 7 and 8.

3.3 Project 2 Genetic Resources Conservation and Characterization (GRCC)

Introduction

CIP's work on genetic resources encompasses potato, sweet potato and nine Andean roots and tubers [*oca, ulluco, mashua, maca, yacon, achira and ahipa*]. The main objectives of this project relate to germplasm collection, conservation of collected genotypes, characterization of collected genotypes, and multiplication of characterized genotypes to make them available to NARS and other types of organizations. These objectives fit well into the CGIAR System Priority 1A on conservation and characterization of staple crops. Preventing genotype loss motivates CIP collection activities. Keeping genetic resources of potatoes and sweet potatoes safe and alive in one biologic form or another so that they can be used as inputs in germplasm enhancement is particularly resource demanding. Evidence of the superior germplasm is often obtained from the documented knowledge of the described characteristics that enable breeders and farmers to compare them to existing farmer varieties. Reducing the collection to a useful "core" or representative subset implies additional work, because defining the "core" is based on correct and accurate identification and characterization of each collection. And because deploying diverse and or superior germplasm is the major channel of CIP's influence on potato and sweet potato systems worldwide, continuous germplasm multiplication is needed.

Current Strategy and Overview

Germplasm collection is an on-going activity at CIP. Efforts are focused on sustaining a steady stream of fill-the-gap genotypes. CIP aims to secure and conserve in the long-term wild and cultivated germplasm of potato, sweet potato, and nine Andean root and tuber crops from high diversity locations, and has followed this line of research aggressively for a long time. CIP is well known in developing and developed country research organizations for the germplasm that it has deployed.

Two main outputs are planned for the next two years (2007-2009 MTP):

- Output 1. Wild and cultivated genetic resources of potato, sweet potato and other root and tuber species and associated information collected, securely conserved through integrated ex-situ, in-situ and on-farm approaches and disseminated to users worldwide.

- Output 2: The diversity of wild and cultivated genetic resources of potato, sweet potato and other root and tuber species is assessed and useful biotic and abiotic characters and nutritional and health-promoting attributes are characterized, documented, and made available to users worldwide.

Table 3.3 shows the output targets in terms of the number of genotypes or accessions that will be handled according to the 2007-2009 MTP:

Table 3.3 Output Targets corresponding to the number of genotypes to be handled.

Activity	**2007/2008**	**2008/2009**
Collection	230	-
Conservation	400	-
Regenerate	2900	-
Cryo-preserve	518	-
Store as DNA	2100	-
Monitoring	700	-
Characterization	150	936
Introgression study	-	310
Inheritance study	-	-
Data base	-	-
Herbarium	500	-

Note: The inheritance study will occur twice. The data base maintenance is continuous. "-"means the activity does not occur in that year.

Resources

The GRCC Division has three agronomists and two geneticists. In 2006, genetic resources research spent US$1.26m. Out of this, US$1.03m (82%) was financed with the Center's own income and unrestricted funds. This funding structure implies that the major sway in what was decided and implemented has been mainly determined by CIP's own assessment of the priorities for its genetic resources work.

One of the strategic issues identified by the Science Council for this review pertain cuts in budget for Project 2 for 2007, between what was planned in the 2006-2008 MTP and what was established in the 2007-2009 MTP. Indeed, having dropped from US$2.54M in 2002, the project for this budget is half of what it what five years ago. The Panel found no rationale for CIP's reduction of efforts on GRCC activities, and considers that the reduction of the budget for this project is certainly not a trivial issue for CIP's ability to produce IPGs, given the strategic role of conserving genetic diversity for roots and tuber crops. The 2008-2010 MTP contemplates a budget increase to US$ 1.73M in 2007 for this project, which is then planned to average US$1.67M annually from 2008 to 2010. This level of resources will certainly not allow CIP to make any significant progress in characterization activities, which, as discussed later, are required in order for CIP to be able to consolidate a core collection, and in order for CIP to strengthen uptake. CIP needs to devise a strategy to increase and sustain funding for this project.

Main Achievements

- The current total potato, sweet potato and other Andean root-tuber collections maintained in trust at CIP's gene bank comprise: 10,494 landraces covering 18 species, and 3,551 accessions

of 264 wild species, 7448 research materials under development and over 5,000 herbarium specimens.
- The in-vitro repository has 4,290 potato specimens, 3,536 sweet potato specimens and 737 specimens of other Andean roots and tuber landraces; out of these, 57% potato, 37% sweet potato and 40% Andean roots and tubers have been pathogen tested.
- During 2002-2005, 2,586 potato, 1667 sweet potato and 64 Andean roots and tubers sets were distributed to 28 developing countries and 14 developed countries.
- The potato and sweet potato collections have been duplicated for safety purposes in INTA, Argentina and CIAT, Colombia.
- Virus-elimination and cryo-conservation techniques are well in place.

One of the recommendations of the 2002 EPMR was that CIP establish a state-of the-art high throughput genotyping facility; skills and competency strengthening in bio-informatics and computational biology. CIP has followed this recommendation in letter and spirit and a high-throughput genotyping facility was established at CIP in early 2004. The main activity of this laboratory has been the production of micro-satellite marker data for potato.

Assessment

The GRCC Division's has achieved much and its performance, given its scarce resources, is commendable. The genetic resources collection and conservation work is well advanced. But the staff and financial resources are spread too thin, and the Division's work on characterization is far from complete.

The molecular characterization of germplasm accessions will help, not only in studying the genetic diversity but also in the constitution of the core collections for potato and sweet potato. But a core collection formed without taking into consideration the various phenotypic and agronomic attributes, including resistance to various biotic and abiotic stresses will be of little use to the CIP's breeders in Lima and in the Regions and to developing country scientists. The slow progress in phenotypic and agronomic evaluation of germplasm is obvious in Table 3.4. Hence, characterization, phenotypic/agronomic in particular, should be given top priority so that it is completed for the totality of CIP's collection at the earliest possible date.

For example, the Panel sees the constraints of weevil damage as essential to realizing all the benefits from good genetic stock or from their enhanced derivatives. Collections of sweet potato and their characterization for sweet potato weevil and work related to that critical issue affecting all sweet potato-growing regions should be revisited bearing in mind the past experiences at CIP and elsewhere.

Table 3.4 Progress in characterization of genetic resources at CIP

Potato				
Attribute	**1997-2001**		**2002-2006**	
	Wild	**Cultivated**	**Wild**	**Cultivated**
Late blight resistance	No data	No data	~130	~700
Bacterial wilt resistance	No data	No data	~530	~210
Virus resistance	No data	No data	<350	~3200 (PLRV) ~2100 (PVX) ~3100 (PVS)
Drought resistance	0	0	0	~30
Nutritional	0	0	0	~500
Processing	0	0	0	~380
Sweet potato				
Virus resistance	0	500	<50	~700
Drought resistance	0	0	0	~80
Nutritional	0	No data	2	~1446
Processing	0	No data	0	~1500
Andean roots and tubers				
Nutrition	0	50	0	~220
Processing	0	<5	0	~10

Source: Genetic Resources Conservation and Characterization Division

The Panel suggests after CIP completes the characterization of all collected genotypes; it will be in a better position to review the 500 plus core they now have. CIP could keep only core collections representing the total range of variability in terms of alleles for all important characters including resistance/tolerance to various diseases and pests and abiotic stresses as active collection in vitro and/or in tuber. All other accessions may be put into long-term cryo-conservation and as true potato seeds, which would reduce germplasm maintenance costs tremendously. In this respect, the Panel notes that while cryo-conservation is meant for long-term maintenance of accessions that are not likely to be used in the near future, the cryo-conserved germplasm at CIP is comprised only of 550 "core" germplasm accessions!

Share of resources to potato, sweet potato, and Andean roots and tubers

Over the years at CIP, there has been an unclear basis for the partitioning of resources to potato, sweet potato and other crops. CIP started research on just potatoes. And while in 1988, CIP's mandate expanded to sweet potatoes, GRCC's efforts are still largely concentrated on potatoes. With the exception of the IE Division's study (Fuglie 2007), the continued emphasis on potatoes has not been evaluated in terms of how this crop parts? Or ranks with sweet potato or with Andean roots and tubers in CIP's effort to bring maximum benefits to the poor. It is important that CIP carry out this evaluation thoroughly.

The Panel views the Andean roots and tuber crops as very important either as nutraceutical crops of endemic usage or as cash crops in the Andean region. CIP has collected a sizeable number of nine such species over the years. Their genetic resources accessions collected for this group of crops were maintained over the 2002-2006 period without direct usage in the focal breeding activities of the CIP or its relevant development partners. The discovery of bioactive ingredients of potential interest requires much more than mere proximate analysis of crude protein, carbohydrate, fats, minerals, vitamins, moisture, and fiber. And the additional fine work of

characterization and evaluation required needs more resources than currently available to CIP. These crops can be made more valuable after evaluation with the possible engagement of commercial concerns that would wish to explore how to make the best use of the collections rather than just as genotypes in store of unknown utility. Therefore there is need to examine the possibility of sharing the conservation cost for Andean Root and Tuber Crops with Private Sector and Public institutions. This will help CIP cut on its budget for this group of crops that are important though in a restricted regions of CIP's target area of operation. In addition, the Panel suggests that CIP do less collection and storage of the Andean root and tuber germplasm and conserve what they now have. Those areas that are not at risk of human damage should not be collected, except if they are to be used by CIP to solve specific areas of work for which new collections are required.

Fuglie's (2007) assessment suggests that impacts associated with sweet potato research are likely to be high. The greatly untapped sweet potato germplasm should be collected, conserved and characterization so that its potential be shifted to a higher gear. Therefore, the Panel suggests that about 5% of the GRCC budget be allocated to Andean roots and tubers, and that the remaining project funds be allocated in a ratio of 50-60% for potato and 40-50% for sweet potato.

GRCC in the Regions.
Just how much is done is difficult to quantify by regions, but this activity in SSA germplasm conservation is at a low scale. In order for GRCC outputs to be fully realized, and someday result in outcomes and impact, they should also actively involve CIP's Regions, through ex-situ conservation also in cultivation, gardens, and collections maintained/multiplied in various other agencies and even in farmers' fields. Only by actively engaging CIP's Regions, will utilization of the genotypes in local breeding efforts across the potato and sweet potato programs of the world, not just for CIP's, be spurred. The extent of germplasm work in the regions should be considered as the ultimate way for their security. NARS systems are to be strengthened to hold and keep them as replicate deposits, as not done in the case of INTA and CIAT.

EU Commissioned Review of Project 2
This Donor Commissioned External Review (DCER) on "Conservation and characterization of root and tuber crops genetic Resources" of August 2003 produced 11 recommendations. They are all in line with the thinking of the Panel. However, while the Panel agrees with the recommendations in general; and while the Panel also notes that all of them are positive towards helping the Project better serve the purpose of its *raison d'être*, the Panel would like to support the need and urgency to add far more weight on Recommendation 10 ("that CIP accords priority to the public accessibility of gene bank evaluation data").

The DCER examined adequately the structure and working of this Project. While it is important to accept their recommendations, the Panel understands that 2006 funding (MTP 2008-2010) of US$1.26M is unlikely to give the project enough capacity to fully implement them. This is because of the rather large number of plant species to be handled as well as the many inter-linked recommendations to collect, conserve, characterize, evaluate, document, and disseminate these genetic resources. The project is also requested to liaise with many other germplasm institutions. For example, the project still needs to acquire about 50 species of potato to complete the gap of its collection of all known Solanaceous species, yet the project is yet to complete the characterization of those already in hand.

The Panel believes that as much as the DCER recommendations are relevant, the reality of the circumstances of tight funding scenarios, CIP should adopt the 11 recommendations but review them in terms of their effectiveness, value to contribute to MTP and urgency. The need for internal priority setting among these recommendations is necessary. However, this exercise would take note of the ranges of resources at hand, time taken to complete the task, and the short-term relevance in attending to current constraints for which solutions from better germplasm is sought. It clearly appears to the Panel that it is an inescapable fact that the Andean and other root and tuber crops would have to enjoy far less of an emphasis compared to potato and sweet potato. See section on "Share of resources to potato, sweet potato and other crops".

Furthermore while the DCER recommended that CIP define its objectives for the establishment of core collections of different crops. This Panel feels that core collections should be constituted after the complete characterization of the germplasm not only for phenotypic and molecular diversity, but also for agronomic attributes, including responses to various biotic and abiotic characters important to breeding.

CIP's implementation of the DCER's recommendations are mostly on-going but at varied levels for each specific recommendation. CIP's Highlights for the 2002 to 2005 period indicate these levels.

Publications

The Panel examined the key publications from this project. They relate to: studies on variation in the major characters and diversity/taxonomy of the genotype and identification of the collections held in CIP's gene bank. These publications though related to the project activities, need to be re-presented in assembled formats for many users of the germplasm. Only about half of the papers attend to issues that are relevant as IPGs that would key into the development or enhancement of these crop commodities.

No matter how rigorous and exciting, scientific information should be effectively disseminated to NARS and other research and extension organizations, especially in developing countries, if science is to be mobilized to create impact. Results from the evaluation and characterization work should be documented, published, and disseminated periodically in the form of user-friendly electronic databases and in printed form, and made available to the potato and sweet potato researchers globally. Effective dissemination of information resulting from the evaluation and characterization will help users know the available "supply" of germplasm attributes, better focus their demands from CIP, and better plan their research work.

Recommendation # 4

Because the characterization of genetic resources is important for its utilization in the breeding program, and because this process has been relatively slow at CIP, ***the Panel recommends*** that CIP:

i. Accelerate the characterization of the remaining genotypes in the Center's gene bank, and that this be completed for all key traits;
ii. produce a compendium based on passport, morphological and molecular data and characterization results for key biotic and abiotic stresses; and
iii. Make this information widely available to all collaborating NARS to enable them to make choices of what may be needed to enhance their genotype selection and crossing schemes.

3.4 Project 3 Germplasm Enhancement and Crop Improvement (GECI)

Introduction

Being located in the centre of diversity for potato and many other root and tuber crops conveys comparative advantage in access to landraces and wild species of these crops. CIP is aware of its advantage in this respect, and thus potato and sweet potato improvement are the core elements of CIP's research agenda. CIP's work in this area includes genetic enhancement and crop improvement through a variety of techniques, ranging from traditional plant breeding, to using a range of modern tools of biotechnology.

CIP's MTPs indicate that objectives of this project are to undertake activities that should lead to the following major outputs:

i. Development of potato populations, clones and TPS varieties possessing resistance to major diseases and pests, having market oriented traits and nutritive value;
ii. development of sweet potato varieties with enhanced dry matter, β-carotene, Fe and Zn content with resistance to pests and diseases especially virus complexes;
iii. enhancement of breeding methods via new tools, information and capacity building; and
iv. Development of transgenic potato and sweet potato.

These objectives fit well into the CGIAR system priority 2 (2A, 2B, 2C and 2D) that is aimed at producing more and better food at lower cost through genetic improvements. Genetic enhancement of a crop also indirectly promotes conservation and characterization of biodiversity, and hence the CGIAR system priority 1A.

Resources

Investment in this project has been quite satisfactory for the period 2002-2006 and it has grown to more than double between 2002 (US$ 3.53M) to 2006 (US$ 7.47M). However, 2006 budget also included the grant of US$1.3M for the VITAA project which is a not a research but a development/extension awareness campaign project for scaling-up the use of vitamin A-rich sweet potato. If this amount is excluded, even then the germplasm enhancement and crop improvement project will have more than US$6.0M in 2006, an amount that is good enough for undertaking the activities of this project.

Current Strategy and Overview

Despite their outstanding biological, food value and income-generating potential, potato and sweet potato can yield poorly and suffer high yield losses in marginal environments. Furthermore, reliance on pesticides to maintain productivity in tropical and subtropical ecologies has significant negative effect on the environment and human health, in particular for smallholders who often misuse pesticides when they are available. Realizing this scenario, CIP has embarked upon genetic enhancement and crop improvement programs for potato and sweet potato. One of the major genetic enhancement activities is to develop parental lines and varieties carrying durable resistance to late blight caused by *Phytophtora infestans*, which is the number one problem of potato production worldwide. Advanced populations carrying quantitative resistance to late blight are improved for meeting high standards for productivity and table quality. Advanced clones are being evaluated for future releases in target countries of Latin America, Africa, and Asia where European-type tubers are preferred.

CIP is also developing potato clones carrying combined resistances to viruses PVY, PVX and PLRV, which are the major causes of seed degeneration. By producing varieties with combined

resistance to various viruses, CIP's strategy is to provide an inbuilt system of production of virus free seed. Tissue culture plantlets of advanced selections are sent to the regions for multiplication and testing under regional environments.

Sweet potato improvement has centered on higher yields through better resistance to SPVD and higher dry matter content. The new move is to enhance beta-carotene together with Fe and Zn. Such orange-fleshed sweet potato varieties are particularly developed for Africa to provide β-carotene rich cheap staple food to the nutritionally-starved population of this continent.

Post-harvest quality is another area for which CIP evaluates breeding populations, in order to identify potato cultivars that demonstrate outstanding parameters for processing as potato chips. For quality screening Near Infrared Reflectance Spectroscopy (NIRS) technique is used for nutritional traits including protein, total and specific carotenoids, Fe, Zn, P and Ca, allowing high selection intensities to improve potato and sweet potato crops for better nutrition.

Conventional as well as parthenogenic breeding approaches are being used to produce TPS progenies having high and stable yield and resistance to late blight and such populations are distributed for evaluation to Asian and the Caucasus countries. Tuberosum x Andigena crosses are exploited to produce heterotic TPS progenies.

CIP also undertakes water-stress studies to identify specific attributes suitable for breeding drought tolerant potato for different target regions. Biotechnological tools like DNA fingerprinting, molecular mapping, marker assisted selection, genetic transformation are being used to achieve the crop improvement objectives set forth by the CIP. Transgenic are being developed for late blight resistance, enhanced content of free-lysine in tubers, and resistance to PLRV in potato, and for high amylose starch, resistance to SPVD complex and Andean weevils in sweet potato.

Main Achievements

1. Sixty-four potato and sweet potato varieties were released by National Research Institutes of 13 countries during 2002-2006 by selection from the crosses or by utilization of advanced breeding/germplasm lines supplied by CIP.
2. Over 600 new hybrids (not clear) potato and four new sources of resistance to late blight were developed by controlled crossing and embryo rescue methods for broadening the base of resistance to this important disease.
3. Sensitive and fast screening methods have been developed for bacterial wilt and nutritional traits including micronutrients.
4. A tetraploid molecular genetic map of potato was developed facilitating the localization of new major gene for PLRV resistance with a view toward marker-assisted selection in breeding programs.
5. Transgenic potatoes with constructs conferring resistance to late blight and PLRV, and transgenic sweet potatoes with constructs conferring resistance to SPVD and weevil have been developed. Transgenic potatoes and sweet potatoes with enhanced content of free-lysine and high amylose starch, respectively have been developed. Plant transformation vectors with non-antibiotic selectable marker gene have been developed.

Assessment

The genetic enhancement program of the CIP has made significant advancements in developing late blight and virus resistant breeding lines through conventional breeding by deriving

resistance from diverse wild species and thereby providing durable and broad genetic base resistance for these two most important pathogens of potato. These breeding lines are being improved for characters like early tuberization/early maturity, tuber dry matter, micronutrients and processing attributes. Though comparatively less effort appears to have been made on sweet potato in this regard, virus resistant breeding lines of this crop too have been developed.

The supply to, and utilization of such material by national breeding programs has resulted in the release of as many as 64 potato and sweet potato varieties in 13 countries. But the adoption of these varieties, particularly of potato, is not as expected. Similar remarks had been made by the Interim Science Council (iSC) of CGIAR in its commentary on the report of 2002 EPMR. The quote: (The iSC is alarmed by the discrepancy between the release of CIP-derived varieties and the much lower and variable adoption of those materials). This also reported in the Science Council's Brief No5, of October 2006).

The adoption of a new variety depends upon: (1) the level of its superiority over the existing varieties in cultivation; (2) multiplication and supply of the healthy seed material of the new variety to the farmers; and (3) the duration over which the variety has been disseminated. The genetic enhancement program of CIP is mainly concentrated at its headquarters, and actually amounts to pre-breeding/breeding of potato for resistance to late blight and viruses and of sweet potato for viruses. Utilization of wild species for introgression of diverse genes into the breeding populations has resulted in breeding lines that are late in maturity, and possess tubers unlike those of the desired types as produced by the European and American potato varieties. CIP is aware of this problem, and is therefore trying to improve the pre-bred lines for agronomic and processing attributes. These lines, being selected mainly under the Peru conditions, are also not well adapted to the conditions prevalent in other target countries, which have many additional requirements that vary from region to region. For example, highland tropics of Sub-Saharan Africa, South East Asia and the Andes of South America are characterized by a short day length, with a rainfall pattern that allows 1-3 potato crops per year. Frost and drought constitute significant abiotic limitations to optimal crop production in parts of the Andes and Sub-Saharan Africa. On the other hand, the continental semiarid region of Central Asia is characterized by long day length where the crop is irrigated, and soil salinity, drought and high temperatures are the main abiotic constraints. Early maturing/bulking cultivars are often required in subtropical lowlands of South West Asia, South East Asia, and Central and East Africa for diversified cropping system, whereas subtropical highlands of East Asia, typically with one potato season per year, require cultivars with medium maturity. Colorado potato beetle is a serious problem of potato in central Asia and Caucasus countries, and bacterial wilt in sub-Saharan Africa.

Varieties which lack regional adaptation particularly under smallholder conditions prevalent in developing countries are not expected to find good acceptability, even if they are resistant to late blight and viruses. Resource poor farmers of developing countries need varieties which have high yield with low inputs and assured economic returns, even if harvested at varying crop duration. In tropical and sub-tropical countries temperatures start rising after the potato crop is harvested. In these countries, low-temperature storage facilities for perishable crops like potato and sweet potato are inadequate and expensive. Hence, varieties of potato and sweet potato with good storability at ambient temperatures are required for such regions. These varieties should also possess attributes needed for trade and processing, otherwise farmers are excluded from emerging markets. Thus, breeders need to combine a large number of characters in a single genotype, so that its value-added is sufficiently high to motivate farmers to replace more

traditional varieties. This is a cumbersome task, particularly so in potato and sweet potatoes, as both these crops are polyploidy and yield best under highly heterogeneous conditions.

For such a complex scenario, it is desirable that CIP undertake pre-breeding/breeding for characters of universal importance like late blight and viruses at its headquarters, and that these pre-bred populations are improved for specific regional requirements by breeding programs undertaken in the concerned region, by CIP's Regions. This would result in development of breeding lines combining major requirements of the region, including adaptability. Such improved lines may be accepted by the farmers directly as cultivars or can serve as desired types of parents for use by the NARS in developing varieties having superiority over the existing cultivars of the region. For the successful adoption of the new varieties, CIP needs to support NARS in the development of the seed production programs in the target countries so that healthy seed of the recommended varieties are made available to the farmers at a reasonable price. In trials with the breeding material, healthy seed of same physiological age for the control varieties should be used for evaluation, in order for results to be fare and reliable.

One of the recommendations of the 2002 EPMR was that the potato improvement activities are coalesced into a single project and the leader be empowered to champion the development and delivery of a coherent breeding program. CIP has implemented this recommendation by putting all breeding activities under the Division of Germplasm Enhancement and Crop Improvement with head of the Division as Project Leader. This has been a good step forward. But the Panel feels that there is need to integrate the research and development activities so that genetic improvement is aimed at not only one or two characters, but for the development of clones/varieties possessing all characters required by the regions. The Panel thus strongly emphasize that CIP should strengthen the breeding activities in the regions so that potato and sweet potato populations/clones developed at its headquarters are improved for the specific attributes as per requirements of the different regions.

Due to global climate change, warming and water scarcity are being looked as the major future constraints for sustaining agricultural production. Though CIP is doing some work on drought tolerance in potato, more resources need to be used for research on these problems. CIP should concentrate on developing practical screening techniques for heat and drought stress, and develop breeding lines tolerant to these stresses. Marker-assisted selection, and identification and cloning of genes imparting tolerance to these stresses should get priority over the use of the biotechnological tools for late blight and virus resistance, which can be handled also through conventional breeding quite effectively as has been achieved by CIP. Bacterial wilt and Colorado potato beetle in potato, and weevil resistance in sweet potato for which durable source of resistance are not available, are other important candidate traits for genetic improvement through the intervention of biotechnology. Hence, in the Panel's opinion, CIP should use its strength in biotechnology for genetic improvement of heat tolerance, drought tolerance and bacterial wilt and Colorado potato beetle resistance in potato, and weevil resistance in sweet potato.

CIP has done good work in genetic transformation and has developed transgenic potatoes with constructs conferring resistance to late blight and PLRV, and transgenic sweet potatoes with constructs conferring resistance to SPVD and weevil. Transgenic potatoes and sweet potatoes with enhanced content of free-lysine and high amylose starch, respectively, have also been developed. CIP had a CCER on development and deployment of genetically engineered (GE) potatoes and sweet potatoes in June 2005. The CCER Panel made as many as 73

recommendations in this regard. The CCER's major recommendation was that CIP should go forward with GE traits as it has institutional advantage to draw upon this strategy for genetic improvement of potato and sweet potato. But the CCER also suggested that CIP should ensure that it only develops GE crops that offer benefits to the resource poor, and both fit for purpose and are fully bio safe. While the Panel for this 6th EPMR agrees with the strategies suggested by the CCER for development and deployment of transgenic, it notes that the CCER did not take into consideration the fact that scenario regarding the commercialization of transgenic is still controversial. Therefore, the Panel feels that since CIP has already made considerable progress in the development of transgenic for various characters of interest, it should conduct field trials with these transgenic in the target countries to test their worth. However, if these countries are reluctant in granting permission for conducting field trials with the transgenic, CIP should go slow on transgenic work, and divert the resources for the development of marker based screening techniques for use in association with conventional breeding for the characters which are otherwise difficult to select based on phenotype and have high genotype x environment interaction.

CIP had once projected True Potato Seed (TPS) as a widely adoptable technology as an alternative to clonally potato seed. However, CIP as well as NARS in many third-world countries could not be successful in popularizing TPS technology because this technology showed lower and in some cases negative returns. It is now felt that TPS is a niche technology for situations where reasonable quality clonally seed is not economically available. CIP is thus now rightly limiting its research on TPS and testing the improved TPS populations only in some niche areas in South West and Central Asia. The two major inherent drawbacks that can come in the way of adoption of this technology, even in the niche areas are high sensitivity of TPS seedlings to environmental stresses, and longer duration of the TPS crop compared to one rose from seed tubers. CIP is aware of these problems, and thus its TPS program includes breeding for hardy and early bulking/maturing populations having synchronized tuberization. CIP, however, should also undertake physiological studies to see what governs hardiness, and if possible look for genes governing hardiness and early maturity.

CIP's publications from this project, though few, have been relevant to the targets. These mainly concern genetics of late blight and viruses, and evaluation of potato and sweet potato cultivars for micronutrients and drought; and some are on genetic transformation. Most of these are of high quality and important for breeding potato and sweet potato for problems of universal nature. However, publications on identification of parental lines based on their breeding values for all major traits, and also relevant to regional needs would be of more practical value and thus should be aimed at in future.

Recommendation # 5

Because of the low adoption of CIP-derived varieties relative to the high number released, ***the Panel recommends*** that CIP implement full-fledged potato and sweet potato breeding activities at the regions so that parental lines/varieties expressing superiority over existing cultivars, and possessing required regional attributes are developed.

Recommendation # 6

Because warming and water scarcity are perceived as increasing constraints to sustainable agriculture as a result of climate change, ***the Panel recommends*** that CIP focus on developing breeding lines tolerant to these stresses, by using biotechnological as well as conventional approaches to develop practical screening techniques.

3.5 Project 4 Integrated Crop Management (ICM)

Introduction

The reasons for the differences between regions are many but among them, poorly controlled pests and diseases, poor seed control, inexpert crop management and storage, drought, and genotypes less than perfectly matched to the environment are among the most significant causes. With such a diversity of reasons why a crop may under-perform, it is evident that solving any one of the problems is insufficient to gain significant and lasting improvement. What are needed in each region are integrated solutions that minimize each risk of loss without worsening other risks. That is quite properly the aim of Project 4 at CIP, Integrated Crop Management (ICM).

Current Strategy and Overview

Research Project 4 has its origins in four former projects and GILB. These former projects, which represented a potentially confusing sub-Division of related topics, were: Integrated Management of Late Blight (LB), Uptake and Utilization of Potato Production Technologies: Seed, Virus and BW components, Integrated Pest Management (IPM), and Sweet-potato Improvement and Virus Control. Confusion of purpose was worsened by the combination of breeding and selection work with work on understanding and managing the diseases within each of these projects. The present arrangement with the separation of work on the genome from work on crop management, and the creation of a single Division with the ability to overview the range of related problems of crop health and crop management is much better than in the past. However, even yet, the structure is not without shortcomings, e.g. omissions from the range of topics covered.

The current structure within the Project is based on 'Outputs' described in the MTP 2007 – 2009 (Medium-Term Plan 2007 – 2009, p. 18) and which have progressed even over the last two years so that the two crops potato and sweet-potato are, at last, given equal prominence. The projected outputs are classified by the nature of the problem to be solved. Comparing the intended outputs for the interval 2007 – 2009 with the foreseen developments in these Outputs for the near future (2008 – 2010), it seems that changes in the definitions are largely concerned with improved specification of the targets' regions and dates. In each case the target is to meet the requirements of the Output in 'at least 3 priority countries per region' and to achieve that by 2012. In addition, Output 2 indicates a greater emphasis on the role of the soil as an important medium for the crops. Output 5 emphasizes the development of participatory strategies and methods for the socioeconomic integration of ICM.

This organization of the work giving emphasis to 'components', should allow staff to work in a more focused manner. And the emphasis on integration of management and the inclusion of both agronomy and seed systems in that management remit should encourage the development of solutions that are genuinely more applicable to real situations and, accordingly, have a greater chance of uptake by growers. These would be proper 'IPGs'.

The Panel notes a certain rippling repetition in the titles of the outputs. Comprehension of the range covered is aided by cutting away most of the repetition, leading to the following: Output 1 is about seed systems and Output 2 about integrating management of soil, seed, pest and disease for the subsistence and semi-commercial growers (for the first time describing the growers), while Output 3 is about diseases and Output 4 is about pests. In each case the output is planned to be developed, tested and disseminated as part of ICM strategies in LAC, SSA and Asian

priority countries. Output 5 is about strategies and methods … made available for improving … innovation systems in LAC, SSA and Asia. The Panel considers the word 'innovation' to be redundant in this context. What is required in these cases is the introduction of a system that works or that works better than a previous one.

The Panel understands that the relative emphasis on potato or sweet-potato should differ between outputs according to which species has the more serious problems within each component, e.g. realistic methods for production of seed with reliable health status, or the more serious need, e.g. orange-fleshed sweet-potato. That balance is likely to differ between regions and, possibly, even between countries, although there is no statement explicitly to that effect.

Making an appropriate choice in the balance of effort between one crop and another while working towards any of the 'Outputs' should entail thorough and repeated referral to Regional units within CIP. Such a practice would give regions a greater involvement in the definition and evolution of projects.

The inclusion of Output #5 is important to allow testing of each proposed solution for its coherence within a farm management system. Again, the use of participatory methods of testing will provide, at the one time, the most effective means to test the degree of integration and the best method of extension - to 'get the message across'.

It is most important to have collaboration between Projects. This has been achieved between Projects 4 and 5 in work such as the use of modeling and GIS to monitor pest and pathogen populations and predict emerging problems. Another example has been the elaboration of crop models to assess management technologies. Two examples of desirable collaboration with Project 3 are discussed later in the Assessment section.

Of the partners named in MTP 2007 – 2009 at pp. 55 – 57-sixteen are NARS headquarters staff-told the Panel that they received notification of problems and requirements within regions through the Regional Offices and were able to cite examples of this. It was also told that the Project plans visits to the Regions each year according to the problems identified by those Regions. The outstanding problem for expediting the work of CIP in Asia is the scarcity of permanent personnel there. However, the Project is looking to appoint an entomologist to Nepal, with the assistance of a donor country, to work on the problems in SE Asia, e.g. Potato Tuber Moth. Similarly they are planning, in response to a request from the region, to appoint a specialist in potato seed to work in China and Inner Mongolia. They are currently looking for funding to appoint an agronomist in Indonesia to work in a collaborative task between Projects 3 and 4. An important factor influencing CIP's ability to extend its work into the regions is the quality of the NARS. In some countries the NARS are strong and are well-supported by the national government. In others they are weak or even absent.

Project 4 has had the support of the OPEC fund for International Development to set up 'Researcher Field Schools' in Kenya, Uganda, and Ethiopia. These RFS are a mentoring system that is possible with good and strong NARS and provide an excellent means to carry CIP's outputs to their intended recipients. Such associations help the dissemination of CIP's research and enhance that of the NARS.

Main achievements

A large list of output targets achieved in 2006 was detailed to the Board of Governors in April 2007. The Panel was given a detailed account of achievements over the last five years. Among the highlights were the following:

Seed related research

Country-specific, cost-effective rapid multiplication technique has been validated as part of a seed production scheme for potato in Uganda, Kenya, Ethiopia, Uzbekistan, Bhutan and Afghanistan. And the same things for sweet-potato in Uganda, Kenya, Tanzania, and the Philippines.

Farmer knowledge and practices in the highlands of Peru about the use of inputs for soil fertility management in the potato crop, and also constraints in Peru related to conservation agriculture and soil fertility management in potato cropping systems have been understood and documented together with additional output related to soil management.

Integrated disease management LB team

Scientific knowledge about the interaction between P. infestans and -Solanum has been developed; LB biology studies demonstrated that one population attacks both wild and cultivated potato hosts. This knowledge simplifies the resistance screening. An international study led by CIP demonstrated geographic stability of quantitative resistance in potato cultivars.

A user-friendly LB simulator has been developed that works in the highland tropical Andes and is being used for epidemiology studies. Using threshold values of accumulated rainfall has been evaluated as a farmer DSS in the Andes, increasing the potential for working with resistant cultivars. In contrast, the idea of using mixed potato genotypes for controlling LB showed little effect.

Training modules for LB-related research have been developed for NARS and DM-LB strategies have been tested under farmer conditions in SSA and have shown promising results.

IDM BW team

Serological tests have been developed for detection of soil populations of *Ralstonia solanacearum*, and for its detection in irrigation water. A technique has been developed to detect symptom less bacterial wilt infection in potato stems before harvest; Detection methods for BW in potato seed and in the environment are being used by NARS in 12 countries (mainly in LAC and SSA). Knowledge on bacterial wilt epidemiology has been enhanced (e.g. soil factors and crops that affect pathogen survival). And promising bacteria, antagonistic to BW have been selected.

Further, and involving farmers: - From among 13 promising clones, 5 were selected with farmer participation in Peru and Bolivia for their low susceptibility to BW and were distributed to NARS in 4 other countries; BW cultural control practices were validated for potato production with farmers' participation in Peru, Bolivia, Kenya and Uganda; and a manual for farmer participatory training and research for IDM-BW was produced and several other diffusion materials were developed.

Virology team

CIP continues to be the most important source of antibodies to detect potato viruses for NARS and it is the only supplier of antibodies to detect sweet-potato viruses:

- **Potato**- ELISA kits distributed to 41 institutions in 28 countries;
- **Sweet-potato** - Antisera distributed to 44 institutions in 24 countries;
- **Sweet-potato** - Synergistic interactions among viruses (SPVD) cause major effects on yield, a new species of whitefly, Bemisia afer was determined as a vector of sweet-potato chlorotic stunt virus (SPCSV). Major sweet-potato viruses occurring in SSA confirmed, and control methods adapted and validated through FFS.
- **Potato** - Variability amongst new and emerging potato viruses (Potyviruses, Potexviruses and Carlaviruses) determined and protocols for their detection developed, Non-radioactive probes developed for detecting ASBVd, PSTVd, PVT, PLRV, PVX and PVY (replacing radioactive NASH technique), Probes also developed for PYW, PMTV and viruses of solanaceas (PMMoV) and for detecting groups of virus: members of genus Carlavirus (PVM, PVS and PLV)

Agro-ecology
IPM - PTM research - Model for population phenology of P. operculella has been developed and GIS software is available to support mapping of pest risk; another species was confirmed to be a dominating pest in potato fields and stores; improved understanding of factors affecting baculovirus effectiveness; and a dust-formulation of B. thuringiensis developed providing 5 months protection against both PTM species).

IPM: APW research (Andean Potato Weevil)
Two bio control agents were identified and an effective means was devised to inhibit field infestation by APW.

IPM: LMF, Whitefly
A complex of 5 LMF species was identified and its distribution was mapped; an entomopathogen was identified and its potential was evaluated.

Soil-related and integrative research
Farmer knowledge about soil management has been documented in Peru, conservation agriculture technologies (mulch) have been assessed, and beneficial soil micro organisms to improve plant growth and health have been identified.

Socioeconomic and participatory research
Participatory research and training methods (FFS) have been adapted and evaluated showing impact on farmer knowledge, practices and productivity. A method has been adapted to estimate the impact of pesticides for controlling the main potato pests in Peru. Potato-related knowledge has been characterization in Ethiopia, Uganda, Kenya, Bolivia and Peru. A participatory assessment method for analyzing poverty in relation to the potato crop has been developed.

A wide range of countries were involved as partners in the work just described. These included: NARS (Ecuador, Ethiopia, Kenya, India, Uganda, Uzbekistan, Afghanistan, Cameroon, Bolivia, Peru, Argentina, Brazil, China, Tanzania, Nepal, Philippines,); Universities (ETH-Zurich, Cornell, SLU-Uppsala, Copenhagen, Louisiana State, Wageningen, Finland, Sweden, California, Hohenheim, Humboldt); ARI (Institute of Biological Control-BBA, USDA, SCRI-Scotland, PRI-Wageningen, CIAT); and NGO(Peru). That range of partners and collaborators speaks volumes for the significance and quality of the science being conducted and of its relevance to national programrs.

Resources
The Project has seven team leaders and in 2006 there was an increase in the number of nationally recruited professional staff (NRS) to 16. (Associate Researcher – 2, Assistant Researcher II 11, Assistant Researcher I -3).

The total amount spent on Project 4 in 2006 and attributed across all the CGIAR priorities was US$ 4.79M or 21% of the CIP budget (MTP 2008-2010).

Assessment
It is reported that the outputs from Project 4 over the period under review included fifty papers in peer-reviewed journals, thirty book chapters, and one hundred papers in symposia and conferences. In CIP's Annual Report for 2005 (published October 2006) the list of selected publications included fifteen that were authored by members of Project 4. Eleven of these papers were published in international journals. Other papers were book chapters. We have not assessed that quantity of material directly. However, a list of key publications was provided and we have read all of these (nine) and made assessments of them.

The range of topics needed to present an integrated system for crop management is extensive. Each 'output' that corresponds to a class of pest or disease includes a wide range of problems – the interaction between the crop and whichever pathogenic species and, within any such interaction, the biological level that is appropriate for investigation. The agronomy output may range from seed conditioning, through crop management to soil condition and supply of water and nutrients and harvest to reduce the risk of disease. Underlying all these is the necessity for a robust system to produce healthy seed within the social and economic constraints of a region.

The range that is represented in the declared 'outputs' is good and is necessary but may not yet be sufficient. The component that is omitted from the current system and which the Panel considers could prove to be highly important is a team to work on the problems of nematodes – whether cyst nematodes or free-living ones. Both kinds of nematode can have serious consequences for the level of yield. Nematodes present a threat that is recognized in at least some of the regions visited and which are a nascent threat even where they are thought to be absent. Given the minimum levels of infestation which are detectable, it is evident that a field may become infected and it not be known for as many as 10 crop cycles,[4] by which time the problem has become serious and other fields have doubtless been contaminated either by movement of machinery or implements or by planting of saved, infected seed. Note: In the year 2000 – 2001 a task force was identified for work on nematology with CIP among the collaborating Centres - First External Review of the System-wide Program on Integrated Pest Management (SP-IPM) – 2003.

Two essential steps in the development of a potato crop are the process of tuber initiation followed by tuber filling. The time taken from planting or from emergence to tuber initiation is often described by the term 'maturity class' which is an attribute of a cultivar that is recognized during the selection of a cultivar and is generally retained as part of its description. However,

[4] Populations of potato cyst nematode (PCN) can exist for at least 40 years before detection through sampling by which time, assuming an even coverage across an infested field, the population could be in excess of 3,000,000,000 eggs/ha, when the sampled population could be measured between 0 and 5 eggs/g soil. This range is due to the distribution within the soil profile and the clustering of cysts on root material and the nature of PCN sampling.

the time taken to tuber initiation is not an invariable characteristic. It is influenced by both day length and temperature, and therefore by the interaction between these two variables. This feature of the potato can be among the factors responsible for a poor uptake of new cultivars in the regions targeted by CIP. That is, they may be well suited under the conditions in which they were bred, but yet not well suited in their intended destination. This is another problem that could usefully by investigated by collaboration between Project 4, Output 2, and Project 3, Outputs 1 and 3. However, in this example, more than in most, it would be very important to involve the destination region in testing the characterization of a candidate new genetic line; an example where collaboration between headquarters and Region is essential.

Taking the Project 4 as a whole, according to CIP, the members of the Project have had key partners in several agricultural research institutes in Europe, twelve universities in Europe and the USA, other CGIAR institutes and several NGOs.

Work was described that was done in participation with the regions SSA, SWCA, LAC and included FFS. In the MTP 2007 – 2009, the Project members seem to be aware of the importance of strengthening their links with their ultimate users. The MTP 2007 – 2009, at pp. 55 – 57 lists thirty two collaborators ranging from NARSs and NGOs through 'Networks' and 'Programs' to Universities in developed countries. There is a good account given in MTP 2007 – 2009 at pp. 52 – 54 of mechanisms by which scientific outputs can be argued to match 'moral' requirements from the CGIAR.

Recommendation # 7
Because nematodes present a threat recognized in at least some of the Regions, ***the Panel recommends*** that CIP make a full assessment of the actual and potential constraint to regional potato production posed by nematodes (PCN and free-living), and plan its research on integrated crop management accordingly.

Recommendation # 8
Because water stress is the abiotic factor that presents the most serious and common depressant of yields of potatoes and sweet potatoes, and because the solution to the problem requires an integrated approach from genotype to landscape, ***the Panel recommends*** that the Integrated Crop Management Division take up the opportunity to investigate options for drought avoidance and tolerance, jointly with other Divisions.

3.6 Project 5 Natural Resource Management (NRM)

Introduction
Increased productivity in agriculture and more effective management of natural resources are central to alleviating poverty and food insecurity, in particular in the poorest countries. Natural Resource Management (NRM) is intended to provide integrative approaches to management at a higher organizational level than just the crop. It is quite properly concerned with the steps from crop to farm to landscape and from the current season to extend over the indefinite future period implied by the term 'sustainable'. It offers the means to cope with the effects of uncertainty about inputs (variability) on the values of outputs. Put concisely, NRM at CIP involves characterizing the sustainability of targeted agro-ecosystems, examining external disturbances of targeted agro-ecosystems, and designing and validating resilient agro-ecosystems.

NRM was given strong support in the 2002 EPMR from which there was a recommendation that "a priority setting exercise be conducted for NRM, … to help focus the research agenda and develop a proper balance between process oriented and application oriented research, and between production systems based on CIP mandate crops on the one hand and livestock-pasture-based production systems on the other hand". In the Section 'Assessment' we will consider whether that has been achieved. The NRM-recently experienced CCER is also discussed.

Current Strategy and Overview

Just as the better management of a crop involves an integrated approach to tackling all the crop issues together, with the solution to each problem being sensitive to its potential effects on other problems, so the better management of land requires an integrated approach to its use. In modern land use we are aware that the issues that must be considered are wide and all-embracing. NRM aims to provide the means to consider all the relevant issues affecting land use and cropping for a specified area with factors ranging from weather, its variability and possible changes, through soil, its nature and its susceptibility to degradation, to socio-economic influences.

Given that task and that background, the science of NRM is strongly focused on the means to acquire information, largely quantitative data, and on the means to manage that data including systems analysis in order to permit its reliable analysis and to enable its robust interpretation. Applications include soil-crop-nutrient modeling, quantitative methods to assess the impacts of operations on the environment, forms of decision support, climatic interpolation models, and fractal models for up-scaling and down-scaling spatial data. It may also be required to cover human actions. Given the range of techniques that are available to scientists working within NRM the application of their skills can go wider than land-use and deeper; wider, to cover animal husbandry; and deeper, to offer understanding of component parts such as soils, roots, and nutrition.

Being consistent with the mandate crops, at CIP, the larger number of NRM studies concern systems that include potato or sweet potato but they are not confined to these crops. The multiplicity of the relevant variables means that initially at least studies and their outputs are site-specific. The translation of such studies to wider relevance and to the status of IPGs requires a second stage of development and further data management.

The current structure within the Project is based on 'Outputs' described in the MTP 2007 – 2009 (*Medium-Term Plan 2007 – 2009*, p. 19) - Changes from the previous two years were simply to modify the targeted regions. Foreseen changes (M*edium-Term Plan 2008 – 2010*, p. 7) clarify the methods to be used (OP1), give emphasis to the results of the work (OP2), and modify the emphasis (OP3). The declared 'Outputs' indicate classes of problem to be tackled, methods likely to be used, and the relevant geographic areas. Particular crops, or other biological types, are not specified.

As will be discussed under 'Achievements' it is increasingly important for collaboration between Projects. Project 3 producing genotypes with putatively desired characters, Project 4 taking an integrative approach to their possible management, and Project 5 providing the means to reconcile the information from the other two Projects with the information which characterizes the many candidate regions. We understand that some such collaboration is planned. We recommend that the plans are brought to fruition.

There is regional involvement with NRS staff in SEA with feeding swine (sweet-potato); in India & Bangladesh; in Bolivia; and in Puno, Peru; and also with an IRS scientist in Nairobi.

Main achievements

The project has developed a sound knowledge of CIP's mandate crops and their systems. It has then taken that knowledge and used it in the development of modeling approaches to the understanding of these crops and of the cropping systems by combining their expertise in physiology, modeling, systems theory and analysis. It is a characteristic of models that the meta-data required differs between those addressing differing scales of organization and with differing applications. The scientists in this project have tested models from elsewhere and in some cases they have adapted them to their own purposes. In other cases, the larger number, they have developed their own.

Cases in point can be found in their work on linkages with commodity research. Some publicly available models, such as DSSAT for crop simulation and TRADEOFF for system analysis, were too sophisticated and did not work well in the circumstances in which they were being applied. The NRM team has developed its own alternatives with simpler inputs that work better.

Modeling is based on knowledge and understanding and where elements of either of these are missing then the modeler has to collaborate with colleagues to obtain these things. The NRM Project has developed a controlled environment facility where it can conduct experimental investigations into features of the mandate crops to provide the knowledge and understanding that will advance some of their models and widen their applicability. That facility could be used to enhance collaborative work with both of Projects 3 and 4.

A significant part of planning to manage resources for sustainability at the landscape level is the ability to understand risk. Examples of such risks are deviations from historical mean climate patterns (whether these deviations have occurred previously or are unprecedented). Understanding these provides increased realism in simulation modeling and can aid down-scaling from Global Circulation models. The NRM team has been engaged in characterizing multiple shock events: droughts, frosts, floods, hail, snow, over successive years. Equally relevant understands people's perceptions of risk which will modify their responses to opportunities. The NRM team has provided several studies of this nature.

The model LIFE-SIM provides a simulation of livestock feeding strategies and for the purposes of this EPMR it provides an excellent example of how studies at a level wider than the mandate crops can then be highly relevant to these. LIFE-SIM is itself an integration of several sub-models for different animals that had been used in several workshops to assess year-round feeding strategies in small-holder livestock systems. The sweet potato can be an important component of the feeds provided by such a small-holder. A development of that model is now being used to increase productivity of a current collaborative programed on swine-feeding in Vietnam using sweet potato and other vegetation by informing the evaluation of sweet potato clones with widely differing harvest indices.

Members of the NRM team have provided increased understanding at both the macro-scale and the micro-scale. Examples of the former are seen in its studies on atmospheric transmissivity in the Andes and on the interaction between precipitation patterns and land-use in Tibet. Examples of the latter are provided by the work to characterize soil pore systems – with relevance to the

movement of water in soil – and the still current work developing electrical tomography to represent and develop understanding of influences on roots.

An example of the team's experience in integrated assessment of human-natural systems is seen in their collaborative study of causes of environmental degradation in the Altiplano of Peru with the key output that environmental degradation is not necessarily attributable to the poor.

Another important achievement at the field scale and upwards has been the development of field methods to detect PYW using remote sensing. Further work to expand coverage by using an airborne camera should lead to a positive outcome.

An important component of the work of the NRM team is Environmental Vulnerability Assessment (EVA) which effectively means by how many the causal variables can be altered before there is a significant change in the response variable. An example of that was an evaluation of the sensitivity of local market farmers to achieved yields and the costs of production which indicated a lower threshold for economically sustainable yield and an upper threshold for acceptable costs of production.

Resources

Project 5 has operated on an annual budget of approximately US$ 2.5M of which 80 – 90% has been 'restricted' funding and the core funding has amounted to ca. US$ 100 – 150k. Apparently the success rate in winning external funding has been around 40 – 50% over the last five years which is a creditable performance.

We note from the MTP 2008 – 2010 that the project expenditure between the regions will change over the period so that expenditure attributed to LAC will decline from 79% in 2006 to 69% in 2010. The other three regions will have slightly increasing shares: SSA (5%), Asia (3%), CWANA (2%). The ability of the Centre to define its research agenda in this project is expected to change substantially in the near future, since it will become more dependent on restricted funding.

In early 2007 (CCER report), scientific staff in NRM numbered 13 plus a consultant and one more appointed jointly by CIP and PROINPA, Bolivia. There were a further six technical staff and three in charge of regional field work. Between them, these staff represent a wide range of expertise including: simulation modeling, soil science, farming systems, agronomy and physiology, physics, meteorology, economics, mathematics, remote sensing, and IT-GIS.

The project management feels the need for more senior staff (IRS). Currently there are 5, one in Africa and four in Lima. The projects need to operate as partnerships with local staff but they do also need first-hand local experience. An ideal target would be 2 in Africa, 2 in Asia and still retain 4 in Lima.

Assessment

As already mentioned, NRM was considered carefully in the 2002 EPMR Project 5, and was the subject of one specific recommendation, quoted in Section 3.5.1, that "a priority setting exercise be conducted for NRM …to develop a proper balance". Although natural resource management featured strongly in CIP's Visioning Exercise (*The CIP Vision – Preserving the Core, Stimulating Progress*, October 2004) yet we have not been able to find a statement, there or elsewhere, of the 'priority setting exercise' that was recommended for NRM by the 2002 EPMR.

Regarding the Science Council's question on whether clear impact pathways been developed for CIP's NRM research, CIP's Strategic Plan, first sets NRM in a global context and then in the context of CIP, where the considerable skills of CIP's NRM team are described. Finally, the outlook for NRM is considered over two paragraphs where it is declared that CIP will acquire additional modeling capability and it is recognized that one of the most immediate needs is to combine crop physiology with genomics to improve tools that better assess GxE interactions in order better to predict gene-to-phenotype relationships. This would involve collaboration between the three projects #3, #4, and #5. It is also foreseen in that publication that CIP will acquire, process and distribute high-resolution databases required for sub-national targeting and link these with process-based models and geospatial data to assist national agencies to improve the quality of national statistics on root crops and to offer the ability to forecast yields. In addition to that section, NRM receives a single mention in each of the chapters devoted to the four regions, LAC, SSA, SWCA, and ESEAP. The aims are admirable and, we are sure, achievable. Yet, that brief statement hardly constitutes the 'clear impact pathway' that was sought.

The CCER done in February 2007 was conducted by people who were themselves, NRM scientists. This meant that they had a deeper understanding than most people of the issues involved, both in the work and in the matter of fund-raising. We make a plea that in preparing its priority setting exercise and its 'conceptual framework', CIP, and within it the NRM project, couples clarity of words and meaning with its clarity of vision. The Panel's reactions to the recommendations of the 2007 NRM CCER are described in detail in Annex 8.)

Turning to what has been achieved by the project it is possible to answer the question from the Science Council on what is the value added (global impact vs. local relevance) of CIP's research on NRM. Because the Division is heavily dependent upon 'restricted' funding it may consider that it has to apply its skills to a wider range of crops than are in the core of CIP's remit in order to thrive. And, in consequence, the Science Council may question the relevance of part of the work. However, NRM studies are typically site-specific. Therefore, the Project should aim to choose sites for study that include potatoes or sweet-potatoes. This would be more easily justified had NRM prepared a 'Road Map' as recommended by the 2002 EPMR.

Several instances named in the 'Achievements' section show that NRM approaches provide solutions that can be re-scaled. A model is be prepared that treats the nutrition of grazing animals and it can then be adapted to treat housed animals. It may deal with a few species and be modified to treat yet another. A study may model the influences on the profitability of a small farmer of a specific crop and then be transportable to another region or modifiable for another crop or eventually for the diversity of crops on a farm. As a general principle: Where the science is good it also has a wider applicability.

The Science Council should be reassured that the work being done by the NRM Project is worthwhile. However, the intellectual sophistication of the outputs is such that most of the anticipated outcomes will come from transferring the models, in the widest sense, to research partners or, conceivably, to government or local authority agencies or policy makers. The Project does undertake such work in mentoring workshops which can carry the output to NARS, for example. However, it may take further work of the 'outreach'-type properly to inform the advisors of policy-makers.

It is reported that the outputs from Project 5 over the period under review included sixteen scientific papers (all but one in peer-reviewed journal; most of them international, two 'regional' in Spanish) and an abstract, twenty-six other publications, a CD-ROM in Spanish, and thirty-six scientific presentations. The 'other publications included PhD thesis, Course manual, four book chapters, five working papers, and fifteen articles in conference proceedings. CIP staff was the senior authors or a significant author in most of the scientific papers. A further ten papers have been submitted for publication.

The Panel has not assessed that quantity of material directly. However, a list of key outputs was provided and the Panel has read all of these (nine), and provided its assessments and comments. The Panel is glad to see this level of publication, which indicates that the NRM project has responded to Recommendation 10 of the 2002 EPMR to produce more frequent publications in refereed journals and set more demanding annual publication performance targets.

It is widely recognized that drought or, at least water-stress is the abiotic factor that possibly presents the most serious and common depression of yield. In the course of the field visits drought was cited by growers as a major reason for loss of yield and for a switch from profit to loss. CIP staff has the opportunity to investigate options for drought avoidance and tolerance through collaboration between Project 5 and Project 4, Output 2 and Project 3, Outputs 1 and 3.

Two essential steps in the development of a potato crop are the process of tuber initiation followed by tuber filling. The timing of tuber initiation and the period from then until crop maturity are influenced by an interaction between temperature and photoperiod. This feature of the potato can be among the factors responsible for a poor uptake of new cultivars in the regions targeted by CIP. That is, genotypes may be well suited under the conditions in which they were bred but yet not well suited in their intended destination. This is another problem that could usefully investigated by collaboration with Project 4, Output 2, and Project 3, Outputs 1 and 3.

The task for NRM would be to incorporate the best understanding of the influence of the interaction between temperature and length of day on the timing, rate, and extent of tuber initiation into models of the potato crop together with options to specify 'maturity class' could assist in the defining the specification of genotypes best suited to particular regions and could enhance the breeding and selection of such genotypes.

In this example, more than in most, it would be very important to involve the destination region in testing the characterization of a candidate new genetic line; another example where collaboration between headquarters and regions is essential.

Recommendation # 9

Because the Panel analyzed the Terms of Reference of the 2007 NRM CCER, and is of the opinion that they were designed to shed light on CIP's options and means of addressing recommendation # 3 of the Center's 2002 EPMR, and because the Panel studied the report of the review, ***the Panel recommends*** that: (1) CIP implement Recommendations 1 to 6, and Recommendation 8; (2) CIP implement Recommendation 7, with reservations; and (3) CIP not implement Recommendations 9 and 10 of the 2007 NRM CCER, unless these actions are dictated by the priority-setting exercise. (The Panel's reactions to the recommendations of the 2007 NRM CCER are described in detail in Annex 8.)

Recommendation # 10

Because the development of greater synergies between CIP's commodity research and its NRM work would be likely to strengthen the overall coherence of CIP's research agenda, and given the

need for CIP to improve the focus of its NRM research agenda and to define impact pathways to NRM research outputs, ***the Panel recommends*** that: (1) CIP use the 2007 NRM CCER's analysis and recommendations, and the Panel's reactions to them, as inputs to conduct a sound priority setting exercise, as recommended by the 2002 EPMR; and (2) CIP initiate that exercise without further delay.

3.7 Project 6 Agriculture and Health (A&H)

Introduction

The younger sister among CIP´s research Divisions, and reported as an MTP project, A&H was put together as one result of the Center's Visioning Exercise, in order to address the need to put greater emphasis on agriculture-health linkages, and related challenges such as crop bio-fortification and reduction in pesticide exposure. The creation of A&H was based on the premise that, historically, the areas of agriculture and human health have been compartmentalized, both in research and in development efforts. Thus, A&H's envisaged logic runs as follows: New and appropriate technologies bring up opportunities to enhance human health through agricultural interventions on the one hand; but on the other, agricultural interventions can minimize the risks to human health. For this logic to be applied successfully a "decompartmentalization is needed, which explains the dual purpose of the A&H Division of searching for ways to increasing health benefits of agriculture (primarily nutritional), and decreasing health risks from agriculture (food and occupational/environmental safety). The overall objective of A&H is "to create and institutionalize a trans-disciplinary research team to generate understanding on the human health, environmental and economic impacts of agricultural production technologies in target systems as an input to designing healthy, sustainable agricultural production systems".

Strategy and Overview

Reducing pesticide exposure risk to farm families is approached from competing paradigms. The predominant one, promoted by industry, is the 'safe management' philosophy, placing the blame for unsafe management to farmers. The approach is to teach them better handling, preparation, application, clean up and storage practices. But potato farmers continue to use highly toxic pesticides in conditions where safe management is not practical or very expensive. The effective policy intervention identified by CIP and others is the prohibition on use of highly toxic pesticides. The irony of all of this is that while many potato communities around the world rely heavily on pesticides to protect their crop, some times with twenty or more applications, CIP has available clones with some resistance to common potato pests (late blight in first place) that promise reducing pesticide application by at least half. In addition, through its Farmer Field Schools for output mobilization, CIP has shown in many parts of the world that pesticide use can be reduced from 12 to 7 applications (up to 60% less active ingredients by area) without affecting crop yields.

There is little information concerning the nutritional composition of Andean roots and tubers, and while it is well-known that potatoes and sweet potatoes are valuable sources of quality protein, vitamins and minerals, there is limited understanding of the contribution that these crops make to the nutrition of rural families; an issue that certainly warrants CIP's attention. The emblematic case regarding nutrition has been the vitamin A-rich orange-fleshed sweet potato (OFSP), and CIP´s efforts to introduce the crop in production systems of SSA through the VITAA partnership. The potential for uptake and impact is huge. Approximately nine hundred thousand hectares of sweet potatoes, well adapted to local growing conditions and consumer preferences -- mostly high-starch, low sugar, white or cream-colored landraces – are planted in just three

countries (Kenya, Uganda and Tanzania). Because the high content of beta-carotene in the OFSP, the recommended daily allowance of vitamin A can be obtained by consuming just 100 grams. CIP's challenge is to develop OFSP varieties adapted to local conditions and consumer preferences in those countries.

Resources

Human and financial resources for the A&H Division are quite modest:

- Small *staff* including IRS (a community medicine specialist & epidemiologist (part-time) – new 2007 - a human nutritionist, and a social anthropologist shared with UH), and NRS.
- Funding comes from restricted grants e.g. IDRC & CIDA, and partnerships e.g. Harvest Plus.
- The MTP 2008-2010 shows an actual 2006 budget of US$339 thousand.
- A&H is the smallest Division in the Center's current organizational structure. The imbalance is evident when compared with the other Divisions: Its 2006 annual budget was 7.4% of the average for the other five Divisions (US$4.6 per Division).

Main Achievements

CIP´s current scientific achievements in this area are very promising and there is potential for much more with CIP's increased capacity to enhance micronutrient contents using near-infrared methods. A&H mentions the following as main achievements:

- Carotenoid characterization and Biofortification work by Germplasm Enhancement & Crop Improvement colleagues;
- child nutrition improvements associated with orange-fleshed sweet potato (OFSP) consumption Sub-Saharan Africa (SSA) (VITAA);
- improved agro-ecosystem management to improve human health (TOA and Ecosalud) through NRM and EcoSalud II linked with Papa Andina Initiative; and
- Fifty landraces of OFSP collected in SAA, and their evaluation initiated (one OFSP clone (CIP 19906.12) close to being released in Uganda, Kenya and Tanzania, and others are in final evaluation in Mozambique and Ethiopia. Some of these materials have revealed that SP can be a significant source of Fe and Zn.)

The Panel notes that, from the perspective of IPG research outputs, the achievements mentioned above are results that have been produced by two other research Divisions: Germplasm Enhancement and Crop Improvement, and Integrated Crop Management (Farmer Field Schools).

In the MTP 2007-09 two outputs are reported for A&H: (1) Integrated health and agriculture strategies to reduce pesticide exposure risks; and (2) importance of safe and healthy roots and tubers. For output 1, of the A&H Division, five flag publications have been reported:

- Relationships among production systems, preschool nutritional status, and pesticide-related toxicity in seven Ecuadorian communities (reported as well for the Urban Harvest project);
- Pesticide use in commercial potato production: Reflections on research and interventions efforts towards greater ecosystems health in Northern Ecuador;
- Pesticides and health in highland Ecuadorian potato production: Assessing impacts and developing responses;
- Cultural encounters: Learning from cross-disciplinary science and development practice in ecosystem health; and
- Persistent organic pollutants and hazardous pesticides in Andean farming communities in Peru.

These publications are basically field studies related to pesticide use and ecosystem health, and provide important information for public health authorities in their efforts to reduce the use of hazardous pesticide and create awareness of the dangers of misuse. But for the Panel, the relevant question is about CIP's comparative advantages for that kind of research. A serious research work in the area of ecosystem and human health would need to go beyond potato and sweet potatoes encompassing specific expertise beyond that of CIP.

Assessment

Science Council concerns about A&H have been related to the IPG nature of this project's expected achievements (outputs), and to whether CIP has a comparative advantage for research in the area of human health related to pesticide use. The Panel has no doubts about CIP's comparative advantages to produce more nutritious potato and sweet potato materials and/or in generating technologies to reduce pesticide application via breeding for resistance to pests in the first place, and via integrated crop management in the second. In fact, these are essential research outputs of two other research Divisions.

But the Panel believes that CIP should not do research on pesticide use and ecosystem and human health at large. Notwithstanding the desirability of collaborative research in support of projects like Ecosalud in Ecuador, it is the ICM Division, with inputs from GECI Division that has the responsibility to look for good agronomic practices to reduce potato pesticide application.
The relevant question then regards the added value of A&H under these circumstances.

The goal of "decompartmentalization" and the needed trans-disciplinary research to integrate agriculture and human health is not an IPG in and of itself. It is an approach for research and development that should be incorporated at the level of country programs and partnerships, to make sure those synergies between bio-fortification, pest resistance, and improved crop management result in greater benefits than those of these three agriculture-human health components taken in isolation. If opportunities for IPGs are envisaged to facilitate the implementation of the approach, then joint-outputs could be planned and developed under the responsibility of CIP's other research Divisions.

Recommendation # 11

Because CIP needs to concentrate on fulfilling its mission, by developing disease/pest resistant and more nutritious potato and sweet potato varieties, as well as complementary crop protection and management practices, and because it needs to promote more integration among the Research Divisions responsible for the Center's research outputs, ***the Panel recommends*** that: (1) the Agriculture and Health Division be phased out; more specifically, that agricultural-health interface activities (crop breeding for bio-fortification, reduction of pesticide exposure and the needed trans-disciplinary research to integrate agriculture and health) be carried out through joint research activities and promotion of partnerships (for output mobilization) under the leadership of CIP's other Research Divisions; and (2) CIP agrees the terms of the recommended "phasing out" with all concerned parties, taking into account projects underway and people involved.

3.8 SWEPs at CIP: Assessment and Recommendations

Introduction

CIP's diverse partnerships have taken the Centre to become involved in eleven SWEPs, including those convened by the Centre: (1) CONDESAN (*Consorcio para el Desarrollo Sostenible de la Eco-*

región Andina), a consortium for the sustainable development of the Andes; (2) the Global Mountain Program (GMP) that aims to promote synergies through sharing and application of knowledge on sustainable agriculture and integrated natural resource management in mountainous regions; and (3) Urban Harvest (UH), that aims to direct and coordinate the collective knowledge and technologies of CGIAR Centres towards strengthening urban and peri-urban agriculture. CONDESAN and GMP are part of CIP's NRM program, and UH basically carries CIP's Urban and Peri–Urban Agriculture program. CIP's role as host of several SWEPS originated from its early development of solid convening skills through its networking in several regions and countries. According to Science Council comments on CIP's 2007-2009 MTP, all CIP's convening SWEPs appear relevant for the CGIAR. Although this may be the case, the Panel's view is that they do no appear to be of any significant relevance for CIP's mission.

This Panel has limited the extent of its review of these three SWEPs to what it has considered necessary to evaluate the benefits that each of these programs has brought to CIP's research portfolio. In its review, the Panel uses basically two criteria for the evaluation: (1) whether research products from the SWEP complement CIP´s main research OUTPUTS; and (2) whether the SWEP contributes to the CGIAR system priorities. Background, strategy and main achievements for each SWEP are provided in Annex 12. This Panel's assessment and recommendations for the three SWEPs are presented in the sections that follow.

Project 7 CONDESAN

CONDESAN can be truly considered as an OUTPUT of CIP. Indeed, CONDESAN is an "institutional output" that put together a powerful platform to address the problems of natural resources management in the Andes. Created as a consortium in 1993, in 1997 CIP requested the CGIAR to recognize CONDESAN as an eco-regional program. From 2002 to 2005, six topics integrated the CONDESAN "research" agenda: (1) Soils and water management; (2) agro-biodiversity in Andean root and tubers; (3) improved farming system for the Andes; (4) policy research; (5) capacity building; and (6) enhancing communications through InfoAndina. The results of this "research", based on a benchmark-sites approach, may be useful for changing conditions at specific locations in the Andes.

But because the scaling up of the accumulated knowledge – partly from CIP' outputs, but mainly from research of CONDESAN's other partners – was considered to have had limited results, while having great potential, CONDESAN recently decided that the benchmark-sites approach had to be abandoned, and that the two pillars of its strategy should be: (1) integrated water resource management and (2) innovative farming systems. With this new approach the 2002 EPMR recommendation that "all CIP scientists ... work together in the CONDESAN benchmark watersheds and use the CONDESAN mechanism for the development, evaluation, dissemination of integrated technologies, and policy and management recommendations", fell apart.

Benchmark sites in the Andean Ecoregion used to be selected because they represent a "typical" location within an important Andean ecology. These ecosystems are under threat due to unsustainable human activity, and hence explain the pervasive relation between resource degradation and poverty. Undertaking research and generating knowledge about the issues that can change poverty and resource degradation in these environments was thought to be most needed; thus a justification for the work of CONDESAN and its local partners.

The Board of CONDESAN has expressed its appreciation for CIP's inputs towards a CONDESAN Road Map, which focuses now on Water Resources Management and Innovation Systems. The Road Map clearly provides the directions for CONDESAN research and development work in these two areas. However, the Board of CONDESAN recognizes that the Road Map has not yet materialized into concrete research.

CONDESAN has been a prolific publisher. Since 2002 more than fifty publications have been released, in printed or in electronic form. They include books and book chapters, articles, posters, flyers, and CD ROM. The Panel reviewed them and found the quality of the material to be good in general. Yet, the outputs, including CIP's, to which these publications relate, are not evident, and there is not enough clarity about what the expected audience is. In the Panel's opinion, CIP has very little to contribute to the main pillars of the new CONDESAN Road Map.

CIP claims that all the 2002 EPMR recommendations with respect to CONDESAN have been fulfilled. But this Panel sees no evidence that between 2002 and 2006 CONDESAN's work has increased its contribution to CIP's mainstream research and output mobilization initiatives, not even to CIP's NRM research or Papa Andina's output mobilization.

In conclusion, regardless of whether CONDESAN has or has not been successful in developing fruitful partnerships, in generating relevant knowledge, and in contributing to better policies, its work has not been done in any significant relation with CIP's research or with the mobilization of CIP's outputs. What the Panel sees instead is that CIP has used the CONDESAN mechanism to a very limited extent, and that as a result, both CONDESAN and CIP have lost an opportunity for relevant research outputs and a more effective output mobilization for the Centre. Thus, financial considerations notwithstanding, the Panel strongly questions the benefits for CIP as CONDESAN's convening Centre.

In addition, the Panel sees that this SWEP has little or no capacity to undertake research on the selected Road Map areas. Perhaps the "exit" for CONDESAN in this respect will be to contract-out this research with alternative suppliers. However, the Panel would like to point out that CONDESAN is indeed very valuable as a platform and partnership concerned with natural resources management in the Andes, and should play an important role in the future vis-à-vis the work of NARS and regional organizations, including CAN *(Comunidad Andina de Naciones*) and CAF (*Corporación Andina de Fomento*) to promote the sustainable development of the Andes.

Recommendation # 12
Because CONDESAN and CIP have no extant, significant and fruitful working relations, in spite of strong previous recommendations on this regard, CONDESAN is no longer contributing to CIP's research outputs. Furthermore, current CONDESAN achievements are due mainly to its own efforts. Therefore, ***the Panel recommends*** that: (1) CIP disengages from convening CONDESAN; (2) the Board of CONDESAN, the Head of the Coordination Unit, and CIP, in coordination with the Alliance, discusses and agree on the exit strategy, and define a working plan for a three-year transition period; and (3) this working plan addresses the financial repercussions for CONDESAN and CIP.

Project 8 Global Mountain Program (GMP)
The Global Mountain Program is a SWEP that promotes CGIAR action in support to agenda 21, chapters 13 and 14, on sustainable mountain development. In CIP´s previous "project" research structure, this program was originally part of the Center's "Integrated Natural Resource

Management in Mountain Agro-ecosystem project". When in 2004 the NRM Division was created, CONDESAN and GMP were pulled out from CIP's research projects.

The GMP's mission is basically about linking research with development, and searching for information and models that planners and policy makers can use to promote development in mountain ecosystems. Its work was planned to be done mainly by gathering technologies produced by CGIAR Centres, acting as an umbrella organization for that purpose, and then making them available to mountain peoples. A benchmark site was proposed (developed) for the rural/urban linkage area.

But because these technologies are often not adapted to mountain environments, and plans for their testing have not yet been clearly outlined, adoption of GMP's technology "offers" has been low. Furthermore, policy frameworks developed by GMP for sustainable mountain development have not been effective in influencing governments. Science Council comments on CIP´s 2007–2009 MTP stated that the GMP´s output targets were not defined in sufficient detail and did not appear in those of partner Centres´ either. And GMP's financial prospects do not appear to be healthy either. Funding for the program is expected to decline from US$0.4 in 2006 to a planned level of less than US$ 0.3 in the coming years.

In sum, due to the above reasons, the level of contribution of the GMP to CIP's research outputs is small, and so is its value to mobilize the Center's main outputs.

Recommendation # 13

Because, since its creation in 1997, the GMP has concentrated on addressing policies, understanding processes, and analyzing technology "offers" from CGIAR for mountain people, the Program makes a negligible contribution to CIP's core research outputs. Therefore, ***the Panel recommends*** that: (1) CIP disengages as the convening Centre for the GM; (2) the Board of the GMP and CIP, in coordination with the Alliance, discuss and agree on an exit strategy and a working plan for a transition period; and (3) this working plan address the financial repercussions for the GMP and CIP.

Project 9 Urban Harvest (UH)

Urban and peri-urban agriculture was a recommendation from the 1998 Third CGIAR System Review made, among others, in the context of a special collaborative focus on Africa: "Develop research programs in urban and peri-urban agriculture in cooperation with relevant organizations, including AVRDC". UH, originally called the System Initiative for Urban and Peri-urban Agriculture (SIUPA), was formed in 1999 and approved as a SWEP by TAC.

In an attempt to validate this "would be IPG-research theme", the Centre Vision exercise selected Slum Dwellers as one of the MDG targets to be incorporated formally into CIP's research portfolio. The consultation among CIP's stakeholders had given 66% of approval to this particular MDG target. It was post 05, with the new System Priorities (SPs), that the SC decided not to recognize UH as a CGIAR system business. According to the Science Council, the continuation of UH should be considered part of the twenty percent of the system's resources spent on non-agenda research.

A further comment by the Science Council to CIP's 2007-2009 MTP expressed that "the UH program plan is improved with an adequate IPG research agenda, and it seems that sufficient and appropriate networks and individual R&D centres have been identified to implement it".

While in the 2007-2009 MTP the UH program reported most of cost allocation to SP 5A, in the 2008-2010 MTP its entire budget is under "new research areas".

UH reports the establishment of R&D "anchor sites" and "contact cities" in South East Asia and SSA, following basically two approaches for developing IPGs. The first is to focus on the testing and validation of strategies, frameworks and methods (which are UH's major types of outputs) in multiple sites, after they have been developed initially in a single or sometimes in two sites. The second is to carry out "meta" evaluations of similar output targets from sites in different regions. Last Center's MTP reports three outputs: Innovative technologies and practices developed for increasing productivity and marketing, methods developed to enhance the safety and sustainability, and policy options and institutional and planning strategies. The Panel has not found evidence of sound research on these themes.

In the Panel's opinion there are at least two important considerations regarding UH and its convening by CIP. The first one, also discussed in Chapter 2, is in regard to the whole idea of allocating CG System resources to the "slum dwellers" MDG target, regardless of whether the associated research could be of an IPG nature. The second consideration is whether in fact research conducted so far by the Urban Harvest program is yielding significant IPGs related to CIP's core business, and whether CIP has a comparative advantage in undertaking such research.

Since most of the poor people of the world still lives in rural areas, and the accomplishment of CGIAR goals is still far down the road, due to the formidable challenges ahead and to limited financial resources to solve the world's agricultural problems, logic dictates the need to concentrate CGIAR activities in the rural sector of developing countries.

The Panel's analysis of achievements/outputs and publications from the Urban Harvest program, reveals that most of the knowledge and information generated, despite its value for urban planners and organizations concerned with urban livelihoods, is of specific importance for particular socioeconomic situations in particular sites. The proposed "meta" evaluation of similar output targets from sites in different regions has yet to be seen. The Panel has no doubt that some lessons and methodologies produced by Urban Harvest may be of an IPG nature, but more as a by-product. In their field visits (Hanoi and Kampala) the members of the Panel found no evidence of concrete work by UH.

Furthermore, the Panel believes that the initiative on "Sustainable and healthy horticulture in and around cities", proposed in the Center's Strategic Plan, is outside CIP´s comparative advantage and this involvement would certainly drain CIP's scarce human and financial resources diffusing its research agenda even further. The Panel believes that today there is the need for a sustainable global food chain and world's natural resources are under survival stress. The CGIAR is still the best instrument to propel resolving the world's agricultural problems, and its Centres best equipped to provide needed agricultural technologies.

Recommendation # 14

Because the research challenges to improve the livelihood of poor potato and sweet potato farmers are still of great importance for CIP, working to alleviate the poverty of poor urban dwellers distracts CIP's resources away from the rural poor. Furthermore, the Urban Harvest Program is neither complementing CIP's main outputs nor addressing the CGIAR System Priorities, as expected from SWEPs. Therefore, ***the Panel recommends*** that: (1) CIP disengages from being the convening Centre for the Urban Harvest SWEP; (2) CIP set the terms of

disengagement in coordination with the Alliance; and that CIP assure donors to this Program that CIP will carry on its responsibilities until the completion of current project activities.