

Towards a Strategy and Results Framework for the CGIAR

*Preamble from the Alliance Board and Alliance
Executive Chairs*

And

Report by the Strategy Team

November 18, 2009

Preamble from the Alliance Board Chair and the Alliance Executive Chair

The Alliance commissioned a small team to develop the first CGIAR Strategy and Results Framework (SRF). This Team worked assiduously over a relatively limited period to produce the document that follows. The time constraint meant that consultations with partners, stakeholders, and within the Alliance were limited in scope.

The Alliance was able to discuss Version 5 of the SRF at the end of October. Much appreciation was expressed to the Strategy Team for having risen to the almost impossible challenge of producing an innovative and convincing strategic framework for the whole System. The Alliance supports the broad strategic directions in the document. At the same time, it has some concerns that the evidence base and the philosophical underpinnings of the SRF require further elaboration. Furthermore, the logic for deriving a portfolio of MPs from the Strategy needs to be clearer. Most importantly, the Alliance recognises that stakeholders' involvement and inputs are essential, before the Strategy and the mega-programs (MPs) can be finalised. Moving forward, we will ensure that the necessary consultations are effective and linked with the GCARD process. Finally, the Alliance considers that the very concept of a MP requires further clarification, to establish a clearer basis for the operationalisation of the portfolio.

In view of the above considerations, the Alliance has agreed the next steps for further developing the SRF and the portfolio of MPs derived from it. Based on further inputs by Centers and partners, the analytical basis of the SRF will first be strengthened, and a new version of the document produced by the end of January. This will be widely shared within the Alliance and with key GCARD partners. A face to face meeting of the Alliance, Consortium Board, GCARD global consultants, GFAR representatives and Science Council members will be held in early February 2010. Participants at this meeting will further consider the derivation of a portfolio of MPs from the SRF. There will also be a day of discussion with Fund Council members at this time. This should result in an agreement to present a set of MPs for further consultations and deliberation at the GCARD in Montpellier. The inaugural Consortium Board will then finalise the SRF and portfolio of MPs, in consultation with the Fund Council, for submission to the Fund Council shortly after the GCARD.

We envision that Business Plans for the MPs will be developed after approval by the Fund Council of the SRF and portfolio, and will be submitted to the Fund Council by the Consortium Board as they become available. In constructing these business plans the following expectations regarding MPs will be observed.

- It will have a clear impact pathway
- It will address one or more strategic objectives

- It will have sufficient scale to deliver on results and/or measurable impacts
- It will reflect the CGIAR's comparative advantage in leading/catalyzing research
- It will effectively mobilize resources, capacity, and synergies among partners
- It will have an investment time horizon of 6 to 20 years

It will have a simple and cost-effective management mechanism.

The phasing in of MPs should begin in late 2010-early 2011.

The Alliance considers that these steps will allow us to produce a strong and compelling SRF and portfolio of MPs, supported by our partners and stakeholders. We do look forward to the operationalisation of such a strategy. A synthesis of the comments received to date on the SRF follows.

Guido Gryseels and Stephen Hall
Alliance Board Chair and Alliance Executive Chair

Synthesis of comments on the Strategy Team's Final Report and Progress Report #4

What follows is a synthesis derived from the commentary received on the final draft Report and on Progress Report #4. The bulk of the comments were provided on Progress Report #4 although there are some unique to the final draft report. Comments were received from twelve of the Centers, from the Alliance website and from three regional GCARD face-to-face meetings (Europe, Africa and Central Asia). The Science Council and the Gates Foundation also provided comments on the final draft Report.

A. On the framing around the Strategic Objectives

1. The three Strategic Objectives are not well balanced and are not all at the same level
2. A re-framing of the three Strategic Objectives against key development challenges is needed
3. The proposed focus on areas of abject poverty excludes Southeast Asia, East Asia and the Pacific where poverty and environmental challenges are equally important
4. The poverty agenda would be better served if the approach included rural livelihoods

5. More in the report is required on the role of agriculture in incomes, savings/assets and employment
6. Need to provide a more quantitative objective/goal for the two Strategic Objectives *Environment for People* and *Policies for People*

B. On the tools and processes

1. The approach used relies on extensive and well-studied data sets that overlook innovation and underestimate the potential of less studied species, ecosystems and approaches. Research beyond the main crops and high productivity regions is therefore under-valued in this approach.
2. Need to justify why the analytical tools used are the most appropriate
3. Little transparency with respect to how evidence was used for designing the MP portfolio; GIS maps seem inconsistent with MP mix and overall GIS portion of the analysis to proposed MPs is unclear.
4. Critical assumptions for the scenarios are not clear; results need validation
5. There are limitations in the modeling approach for setting priorities among mega programs that are not easily defined in geographic terms – this needs to be addressed
6. Given the paucity of documented impact for natural resource management and policy research, it is surprising that 4 out of the 7 MPs focus on these lower impact research areas
7. It is unclear how inputs from science and wisdom helped in defining the SRF and MPs.
8. Views of scientists were obtained through an imperfect process and the sample of views should thus be treated cautiously
9. Missing the presentation of a transparent process of evidence checking and ground-truthing by the different stakeholders

C. On the logic

1. Need to provide consortium-level indicators of achievement of the Strategic Objectives and then the link to the MPs through indicators of results and impact.
2. It is not apparent what the logic is for deciding on competing MP opportunities; the sub-goal criteria do not help here; sub-goal criteria appear to be a mix of outcome indicators, impacts and goals
3. There should be a realistic plan for monitoring the System's effectiveness in reaching its goals (the three outcomes presented may not be so useful for monitoring program success).
4. Estimates of reduced childhood malnutrition, reduced numbers of poor etc. are not based on specific outcomes from MPs but on generic, global level assumptions about productivity increases, therefore it is not readily apparent that the scenarios have been used in selecting the MP portfolio
5. Need to address impact pathways and have indicators for poverty impact – more is needed on poverty reduction

6. There are multiple pathways to impact for poverty reduction through natural resources management research – these are not all taken into account and should be better developed and made more explicit
7. Need better analysis of the importance of agriculture- environment linkages

D. On the links with partners

1. Need to be clear on the CGIAR's role, the role of partners and how they are involved
2. Need to get substantive input from the scientific community and partners from the South in further developing the SRF and the MPs
3. Need to explain the comparative advantage (current and future) of the Consortium in the global ARD system and in the specific MPs
4. Need to show how the Strategy supports broader development processes e.g. CAADP

E. On the MPs and Platforms in general

Content:

1. The MP's look more like a re-shuffling of Centers' activities, or gigantic Challenge programs (although with important changes in emphasis), than 'simple and cost effective' vehicles that ensure a structured implementation of the SRF.
2. The need to obtain more convincing evidence to justify the proposed composition of the MP portfolio
3. MPs are a mix between those providing global outputs and those providing regional outputs – this contributes to a “silo” approach; MP portfolio should provide effective support to the world's most important agricultural commodities or production systems in a coherent, integrated manner.
4. Separate MP for breeding, crop management and socio-economics research creates new artificial separations, as fields need to be combined again if synergies are to be generated impact is to be achieved
5. MPs should be a combination of Global Programs (high science, foresight work) and Regional Programs around targeted hot zones
6. Major challenge to agriculture, globally, from pests and diseases, including trans-boundary diseases affecting key crops and animals, needs to be addressed.
7. Rather than a stand-alone MP, climate concerns should be integrated across all MPs.
8. Case could be made for a platform on genetics (CGIAR role in the characterization, conservation and use of important crop diversity, involving research, services and policy)
9. It remains a question whether some MPs are best led by CGIAR Centers or by national research programs (with Centers contributing technology and knowledge).

10. Unrealistic research expectation concerning human disease challenges that are the responsibility of other agencies
11. How will priorities be established and tackled within each MP?
12. The case for separate platforms is not strong enough – suggestion to integrate into the individual MPs – a single coordinator may be sufficient

Management/Structure:

1. The proposed set of MP's looks like an implementation nightmare. There is extensive overlapping between MPs, introducing new redundancies and inefficiencies, leading to multiple MP x Centres combinations.
2. Need to avoid complex management, avoid bureaucracy and increased transaction costs
3. Needs serious management expertise in the design and implementation of MPs

F. On next steps (taking into account the above and...)

1. MP development needs to be accompanied by appropriate decision making in line with the prospective guidance of the SRF so that detailed, targeted proposals will result.
2. Need to clarify the process of how final decisions on the MPs will be made; and a clear rationale of how the final set of MPs has been developed and decided upon (room for discussion on alternative designs)
3. Further development and revision should be through a process to engage effectively with key researchers within the Centers.
4. Ensure important constituency groups are not overlooked in any of the regions in the next round of consultation; need to draw on feedback from GCARD processes. Further steps in the process need to be defined beyond open e-consultations. Need to engage with small group of identified leaders from BRICS, ARIs, regional/national partners –partners, private sector and donors (first quarter of 2010).
5. MP portfolio must be rooted in the principles of the CGIAR reform
6. Centers' own strategic plans and models seem to have been overlooked as a relevant source of strategic thinking and should be used to provide systematic context and problem analyses to strengthen the SRF
7. Better integration of the three sources of input (trust in modelling, trust in wisdom, trust in science) is needed; ground test, through further analysis the “wisdom” approach
8. Explain how the Challenge Programs and System Wide Ecoregional Programs will be part of the SRF and MPs.

Towards a Strategy and Results Framework for the CGIAR

Report by the Strategy Team

November 18, 2009

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Dr. Joachim von Braun
Director General

November 18, 2009

Dear Steve, and Colleagues,

Attached I submit the report of the CGIAR Strategy Team in my role as Chair of the team.

I take the occasion to thank the many contributors who have made inputs with analyses, participated in the consultations, or contributed with comments on earlier drafts.

I point to a number of updated and new documents on the Alliance website that provided important information for the Team in support of the development of an evidence based strategy for the CGIAR.

I highlight, what is novel here:

- we present a strategy of the whole CGIAR system – there was no explicit one;
- the Strategy is results-oriented – the CGIAR did not have that;
- the strategy focuses explicitly on poor people – the current CGIAR focuses on that only implicitly;
- the strategy addresses current and emerging threats of the global food system at scale through global public goods research;
- a rationale for a large scaling up of the overall funding of the System is provided.
- a concept for partnership is presented at system level, to be further developed with partners;
- a concept for inclusion of gender in research at system level is presented;
- the strategy includes important new research programs to achieve the defined results, while de-emphasizing some ongoing activities;
- the strategy integrates traditional approaches (such as commodity programs) in a system's framework and in priority areas that have been mapped out in preliminary ways;
- the portfolio of Mega Programs promises to produce untapped synergies across the system;

While strategizing must go on, especially in coming months in well structured consultations with partners, this Strategy can already serve as a basis for action. All defined Mega Programs have elements that can move to implementation, but they also have elements that are new and require more conceptual work, and the partnership opportunities require dialogues and clarification.

The proposed next steps are development of Mega Program proposals and business plans. The development of the Strategy and Results Framework with the Mega Programs (MPs) is an *iterative process*. The preparation of individual MPs will provide significant additional information that may also change the overall results indicators in the process.

Fast-tracking of the Strategy is recommended, but is not advisable to do so with a few selected Mega Programs. Fast tracking just a few selected Mega Programs could undermine the potential synergies among the Mega Programs in the systems context. Still, fast tracking the portfolio can be done because all Mega Programs have elements that can be fast tracked.

We expect that the strategizing will specifically continue in the context of GCARD processes and with guidance of the Consortium Board. It will require strategic leadership by the Consortium Board with advice by independent bodies and reviewers to move the Strategy and Results Framework to coherent implementation by the Centers.

Best wishes,

A handwritten signature in blue ink, reading "J. v. Braun". The signature is fluid and cursive, with the first letters of each word being capitalized and prominent.

Joachim von Braun
Director General, IFPRI

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The important set of background documents produced specifically for the development of this effort was of tremendous importance for the conclusions of the Strategy Team. We are most grateful to all the authors and contributors of these studies (see the Alliance Web site: <http://alliance.cgiexchange.org/strategy-and-results-framework-and-mega-programs/>). Participants in strategy-related workshops and surveys made major contributions to this ongoing process.

We received extensive and constructive comments from all Consultative Group on International Agricultural Research (CGIAR) Centers and partners of the CGIAR, especially from national agricultural research systems, regional research organizations, and the Global Forum on Agricultural Research (GFAR), on earlier progress reports and look forward to comments on this draft report.

We knew before embarking on this task that strategizing is a contentious and thankless task, and we accept responsibility for all shortcomings of this report. We nevertheless enjoyed the task and appreciate the trust of the CGIAR Alliance that elected us as a team to deliver this draft strategy.

The Strategy Team

Executive Summary

The recent food crisis—combined with the global financial crisis, volatile energy prices, natural resources depletion, and emerging climate-change issues—undercuts and threatens the livelihoods of millions of poor people and destabilizes the economic, ecological, and political situation in many developing countries. Progress in achieving the Millennium Development Goals (such as halving hunger and poverty by 2015) has been delayed significantly; in fact, as the Food and Agriculture Organization of the United Nations (FAO) reports, the number of undernourished people actually increased in the past two years. These challenges require coordinated, multifaceted, science-based technological, economic, and policy approaches. The Consultative Group on International Agricultural Research (CGIAR) has a key role to play in addressing these challenges.

The CGIAR vision is to “*reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership, and leadership.*” By creating and facilitating innovative technologies, exploiting vast germplasm resources, marshaling public and private research through a broad network of partnerships, and pointing the way to policy and institutional innovations, the international research Centers of the CGIAR are well positioned to contribute to the global effort to foster food production, sustainably manage natural resources and the environment, increase access to food, and reduce poverty and hunger in both rural and urban areas.

The CGIAR system will effectively address these global challenges with a new results-oriented strategy and an improved organizational design, which will attract the additional funds the CGIAR needs to fully exploit its potential for enhancing global food security and environmental sustainability. An ongoing change process is addressing organizational design and funding. This paper aims to develop a comprehensive new strategy for the CGIAR, spell out its programmatic focus, and examine what can be expected from a scaled-up CGIAR.

The aim here is to articulate a strategy that promises to get the job done—that is, a strategy oriented to results at scale. The Strategy Team is pursuing a results orientation not only at the system level, but also at the level of identified Mega Programs (MPs)—major research efforts reaching across CGIAR Centers and their partners that promise to make an important difference to achieving global development goals. Developing a results-oriented *research system*—in contrast to, for instance, a results-oriented *development program*—requires due attention to be paid to the unpredictable outcomes of research undertakings and the tendency of science to be full of surprises. Freedom of research and space for “blue-sky” innovation and experimentation are needed to tap the creativity of researchers.

There can be no doubt about the strong role of agricultural research, in concert with other development investments, in poverty reduction and growth:

investments in agricultural research typically rank first or second in returns to growth and poverty reduction, along with investments in infrastructure and education. Fortunately, a new and broad based consensus is emerging that investment in agriculture and in related, research-based innovations must be accelerated. This new consensus raises several obvious questions: *on what and where should research be focused, by how much should this investment be accelerated, and what can be expected from it?*

In developing the Strategy and Results Framework, the approach taken here is to

- consult broadly with research communities inside and outside the CGIAR and to use related systematic surveys;
- draw on comprehensive modeling and mapping, employing the best tools on hand; and
- communicate with leaders in related professions and noted visionaries.

This report documents a preliminary Strategy and Results Framework. The strategy presented here is for the CGIAR as a whole. It is being developed on the basis of evidence and expected outcomes in support of the CGIAR vision. The Strategy Team respects interests of research communities and stakeholders; it expects that a process of consultations that factors in opinions and interests will follow, and it did not aim to pre-empt that process. The Strategy Team has operated openly, making all of its sources publicly available. It has also paid attention to the legitimacy of process, building on the approved CGIAR vision, mission, and objectives and drawing on earlier CGIAR and partners' initiatives, such as long-listings of potential programs, rather than creating new ones from scratch. Furthermore, as a public good, the team is documenting the tools it uses for aggregation and judgment to facilitate the CGIAR's capacity to strategize as a system and to provide a useful toolbox for future CGIAR strategizing.

Worldwide, more investment in agricultural research is clearly needed. To determine how much more, the Strategy Team uses a scenario analysis based on a global model to assess the future threats to people and ecologies and the opportunities for agricultural research and development (R&D). Under a business-as-usual scenario that includes climate change, production and crop yields will increase too slowly and food prices are expected to increase significantly. Accelerated R&D investment—combined with plausible increases in other development investments—will make a big difference to agriculture, global and regional food security, and child nutrition. The results suggest, for instance, that when compared with the baseline scenario, a high-investment comprehensive scenario with improved research efficiency, irrigation, natural resources management, and market access could reduce the price of maize by 22 percent in 2025, wheat by 17 percent, and rice by 13 percent. By lowering the prices of food staples for the poor, such a scenario, compared with the baseline, would reduce the number of undernourished children in developing countries by 17 million in 2025. Expanded R&D investment in agriculture is critical for preventing future global food crises and human suffering.

A coherent global and regional strategy is needed for scaling up and improving the efficiency of agricultural R&D in general, and the role of the CGIAR in particular. To increase agricultural productivity annually by 0.5 percentage points across all regions until 2025 (the desired level estimated for a food-secure world) would require a massive expansion of investment above the current levels in public agricultural research in developing countries, including the CGIAR. Beyond just spending more, however, two other actions need to be taken: increase the efficiency of R&D and allocate investments more optimally. Combining these three actions has large impacts on the reduction of poverty. Poverty (defined as living on \$1.25 a day) would be reduced by 401 million people by 2025. Most of the poor earning less than \$1.25 a day live in South Asia (698 million people) and Sub-Saharan Africa (365 million people). Reducing poverty thus means allocating a significant share of R&D investment to those regions. At a global scale, public agricultural R&D for developing countries would need to increase from the current US\$5.1 billion to US\$16.4 billion in 2025. This figure includes the investment needed for international public goods, as well as national public agricultural research. The underinvestment in international public goods in general, and in agricultural research in particular, is well documented. Holding constant the share of international public goods R&D of total public R&D spending (which is currently about 10 percent) seems to be a conservative assumption. Thus, applying this 10 percent share to the total needed public agricultural R&D investment of US\$16.4 billion suggests we would need to aim for a CGIAR of US\$1.6 billion—in other words, tripling its current size by 2025.

To address specifically where the CGIAR should focus its investments, the Strategy Team used comprehensive and innovative mapping to complement the modeling as it developed the Strategy and Results Framework and the MPs for research. This approach brings together for the first time information on poverty, production and market access opportunities, and ecosystems challenges in spatially disaggregated ways. In particular, this approach helps to identify subregional and domain priorities and hot spots for R&D actions in the various proposed MPs. The detailed mapping of multiple, overlaid categories of information can contribute to the regional consultations of the Global Forum on Agricultural Research (GFAR) and others.

A large-scale survey of scientists on research opportunities has been completed, and the Strategy Team has used it to explore MP opportunities. About 400 scientists participated, suggesting more than 500 research opportunities. Each of the MPs will be further scrutinized in view of these bottom-up ideas. The findings will also be of use for upcoming regional consultations by the GFAR.

A Framework for the Whole CGIAR System

The Strategy and Results Framework serves the overall CGIAR system goal and builds on the three CGIAR system objectives (subgoals):

1. Create and accelerate sustainable increases in the productivity and production of healthy food by and for the poor. (Food for People)

2. Conserve, enhance, and sustainably use natural resources and biodiversity to improve the livelihoods of the poor in response to climate change and other factors. (Environment for People)
3. Promote policy and institutional change that will stimulate agricultural growth and equity to benefit the poor, especially rural women and other disadvantaged groups. (Policy for People)

For that, ambitious but realistic results on timelines are being defined. Investors should know what they can expect when they invest in the CGIAR. The expected outcomes at the system level, arising from the research outputs in the Strategy and Results Framework, are defined as system-level results, which at this stage of the development of the Strategy and Results Framework (SRF) are only partly quantified in the following ways:

1. *Lift productivity and reduce poverty.* An increase in annual agricultural productivity by an additional 0.5 percentage points to help farmers meet the food needs of the future world population and to help reduce poverty by 15 percent by 2025, as part of an overall global agricultural R&D strategy.
2. *Contribute to reduction of hunger and improved nutrition.* A reduction of hunger and improved nutrition in line with Millennium Development Goal 1 (MDG 1) targets, cutting in half by 2015 (or soon thereafter) the number of rural poor who are undernourished, with a focus on contributing to a reduction in child undernutrition of at least 10 percent.
3. *Contribute to sustainability and resource efficiency.* A reduction in the impacts of water scarcity and climate change on agriculture through improved land, forestry, and water management methods that increase yields with 10 percent less water, reduce erosion, and improve water quality by maintaining ecosystem services.

Furthermore, gender and capacity-strengthening indicators are being factored into each of these results-oriented indicators.

The development of the SRF with the Mega Programs (MPs) is an *iterative process*. The preparation of individual MPs will provide significant additional information that may also change the overall results indicators in the process.

Seven Interlinked MPs

The building blocks of the Strategy and Results Framework are a set of seven interlinked MPs and two platforms—gender and capacity strengthening—that serve cross-cutting purposes for all MPs. Using the analysis tools already described, but noting that there exists no model to “produce” MPs, the Strategy Team went through a process that began with long-listing of MPs produced by CGIAR and GFAR teams and moved toward assessments and short-listing of concept notes for MPs, as reported here.

The Strategy Team carefully considered alternative options for structuring MPs, including a commodity-by-region approach. Given that value chains are rapidly changing, even for low-income people, but recognizing that commodity chains do matter for some commodities at the global level (rice, wheat, maize) and for others at the agroecosystem level, the Team decided to integrate commodity approaches inside MPs, where relevant, especially in MPs 1 and 3 (see below).

The seven MPs are indeed “mega”—large—and while they are clearly distinct, they form clusters of results-oriented innovation activities whose impact is greater than the sum of their parts because of synergies and systemwide cooperation. The proposed MPs will not be of equal size. The identified MPs follow (with indicative percentage shares of an overall CGIAR investments in parentheses, were we assume that the CGIAR would grow to a budget of about US\$ one Billion in coming years):

1. ***Agricultural Systems for the Poor and Vulnerable***—Research that integrates promising crop, livestock, fish, and forest production with innovative policy and natural resources interventions to improve food security in those domains that are home to high concentrations of the world’s poor and that offer agricultural potential. (28 percent)
2. ***Institutional Innovations and Markets***—Knowledge to inform institutional changes needed for a well-functioning local, national, and global food system that connects small farmers to agricultural value chains through information and communications technologies and facilitates efficient policy and institutional reforms. (11 percent)
3. ***Genomics and Global Food Crop Improvements***—Joint genomics research in the CGIAR serving all crops and animal products, providing for the needed innovation capacity of the CGIAR and genetic improvement of the world’s leading food crops (rice, wheat, maize) that builds on the success of the CGIAR with commodity research, including its crucial role in conserving genetic resources. (21 percent)
4. ***Agriculture, Nutrition, and Health***—Improvement in the nutritional value of food and diets, enhanced targeted nutrition and food safety programs, and changed agricultural commodities and systems in the medium term to enhance health outcomes. (8 percent)
5. ***Water, Soils, and Ecosystems***—Harmonization of agricultural productivity and environmental sustainability goals through policies, methods, and technologies to improve water and soil management. (18 percent)
6. ***Forests and Trees***—Technical, institutional, and policy changes to help conserve forests for humanity and harness forest ecosystem services, including forestry and biomass production potentials, for sustainable development and the poor. (6 percent)

7. *Climate Change and Agriculture*—Diagnosis of the directions and potential impacts of climate change for agriculture and identification of adaptation and mitigation options for agricultural, food, and environmental systems. (7 percent)

A large share of the overall MP investments is for the further development and innovation in the traditional strength of the CGIAR in crop and animal production and productivity (about 40 to 50 percent), with a new focus on results at the level of poor people and communities.

Actions to specifically address gender issues and to strengthen the research capacity of national agricultural research systems (NARSs) will be deeply embedded in each MP. Furthermore, these MP activities will be supported by cross-system “platforms” to help MPs deliver

- increased involvement and income of women in agriculture in production, marketing, and processing, and reduced disparities in their access to productive resources and control of income; and
- enhanced participation of national scientists in global research networks and strengthening of NARSs to be more effective, independent research partners.

Figure 1 gives a stylized overview of the Strategy and Results Framework and its elements.

Implementation of these systemwide activities will be a task of the Consortium Board. The Strategy Team proposes that detailed proposals, with business plans for the implementation of each MP, be developed once lead Centers are identified for the task. Outlines for MP concept notes appear in this report and can serve as a basis for the suggested MP proposals with business plans.

Hard Choices

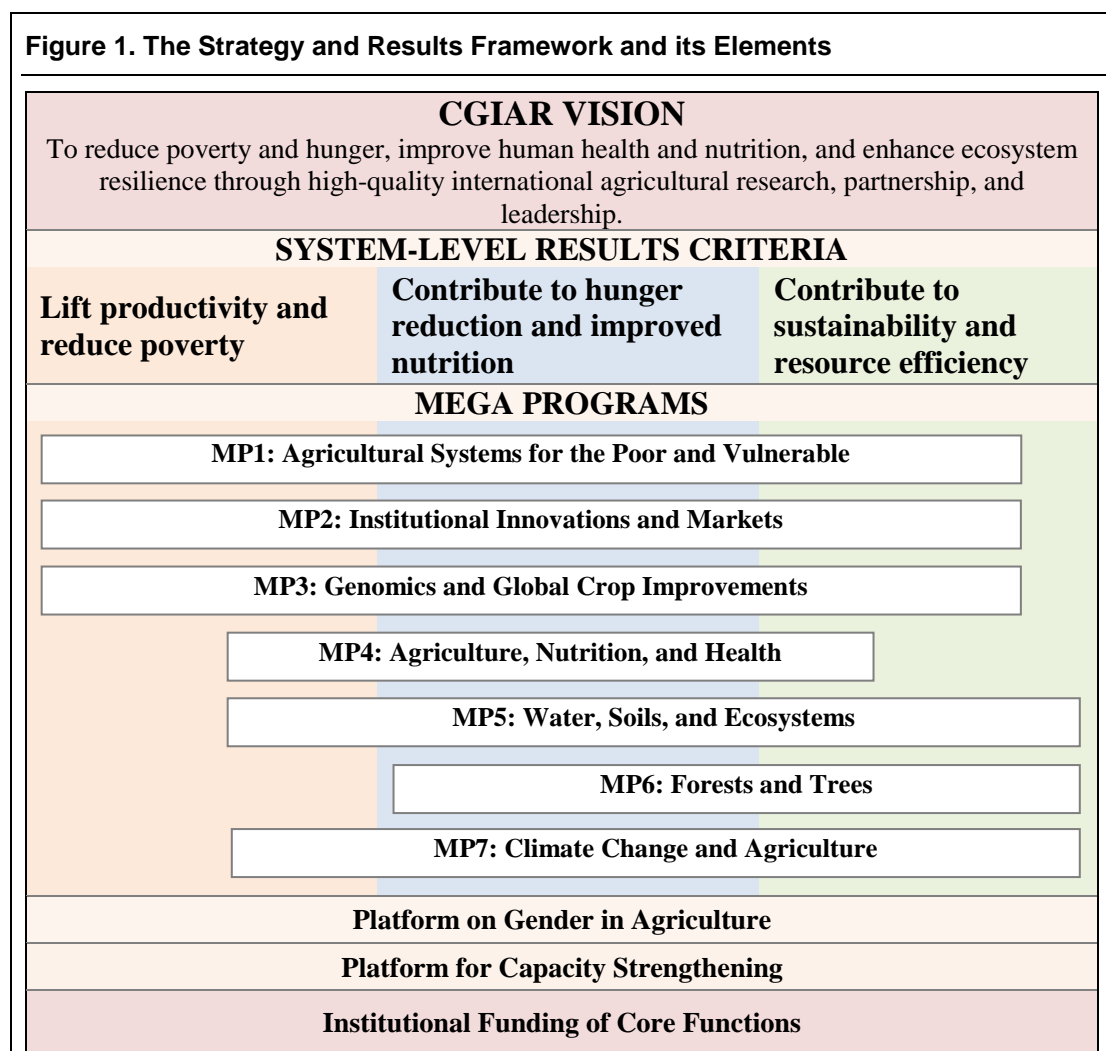
Pragmatically, hard choices may need to be made among the programs proposed if the funding for a get-the-job-done strategy cannot be mobilized. In that case, three options can be considered: reduction at the goal level of the CGIAR (“drop a goal”), reductions in favor of a limited set of global public goods (“drop some MPs”), or some reductions in all MPs (“cut across”). The third option would be the least strategic and not advisable.

Implementation of the Strategy and Results Framework

Implementation of the Strategy and Results Framework and the MPs is proposed here to take place largely through the CGIAR Centers. The envisioned CGIAR Consortium Board will oversee coordination of the MPs and the delivery of system results (based on the Strategy and Results Framework). Although the Strategy Team has considered several alternatives, it proposes that the Consortium not manage individual MPs, but rather that one or more Centers of the Consortium be accountable for delivering on results for each MP.

To move forward, the Strategy Team provides suggestions for transition management, including the appropriate inclusion of current Systemwide and Challenge Programs. Supporting platforms for gender and capacity strengthening will be coordinated by Consortium-based units.

Some institutional support for the participating Centers is required to effectively deliver on the MPs, especially for core functions, such as germplasm collections. Centers of the CGIAR tasked with delivering on the Strategy and Results Framework and the MPs will, at the same time, remain free to pursue their strategic agendas, as long as these activities are executed with full cost coverage from other funding sources.



The Strategy and Results Framework-driven CGIAR will reach billions of people. A reformed and efficient CGIAR will not only help increase productivity, improve the natural resources base, and strengthen policy and institutions through its own research, but also better link with partners, the private sector, and end

users, especially farming communities and women. The result will yield high payoffs for development investments, food security, and poverty reduction.

1. Introduction

The Consultative Group for International Agricultural Research (CGIAR) is facing a time of both challenges and opportunities. Global food insecurity has increased and undernutrition remains stubbornly entrenched among many of the world's poorest people. Global economic and population growth have increased the pressure on food supplies. Natural resources are overstretched. And climate change imposes new stresses on natural resources, agriculture, and the health of the poor. The commercial pressure on land and water resources is increasing, and conflicts over land and water are widespread, with poor communities' rights often going unprotected. The Strategy Team notes that the CGIAR is well positioned to help overcome these challenges.

After nearly two decades of neglect, the role of agriculture and agricultural research in poverty reduction is once again receiving high-level political recognition. The World Bank *World Development Report 2008*,¹ policy statements from the United Nations, the Groups of Eight and Twenty, the European Union, the United States, China, and the African Union, among others, and numerous reports from other institutions,² are focusing attention on issues close to the heart of the CGIAR. The time is ripe to develop a truly global agricultural research effort, drawing upon existing resources in the CGIAR and its partnerships and building increased support for their important activities.

As a key component of the international agricultural research system, the CGIAR has contributed mightily to innovations that have led to increased food production and availability for poor people and improved natural resources management. Yet the context of R&D in world agriculture is changing. Private sector research is playing a growing role in agriculture. Although very limited research capacity is the norm in many low-income countries, some large national research systems, especially in Brazil, China, and India, have made rapid advances. The new challenges already mentioned require new and increased R&D attention. And science is presenting new opportunities. The CGIAR has to reexamine how it does business in this changing environment.

The CGIAR has thus embarked on a reform designed to create a more coherent program, with a single, new Strategy and Results Framework to help it

¹. World Bank, *World Development Report 2008: Agriculture for Development* (Washington, DC, 2008).

². *International Assessment of Agricultural Knowledge, Science and Technology for Development, Agriculture at a Crossroads* (Washington, DC: Island Press, 2009); Intergovernmental Panel on Climate Change, *IPCC Fourth Assessment Report: Climate Change* (Cambridge: Cambridge University Press, 2007); *Millennium Ecosystem Assessment*, in the four volumes in its *Ecosystems and Human Well-Being* series (Washington, DC: Island Press, 2005); D. Molden, ed., *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture* (London: Earthscan, 2007).

more effectively meet current and emerging challenges. It cannot do so with the current level of resources.

The strategy presented here is for the CGIAR as a whole. It is being developed on the basis of evidence and expected outcomes, not on the basis of articulated opinions. “Evidence based” does not mean, however, that the Team was driven by models. No model can produce a research strategy. Rather, the Team used many sources of information and advice, all of which are made transparent. The Team did not try to second-guess investors’ preferences but assumed that most investors want to hear first from research communities what and where the strategic R&D investment opportunities are. This approach also allows policy choices under budget constraints to be made more rationally.

This draft final report presents for further review and discussion the findings and proposals of the Strategy Team appointed by the Alliance of CGIAR Centers. An earlier Progress Report (No. 3, May 2009) outlined the intellectual and conceptual framework developed by the Strategy Team. That conceptual work is not repeated here.

To strengthen the evidence base for strategizing, the Strategy Team has engaged in in-depth analyses and consultations with scientists, which are documented in the following materials:

1. scenario analyses using the IFPRI IMPACT model (“Agriculture and Food Security under Global Change: Prospects for 2025/2050”);
2. simulations of the needed scale and impact of agricultural R&D investment (“R&D Investment in National and International Agricultural Research: Productivity and Poverty Impact and Allocation among Regions”);
3. comprehensive mapping (“Geographic domain analysis”);
4. decision support with an analytical hierarchy (expert choice) model (“An AHP-Expert Choice Model for the Strategic Results Framework of the CGIAR”);
5. large-scale scientists survey of key opportunities for international agricultural research (“Analysis of the Questionnaire for Elicitation of Key Opportunities for International Agricultural Research”);
6. workshops with leading scientists (“Summary Report from the Technical Design and Implementation Meeting of Scientists”);
7. workshop on poverty (“Current Status and Future of Poverty Research in the CGIAR”); and
8. report on gender in the CGIAR strategy, with findings from e-consultations (“Recommendations for Gender Integration in the CGIAR Strategy and Results Framework”).

All these materials are available on the Alliance Web site: <http://alliance.cgiar.org/strategy-and-results-framework-and-mega-programs>.

The Strategy Team notes that the actual work toward making the strategy a reality has barely started, and consultations toward the Global Conference on Agricultural Research for Development (GCARD) are ongoing.

The Global Food and Agriculture System and the CGIAR

The Context for the CGIAR Strategy

The CGIAR develops its Strategy and Results Framework in the context of persistent food insecurity and deteriorating natural resources, coupled with a renewed commitment to solving the problems of food and agriculture on the international stage. In 2009, 1 billion people around the world suffer from hunger and undernutrition and many more from diets deficient in micronutrients because they cannot afford a healthy diet.

Agriculture Is Key to Reaching Development Goals

The livelihoods of many smallholders and rural people depend directly on their ability to produce and market crops, livestock, fish, and forest products. The indirect effects of agricultural growth and ecosystems services through value chains, ecology, and consumers' nutrition and health are even larger. Therefore, agricultural growth in developing regions remains fundamental for poverty reduction and food security. In many countries, the targets associated with Millennium Development Goal (MDG) 1, to halve poverty and hunger by 2015, will not be reached. If poverty and hunger are to be eradicated in the longer term, substantial investments must be made in agricultural research and innovation. *The proposed Strategy and Results Framework reflects the opportunities agriculture presents for development and the fundamental role of a well-functioning food system for human security.*

Improved agricultural and forestry systems have crucial roles to play with regard to other development goals, including the MDGs related to achieving greater environmental sustainability, improving access to water, promoting gender equality, reducing child mortality, and improving maternal health. Agricultural research must tackle how best to manage the scarce resources that contribute to agricultural production, including water, soils, forests, and fisheries. Because climate change increases uncertainty about climatic events and raises poor farmers' vulnerability to crop losses and damage, research is essential to identify means of adapting agricultural systems to changing environmental conditions and determine how to better manage agricultural and forest systems to mitigate climate change. Newly designed programs need to address these issues.

Agriculture has the potential to significantly affect health—negatively through the prevalence of food-borne contaminants such as aflatoxins, for example, and positively through the potential for improved nutrition, such as through biofortification and healthy affordable diets for the poor. Agricultural systems themselves can threaten the health of rural people through pesticide misuse and the creation of breeding habitats for disease vectors, for example. Therefore, agriculture's close connection to health demands research in pursuit of future improvements in health and nutrition. *A program on agriculture, health, and nutrition is needed to address these challenges.*

At all levels, meeting these development challenges requires a specific focus on empowering women to grasp opportunities for improving their livelihoods and those of their families.

Most important, agricultural research must take advantage of innovative opportunities to improve developing-country food systems through cutting-edge science. Advances in areas like genomics, information technology, geographic information systems and precision technologies, and nanotechnology can increase the productivity and sustainability of the main crops and animal products consumed and produced by the world's poor. *A program on genomics and global food crop improvements will embrace these issues.*

Multiple Challenges

Challenges to overcoming poverty and food insecurity and achieving sustainable management of natural resources arise on several fronts. Decades of underinvestment in agricultural innovation have reduced agricultural productivity growth. Annual growth in cereal yields worldwide has declined from about 3 percent in the 1960s and 1970s to less than 1 percent since 2000. In 2007 and 2008, high prices and favorable weather encouraged agricultural expansion in developed countries, but production in developing countries failed to take off. Cereal output grew by 11 percent in developed countries between 2007 and 2008 and by only 0.9 percent in developing countries. If Brazil, China, and India are excluded, cereal production in the rest of the developing world actually fell by 1.6 percent.

Recent food and financial crises have had serious implications for food and nutrition security in developing countries. In 2007 and 2008, the price of nearly every agricultural commodity rose sharply, creating a global food price spike. Several factors contributed to these food price increases: rising energy prices and subsidized biofuel production, income and population growth, and distortionary market and trade policies. Although prices have since fallen somewhat, they remain high by recent historical standards, as do critical price ratios such as crop-fertilizer price ratios. Increased volatility and risk are lasting features of the world food system and require urgent attention. Poor people spend 50–70 percent of their income on food. Because wages for unskilled labor tend not to rise along with food inflation, the poor have little capacity to adapt as prices rise. Moreover, even before the recent food crisis, the poorest of the poor were being left behind. *A program on institutional innovation and markets will have to address these policy challenges.*

At the same time, the natural resources on which agriculture depends are under stress. Global economic and population growth have contributed to increased pressure on food supplies. Shortages of water and land are becoming more frequent, and climate change will further threaten agricultural productivity and production by increasing climate variability, temperature, and the risk of droughts and floods. The consequences of natural resources depletion and degradation are a dire threat to the future of civilization. Different regions face particular challenges. Poverty and food insecurity in Sub-Saharan Africa persist and are even worsening in some countries. Much of Asia and Latin America have

benefited from rapid economic growth in recent decades, but inequality remains a serious problem, with gaps between rich and poor widening. North Africa and West and Central Asia confront particularly serious water stress issues. It is becoming increasingly apparent that plant breeding alone is not going to be a panacea for achieving sustainable agriculture and food production over the next half century. The CGIAR Centers and their partners will have to increase their focus on improving land and water management to combat degradation caused by increasing population pressure. Methods and policies must recognize the importance of forests and good land cover in minimizing soil erosion, fertility decline, and decreasing water quality. Agricultural systems should be harmonized with the ecosystem services provided by a healthy landscape, but to achieve sound outcomes, considerable effort will be needed to instigate the required policy and land management changes. *Research programs on climate change, on forests and trees, and on water, soils, and ecosystems will address these opportunities.* In addition, the CGIAR's strategic approach and research agenda will contribute to overcoming the divisiveness in some professional and public debates regarding productivity- versus sustainability-oriented approaches to agricultural development, because the two approaches must go hand in hand.

Multiple Opportunities

On the positive side we note potentially rapid progress in new basic sciences relevant to agriculture and new expressions of political will for change. The international community has made new commitments to eradicating global poverty and hunger, partly in response to the food crisis of 2007–08. In 2008, the United Nations assembled a High-Level Task Force on the Global Food Crisis, which developed a document called “Comprehensive Framework for Action” that represents the consensus view of the UN system on how to respond to the food crisis. Promotion of smallholder food production plays an important role in this framework.³ *Capturing these opportunities will require a strong systems approach. A program on agricultural systems for the poor and vulnerable, which includes crops, livestock, and fisheries, is a centerpiece of the strategy.*

The Group of Eight (G8) countries together with others issued a statement in July 2009 stating, “There is an urgent need for decisive action to free humankind from hunger and poverty ... We therefore agree to act with the scale and urgency needed to achieve sustainable global food security. To this end, we will partner with vulnerable countries and regions to help them develop and implement their own food security strategies, and together substantially increase sustained commitments of financial and technical assistance to invest in those strategies.”⁴ This statement, which specifically supports reform of the CGIAR, was later affirmed by the Group of 20 (G20) and signed by 36 nations and UN agencies. African leaders have undertaken a new commitment to invest in agriculture and pursue agricultural growth through the Comprehensive Africa Agriculture

³. United Nations, High-Level Task Force on the Global Food Security Crisis, “Comprehensive Framework for Action” (New York, 2008).

⁴. Group of Eight, “L’Aquila Joint Statement on Global Food Security,” July 10, 2009, [http://www.g8italia2009.it/static/G8_Allegato/LAquila_Joint_Statement_on_Global_Food_Security\[1\],0.pdf](http://www.g8italia2009.it/static/G8_Allegato/LAquila_Joint_Statement_on_Global_Food_Security[1],0.pdf).

Development Programme (CAADP). Agricultural R&D is an important pillar of CAADP and will be acted upon by the Forum for Agricultural Research in Africa (FARA). The CGIAR thus faces the sizable task of contributing to reducing hard-to-overcome poverty and hunger, but it does so in a setting in which the value of agricultural research and development are increasingly well recognized.

The Role of the CGIAR in the Global Food and Agriculture System

In the 1970s, CGIAR Centers contributed to increased tropical agricultural production through innovative scientific research that was beyond the capabilities of NARSs in Africa, Asia, and Latin America and unlikely to be undertaken by the private sector. Today, that situation has changed. NARSs in Brazil, China, and India undertake world-class research on tropical crops, and private sector investment in agricultural research relevant to these crops has grown enormously.

Nonetheless, the CGIAR has a unique and specific role to play in this changing context. Neither NARSs nor private agricultural companies can be expected to provide international and global public goods in the areas of agricultural research and environmental sustainability, with the ultimate goal of eradicating poverty and hunger worldwide. In many areas of the world where the poorest people live, private sector products and technologies are unavailable and national agricultural systems are weak. Yet alleviating human suffering and meeting international targets for poverty and hunger reduction will require more attention to these areas and people. The CGIAR has a crucial role to play in generating public information and knowledge—global public goods—that can reduce poverty and enhance ecological sustainability. It is well placed not only to fill knowledge gaps in the global food and agriculture system, but also to deliver those public goods to a range of actors worldwide who can use them effectively.

As the CGIAR turns to the task of creating a Strategy and Results Framework that will carry it forward in the 21st century, it benefits from its historic strength and past impacts (see box 1), in addition to its current core assets and comparative advantage. Within the international agricultural research system, the CGIAR is widely recognized as having a number of core assets:

- a group of 64 member countries and organizations committed to addressing global development challenges through international research for agricultural development and food security;
- a critical mass of scientists with multidisciplinary knowledge of key agroecosystems;
- extensive global research infrastructure (such as research stations representing many agroecosystems);
- global or regional research networks with strong links to national agricultural research and innovation systems;
- global collections of genetic resources held in trust for the world community; and
- global public trust as an “honest broker,” acting in the interests of the world's poor in the global science and policy-making communities.

These core assets point to the CGIAR's comparative and complementary advantages in international agricultural and natural resources research:

Box 1. The CGIAR's track record of sustainably improving livelihoods of the poor

Since its inception, the CGIAR has been associated with some phenomenal successes—most notably the large increases in the productivity of Asian cereal systems. Global and regional evaluations suggest that investments in the CGIAR have paid for themselves by a wide margin, generating plausible impacts of hundreds of billions of dollars and providing rates of return well in excess of 40 percent. Considerable evidence also points to large pro-poor impacts of international agricultural R&D.

Principal outputs of CGIAR research have included improved crop varieties and associated knowledge. These outputs have contributed to substantial outcomes—more than half of improved modern varieties of crops grown in Africa, Asia, and Latin America contain germplasm arising from CGIAR research. Evidence also points to widespread use of CGIAR knowledge products, including tools for participatory analysis of local governance systems, spatial mapping of land and water resources, and new poverty maps for informing national strategies. The CGIAR has for many years made a concerted effort to measure the impact of its research outputs.

Not surprisingly for a system encompassing a highly diverse portfolio of research activities, some types of research have been more successful in generating positive impacts than others. CGIAR research on genetic improvement, pest management, natural resources management, and policy has been shown to yield strongly positive impacts relative to investment. Successes of crop genetic improvement have been widely documented. The yield-enhancing and yield-stabilizing modern varieties produced by the Centers and their partners have had—and continue to have—large direct impacts on productivity and indirect impacts on wages and prices, generating profound benefits to poor people both within and outside the agricultural sector. Investments in the CGIAR to 2000 have increased cereal yields by 0.7–1.0 percent annually, reduced world grain prices by about 20 percent, and prevented 13 million to 15 million children from being malnourished. Impacts in Sub-Saharan Africa had been lower than in other regions, but there have been notable recent successes related to maize, cassava, beans, cowpeas, and potatoes.

Assessments of CGIAR research on pest management reveal substantial positive impacts of biological control research (particularly in Africa), pest-resistant varieties, and localized successes in integrated pest management. Research on natural resources management tends to have more local impacts, although there are notable successes at the regional level, such as adoption of conservation farming and improved aquaculture and adoption of sustainable forestry management guidelines. Policy-oriented research has also affected large numbers of people at the country level through, for instance, improved policies on prices and marketing, pesticide regulation and control, policies to encourage smallholder dairy, and policies to reduce deforestation, as well as at the global level through, for instance, research on trade and public investment strategies.

International research generates spillover knowledge relevant to countries other than those where the research takes place and has nonmarket environmental benefits that are often underestimated. These types of research may have some of their greatest impacts on the global policy agenda, as did the just-in-time analysis of the 2008 global food crisis or the strategic input to the international treaty on crop genetic resources.

These diverse successes highlight the importance of a wide-ranging portfolio of research investments, given that real-world outcomes from individual research endeavors are inevitably uncertain.

Sources: CGIAR System-wide External Review, 2008, and documents of the CGIAR Standing Panel on Impact Assessment.

- conducting research for development;

- conserving core collections of germplasm and related knowledge;
- catalyzing technological and institutional innovations;
- raising awareness, including anticipation and foresight;
- supporting policy making and decision making; and
- strengthening research capacity.

These comparative and complementary advantages need to be set against future opportunities arising from new technologies for improved agriculture, which the CGIAR and its partners may have an advantage in developing and delivering. The CGIAR has a particular role to play in helping to strengthen weaker NARSs so that they can participate effectively in global agricultural innovation systems, in building and supporting international research networks, and in developing effective partnership models with civil society and private sector investors in agricultural research. The CGIAR's enduring value as catalyzer, facilitator, and leader of international public goods research in agriculture continues, but to deliver outcomes effectively and efficiently it must now build even stronger partnerships with the other actors in the changing global food and agriculture research system.

2. Towards a Strategy and Results Framework for the CGIAR

Given the broad scope of its agricultural research capacity, its global positioning, and its strong international networks, the CGIAR is well placed to address the global nature of today's agricultural research challenges and their solutions. It can and should play a central role in the global system.

To help it meet the challenges of the coming decades, the CGIAR has undertaken a broad review and consultation process to develop a Strategy and Results Framework. This process is still ongoing. The ultimate goal of this process is not just a set of future research programs, but a strategy to address current and emerging challenges in ways that produce measurable results for human well-being. It complements and provides strategic inputs to development agencies at international and national levels.

The Starting Point: A New Vision for the CGIAR

Strategic planning for the CGIAR began in 2008, when the CGIAR developed a new vision,⁵ as follows:

To reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership, and leadership.

The CGIAR, along with partners, stakeholders, and potential beneficiaries, will work toward achieving this vision. The CGIAR will pursue this vision through three strategic objectives, which can in fact be understood as instruments to achieve the vision⁶:

1. Create and accelerate sustainable increases in the productivity and production of healthy food by and for the poor (FOOD FOR PEOPLE).

⁵. CGIAR Working Group on Visioning, "Visioning the Future of the CGIAR," Report to the Executive Council (Washington, DC, CGIAR, 2008).

⁶. In the terminology of Analytical Hierarchy Processes (AHP) and Planning Programming Budgeting Systems (PPBS), a higher-level goal is pursued through subgoals (or strategic objectives), subgoals are pursued through lower-level goals, and so on. By definition, all subgoals (and lower-level goals) are instruments for achieving the next higher level goal(s) and, ultimately, the top goal (in this case, the CGIAR vision).

2. Conserve, enhance, and sustainably use natural resources and biodiversity to improve the livelihoods of the poor in response to climate change and other factors (ENVIRONMENT FOR PEOPLE).
3. Promote policy and institutional change that will stimulate agricultural growth and equity to benefit the poor, especially rural women and other disadvantaged groups (POLICIES FOR PEOPLE).

These strategic objectives start from a recognition that the CGIAR focuses directly and indirectly on sustainable development and on people, especially the poor, women, and the marginalized. These objectives were designed to address the key development challenges for which the CGIAR has a comparative advantage. They can be achieved only with the help of partners in the public and private sector and through government actions.

For the CGIAR to have impact, we must transform these strategic objectives into a set of measurable outcomes that contribute explicitly to a “world free from poverty and hunger, supported by healthy and resilient ecosystems.” In the context of a creative research organization, however, this outcome and impact orientation must remain at an appropriate strategic level and not be overdone. Given that the CGIAR is primarily a research organization, its Strategy and Results Framework must take account of the characteristics of research, such as the unpredictability of success and the need to make potentially high-impact, high-risk, long-term R&D investments. Applying the concept of results-oriented planning to research investment involves providing creative space for researchers—typically best achieved in decentralized and nimble systems.

From Vision to a Results-Based Framework

To develop a Strategy and Results Framework, the CGIAR has adopted an approach known as “managing for results”—a business concept that has moved into the public sector, including into the realm of international development.⁷ The Independent Review of the CGIAR System,⁸ completed in 2008, highlighted the advantages of this approach for the CGIAR system. The idea is to manage and implement investments in a way that focuses on the results desired and uses information to improve decision making. According to the Independent Review, managing for results is “a coherent framework for strategic planning, management, and communications based on continuous learning and accountability.” It requires:

- a results-oriented strategy that sets directions and outcomes;
- management decisions and resource allocations that align with strategic outcomes;
- program performance indicators that target clients and their beneficiaries and improvements in the lives of beneficiaries; and

⁷. The Paris Declaration on Aid Effectiveness, for example, has established managing for results as one of five mutually reinforcing pillars.

⁸. CGIAR Independent Review Panel, “Bringing Together the Best of Science and the Best of Development,” Independent Review of the CGIAR System, Report to the Executive Council (Washington, DC, 2008).

- indicators that are used as signals to motivate staff and to provide a base for learning and improving.

How do we relate this process to the activities of the CGIAR? Put simply, agricultural research undertaken by the CGIAR and its partners generates *outputs*, such as improved crop varieties, improved policy instruments, or water use strategies. When these outputs are used by target clients and beneficiaries, they can generate *outcomes*, such as increased agricultural production, more efficient production systems, or lower food prices. These outcomes lead to *impacts* on beneficiaries, in the form of improved health, livelihoods, and choices.

The path from agricultural research to outputs, outcomes, and impacts—the impact pathway of research—is not always direct or smooth. Research that delivers substantial benefits in terms of international public goods is often risky, and results are unpredictable. Flexible resource allocation and long-term investment are needed to allow for a process of trial and error that will lead to significant outputs. And the research investment effort must be at a large enough scale to improve the chances of success. In addition, without local research to adapt outputs to local conditions and needs, outcomes may not emerge—this reality is a major argument in favor of CGIAR researchers’ working closely with partners in government and civil society to support the application of international public goods.

Identifying the Strategic Outcomes

In identifying the outcomes for the CGIARs’ results-based framework, we were mindful of the CGIAR vision: “*to reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership, and leadership.*” The ideas underpinning the vision have already been framed as outcomes by the MDGs. In particular, MDG 1 sets targets for poverty and hunger reduction, while MDG 7 states that sustainable growth requires the protection of ecosystems and ecosystem services.

What evidence is there that different aspects of agricultural research can contribute to outcomes like these?

To help answer this question, the Strategy Team used, for instance, the IMPACT model from the International Food Policy Research Institute (IFPRI) to analyze a variety of possible policy and investment scenarios.⁹ The scenarios used assume several combinations of investments in agricultural R&D; efficiency of agricultural R&D; investments in irrigation infrastructure; changes in natural resource management, and changes in agricultural marketing. More specifically,

⁹. Here only an overview is given. IMPACT has 115 countries (or in a few cases country-aggregate regions), within each of which supply, demand, and prices for agricultural commodities are determined. Large countries are further divided into major river basins. World agricultural commodity prices are determined annually at levels that clear international markets. Growth in crop production in each country is determined by crop and input prices, exogenous rates of productivity growth and area expansion, investment in irrigation, and water availability. Demand is a function of prices, income, and population growth and contains four categories of commodity demand—food, feed, biofuel feedstock, and other uses. For details of results and model design, see report by Rosegrant et al. (2009) on the Alliance Web site.

Scenario 1a—An increased agricultural research investment scenario assumes a 60 percent increase in all crop yield growth rates over the baseline and a 30 percent increase in livestock.

Scenario 1b—This scenario is the same as Scenario 1a, but with special emphasis on investment in agricultural R&D in South Asia and Sub-Saharan Africa.

Scenario 2—This scenario combines improved natural resources management with enhanced market efficiency.

Scenario 3—This comprehensive scenario combines increased agricultural research investment with more efficient research, expanded irrigation infrastructure, improved natural resources management, and enhanced market efficiency (it thus equals Scenarios 1a + 2 + more efficient R&D and expanded irrigation infrastructure).

The projections extend to 2025 and 2050. Alternative policy and investment scenarios overlay a baseline that assumes a continuation of trends in population and agricultural and economic growth and that postulates moderate climate change through 2050. For each scenario, changes in yield, total production (crops and livestock), world prices, trade, and child malnutrition are presented for 2025.¹⁰

Table 2.1 shows changes in production and prices for important crop and animal products under the three scenarios that inform the results focus of the strategy.

¹⁰. For the results on 2050, see background paper on Alliance Web site

Table 2.1. Production and price changes under various investment and policy scenarios, 2025

Commodity	Scenario 1a	Scenario 1b	Scenario 2	Scenario 3
(% change in production in developing countries from baseline scenario)				
Rice	3.8	5.0	5.2	10.7
Wheat	5.0	5.2	7.4	13.2
Maize	3.7	2.4	4.8	9.4
Groundnuts	6.0	7.7	4.8	12.0
Cassava and other roots and tubers	8.1	11.2	4.8	14.8
Vegetables	9.2	11.2	5.3	17.2
Beef	4.8	5.5	5.0	13.1
Poultry	5.3	6.2	4.1	12.4
(% change in world prices from baseline scenario)				
Rice	-7	-10	-4	-13
Wheat	-12	-15	-4	-17
Maize	-18	-24	-3	-22
Groundnuts	-14	-17	-5	-20
Cassava and other roots and tubers	-21	-28	-2	-24
Vegetables	-10	-12	-1	-14
Beef	-5	-6	-1	-9
Poultry	-7	-8	-1	-10

Source: IFPRI IMPACT, Mark Rosegrant et al. for Strategy Team, 2009. See Alliance Web site for full report.

The research, environmental, and policy changes also have implications for nutrition, as shown in table 2.2.

Table 2.2. Child malnutrition under various investment and policy scenarios (millions of children), 2025

Region	2005	2025 baseline	Change from baseline scenario			
			Scenario 1a	Scenario 1b	Scenario 2	Scenario 3
South Asia	75	70	-2	-3	-2	-4
East Asia and the Pacific	23	18	-2	-2	-1	-3
Eastern Europe and Central Asia	4	4	0	0	0	0
Latin America and the Caribbean	8	8	-1	-1	-1	-1
Middle East and North Africa	3	3	0	0	0	-1
Sub-Saharan Africa	39	49	-4	-5	-3	-7
Developing countries	152	152	-9	-12	-7	-17

Source: IFPRI IMPACT, Mark Rosegrant et al. for Strategy Team, 2009.

Note: The 2025 baseline scenario is with climate change.

Overall, Scenario 3—the comprehensive scenario—achieves the largest yield increases for farmers and the greatest reductions in prices and childhood malnutrition. These results point toward the type and scale of investments needed to achieve real progress in alleviating poverty and hunger, and in turn toward the types of research that will be needed to support such investments.

An important feature of this model is the complementary contribution of increased agricultural productivity (“investment in agricultural R&D” and “expanded irrigation infrastructure”), improved policies (“enhanced market efficiency” and “more efficient R&D”), and improved natural resources management. All of these aspects are demonstrably improved by agricultural research, and the CGIAR has a strong track record in delivering on all of them (see box 1).

Although increasing agricultural productivity (Scenario 1) makes the largest contribution in terms of reducing the price of staple crops, the other scenario elements also make significant contributions, and the effect of all factors is usually greater than the sum of the parts. But when we consider the goal of reducing hunger itself, we see the elements making much more equal contributions and again achieving a degree of synergy.

Drawing on this evidence from predictive modeling, and the basic structure of the MDGs, we arrived at three proposed system-level results criteria for achieving specific outcomes for the CGIAR Strategy and Results Framework, which cater to the strategic objectives already mentioned¹¹:

1. *Lift productivity and reduce poverty*: An increase in annual agricultural productivity by an additional 0.5 percentage points to help farmers meet the food needs of the future world population and to help reduce poverty by 15 percent by 2020, as part of an overall global agricultural R&D strategy.
2. *Contribute to reduction of hunger and improved nutrition*: A reduction of hunger and improved nutrition in line with MDG 1 targets, cutting in half by 2015 (or soon thereafter) the number of rural poor who are undernourished, with a focus on contributing to a reduction in child undernutrition of at least 10 percent.
3. *Contribute to sustainability and resource efficiency*: A reduction in the impacts of water scarcity and climate change on agriculture through improved land, forestry, and water management methods that increase yields with 10 percent less water, reduce erosion, and improve water quality by maintaining ecosystem services.

Developing Mega Programs to Achieve the Outcomes

There is no model on hand that “produces” a set of Mega Programs (MPs). The Team addressed the challenge to identify and delineate MPs, using the three system-level results criteria as points of departure; we started from the position

¹¹. These three system-level results criteria capture the relevant outcomes related to the strategic objectives and partly cut across the strategic objectives; separate, specific outcomes are also defined for the MPs.

that the CGIAR could achieve the greatest impact by integrating research on increased productivity, natural resources management, and institutional and policy change. This conclusion is amply demonstrated by the CGIAR's experience over the past 20 years and recent CGIAR impact assessment in each of these areas (see box 1). It is further supported by the IMPACT model described earlier, which shows that enhancing agricultural productivity, natural resources management (through improved technology and institutional innovations for water and soil), and market access have a *more than additive* impact on reducing hunger.

Second, we asked the question, how should research into productivity, resource management, and policy be directed so as to reduce poverty and hunger in a sustainable manner for the greatest number of people over the shortest period? To answer this question, we turned to recent CGIAR research and discussions on poverty. We engaged with and expanded ongoing mapping studies on the distribution of populations, poverty, and the potential for agricultural growth (see figures 2.1 and 2.2). A geographical focus can have real benefits: modeling shows that lifting agricultural production by 0.5 percentage points can do substantially more to reduce poverty if that effort is focused on Sub-Saharan Africa and South Asia, where poverty is most intense (see the indicative mapping in figures 2.1 and 2.2 as well as model results in box 3). This mapping also helps clarify that although research related to rangeland used for grazing is important for certain regions, relatively few poor people live on such lands, and it is thus not emphasized here as a global priority.

Figure 2.1. Subnational poverty mapping results, circa 2005 (preliminary)

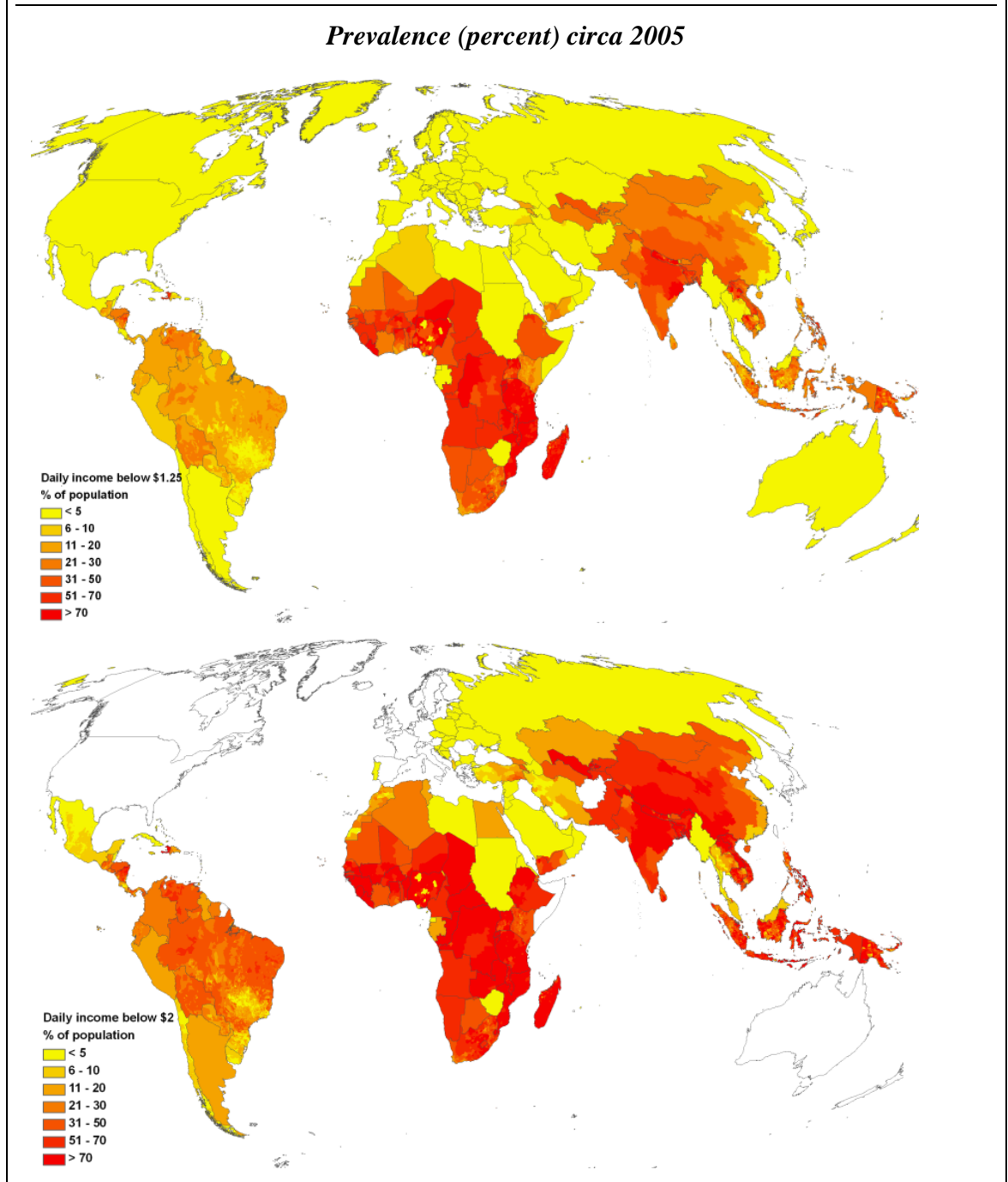
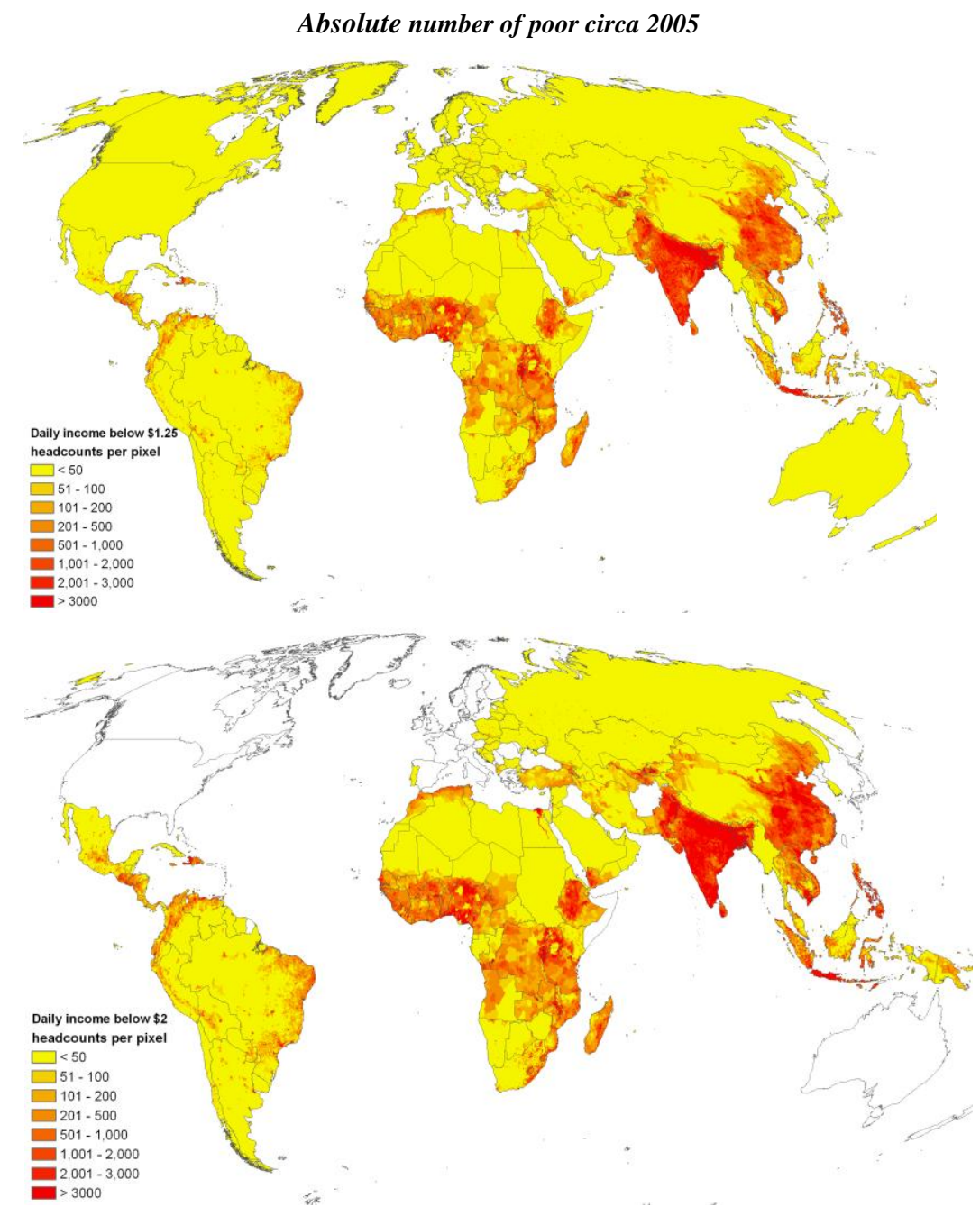


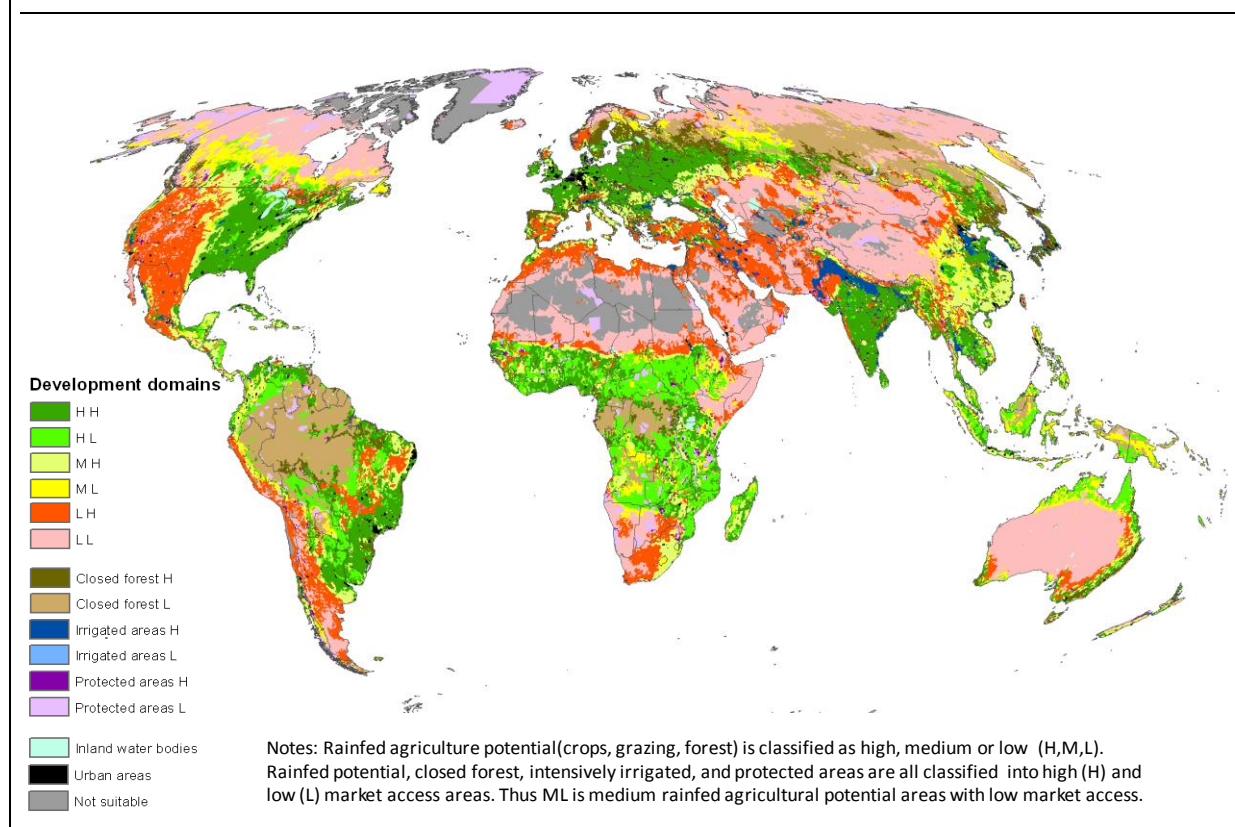
Figure 2.1 (continued)



Source: CGIAR Strategy and Results Framework Spatial Analysis Team, Stan Wood et al. (CGIAR, World Bank, RIMISP, and other sources; see background documents on Alliance Web site).

Note: Units of figure 2.1 are number of poor people living on < \$1.25 and \$2/day/grid cell (based on 2005 purchasing-power-parity dollars). These are interim results, and work proceeds to enrich and refine them; results should be interpreted with caution. The spatial resolution of mapping varies widely among countries, as do the specific poverty metrics and thresholds used in individual national results. Where 2005 subnational estimates are based on rescaling of existing national poverty line headcount index (p0) results, the reliability of that rescaling depends on, among other things, the year of the national survey, the change in local consumer prices between 2005 and the survey year, and the gap between the national and the internationally comparable poverty lines (based on 2005 PPP\$). The spatial resolution of mapping varies widely among countries, as do the poverty measures and, where relevant, the consumption baskets to which they are applied.

Figure 2.2(a). Development domains (provisional): Agricultural potential and market access



Source: CGIAR Strategy and Results Framework Spatial Analysis Team, Stan Wood et al. (CGIAR, World Bank, RIMISP, and other sources; see background documents on Alliance Web site).

Note: Development domains reflect agricultural potential and market access. Closed forest, intensively irrigated, protected, urban, and not suitable areas are not altered from an agricultural potential map. Other areas of rainfed agricultural potential are classified according to high, medium, and low agricultural potential and high or low market access.

LL = low agricultural potential and low market access.

ML = medium agricultural potential and low market access.

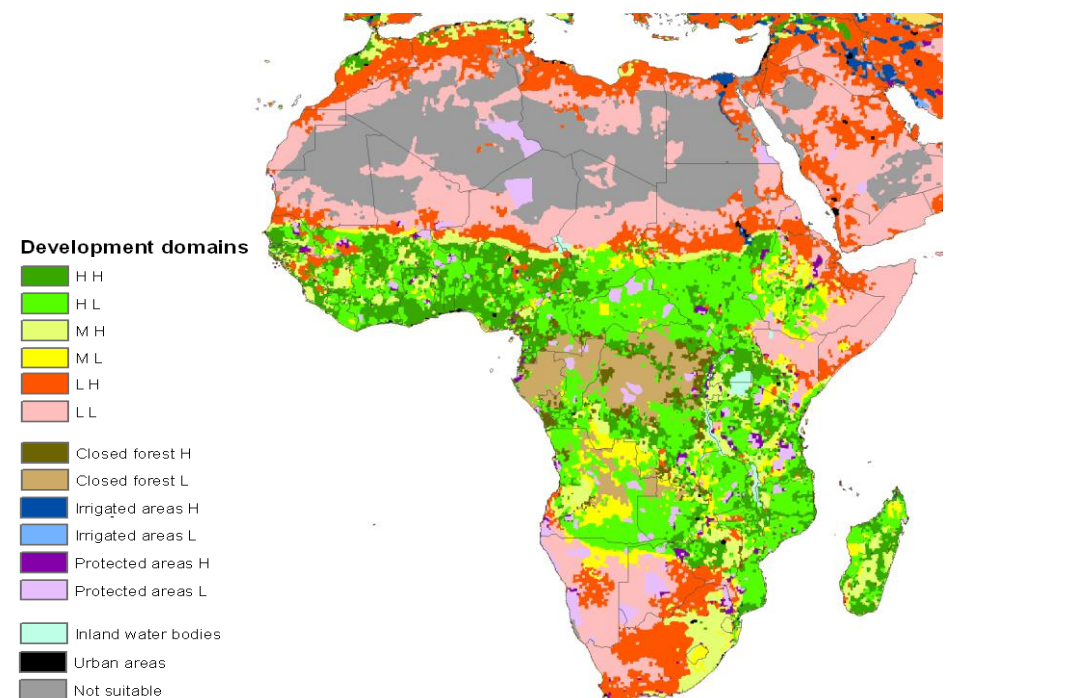
MH = medium agricultural potential and high market access.

LH = low agricultural potential and high market access.

HH = high agricultural potential and high market access.

HL = high agricultural potential and low market access.

Figure 2.2(b). Development domains (provisional): Agricultural potential and market access in Africa



Source: CGIAR Strategy and Results Framework Spatial Analysis Team, Stan Wood et al. (CGIAR, World Bank, RIMISP, and other sources; see background documents on Alliance Web site).

Note: Development domains reflect agricultural potential and market access. Closed forest, intensively irrigated, protected, urban, and not suitable areas are not altered from an agricultural potential map. Other areas of rainfed agriculture potential are classified according to high, medium, and low agricultural potential and high or low market access.

LL = low agricultural potential and low market access.

ML = medium agricultural potential and low market access.

MH = medium agricultural potential and high market access.

LH = low agricultural potential and high market access.

HH = high agricultural potential and high market access.

HL = high agricultural potential and low market access.

A third, and related, issue is the reality that the world food system is dominated by a set of commodities.¹² Three aspects of this issue are relevant for the CGIAR and have implications for research choices: (i) the role of dominating crops; (ii) foods that dominate people's diets at the level of regions and agricultural systems; and (iii) diet deficiency problems and opportunities for diet diversity. Research on the first two aspects are considered under MP 3 (genomics and global food crop improvements) and MP 1 (agricultural systems for the poor and vulnerable), whereas the latter issue is addressed by MP 4 (agriculture, nutrition, and health).

¹² The main three global foods in terms of calorie consumption—rice, wheat, and maize—are dominant by a large margin: average daily calorie consumption in developing countries is as follows: rice, 655; wheat, 458; maize, 167; cassava, 55; potatoes, 42; millet, 42; sorghum, 41; sweet potatoes, 35; and pulses, 34 (see FAOSTAT database).

This approach seems to hold the greatest promise for achieving the system-level results. Given that value chains are rapidly changing, even for low-income people, the Strategy and Results Framework does not advocate a traditional commodity chain approach in general (although such an approach does have value at the agroecosystem level and for the leading crops at the global level).

Table 2.3 shows that rice, wheat, and maize account for more than 30 percent of calories in dozens of countries whose populations together total more than 4.5 billion people. Only in a small number of countries does another crop account for more calories than rice, wheat, or maize, and the population in these countries adds up to about 370 million people (see table 3.1). The CGIAR must not neglect relevant crops at the agrosystem and regional levels, but the approach to other crops should be different and requires particularly close partnerships with regional and national institutions.

Table 2.3. The roles of rice, wheat, and maize in developing countries' food crop consumption

Commodity	Number of countries where more than 30% of food calories come from these crops, 2003	Population of the countries (millions), 2006
Rice only	18	802
Maize only	10	248
Wheat only	17	564
Rice, maize, and wheat	94	4,574

Sources: Data from FAO (Food and Agriculture Organization of the United Nations), FAOSTAT database (Rome, 2009), and World Bank, *World Development Indicators 2008* (Washington, DC, 2008).

Note: FAO classification for developing countries used for the analysis.

Therefore, from the outset, our consideration of the MPs had a dual focus:

- identifying research on agricultural productivity, sustainability, and policy that would deliver specific outcomes in the form of international public goods that contribute to the three system-level outcomes; and
- focusing research on agricultural systems, regions, and domains where research interventions could achieve the greatest impact on poverty and hunger.

Both of these approaches will involve substantial integration of activities across the programs of existing CGIAR Centers. For the latter focus in particular, all of the resources of the Centers would be brought to bear on the agricultural research challenges of a specific agricultural system.¹³

In generating a set of MPs, we began by examining a large set of potential MPs from the CGIAR Alliance and GFAR (presented in Progress Report No. 3). Informed by expert consultations on priorities and linkages, we arrived at a set of MPs that would meet the system-level outcomes and address the need to focus

¹³. Alternative approaches for defining and delineating MPs could be considered, such as a traditional product-by-eoregion matrix approach or an approach where each strategic objective is addressed by one delineated set of MPs. International agricultural research is inherently a complex system, however, and the Strategy Team opted for an approach that embraces that complexity.

both on international public goods and on short-term impact on poverty and hunger. We followed an iterative process with feedback, from long-listing of proposals of potential MPs, to short-listing with elimination of overlaps, to assessments with the help of analytical tools and inclusion of scientists' input, to ultimate judgments on the best configuration. A large-scale survey of scientists on research opportunities was undertaken to enrich the process. The result was a set of seven complementary MPs listed in box 2. The GFAR and regional dialogues will deepen the process, and material from the survey will be useful in further developing MPs on the basis of the concept notes in this report.

Box 2. The Mega Programs

- *Agricultural Systems for the Poor and Vulnerable*—Research that integrates promising crop, livestock, fish, and forest production with policy and natural resources interventions to improve food security in those domains that are home to high concentrations of the world's poor and that offer agricultural potential.
- *Institutional Innovations and Markets*—Knowledge to inform institutional changes needed for a well-functioning local, national, and global food system that connects small farmers to agricultural value chains through information and communications technologies and facilitates policy and institutional reforms.
- *Genomics and Global Food Crop Improvements*—Joint genomics research in the CGIAR serving all crops and animal products, incl. fish, providing for the needed innovation capacity of the CGIAR and genetic improvement of the world's leading food crops (rice, wheat, maize) that builds on the success of the CGIAR with commodity research, including its crucial role in conserving genetic resources.
- *Agriculture, Nutrition, and Health*—Improvement in the nutritional value of food and diets, enhanced targeted nutrition and food safety programs, and changed agricultural commodities and systems in the medium term to enhance health outcomes.
- *Water, Soils, and Ecosystems*—Harmonization of agricultural productivity and environmental sustainability goals through policies, methods, and technologies to improve water and soil management.
- *Forests and Trees*—Technical, institutional, and policy changes to help conserve forests for humanity and harness forest ecosystem services, including forestry and biomass production potentials, for sustainable development and the poor.
- *Climate Change and Agriculture*—Diagnosis of the directions and potential impacts of climate change for agriculture and identification of adaptation and mitigation options for agricultural, food, and environmental systems.

As mentioned, the development of the MPs was an iterative process in which a host of quantitative and qualitative material was utilized and synthesized. Table 2.4 presents a sketch of the major rationales for the MPs, mentions the information sources used, and relates them to aspects of the CGIAR's comparative advantages.

Table 2.4 Major rationales for MPs (selected highlights)

MP	Major rationale for MP	Additional information for choice	CGIAR's comparative advantage
1—Agricultural systems for the poor and vulnerable	<ul style="list-style-type: none"> • Spatial concentrations of poor people in specific agro-ecological systems • Need for integrative approaches across technology, institutions, NRM, and policies to solve complex problems • Opportunity to show rapid impacts by harnessing the best from the CGIAR system 	<ul style="list-style-type: none"> • Spatial mapping of poverty and agricultural systems • Washington workshop for the Strategy and Results Framework 	<ul style="list-style-type: none"> • Prototypes of Centers / NARS Partnerships with payoffs (e.g., rice-wheat consortium) • Ability to convene research on systems that cut across national boundaries
2—Institutional innovations and markets	<ul style="list-style-type: none"> • Now recognized as a critical complement to technology for productivity growth • Access to information and communications technologies becoming universal, opening huge opportunities for poor people • Critical role of improved markets for inclusion of the poor • Need to manage more frequent shocks from climate change, energy, and so on 	<ul style="list-style-type: none"> • IMPACT • Science Forum • Scientists Survey • CGIAR Poverty workshop 	<ul style="list-style-type: none"> • Considerable capacity with potential for strong international integration • Honest broker and partner for evaluating innovations • Strong international public good (IPG)
3—Genomics and global food crop improvements	<ul style="list-style-type: none"> • Critical to productivity growth needed for food security and poverty reduction • Need for CGIAR to develop strong capacity in molecular work to ensure IPGs for pro-poor traits • Focus on rice, wheat, and maize because these determine global food prices and are widely distributed over poor regions 	<ul style="list-style-type: none"> • IMPACT • Science Forum • Scientists Survey • Spatial analysis of crops in relation to poverty 	<ul style="list-style-type: none"> • Heartland of CGIAR with strong track record; strong IPG • Custodian of genetic resources by treaty • Strong and effective networks with NARS and experience with public – private partnerships for crop improvement
4—Agriculture, nutrition, and health	<ul style="list-style-type: none"> • Better access to and utilization of food is a major determinant of food security • Diet deficiencies of the poor require increased attention • Food safety and quality a major transnational concern • Growing linkages between agriculture and health in intensive systems 	<ul style="list-style-type: none"> • Science Forum • Scientists Survey • Agriculture and health platform of CGIAR • Interest from the health researchers to link to CGIAR 	<ul style="list-style-type: none"> • Recognized leadership in food and nutritional policy research • Broad CGIAR capacity in agriculture-health links with good precedents for linking across Centers / NARS and with international health community • Strong IPG
5—Water, soils, and ecosystems	<ul style="list-style-type: none"> • The looming water crisis has implications for global food security, further heightened by climate change • Major opportunities for better use of water resources in Sub-Saharan Africa • Need for upstream soils research to ensure that intensified systems are sustainable, and to intensify large areas with problem soils 	<ul style="list-style-type: none"> • Spatial mapping of water stress • IMPACT • Scientists Survey • Science Forum 	<ul style="list-style-type: none"> • Recognized leader and partner in water for food and agriculture • Strong IPG • Ability to convene research on water systems that cut across national boundaries
6—Forests and trees	<ul style="list-style-type: none"> • Deforestation major source of greenhouse gases (GHGs) now recognized in climate change agreements • Livelihoods of 0.5 billion poor people • Ecosystem services of global importance (e.g., biodiversity) 	<ul style="list-style-type: none"> • Spatial mapping • Scientists Survey 	<ul style="list-style-type: none"> • Recognized leader and partner in research on deforestation and agriculture-forestry links • Strong IPG
7—Climate change and agriculture	<ul style="list-style-type: none"> • Major threat to poverty and hunger reduction, and sustainability • Agriculture major source of GHGs • Need to raise CGIAR profile in global agenda and better link with the wider community of science of climate change 	<ul style="list-style-type: none"> • Survey and other consultations • IMPACT model on climate change effects 	<ul style="list-style-type: none"> • Capacity to link and integrate research on agriculture and climate change • Strong IPG

At this stage of the development of the Strategy and Results Framework, the MPs are not yet sharply delineated from each other but show some overlaps. As the MP concept notes are reworked into proposals with business plans, this overlap will need to be addressed. An element of overlap at this stage, however, can help to connect MPs later and introduces an element of competition for best concepts and research approaches that promise results.

Needed Scale of Investment for the Strategy and Results Framework and for Individual Mega Programs

In the context of the global agricultural research system, the Strategy and Results Framework of the CGIAR should be seen as part of the system serving developing countries. Estimating the needed scale of investment in the CGIAR must therefore be pursued in a broader modeling context, as described in box 3.

Worldwide, more investment in agricultural research is clearly needed. A coherent global and regional strategy is needed for scaling up and improving the efficiency of agricultural R&D in general, and the role of the CGIAR in particular. To increase agricultural productivity annually by 0.5 percentage points across all regions until 2025 (the desired estimated level for a food-secure world) would require a massive expansion of investment above current levels in public agricultural research in developing countries, including the CGIAR. Beyond just spending more, however, two other actions need to be taken: increase the efficiency of R&D and allocate investments more optimally. Combining these three actions will have large impacts on the reduction of poverty. Poverty (at \$1.25 a day) would be reduced by 401 million people by 2025 (see box 3).

At a global scale, public agricultural R&D for developing countries would need to increase from the current US\$5.1 billion to US\$16.4 billion in 2025. This amount includes the investment needed for international public goods, as well as national public agricultural research. The underinvestment in international public goods in general, and in agricultural research in particular, is well documented. It is at least as deficient as national spending. Holding constant the share of international public goods R&D in total public R&D spending (currently about 10 percent) seems a conservative assumption. Thus, applying this 10 percent share to the total needed public R&D investment of US\$16.4 billion suggests we would need to aim for a CGIAR of US\$1.6 billion—in other words, tripling its current size by 2025.

Moving from the system level to the MP level, it must be stressed that the MPs should not be of equal size; they have different potentials at scale and serve different synergy effects to contribute to the system-level results.

Each MP will need to deliver specific results. A preliminary synthesis of expected MP results and links to system-level results is presented in Table 2.5. Final MP results can only emerge after detailed assessment and business plan development has progressed for each MP. The contributions of MPs to system-level results cannot be simply added up because of synergies between MPs. The Strategy Team employed a decision-support tool to guide its preliminary

assessment and make its conclusions transparent.¹⁴ On a scale of 1 to 100, members of the Strategy Team rated the contribution of the system-level results criteria to the vision goal and the contribution of the MPs to the system-level results criteria. In this exercise, the Strategy Team came to the following rating of the three sets of system-level results criteria in terms of their contribution to the overall CGIAR vision:

¹⁴. For details of the decision support tool, see background paper on Alliance Web site by R. A. E. Mueller (2009).

Box 3. How much scaling up of agricultural R&D is needed to achieve the results? A modeling attempt at scale

To analyze the effects of scaling up and improving the efficiency of agricultural R&D in general and the role of the CGIAR in that context, we use IFPRI's multiplier model. A business-as-usual scenario is contrasted with three R&D policy scenarios projecting R&D investment, agricultural growth, and the number of poor in each developing region to 2025 (the CGIAR reports its spending for Sub-Saharan Africa, Asia, Latin America, and West Asia and North Africa; we use the share of NARS spending to allocate CGIAR spending to each country or subregion):

- Scenario A—**productivity** increases (total factor productivity is assumed to increase annually in all regions by 0.5 percentage points).
- Scenario B—countries and donors become more **poverty oriented** (that is, total R&D invested in 2008 is allocated among regions in such a way that poverty is minimized).
- Scenario C—increased **productivity is combined with increased efficiency of R&D**.

Under Scenario A, increasing agricultural productivity annually by 0.5 percentage points across all regions until 2025 would require about US\$10 billion in R&D investment above business as usual (see table). Under Scenario B, more R&D investment would be allocated to Sub-Saharan Africa and South Asia to minimize poverty. Most of the poor earning less than \$1.25 a day live in South Asia (698 million people) and Sub-Saharan Africa (365 million people). Thus, to effectively reduce poverty, a significant share of R&D investment should be allocated to those regions. Scenario C shows that better results can be achieved if the efficiency of R&D investment is improved at realistic scales. More efficient R&D investment results in significant increases in the rate of growth and the number of poor people lifted out of poverty in both scenarios.

Scenarios for R&D investment and impact on poverty and agricultural productivity growth, 2008–25

Scenario	R&D investment (millions of 2005 US\$)		Number of poor (millions) 2008	Change in the number of poor (millions) 2008–25	Agricultural productivity growth rate (%) 2008–25
	2008	2025			
Scenario A—0.5 percentage point growth in productivity	5,139	18,643	1,420	-318	0.92
Scenario B—poverty minimization	5,139	15,328	1,420	-348	0.71
Scenario C—0.5 percentage point growth in productivity with higher R&D efficiency	5,139	16,347	1,420	-401	1.18

Source: IFPRI multiplier model, A. Nin-Pratt and S. Fan for Strategy Team, 2009.

Note: The scenarios in this table assume a poverty line of \$1.25 a day. For details see report by A. Nin-Pratt and S. Fan (2009) on Alliance Web site. Although the assumptions made in this analysis are broadly consistent with the results and assumptions related to the scenario analyses reported under the IMPACT model, this model is not formally connected with the IMPACT model.

1. Lift productivity and reduce poverty: 49 percent,
2. Contribute to hunger and improved nutrition: 26 percent, and
3. Contribute to sustainability and resource efficiency: 25 percent.

Table 2.5. Expected Results of MPs by System-level Results– a Framework for Further Specification in MP Developments

CGIAR VISION			
To reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership, and leadership.			
SYSTEM-LEVEL CRITERIA AND RESULTS			
	Lift productivity and reduce poverty: Increase in annual agricultural productivity by 0.5% points to help in reduction of poverty by 15% by 2025, as part of an overall global agricultural R&D strategy.	Contribute to hunger reduction and improved nutrition: Reduction of hunger and improved nutrition in line with MDG 1 targets, cutting hunger in half by 2015 (or soon thereafter), with a focus on reduction in child undernutrition of at least 10%.	Contribute to sustainability and resource efficiency: Reduction in impacts of water scarcity and climate change on agriculture through methods that increase yields with 10% less water, reduce soil erosion, and maintain ecosystems.
MPs	MP LEVEL RESULTS (indicative results which need to be further specified in the context of MP proposal development)		
1. Agricultural Systems for the Poor and Vulnerable	Reach 250 m poor by achieving broad-based productivity increases of at least 10% over 10 years Lift 60 m out of poverty	Contribute to affordable and healthy diets in each domain area	Maintain or improve ecosystem health and resilience
2. Institutional Innovations, Policies, and Markets	Reach 400 m small farm households by decreasing transactions costs by 30% by 2025 and mitigating risks Increase access to inputs and finance for small farmers	Safety net program design to improve the efficiency and effectiveness of coverage for the poor	Enhance effectiveness of environmental policies
3. Genomics and Global Food Crop Improvements	Genetic improvement will account for 60% of overall food crop productivity gains (yield gains of 0.4% a year; 0.8% in SSA) and benefit 2.6 b. people CGIAR becomes a leader in international public goods for applied genomics, bioinformatics, precision phenotyping, plant breeding, and will identify and transfer pro-poor crop traits through partnerships Easy access to improved	Improved cultivars will deliver improved and appropriate levels of micronutrients	Eco-efficient cultivars will require fewer inputs and produce higher yields

	cultivars allows rapid adjustment to changing production environments and consumer preferences		
4. Agriculture, Nutrition, and Health	Increase human capital and agricultural productivity of households Increase affordability of healthy diets for the poor	Improve population health, esp. maternal and child Reduce child under-nutrition by at least 10% by 2025 Reduce gender disparities in nutrition Micro-nutrient dense food crops reach 100 m deficient people by 2025	Reduce negative health effects from unsafe food and zoonotic diseases
5. Water, Soils, and Ecosystems	Improve the livelihoods of up to 100 million people in water-scarce and food-insecure basins		Increase crop/water productivity by 20-50% over 30 years Reduce agric. water demand by 10% in stressed systems Improve policies and equitable arrangements for water sharing in at-risk basins
6. Forests and Trees	More equitable sharing of “rent” from forest products, increasing income of local communities 10-fold, for up to 30 m people		Deforestation reduced by 10% from 2005 to 2030 that could reduce carbon emissions by 0.08–0.16 gigatons a year Environmentally friendly certification schemes and low-intensity managed community forests on 15 m hectares in the tropics
7. Climate Change and Agriculture	Enhance crop productivity in climate change context in all major systems domains		Development of international lead role for CGIAR on agriculture-climate change Understanding and use of adaption and mitigation options for agriculture by policymakers

Table 2.6 shows this rating of the MPs in terms of their contribution to each of the system results criteria. These ratings are not just subjective; some of the parameters, such as the productivity goals or the nutrition goals, can be implicitly derived from the Analytical Hierarchy Model employed for the task.

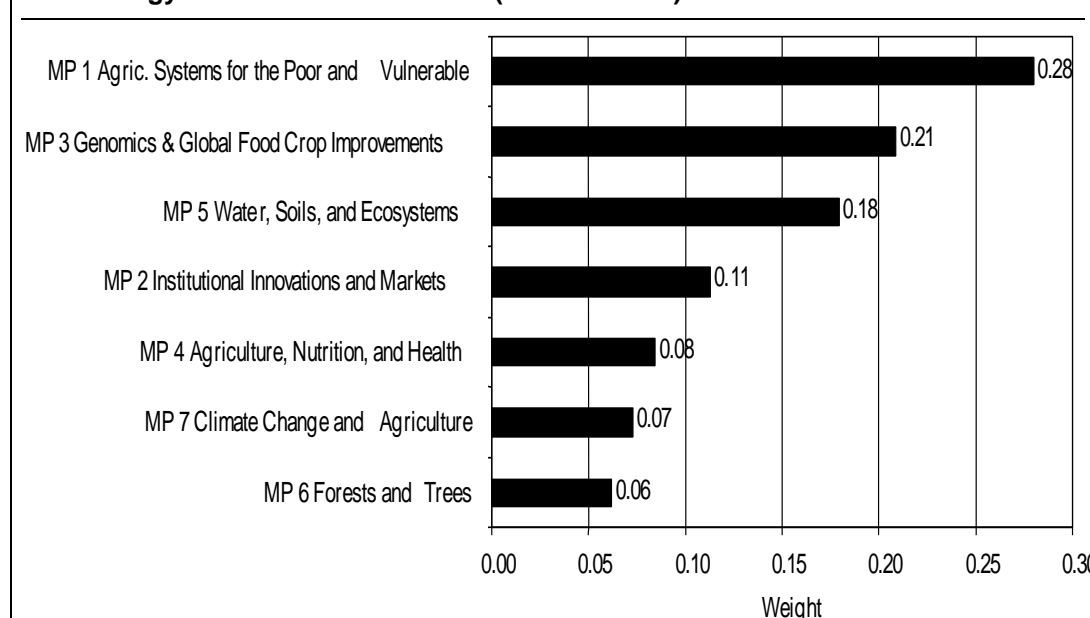
Table 2.6. Expected contributions of MPs to system-level results criteria (%)

MPs	Lift productivity and reduce poverty	Contribute to reduction of hunger and improved nutrition	Contribute to sustainability and resource efficiency
(Expected contribution of each MP to the above stated system-level results criteria, %)			
1. Agricultural Systems for the Poor and Vulnerable	29	30	24
2. Institutional Innovations and Markets	10	13	12
3. Genomics and Global Food Crop Improvements	29	14	12
4. Agriculture, Nutrition, and Health	5	19	5
5. Water, Soils, and Ecosystems	18	11	25
6. Forests and Trees	4	5	11
7. Climate Change and Agriculture	5	8	11
Total	100	100	100

Source: Average indicative weights by Strategy Team members.

Technically, the Analytical Hierarchy Model is equivalent to a scoring model. Based on average ratings, we obtained weights for the MPs to indicate their relative contributions to the overall vision goal (see Figure 2.3).

Figure 2.3. Overall scoring of the MPs: Relative contributions to the overall goal of the Strategy and Results Framework (CGIAR vision)

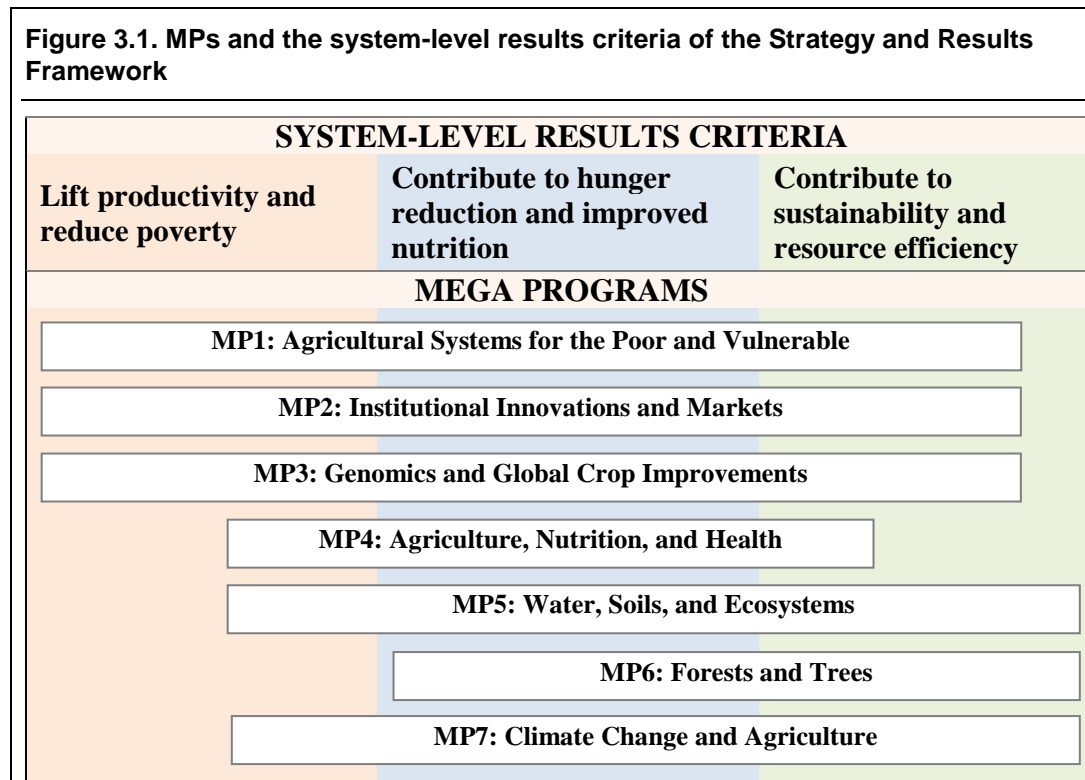


The weights for the MPs derived from this assessment may be used to broadly guide relative resource allocations to the MPs. Of course, any alternative weighting can be explored. The Strategy Team's conclusion as presented here may serve as a starting point for assessments by a future Consortium Board and its partners, who may to re-run the decision support exercise with different assumptions.

3. The Mega Programs and Platforms

Characteristics of Mega Programs

The building blocks of the proposed Strategy and Results Framework are the seven interlinked MPs and two platforms on gender and capacity strengthening that will cut across all MPs. Each of the MPs caters to the system-level results and has its own set of indicators that are broadly consistent with the overall Strategy and Results Framework (see figure 3.1).



This section presents concept notes for the proposed MPs, which have been developed with a number of criteria in mind. Each individual MP:

- addresses one or more of the three strategic objectives and makes a compelling case for results and impacts over time;

- is of sufficient scale to deliver high-level development outcomes and/or measurable development impacts (with associated development indicators that relate to the system-level results criteria);
- reflects the CGIAR's comparative advantage in leading or catalyzing research, given the CGIAR's assets—physical, biological, human, intellectual, institutional, reputational, collective social capital, and so forth;
- effectively mobilizes resources, capacity, and synergies among program partners, both within and outside the CGIAR, so that the impact is much greater than the sum of the parts;
- has a clear impact pathway—is accountable, with all research partners, for research results and responsible, with a range of other actors, for the delivery systems leading to outcomes and impacts; partners will be involved from the design stage;
- can be global or regional with strong international public goods elements;
- has an investment time horizon of 6 to 20 years, with milestones along the way; and
- has a simple and cost-effective management mechanism that does not result in a net increase in bureaucracy.

The following MP descriptions should be regarded as *concept notes* that require further sharpening as part of ongoing consultations over the next few months and the subsequent development of proposals with business plans. This process is described in the sections on organizational design and moving forward.

For the CGIAR to achieve its vision of reduced poverty, improved health and nutrition, and enhanced ecosystem resilience, investments must be made in each MP. Within each MP, system-level results criteria must be applied against major opportunities to prioritize those opportunities. This would help gauge the optimal size for each MP as discussed in the following section. For each MP, opportunities within the MP should be ranked according to expected returns.

Rough estimates of the needed investments for each MP are provided at this stage based on Strategy Team assessments. The cost estimates assume a CGIAR with a budget of US\$1 billion by 2015. The actual investments relative to MP results and to overall system results will ultimately be determined, however, only on the basis of sound proposals and business plans.

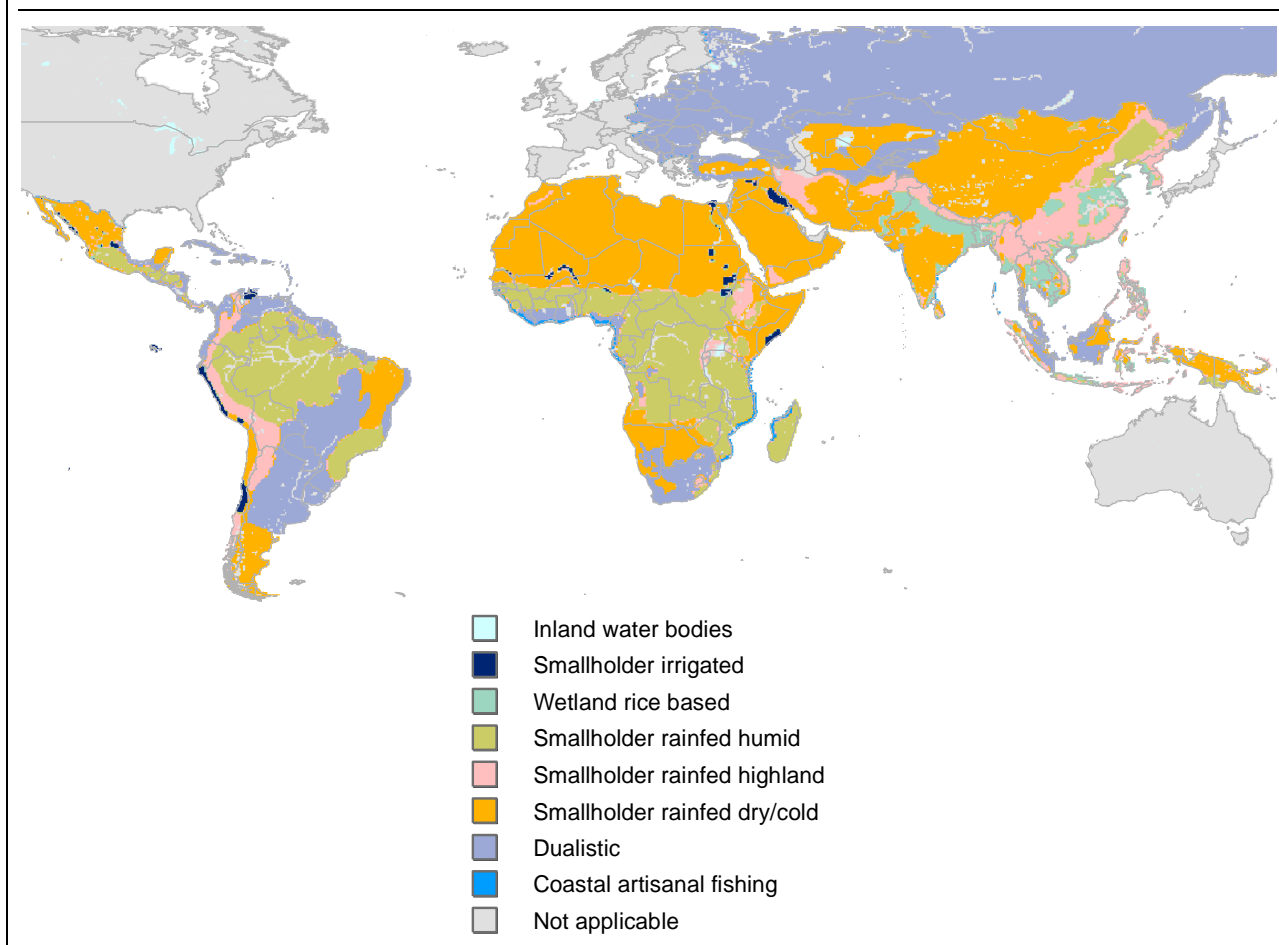
Concept Notes for Individual Mega Programs

MP 1: Agricultural Systems for the Poor and Vulnerable

Seventy percent of the world's poor are rural, and most of these 800 million poor people depend on agriculture for their livelihoods. Poor and hungry people are concentrated in particular regions and associated with particular agroecosystems, mostly in Sub-Saharan Africa and South Asia (figure 3.2). These systems are characterized by major system-specific constraints, whether agro-climatic (such

as drought), poor infrastructure and isolation, or weak institutions and governance. Frequently all three types of constraints act simultaneously, compounding the challenges of development programs targeted on these systems. Prevalence of crops and livestock are major determinants of systems.

Figure 3.2. Dominant agricultural systems



Source: CGIAR Strategy and Results Framework Spatial Analysis Team, Stan Wood et al. (see background documents on Alliance Web site). Data taken from regional maps generated for inclusion in Dixon et al., *Farming Systems and Poverty* (Rome and Washington, DC: FAO and IFPRI, 2001).

A well-designed research program that is tightly focused around particular constraints and opportunities in specific systems and drawing on the best that the CGIAR and its partners have to offer can potentially deliver rapid results in terms of poverty reduction and food security of global significance, given the concentration of poor people in these systems. Moreover, an agroecosystems' perspective that integrates natural and human elements, both on farm and off farm, can contribute to wider ecosystems sustainability.

This MP will be particularly focused on gender, and given the great diversity of women's roles in agricultural systems, a strong outcome orientation for gender research in this MP will enhance the impact of CGIAR research. This work will

include capacity strengthening for women farmers and other women actors in the food value chains.

Summary of the MP

This MP will harness science and other skills across the CGIAR and its partners to rapidly and sustainably reduce poverty and hunger in systems with large numbers of poor people, in order to achieve the greatest improvement in human welfare in the shortest time. This goal requires coordinating research across the CGIAR's three strategic objectives—that is, increased productivity and stability of agroecosystems, underpinned by improved and sustainable natural resources management, and linked to policies and institutions to ensure delivery of the benefits of productivity gains to the poor. The agricultural systems relevant to this MP include not only cropping systems, but also systems for livestock and fish production.

The design of the MP will be specific to the particular system, but four general principles will guide the design. First, research will be tightly structured around the major system constraints (such as mitigation of risk) and opportunities (such as new markets and other potential links to MP 2) rather than around discipline, commodity, or resource. It is suggested, however, that applied breeding for critical food security crops such as cassava and sorghum in Africa, closely linked to upstream genomics work in MP 1, will be included (see table 3.1). This MP will embrace livestock systems and grazing land where relevant for the poor.

Second, as noted earlier, the research would aim for quick payoffs through productivity improvements at the system level, with due attention to sustainable use of natural resources and resilience to climate change-related shocks, which are likely to be more frequent. Third, the MP would employ a value chain perspective that includes agro-enterprises, with a strong emphasis on value added from livestock production. Finally, the research would be conducted in close partnership with NARSs and subregional research organizations.

Table 3.1. Developing countries where crops other than rice, wheat, and maize dominate food calorie consumption (excluding feed use), 2003

Country	Most important food crop	% in total crop calorie consumption	Population of country (million)
Angola	Cassava	31.4	16.5
Burkina Faso	Sorghum	27.8	14.4
Chad	Sorghum	20.4	10.5
Congo, DR	Cassava	55.6	60.6
Ghana	Cassava	24.4	23.0
Mozambique	Cassava	35.6	21.0
Niger	Millet	49.8	13.7
Nigeria	Sorghum	13.3	144.7
Sudan	Sorghum	29.2	37.7
Uganda	Plantains	17.7	29.8
Total			372.1

Source: Data from FAO 2009.

Note: FAO classification for developing countries was used for the analysis. Countries with population less than 10 million were excluded from the analysis.

Design of the MP

The components of this MP would be the set of research activities built around each selected system. Selection of priority systems will be guided by four elements:

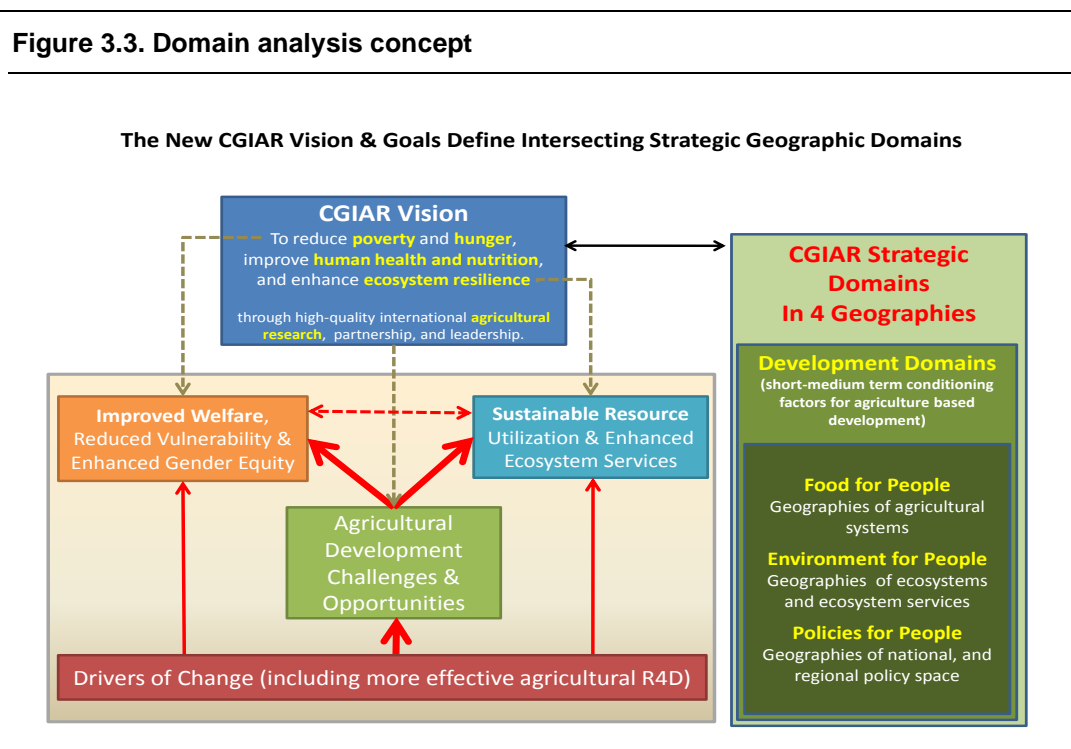
1. First, the distribution of poor and food-insecure populations has been mapped and compared with likely factors contributing to poverty: agricultural production, access to natural resources like water, and effective governance and policy environments. Using subnational units such as states as the basis of analysis, this *CGIAR Impact-Focused Analysis* identifies regions with the largest number of poor people (table 3.2 gives some guidance).
2. Second, in the identified poor regions, the potential for agricultural improvement will be mapped in terms of factors such as agricultural potential, market access, and a minimal level of governance. This *Development Systems-Focused Analysis* will identify areas where agricultural research investments would be most promising.
3. Third, based on the above mapping, up to five systems or domains with a minimum of 30 million to 50 million poor people would be identified where agricultural research focused around common constraints or opportunities in that system offers significant potential to contribute to rapid and sustainable poverty reduction.
4. Finally, in selecting systems, priority would be given to those that cut across national boundaries in order to maximize the generation of regional public goods.

Figure 3.3 describes the conceptual framework.

Although the final selection will be made by a team preparing this MP, it is anticipated that at least four of the identified systems/domains will be in Sub-Saharan Africa and South Asia.

In each domain, CGIAR and NARS researchers will develop a research portfolio based on the most promising crop, land use, livestock, tree, and fish combinations, as well as the specific natural resources and market and institutional challenges that must be addressed to improve productivity.¹⁵

The design of this MP requires a deliberative process and consultation to come up with a research agenda that has enough innovative science to justify CGIAR participation. The science will involve adapting technologies and institutional innovations to local conditions and linking agriculture, ecosystem services, and policy research. New and more effective approaches to agroecosystems research and methods for monitoring poverty incidence, system sustainability, and resilience are also needed. As table 3.2 shows, a number of systems—such as some of the rainfed systems—are spread widely across developing regions and are home to many poor people. CGIAR research of an international public goods character is especially relevant for these systems and domains.



¹⁵ A model for how this can be done through CGIAR-NARS collaboration is the Rice-Wheat Consortium, which, through agricultural innovations such as zero tillage of wheat, generated significant regionwide benefits in a system for poor people. Follow-up research has integrated pulses, livestock, water, and gender issues into the program. Other models with emphasis on ecosystem services (such as CONDESAN), agro-enterprises (such as IITA), and innovation systems approaches (Sub-Saharan Africa Challenge Program) also provide important lessons.

Table 3.2. Preliminary assessment of the number of people living on less than \$1.25/day (\$PPP 2005) in developing regions by development domain, circa 2005 (millions)

Development Domain	Latin America & Caribbean		Sub-Saharan Africa			Middle East & North Africa		Asia				Total
	Central	South	West	East & Central	Southern	M. East	N. Africa	Central	East	South	S. East	
Rainfed H H	1.2	6.3	<i>57.1</i>	<i>34.3</i>	12.1	0.0	0.2	0.7	<i>43.0</i>	<i>273.1</i>	25.9	453.9
Rainfed M H	5.8	5.6	26.8	<i>32.7</i>	11.1	0.1	1.1	1.4	<i>51.1</i>	<i>59.1</i>	23.2	218.0
Rainfed H L	0.2	1.1	14.7	14.1	7.7	0.0	0.0	0.0	5.4	11.3	4.0	58.6
Rainfed L H	0.8	1.7	8.9	3.9	2.2	2.2	1.1	2.7	11.4	21.7	0.7	57.3
Rainfed M L	0.2	0.7	5.1	5.0	1.3	2.6	0.3	1.6	10.5	10.4	1.1	38.8
Rainfed L L	1.1	2.0	8.1	19.5	7.1	0.0	0.1	0.2	26.5	13.0	11.1	88.7
Irrigated areas H	0.1	0.1	0.0	0.0	0.0	0.2	0.8	4.8	13.8	<i>100.1</i>	0.3	120.2
Irrigated areas L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	2.7	0.0	3.5
Closed forest H	0.0	1.2	1.1	4.4	0.7	0.0	0.0	0.0	2.6	7.2	0.1	17.5
Closed forest L	0.0	1.8	1.7	9.4	2.5	0.0	0.0	0.0	4.5	5.3	1.7	27.0
Protected areas H	0.2	0.6	0.7	1.9	0.3	0.0	0.0	0.2	1.0	8.6	0.5	14.1
Protected areas L	0.1	0.7	1.2	3.5	0.7	0.0	0.0	0.1	0.3	2.8	0.9	10.3
Not suitable	0.0	0.1	0.3	0.1	0.0	0.1	0.2	1.2	1.5	0.8	0.0	4.3
Grand Total	9.8	22.1	125.8	128.7	45.7	5.1	3.9	13.1	172.3	516.2	69.4	1,112.1

Source: CGIAR Strategy and Results Framework Spatial Analysis Team, Stan Wood et al. (see background documents on Alliance Web site).

Note: Rainfed agriculture potential (crops, grazing, forest) is classified as high, medium or low (H,M,L).

Rainfed potential, closed forest, intensively irrigated, and protected areas are all classified into high (H) and low (L) market access areas. Thus ML is medium rainfed agricultural potential areas with low market access. Also see map of development domains (Figure 2.2a-b). Inland water and major urban areas were omitted from this tabulation, so absolute poverty numbers are less than in the Agricultural Systems MP summary (areas and populations to be reconciled in revised versions). Regional domains with greater than 30 million poor people are highlighted (red italics).

Given its focus on poor regions, many with weak NARSs, capacity strengthening would play a larger role in this MP than in others. Moreover, the focus on several systems within the MP provides an important opportunity for institutional learning across systems. Likewise, the MP offers good opportunities for South-South collaboration—for example, harnessing Brazilian experience in the Cerrados to the Guinea Savannah regions of Africa.

Expected Results

It is estimated that this MP could reach 250 million poor people by achieving broad based productivity increases of at least 10 percent over 10 years and would lift about 60 million people out of \$1.25-a-day poverty.¹⁶

¹⁶ This calculation is based on an average of 50 million poor people in each of five systems, an increase in productivity growth of 1 percentage point a year, and a poverty-output elasticity of 2.5 percent in poor regions.

Links to Other MPs

This overarching, system-based MP focuses on accelerated reduction of poverty in poverty hot spots. Consequently all other MPs, which are focused on food, natural resources, and institutions, will contribute to its success.

Total Annual Cost

Given the overarching nature of this MP, the investment is likely to be large, and building research capacity in the target domains will figure significantly in it. A preliminary estimate is in the range of US\$250 million to US\$300 million.

Regional/Domain Dimensions

This MP will almost certainly focus on Sub-Saharan Africa, parts of South Asia, and perhaps other regions.

Partnerships

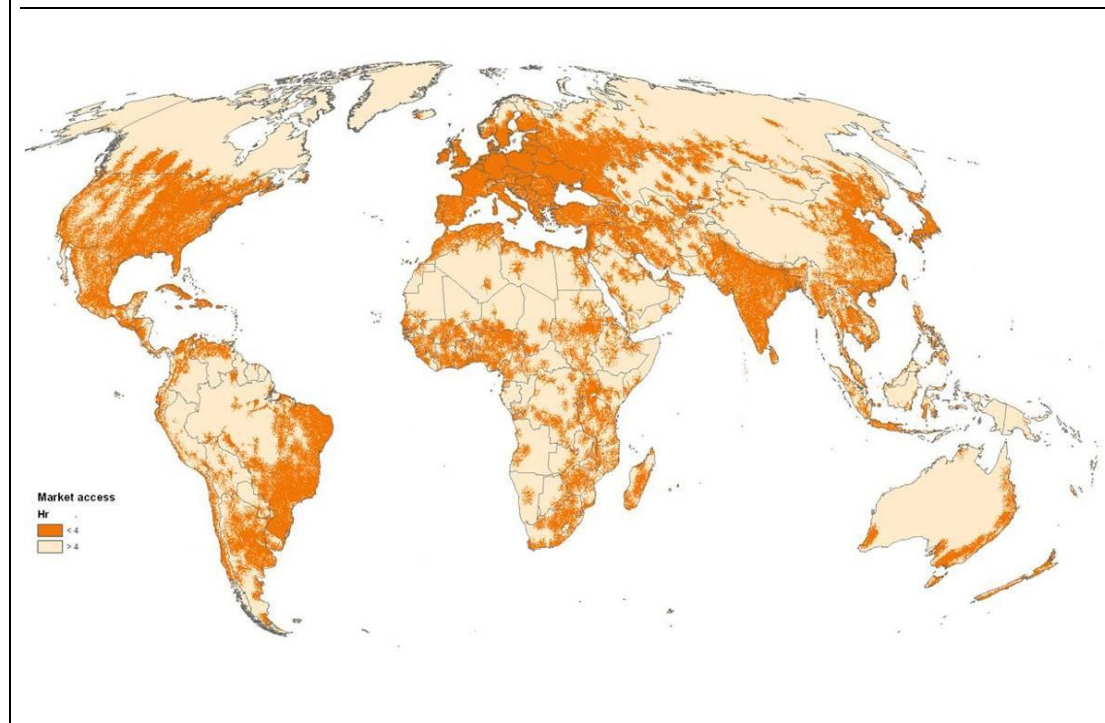
This MP is particularly focused on farmers. In Sub-Saharan Africa, the key partners will be national and regional agricultural research institutions and nongovernmental organizations (such as the Association for Strengthening Agricultural Research in Eastern and Central Africa [ASARECA] and FARA). This MP also supports the CAADP framework. National systems and subregional organizations will play a strong role in the governance of each component of the MP. This MP will especially benefit from international cooperation with producer organizations (such as the International Federation of Agricultural Producers [IFAP]) and with cooperative organizations in the context of testing innovations.

MP 2: Institutional Innovations and Markets

Whereas most MPs have some policy research components to support their outcomes and impact pathways, this MP focuses on institutional innovations directly as a complement to the technological and natural resources management focus of the CGIAR. Improving the institutional settings in which poor farmers and food consumers operate represents an underutilized opportunity for reducing poverty and improving food security.

The MP proposed here aims at research that can help unleash an “institutional and information revolution” with and for farmers and the rural poor that not only improves and secures their livelihoods, but also promotes innovation along value chains. These changes are designed to strengthen poor people’s capacity as economic and social actors. Areas of low market access, as shown in figure 3.4, have particular difficulty in entering new agricultural value chains and thus are in great need of institutional innovations to make their agricultural products competitive and to reduce their vulnerability to shocks.

Figure 3.4. Areas of high and low market access



Source: Adapted from Nelson 2008.

Note: Locations within 0–4 hours’ travel time from a market are classified as having high market access. Locations more than 4 hours from a market are classified as having low market access. This classification reflects a simple rule of thumb: in areas with high market access, it is feasible to travel to and from the market and make transactions in one day.

Institutional innovations are as important as technological innovations for achieving the CGIAR's global goals.¹⁷ In recent decades, important institutional innovations have included the worldwide microfinance revolution, agrarian reforms such as the one in China that put the nation on the fast track to development, commodity exchanges and information systems to improve market access, conditional transfer programs that strengthen social safety nets and human capital, and collective action to effectively manage communal resources such as water and forests. At the same time, there were—and still are—many institutional failures and aberrations, such as government-commandeered agriculture, ill-designed resettlement schemes, and extension systems based on top-down models that do not deliver results. Such failures often have particularly severe implications for women.

Summary of the MP

This MP aims to make the CGIAR a global leader in institutional innovations for agricultural development and facilitate learning across regions and systems. It aims to expand proven successes and adapt existing institutional innovations locally; facilitate reforms that reduce harm from ill-designed institutional arrangements; and breed, test, and scale up institutional innovations, drawing on the CGIAR's worldwide network of Centers and their partners in the public and private sectors. The MP will cover a range of institutional innovations to improve the performance of financial, input, and output markets and reduce the effects of market and climatic risks for agriculture and the poor.

Driven by a strengthened social science and economics research community in the CGIAR, three themes will structure this MP. First, the MP will identify and evaluate *governance structures, the potentials of collective action (instead of and complementing markets and government), and rural community and farmers' organizations* to enhance capacity and empowerment. Research will focus on the constraints and weaknesses of institutions and examine the complementary roles of different actors (the state, the private sector, and civil society) in food policy, along with their attendant responsibilities.

Second, the MP will emphasize the use of *new information and communications technologies* to enhance institutional performance and connect the poor to new opportunities. Almost all people in developing countries who wish to use increasingly sophisticated mobile phones and related devices will likely have access to them within 10 years—a development that opens up huge new livelihood possibilities for poor rural populations.

Third, the MP will scale up *experimental approaches to evaluating institutional innovations*. While inherently more expensive than other approaches, formal experimental approaches have been shown to more quickly and precisely establish confidence in the superiority of institutional innovations. The CGIAR already has a basis for scaling up such approaches, but linkages with advanced

¹⁷. The 2009 Nobel Prize for economics was awarded to two institutional economists, Elinor Ostrom and Oliver Williamson, highlighting the recent innovations in and importance of research on institutional arrangements for development.

research institutes that are already experienced in this area could help rapidly mainstream experimental methods, just as in more traditional agronomic research.

Design of the MP

What might be the next big breakthrough in institutional innovation to be unleashed in support of poverty reduction, food and nutrition security, and environmental sustainability? This MP proposes six program components for the research agenda, which will require further focus and prioritization.

- **Component A: Innovations in markets, trade, and value chains.** Improved access to and processing of production and market information provide major opportunities for adding value in supply chains. This MP proposes combining innovations in the supply of information and communications technologies with farmers' demands for a wider array of more sophisticated information needed for increasingly complex farming and marketing systems. The MP will also pay special attention to advances that link measurements of agricultural production with consumption, health, and income in a more accurate and appropriate way than current methods for assessing economic and societal impact. In view of trade policy's large role in agriculture, this component also addresses the international dimension of markets through enhanced quantitative trade policy research and modeling, including providing capacity strengthening in that field for developing countries to facilitate their strengthened roles in global and regional trade.
- **Component B: Insurance innovations to reduce vulnerability.** Unexpected events that cause poor health, loss of assets, or loss of income play a large role in determining the fortunes of many people in the developing world. Enabling poor households to deal better with shocks is one of the main ways to improve both their welfare in the short run and their opportunities for income growth in the long run. This research seeks to improve the functioning of both informal and market-based insurance tools to allow individuals, households, communities, producer or consumer organizations, and the public sector to better manage risks. A particular focus will be the institutional design of weather-based insurance at scale in order to improve smallholder risk management.
- **Component C: Human capital strengthening through development transfer programs.** This MP will analyze opportunities to link social safety nets and transfer programs to development investments. It will explore synergies between direct investments in people (human capital) and investments in agricultural and other productive rural sectors. This component will include research to develop cost-effective social and productive safety nets that enhance poor people's capacity to manage and cope with production and market-related risks. It complements the indirect poverty reduction efforts from agricultural productivity research.
- **Component D: Rural banking and financial services.** Rural banking and microfinance are among the investments that matter most to the rural

poor, including small farmers and agricultural businesses. This component will include research on enhancing the efficiency of rural financial services and allowing the poor to climb the credit ladder, from small loans to commercial credit that facilitates agricultural investment. Special attention will be given to institutional innovations for delivering financial services to remote areas, including mobile banking and networking among savings and loan associations. Because covariate risks and access to collateral assets are major constraints on delivery of financial services, innovations in this sector will be closely linked to innovations in insurance and property rights (components B and F), as well as input market access. Women's access to finance and assets will be an important aspect here.

- **Component E: Extension and innovation systems.** Innovation systems are becoming more complex and participatory across the spectrum from public to private sectors and farmer organizations. Yet the transformation of the small farm sector will accelerate in the coming decades, and existing modes of extension will have to change radically. This component will evaluate promising institutional innovations to better link farmers to sources of innovation, as well as provide tools and information to enhance farmers' own capacity to innovate. This research will also analyze how incentive and regulatory regimes can enhance the effectiveness of research, help generate innovation, and promote sharing and uptake of technologies. Special attention will be given to the role of rural organizations, including farmer organizations, women-producer organizations, and private-public-civil society partnerships, and how they and other actors in rural innovation systems contribute to enhanced agricultural productivity.
- **Component F: Property rights and access to assets.** Property rights and the governance of land, forests, and water regimes will be integral to this MP and will strengthen the impact of research in MPs 5 and 6. Efficient and equitable methods are needed to strengthen and delineate customary rights to land, water, and forest resources and ensure equitable access to those resources. The integration of satellite imagery, geographic information systems, and easy access to databases and local maps through cell phones could revolutionize this area. Institutional arrangements to prevent expropriation of farmers' land require a sound research and information base. Research will also explore institutional innovations to allow the poor to access land and water assets, through market- and community-based and other mechanisms, such as collective action.

Expected Results

This MP is expected to have an impact on the about 400 million small farm households by reducing the transaction costs and risks they face. The MP will have a strong gender research component. Tentatively, research in the MP is expected to decrease market transaction costs of small farmers by 30 percent by 2025 while mitigating risks. The research on transfer and safety net programs will provide evidence that can serve as a basis for designing these programs and will

thereby measurably improve their effectiveness for the poor, especially in Africa, South Asia, and Latin America, where about 1.5 billion people are included in such programs.

Links to Other MPs

This MP will closely coordinate with MP 1 on Agricultural Systems for the Poor and Vulnerable and MPs 5, 6, and 7 on Water, Forests, and Climate Change. Component E of this MP will also be strongly linked to MP 3 on Genomics and Global Food Crop Improvements.

Total Annual Cost

US\$90 million to US\$130 million

Regional/Domain Dimensions

This MP will be global in reach. Although it will have a special focus on the poorest regions, it recognizes that innovations in more-advanced regions can often offer lessons for less-advanced regions.

Partnerships

This MP will involve strong cooperation with advanced research institutes, universities, and leading associations, such as the International Association of Agricultural Economists; multilateral financial organizations and private firms (such as banks); and farmer and community-based organizations (including the International Federation of Agricultural Producers [IFAP]). The research on innovation systems will require close cooperation with informal policy groups, such as the Neufchatel group, GFAR, and regional and national research organizations. In a rather new step for the CGIAR, this MP will cooperate closely with new private partners that drive information and communications technologies in rural areas to enhance the relevance of the content of information and communications technologies services for small farmers and the rural poor.

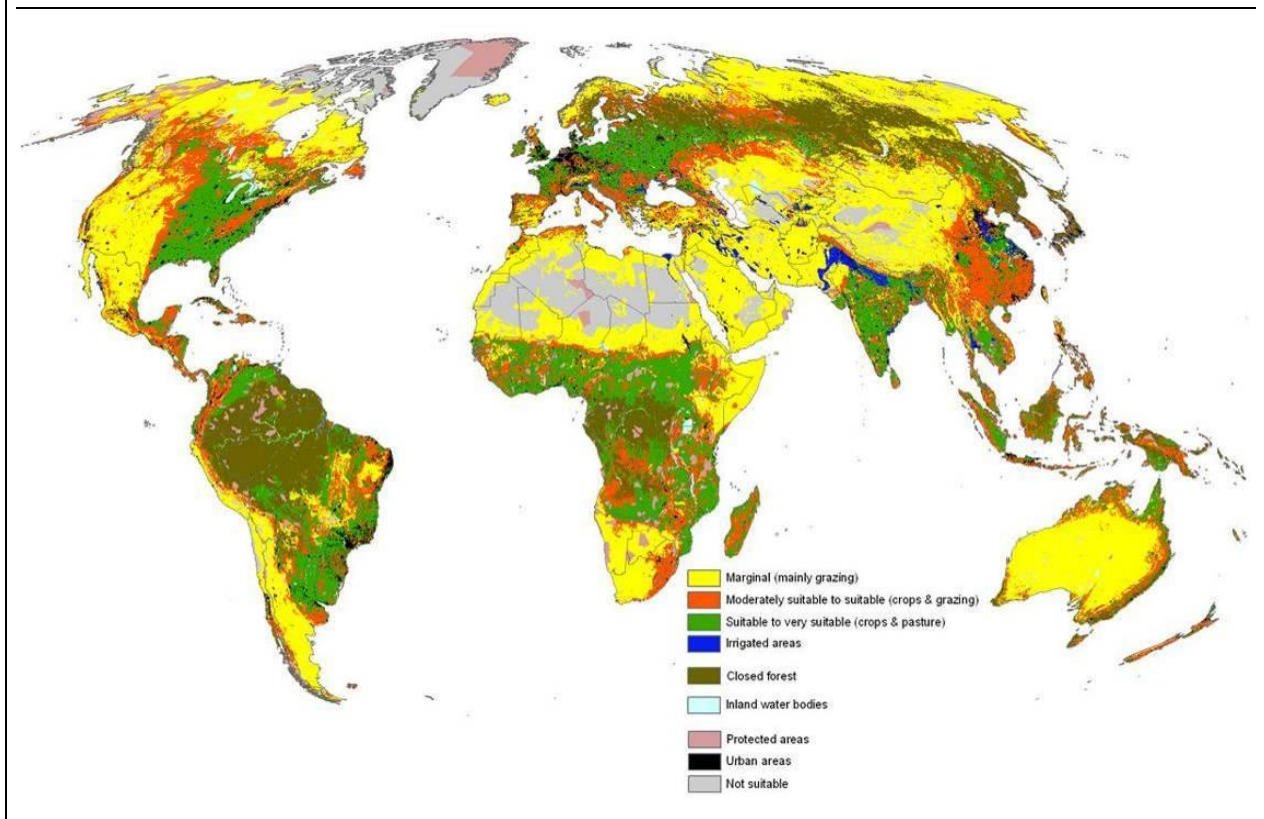
MP 3: Genomics and Global Food Crop Improvements

Crop yield growth in the main food staples (rice, maize, and wheat) has been slowing, and without sharply increased investment in R&D, production will slip below demand. The world's farmers need to produce about 50 percent more staple foods by 2030 to meet the strongly growing demands for food, feed, and fuel from an increasing world population with rising incomes. Furthermore, farmers need to so increase production in a changing climate and using about the same land area and less water as they do now; otherwise, agriculture will encroach further into forests and fragile ecosystems and water stress will increase. If crop productivity is not sharply increased, food prices will increase, with serious negative implications for poor people. At an aggregate level, the people most vulnerable to poverty and hunger resulting from slowing or stagnating agricultural productivity tend to be women and children, owing to price and income effects.

Figure 3.5 shows crop potential worldwide. Productivity increases will depend on greater genetic gains; more effective and sustainable use of water, nutrients, and land; and improved host plant resistance against newly emerging pests and diseases. The CGIAR has documented large-scale success in sustaining and improving the availability of food and reducing poverty through crop productivity enhancement (see box 1). While the private sector is increasing its investment in food crops of the developing world, market failures continue to be pervasive, and this remains a core area of CGIAR competency and comparative advantage for delivering international public goods. Moreover, exciting scientific advances now make possible accelerated breeding, which allows breeders to evaluate, analyze, and stack molecular, phenotypic, and environment information more rapidly and precisely and thus create new, more eco-efficient and resilient plant varieties. In addition, scientists will need to explore transgenic avenues for increasing yield potential, improving water- and nutrient-use efficiency, and generating durable resistance to pests and diseases that threaten global food security.

Summary of the MP

This MP will encompass support for genomics research, bioinformatics, phenotyping, management of intellectual property, and pre-breeding across a broad spectrum of food staples—cereals, legumes, roots and tubers, and fruits and vegetables, as well as livestock and fish—that are essential for ensuring sufficient food supply. In addition, it will encompass breeding research related to the leading global food security crops—rice, wheat, and maize—that are produced over a wide spectrum of developing countries, account for nearly half of calorie consumption in the developing world, heavily dominate food trade, and determine food prices more generally (see box 2). Applied breeding work for crops of importance for regional and local food security, including for large areas, such as cassava, sorghum, millet, sweet potatoes, potatoes, pulses, and others, will be incorporated into MP 1 on Agricultural Systems for the Poor and Vulnerable. Research on more diversified and nutritious diets will be a focus of MP 4 on Agriculture, Nutrition, and Health.

Figure 3.5. Crop potential

Source: Adapted from FGGD (FAO 2007).

Note: This figure shows the potential for rainfed production of pasture, crops, and trees, with existing irrigated areas, closed forests, and inland water bodies.

The vast majority of the world's population depends for food security upon the three leading crops (rice, maize, and wheat) that will be a focus of this MP. Almost a billion of the world's poorest people depend on income derived from these crops. The CGIAR's track record suggests that a large proportion of rice, maize, and wheat producers will utilize, and ultimately benefit from, work under this MP through producer and consumer benefits, more stable yields, increased eco-efficiency of production systems, and avoidance of rising food prices and civil unrest.

Design of the MP

This MP will be structured into interlocking components. Each component is essential to an integrated and indivisible strategy to improve the productivity of specific crop production and distribution systems. Thus, beyond joint genomics platforms, bioinformatics, and policies and regulatory aspects, the primary accountability and management mechanisms will be structured by crop type. Each crop module will establish clear research agendas, well-defined research products, and product development pipelines for each of the major crop production environments.

- **Component A: Genomics and trait identification.** This component addressing the broad spectrum of food crops and animal products covered by the CGIAR will emphasize gene and trait discovery. It will greatly increase the CGIAR's capacity to carry out innovative research on genetic diversity assessment for allele, gene, and trait discovery through large-scale genotyping/phenotyping of world collections of genetic resources and precision breeding for pyramided trait packages designed for diverse environments, cropping systems, and markets. The MP will place special focus on input use efficiency, durable resistance to globally important pests and diseases, and tolerance to stresses, including those arising from climate change. It will also support innovative research to raise the yield frontier and increase the water- and nutrient-use efficiency of the major food crops through processes such as the transfer of the C4 photosynthetic pathway, modified plant architecture, targeted physiological processes, or improved exploitation of heterosis. For CGIAR genomics research, a shared (possibly networked) Molecular Discovery and Enhancement Program (MolDEP) is proposed here for further study. It would provide the specialized breeding stations of the CGIAR and its partners with technology, although much of the technology would also be developed locally because many of the crops require particular breeding conditions. MolDEP would centralize all gene studies, statistics, and data storage, and invest in advanced technologies (including sequencing with potential outsourced options). It would provide an exciting research environment for leading scientists in the CGIAR as they cooperate with advanced research institutions outside the CGIAR. This approach would, however, pose challenges for project management, data logistics (which would probably require a large investment), and the CGIAR culture. The current CGIAR Generation Challenge Program could form an important building block for this program. Implementation will require a balance between a centralized genomics laboratory for the CGIAR system (MolDEP), decentralized units associated with each crop, outsourcing of genomic services, and strategic partnering with advanced research institutes.
- **Components B, C, and D: Enhancement of the global food crops rice, maize, and wheat.** Full exploitation of the crop genomics research in component A will be achieved in components B (rice), C (maize), and D (wheat) by implementing state-of-the-art breeding approaches for each of the major global food crops that so far have mostly been accessible to better-funded breeding programs targeting high-income countries. It will support genetic enhancement through new-generation, high-throughput molecular technologies, bioinformatics, and precision phenotyping. Genotype by Environment by Management interaction (GxExM) approaches will be developed and implemented with the aim of accelerating breeding gains. The MP will make these tools available and integrate regional and global breeding programs to speed up the development of genetically enhanced materials and their delivery. The component will also promote deployment systems for safe use of new

technologies, manage intellectual property, and provide a wide range of genomic information and molecular tools to NARSs and the seed sector.

Breeding for drought, flood, and heat tolerance and resilience to weather shocks to combat climate change will be a particular focus, as will eco-efficient varieties that use fewer inputs of water, fertilizers, and pesticides and produce higher yields and profits. Achieving these goals will require optimizing GxExM in sustainable crop management systems, including tillage and crop establishment options for conservation agriculture. The research will also use a value chain approach that seeks to reduce postharvest losses and efficiently utilize crop residues.

A major focus of this component will be the development and deployment of diverse germplasm to combat pests and diseases that threaten global food security. Use of state-of-the-art global surveillance systems, improved spatial databases of production systems and constraints, and crop and pest modeling will be used to better target research priorities and environments and design efficient cultivar testing systems.

- **Component E: Information and policy support.** This component will provide analysis of markets for the three leading crops, farm household decisions on varietal adoption and traits, and research impact for guiding future priorities. It will also analyze the implications of incentive and regulatory regimes that promote development, sharing, and uptake of varietal technologies including intellectual property rights, licensing arrangements, contracts, biosafety regimes, and seed systems.

Expected Results

It is estimated that genetic gains will account for 60 percent of the overall productivity gains for food crops, equivalent to yield gains of 0.4 percent a year.¹⁸ This gain will benefit 75 percent of the developing world's agricultural population, or 2.6 billion people. Progress in Sub-Saharan Africa will be double the global average. Other expected results of the MP include the following:

- The diversity of the 20 crop species and their wild relatives covered by the CGIAR will be characterized and utilized for crop-breeding programs worldwide.
- The CGIAR will be a recognized leader in applied genomics, bioinformatics, and precision phenotyping, enabling it to partner effectively with agricultural research institutions and the private sector to identify and transfer pro-poor crop traits.
- Farmers will have easy access to improved cultivars appropriate for changing production environments and consumer preferences.

¹⁸. From 1960 to 1998, Evenson and Gollin (2003) estimated overall genetic gains of food crops of 0.71 percent or about one-third of total yield gains. Genetic gains as a share of total gains will increase, however, because farmers in Asia and Latin America have already reached high levels of fertilizer use—a major factor in past yield gains. The IMPACT model suggests that a yield gain of 0.6 percent for cereals is needed to ensure global food security.

- Eco-efficient cultivars will require fewer inputs of water, fertilizers, pesticides, and labor and produce higher yields while having a positive impact on the environment.

Links to Other MPs

MP 3 will link closely with MP 1 on Agricultural Systems for the Poor and Vulnerable, and MP 4 on Agriculture, Nutrition, and Health. Close links to MP 7 on Climate Change and Agriculture will guide and support adaptive breeding priorities.

Total Annual Cost

US\$250 million to US\$300 million

Regional/Domain Dimensions

This MP will be global, cutting across all developing regions. Through its close links with MP 1, it will have a strong focus on the poorest regions and most food-insecure people.

Partnerships

The principal users and partners of this MP's products and services are public and private sector plant breeders in the developing world. Drawing on the wide range of collaborative networks that are linked to CGIAR Centers, the MP will pursue a multistakeholder approach to breed new traits in end-user-preferred germplasm that bears essential or valuable trait combinations. The MP will give particular emphasis to strengthening linkages with advanced research institutes and the private sector worldwide. A strong and integrated capacity in genomics combined with the CGIAR's unique collection of genetic resources will greatly facilitate the negotiating position of the CGIAR in gaining access to modern tools and technologies.

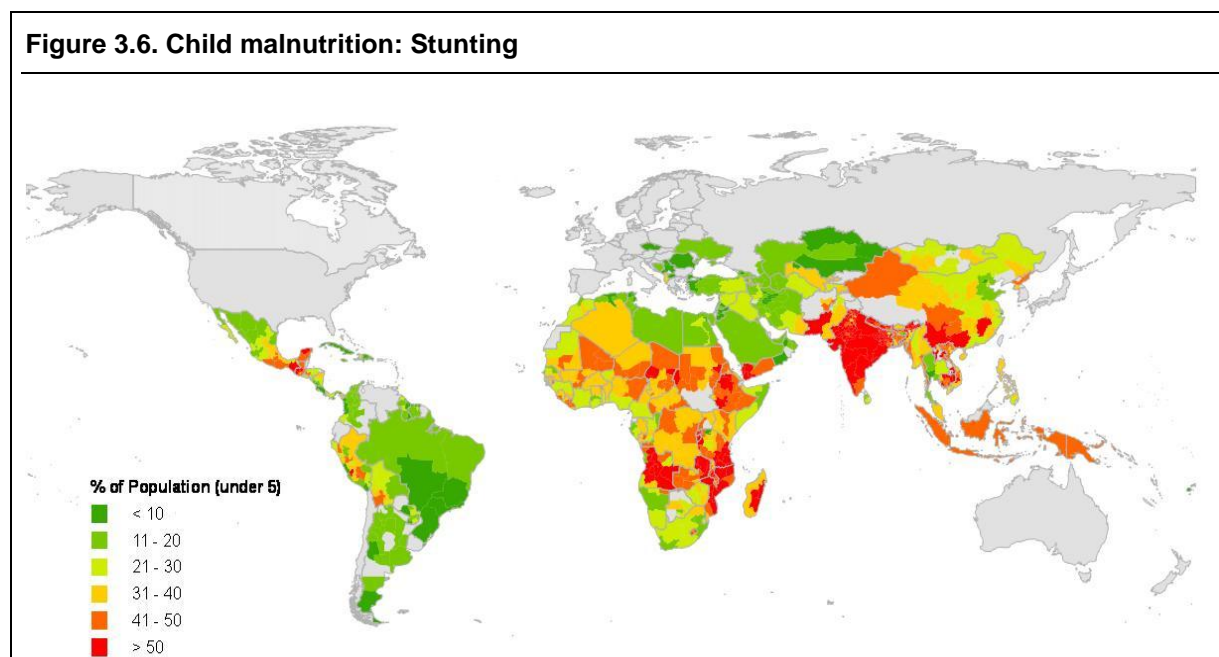
MP 4: Agriculture, Nutrition, and Health

The explicit inclusion of health and nutrition as an MP is one of the novel elements of the Strategy and Results Framework–guided CGIAR.

Agriculture affects health and health affects agriculture. The process of agricultural production and the outputs it generates can contribute to both good and poor health and nutrition, among producers as well as in the wider population. Agriculture is fundamental for good health and nutrition through the production of the world’s food, fiber, and materials for shelter. Yet agriculture is associated with many of the world’s major health problems, including undernutrition, malaria, HIV/AIDS, foodborne diseases, diet-related chronic diseases, and a range of occupational health hazards. In the other direction, the occurrence of these health conditions has tremendous implications for agriculture. Farmers in poor health are less able to work, and unsafe food products reduce market demands, a situation that cuts productivity and income, perpetuates a downward spiral into ill health and poverty, and further jeopardizes food security and economic development.

Improvements in agricultural productivity in recent decades have helped make key cereal staples more accessible and affordable to the poor, bringing about a global reduction in hunger and malnutrition. But many cereals and roots and tubers are relatively low in essential micronutrients, such as iron, zinc, and vitamin A—the leading micronutrient deficiencies identified by the World Health Organization (WHO). Most micronutrients are obtained from sources like meat, fish, vegetables, and fruit, which have remained comparatively costly relative to cereals, making them particularly inaccessible to the poor. As a result, while approximately 1 billion people remain food calorie deficient, an estimated 2 billion are now micronutrient deficient.

The greatest impact of food deficiency is on development during childhood, when micronutrients are most important. Malnutrition in pregnancy and early childhood leads to retarded development, such as stunting (figure 3.6), with profound longer-term implications for human capital and economic productivity. This imbalance of access to different foods is also fueling a global trend toward high-energy, low-nutrient diets, which in turn is contributing to rapid growth in chronic illnesses, including cardiovascular diseases and diabetes. With expanding urban populations, low- and middle-income countries are now shouldering this “double burden” of diet-related disease. A comprehensive CGIAR effort to address the food and nutrition problems of the developing world comprehensively must include this rapidly growing issue into its research agenda.



Source: FAO 2004.

Note: Stunting is defined as height-for-age below minus two standard deviations from the international growth reference standard (National Center for Health Statistics/World Health Organization). This indicator reflects the long-term cumulative effects of inadequate food intake and poor health conditions as a result of lack of hygiene and recurrent illness in poor and unhealthy environments. The prevalence of chronic undernutrition is a relevant and valid measure of endemic poverty and is a better indicator than estimates of per capita income.

Agriculture's impacts on health go well beyond nutrition. Agricultural production and food consumption can also increase the risks of water-related diseases (malaria) and foodborne diseases—as well as health hazards linked with specific agricultural systems and practices, such as infectious animal diseases (avian flu, brucellosis), pesticide poisoning, and aflatoxicosis. Many of these problems are global in nature, especially the growing incidence of zoonotic diseases, which increase risks of human pandemics. Increasing intensification of crop and livestock agriculture and the rapidly growing market for higher-value perishable foods for urban populations is adding urgency to the need to reduce the costs of agriculture for health.

These challenges and their solutions have particular importance to women. Women are responsible for distributing nutritious foods to the most vulnerable individuals in the household. In addition, they are the principle producers of the best sources of essential micronutrients—vegetables, fruit, meat, and fish—and are responsible for much of their postharvest processing and marketing, where quality and safety issues are critical.

Summary of the MP

This MP will invigorate and expand the CGIAR's research on the links between agriculture, nutrition, and health. Research in this MP has a foundation in ongoing innovative research by CGIAR Centers and partners, including research on biofortification, crop and animal improvement, and diversification and the Platform on Agriculture and Health, which will be continued and expanded.

Particular areas of new innovative research will include improvement of vegetable and fruit production, postharvest management of food quality and safety, and better integration of health and agricultural policy.

Improving access to highly nutritious, safe food will make a substantial contribution to reducing poverty and hunger (MDG 1), as well as improving maternal and childhood health (MDGs 4 and 5), reducing infectious diseases (MDG 6), and contributing to greater gender equity (the broad intention of MDG 3).

Design of the MP

This MP consists of two interlinked components:

- **Component A: Improving maternal and child health through improving nutritional value of foods, overall diet quality, and policy interventions.** Agricultural research has a key role to play in improving maternal and child nutrition, and one that is complementary to short-term interventions such as nutrition supplementation. Such research can produce, in the longer term, local sources of inexpensive, nutritious food that are available to the poor. Options include biofortification, diversification of food sources, and improved postharvest and marketing systems. The diverse and local nature of nutritional insecurity recommends that no one approach be pursued exclusively.

This program will support improvement of micronutrient levels in staple crops through biofortification, such as that carried out by the HarvestPlus Challenge Program, which will be an important building block of the MP. The MP will also build on programs for diversifying production systems to improve access to and affordability of foods rich in micronutrients, including neglected, traditional food plants of particular nutritional value to the poor. The program will support research on pro-poor fish, livestock, and dairy production aimed at improving diets, and it will conduct research on postharvest management of foods for nutritional value and safety.

This program will also develop research on tools and policies that support healthy diets and improved nutrition for vulnerable groups, including mothers and children. This research will include methods to establish the relationship between production, consumption, and health effects and intersectoral tools for enhancing the health impact of agricultural programs at a large scale. It will encompass research on the integration of agricultural, health, and nutrition policies and on interventions that improve dietary quality and nutrition for poor vulnerable groups, including smart designs for nutrition interventions in early childhood and in schools.

- **Component B: Changing agricultural production and processing to improve health outcomes.** Agricultural systems have major impacts on health that do not involve the direct provision of food and nutrition. These impacts on health operate through food chains, contaminated water in food production, agricultural processes associate with disease risks, and the

broader relationship between population health and agricultural productivity. For all of these relationships, the poor are demonstrably at greater risk. Neglect of these important relationships reflects past failures to integrate agricultural and health research, which this MP will now address. There is no alternative global player besides the CGIAR to address these research issues comprehensively across these sectors.

As agricultural systems change, so do health risks. Therefore, the research areas identified below are to be considered initial foci, building on work done in the CGIAR and elsewhere, and they will evolve as the Strategy and Results Framework develops:

- zoonotic diseases in livestock production systems, such as bird and swine flu, which affect both livelihoods and health;
- food safety in growing food supply chains, including, for instance, mycotoxin contamination of crop products and bacterial contamination of milk; and
- water-associated disease and water management in agriculture, including use of wastewater and the effect of irrigation on disease vector populations.

In all these areas, research is needed to understand how health threats emerge in agricultural systems, how they affect health and livelihoods, and how they can be reduced. This program will also continue existing research on major diseases that particularly affect poor farming households, such as HIV/AIDS and malaria, to develop policies and practices that reduce disease incidence, severity, and economic impact of these diseases.

Expected Results

The impact of this research will be measured ultimately in improved population health, particularly maternal and child health, and reduced gender disparities in nutrition. Within the Strategy and Results Framework, expected outputs from Component A will be the increased local availability and affordability of nutritious, micronutrient-rich foods to the poor and the demonstration that consumption of these foods will deliver micronutrients at appropriate levels. Expected outcomes will be increased production and consumption of these foods, particularly by women and children. The result aimed for is a CGIAR contribution to a reduction in child undernutrition across developing countries by at least 10 percent by 2025, with larger impacts where undernutrition is currently the highest (in Africa and South Asia).

For Component B, outputs will be pre- and postharvest agricultural processes that demonstrably reduce health risks, while outcomes will include a measurable reduction in incidence of negative health effects from unsafe food, including food-associated and zoonotic diseases among the poor, and demonstration of greater agricultural productivity in households because of these interventions.

Links to Other MPs

Genomics research (MP 3) will underpin both biofortification and crop diversification; research on information and communications technologies and markets (MP 2) will contribute to improved marketing of perishable foods rich in micronutrients; and improved water use (MP 6) will reduce disease risk. With its focus on addressing poverty hot spots through improving agricultural systems, MP 1 will make particular use of agricultural sources rich in micronutrients to build both food and nutrition security in these systems.

Total Annual Cost

US\$70 million to US\$100 million

Regional/Domain Focus

This research will have particular importance for the poorest of the poor, whose diet is presently largely restricted to cereals. Micronutrient deficiencies affect a much larger population in low- and middle-income countries, however, including the urban poor.

Partnerships

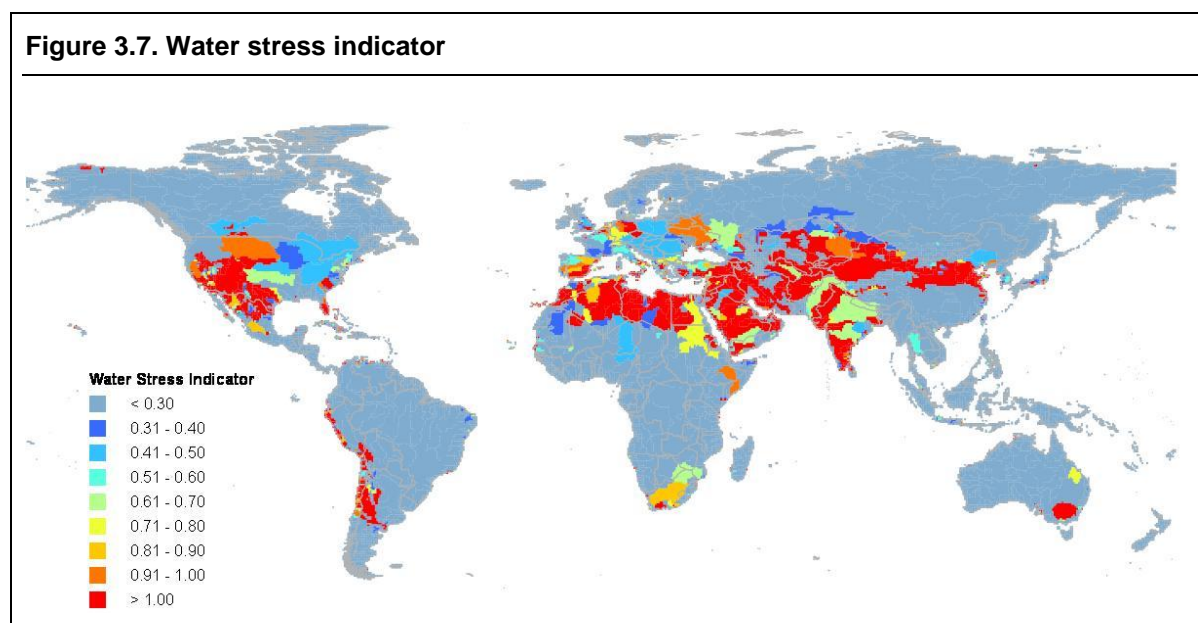
This MP will require establishing a new and unprecedented link between international agricultural and health-related research to ensure that research investments in these two sectors are not just complementary, but realize potential synergies. This is no small challenge. But the CGIAR, with WHO and other partners, now operates a promising Agriculture and Health Research Platform (AHRP), which will be developed further to create partnerships between agriculture- and health-focused programs at the national and international levels. Partnerships will be needed with institutions specializing in non-CGIAR crops (such as the World Vegetable Center [AVRDC] for vegetables) and in postharvest processing and marketing. Private sector partnerships will be particularly important in postharvest processing and marketing, as well as in realizing the benefits of research on biofortification.

MP 5: Water, Soils, and Ecosystems

A significant challenge for agriculture is to increase agricultural productivity while using a declining share of water resources, building soil health, and reversing degradation and environmental harm. Sustainable food production (including crop and animal production) requires healthy soils and adequate, timely water availability.

The inclusion of a strong soil health research component in this MP and the strengthened ecosystems services research component are truly novel for the CGIAR agenda at scale. At the same time, we propose scaling up the water agenda as well.

Water resources are already under stress in many parts of Africa, Asia, and the Middle East owing to arid environments, poor water management, rising populations, dietary change, biofuel and fiber production, urbanization, and industrialization (see figure 3.7). Agriculture uses the major share of water in most developing countries, and this share will come under significant threat from other users. It is projected that water demands from cities and industries will more than double by 2050, but the lion's share of water will remain with agriculture. Climate change impacts will further exacerbate water scarcity in many regions. Nonetheless, with productivity gains in irrigated and rainfed systems and judicious implicit water trade through agricultural commodities, growth in withdrawals for irrigation could be limited to 10–20 percent globally.



Source: IWMI 2004.

Note: This IWMI data set shows what proportion of the utilizable water in world river basins is currently withdrawn for direct human use and where this use is in conflict with environmental water requirements, which is the estimated volume of water required for the maintenance of freshwater-dependent ecosystems at the global scale. This total environmental water requirement consists of ecologically relevant low-flow and high-flow components and depends upon the objective of environmental water management. Both components are related to river flow variability and estimated by conceptual rules from discharge time-series simulated by the global hydrology model.

Agriculture must improve its water productivity or it will not be able to keep up with demand for increasing food production. With rivers such as the Indus, Yellow, Amu, and Syr Daria already fully allocated, and with groundwater levels declining in breadbasket areas, water availability and access will be key constraints to food production (table 3.3). Given these limits on water, it is essential to generate more food per unit of water used in agriculture in areas of “physical water scarcity.”

In many parts of the world with high levels of poverty, key constraints are water access and productivity rather than water availability. Across Sub-Saharan Africa, current levels of water storage per person (often less than 100 cubic meters per capita) are extremely low compared with Asia and the developed world (1,000–5,000 cubic meters per capita). Significant attention must be given to upgrading rainfed systems with better water management and developing new irrigation infrastructure to ensure livelihoods and protect food security in the face of climate change while maintaining ecosystem functions. Research will be essential to target investments in water infrastructure, and the development of human and institutional capacity to cope with this situation of “economic water scarcity.” Women and children often bear responsibility for hauling water and stand to benefit greatly from improved water infrastructure and management.

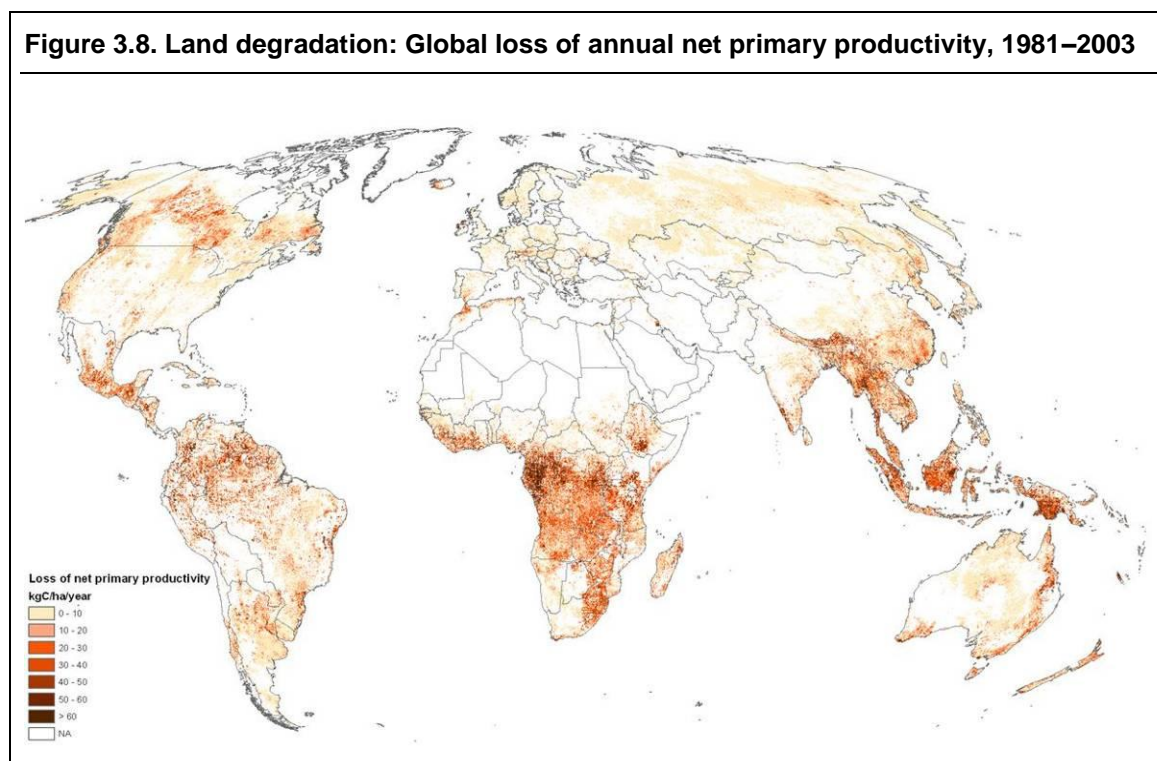
Table 3.3. Water, agriculture, and poverty in water-scarce areas

Indicator	Unit	Ethiopia	Burkina Faso	Ganges (India)	Pakistan	Yellow River	Uzbekistan	Egypt, Arab Rep. of
Water availability per capita	m ³	1,506	871	1,951	1,400	256	1,868	773
Water storage per capita	m ³	48	324	*207	137	370	704	2,278
Available water	%	5	6	*34	75	92	115	120
Agricultural/total withdrawal	%	93	86	*86.3	96	83	93	86
Percent of population in poverty	%	39	46	31	24	21	33	20
Projected population by 2050	million	278	47	868	276	136	35	138

Sources: Data from AQUASTAT, FAO; CIA Factbook, Agricultural Statistics at a Glance (India); Yellow River Conservancy Commission.

Note: * All India figure.

Water shortages are compounded by soil fertility exhaustion, erosion, and salinization. In many developing countries, policies and practices lead to severe loss of soil resources, inhibiting growth in yields and water productivity (figure 3.8). Elsewhere, poor irrigation practices have led to the buildup of toxic salts and elements like sodium and magnesium that significantly reduce crop yields and cropping options. Similarly, soil erosion issues will be addressed with respect to improving overall land management practices and their relation to paid environmental services.



Source: Bai et al. 2007 (LADA, FAO/ISRIC).

Note: This figure shows observed loss of terrestrial carbon, captured as loss of “greenness” after allowing for the effects of year-to-year climate variability. Loss of greenness might occur as a consequence of soil degradation, deforestation, and overgrazing.

The range of land and water issues described are daunting challenges given that global food and animal feed production will likely need to double by 2050. It is, however, a challenge that the CGIAR and its partners must deal with if poverty is to be reduced, livelihoods are to be enhanced, and human and environmental health outcomes are to be improved.

Summary of the MP

Research in this MP will address the complex interactions between soil, water, and productivity; implications for livelihoods; and the role of policies and institutions. Overall outcomes of research in this area would focus on improving crop yields and smallholder incomes, returning degraded lands to production, and minimizing environmental impacts at watershed and basin levels.

The MP will focus on agroecosystems characterized by serious over- or underexploitation of water and related natural resources. It will put new emphasis on the concept of the environment’s role in providing ecosystem services that maintain both quantity and quality of water supplies as well as other functions that promote biodiversity and resilient agroecosystems.

The predominant focus will be on global and regional issues and the delivery of international public goods in the form of management strategies, technologies, and policies required to deal with these issues.

Results expected from this MP include benefits for the livelihoods of up to 1 billion people in water-scarce and food-insecure basins and regions where water and related natural resources problems are critical constraints.

Design of the MP

The research will focus on four components:

- **Component A: Delivering greater water productivity** to combat water scarcity and growing demand for water from other users. Key research areas will include developing and applying multiscale basin hydrological modeling methods to generate strategies for adapting to changing land use and land management as well as agricultural, urban, and other demands on water availability. The MP will develop analytic frameworks and measurement techniques, including remote sensing, to analyze levels of water productivity; innovation in water systems to increase storage; and access to water through rainwater harvesting, small reservoir construction, and soil water storage. Research into the sustainable management of groundwater that supports smallholder agriculture will investigate policies and practices for managing groundwater, including groundwater recharge (“groundwater banking”).
- **Component B: Enhancing and safeguarding water access for the poor** by developing methods and options to improve the definition of water rights, allocation procedures, and national and international water governance. Key research areas will include hydro-economic modeling to determine optimum water allocation procedures; analysis of water valuation, pricing methods, and other incentives to increase water productivity; consideration of the role of water rights frameworks in enhancing water allocation; trading between users in order to maximize productive and efficient water use; and consideration of how poor women farmers and householders can improve their access to water for domestic and agricultural uses by developing multiuse water systems.
- **Component C: A new focus on agriculture and water quality, land degradation, and the environment.** Key research areas will include analysis of how paid environmental services can be identified and developed at the policy and industry levels (such as hydropower generation and urban water supply utilities) and used to provide income to poor farmers; sustainable use of wetlands for livestock, fish, and crop-based agriculture that supports other ecosystem services and biodiversity; and the development of management methods (such as conjunctive use of surface and groundwater) to address salinity, sodicity, and other forms of land and water degradation in irrigated areas.
- **Component D: Development of new technologies, management practices, and policies to improve soil management.** The emphasis would be on upstream research to develop innovative methodologies to describe and improve soil health through soil microbiological and chemical methods, including those that could unlock phosphorus;

biophysical and economic research into the use of soil ameliorants to raise the fertility of sandy and nutrient-depleted soils; and policies and institutions that promote viable soil management. Important research tasks at the level of international public goods may include

- bringing soil science into the 21st century using digital soil maps and information systems adapted for different end users, with pixels at the scale of 90×90 meters;
- scaling up the use of near infrared spectrometry as a reliable tool for rapid diagnosis of soil properties, particularly soil carbon and soil fertility indexes, and providing major training to NARSs in this tool; and
- addressing climate change issues (with links to MP 7), such as modeling how carbon, water, nitrogen, and phosphorus cycles in the main farming systems of priority areas will change under 2- and 4-degree scenarios of global warming; quantifying nitrous oxide emissions from mineral and organic nutrient inputs in main farming systems; and identifying policies that provide financial incentives for smallholder farmers to keep their crop residues on the ground.

Expected Results

Research under this MP by the CGIAR and its partners will aim to increase crop/water productivity by 20–50 percent over the next 30 years (depending on initial levels in a region, noting that in specific sites it could be doubled or tripled). Research will contribute to reducing agricultural water demand by 10 percent in major stressed systems to cope with competition from other users and limit ecosystem degradation caused by excessive water withdrawals. This research will directly benefit livelihoods of up to 100 million people in water-scarce and food-insecure basins and regions where water and related natural resources problems are critical constraints, and where about one billion people live.

Other results would be adoption of more equitable and environmentally appropriate water access and allocation mechanisms, improved policies and equitable arrangements for sharing water in at-risk basins that protect the poor, improved data and information to benefit transboundary river basin management, and increased recognition of the importance of environmental flows in terms of changed river management practices in 10 countries over the next 20 years.

Links to Other MPs

This MP will be closely linked to MP 7 in terms of climate change predictions and adaptation. To deal with food security and poverty hot spots, land and water management practices from this MP will be incorporated into an agricultural systems approach through MP 1. This MP will also interact with MP 3 on water use efficiency and soil fertility issues and with MP 2 on institutional innovations for ecosystem management.

Regional/Domain Dimensions

Work under this MP will take place predominantly in Africa, Asia, and the Middle East and North Africa region, with the potential for ecosystem services work in Latin America as well.

Total Annual Cost

US\$100 million to US\$130 million

Partnership

Partners in this MP include advanced research institutes, NARSs, regional organizations, and international and national nongovernmental and civil society organizations. NARS partners ensure a high degree of probability that research outputs will be tailored appropriately to regional issues and are incorporated into national policies. Such partnerships can facilitate the uptake and impact of outputs and assist in capacity building. Partnerships with nongovernmental and civil society organizations help ensure delivery of new technologies to as many of the poor as possible.

To strengthen international research on soils without duplication, the CGIAR will work closely with the science communities gathered, for instance, in the International Union of Soils Sciences, the World Association of Soil and Water, and the International Soil Tillage Research Organization.

MP 6: Forests and Trees

Approximately 30 percent of the world's land area is covered by forests, which contain about 80 percent of Earth's terrestrial biodiversity. Millions of the world's poorest people depend for their subsistence and survival needs on forests, and more poor people depend on remnant woodlands, homestead tree gardens, and agroforestry systems for their essential fuelwood, food, and fodder needs.

Tropical forests support much of the world's biodiversity and provide a range of ecosystem services (such as erosion control and regulation of water quantity and quality) that are fundamental to the planet's well-being and to humans' vulnerability or capacity to adapt to climate change. Forest products represent safety nets for local communities facing worsening climatic events. Finally, they store carbon and have a huge potential role to play in reducing emissions of the main greenhouse gases. Deforestation—mostly in tropical areas—accounts for 17 percent of current global carbon emissions and 80 percent of emissions from developing countries.

Forests, both natural and planted, make substantial contributions to national and local economies. In many developing countries, forest-based enterprises provide more than one-third of all rural nonfarm employment and generate income through the sale of wood products, enriching private companies, governments, and rural communities. Hunting and fishing, much of it forest-based, provide more than 20 percent of household protein requirements in 62 developing countries. The rapid growth of domestic markets for nontimber forest products (such as honey, nuts, and resins) has created new income-generating opportunities for poor households.

About 40 percent of the world's population relies on fuelwood or charcoal as their primary source of energy for cooking and heating. Fuelwood consumption is the second source of deforestation in the tropics after agriculture and before logging. Women are deeply involved in the management of fuelwood and carry a major burden in traditional household energy production. With rising energy prices and advances in technology, production of biomass is likely to be a rapidly growing industry to serve fuel needs, offering major new markets for developing countries' agricultural and forest resources. With appropriate governance and institutions to connect the poor to these markets, biomass energy production could represent a significant new opportunity for poverty reduction. But if it is managed poorly, biomass energy production will exacerbate competition for land, threatening both food security and ecosystem services provided by natural forests.

Summary of the MP

This MP will aim to improve governance and management of forest resources for conservation and use, promote more resilient forest systems, improve the livelihoods of poor people who depend on forest and agroforestry systems, and ultimately increase biodiversity and carbon sequestration through avoided deforestation in the tropics. Research by the CGIAR and its partners will be associated with local implementation of forest management schemes and

reduction in forest loss. Interactions between forest, agriculture, and biomass production will be a product of the research as well.

The MP's niche will be "upstream" in the research-to-implementation continuum, as it works with implementing agencies to inform research design and dissemination. New tools and methods will include scenario analysis of global trade and investment trends to identify forest areas most at risk of conversion or degradation as a result of dynamic commodity markets and processing capacities, comparative analysis of the experiences of community participation in the first generation of REDD (Reduced Emissions from Deforestation in Developing Countries) activities, improved measures of carbon in above- and below-ground forest carbon pools, and innovative techniques for marrying remotely sensed monitoring information on forest degradation to information from local community monitoring efforts. At the same time, the MP will ensure that research results are timely and relevant to policy arenas and work with advocacy-oriented organizations as appropriate to extend research results.

Design of the MP

This MP, with global and national partners, will have five interlinked components:

- **Component A: Sustainable use of forests and forest products.** The MP will develop policies and governance structures that protect and enhance forests and forest products for poverty reduction while allowing sustainable commercial use of forests. It will place special attention on developing the tools with which governments and civil society can monitor and measure sustainable forest conservation and use. These include the development of standards for risk assessment, monitoring, and disclosure of investments in forest-based industries.
- **Component B: Improvement of incomes from forests and trees.** Research will improve income to the poor from forests, trees, and biomass, through the use of trees and tree products in emerging value chains. Research will seek to better understand the implications of rapid development of biomass and bioenergy production and will formulate policy options. It will give particular attention to institutional innovations that facilitate smallholder and community enterprises, but it will also research large-scale tree production.
- **Component C: Interaction of agriculture, forests, and biomass.** Given that a large share of deforestation is linked to expansion of agriculture, research will seek to better understand and balance the trade-offs and transitions from agriculture and forest systems at the landscape, national, and global levels. This research will also consider the emerging markets for biofuels and biomass production that provide new opportunities but at the same time may accelerate forest land use conversion and place additional pressure on tropical forests.
- **Component D: Conservation, valuation, and delivery of forest ecosystem services.** Research will provide tools for valuing and

efficiently and equitably delivering ecosystem services that are essential in the context of adaptation to climate change, including biodiversity, pollination, hydrological function, and aesthetic and cultural values. It will place special emphasis on managing the trade-offs between the sustainable use of forests and their conservation, including institutional platforms for evaluating alternatives and negotiating trade-offs.

- **Component E: Mitigation of climate change.** With the likelihood that the central role of forests will be formalized through the REDD program, research will give special attention to governance, policies, and institutions for efficient and equitable participation of developing countries, and poor people in particular, in REDD. This component needs to be closely aligned with research activities under MP 7.

Expected Results

- A 10 percent reduction in deforestation, resulting from research, from 2005 to 2030 that could reduce carbon emissions by 0.08–0.16 gigatons a year.
- More equitable benefit sharing of “rent” from timber and other forest products to local communities, which can increase the income of such communities 10-fold, for up to 30 million people.
- Environmentally friendly certification schemes adapted for small-scale producers and low-intensity managed forests on 15 million hectares of community forests in the tropics.

Links to Other MPs

Because a large number of poor people live in and depend on forest margins, forest-agriculture mosaics, and tree crop systems, which are also major sources of biodiversity, it will be important for this MP to closely collaborate with other MPs to integrate research on agroforestry and tree crop systems, and their associated interactions with agricultural systems. This MP will also require close links to MP 7 on Climate Change and Agriculture, MP 5 on Water, Soils, and Ecosystems, and MP 2 on Institutional Innovations and Markets.

Total Annual Cost

US\$50 million to US\$70 million

Regional/Domain Dimensions

This MP will focus on the tropical humid forests and forest margins and mosaics of the Amazon Basin, the Congo Basin, and Southeast Asia (especially important for climate change mitigation and conservation of biodiversity), as well as tropical dry forests (especially important to poor people). Global reach will be achieved through links to large national programs in China and India to promote learning and exchange.

Partnerships

Principle partners for this MP will be advanced research institutes and global science networks (such as the Earth Systems Science Partnership), NARSs, universities, and capacity-building institutes (such as the Regional Community Forestry Training Center [RECOFTC]). They will include international and regional organizations and national governments that influence key policy arenas affecting forests (such as the Collaborative Partnership on Forests), formal intergovernmental organizations such as the Central African Forest Commission (COMIFAC), the Common Market for Eastern and Southern Africa (COMESA), and the Amazon Cooperation Treaty Organization (ACTO), as well as more informal fora such as the Asia Forest Partnership. Additional partners will be the nongovernmental organizations and private firms that are targets for the adoption of improved forest management practices.

MP 7: Climate Change and Agriculture

Climate change represents an immediate and unprecedented threat to the food security of hundreds of millions of people who depend on small-scale agriculture for their livelihoods. At the same time, agriculture and related activities contribute to climate change by intensifying greenhouse gas (GHG) emissions and altering the land surface.

Agriculture is extremely vulnerable to climate change.¹⁹ Although there will be gains in some crops in some regions of the world, the overall impacts of climate change on agriculture are expected to be negative, threatening global food security (table 3.4 and figures 3.9(a) and 3.9(b)). Higher temperatures eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines. Populations in the developing world, which are already vulnerable and food insecure, are likely to be the most seriously affected. In developing countries, climate change will cause yield declines for the most important crops. South Asia will be particularly hard hit.

It is predicted that climate change will result in additional price increases for the most important agricultural crops—rice, wheat, and maize. Higher feed prices will result in higher meat prices. As a result, climate change will reduce the growth in meat consumption slightly and cause a more substantial fall in cereals consumption. Calorie availability in 2050 will actually decline relative to 2000 levels in much of the developing world unless large investments are forthcoming. By 2050, the decline in calorie availability will increase child malnutrition by 20 percent relative to a world with no climate change. Climate change will eliminate much of the improvement in child malnutrition levels that would occur with no climate change.

Table 3.4. Yield changes in developing countries between 2000 and 2050 by crop and management system scenarios, with CO₂ fertilization (CF) and without CO₂ fertilization (No CF)—(% change)

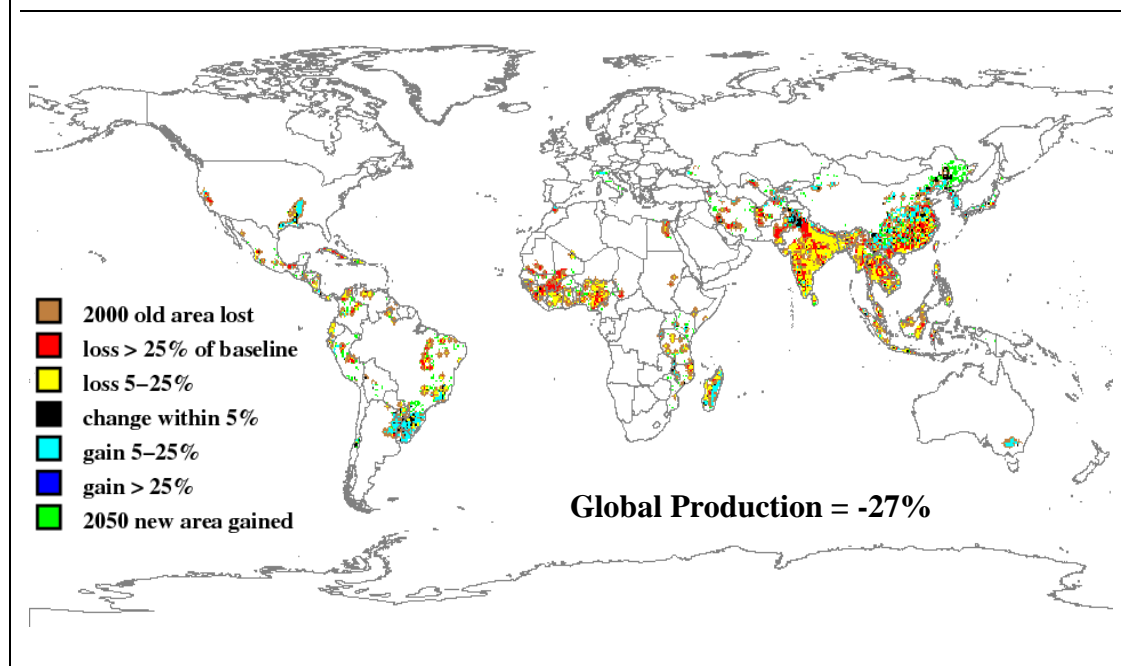
Scenario	CSIRO, No CF	NCAR, No CF	CSIRO, CF	NCAR, CF
Maize, irrigated	-2.0	-2.8	2.4	-2.1
Maize, rainfed	1.4	-2.0	6.6	-0.4
Rice, irrigated	-14.4	-18.5	2.4	-0.5
Rice, rainfed	-0.9	-0.8	6.6	6.6
Wheat, irrigated	-28.3	-34.3	-20.8	-27.2
Wheat, rainfed	-1.4	-1.1	9.4	8.6

Source: Adapted from G.C. Nelson, M. W. Rosegrant, J. Koo, R. Robertson, T. Sulser, T. Zhu, C. Ringler, S. Msangi, A. Palazzo, M. Batka, M. Magalhaes, R. Valmonte-Santos, M. Ewing, and D. Lee, *Climate Change: Impact on Agriculture and Costs of Adaptation* (Washington, DC: IFPRI, 2009).

Note: NCAR = the National Center for Atmospheric Research, U.S. model; CSIRO = the Commonwealth Scientific and Industrial Research Organization, Australia model.

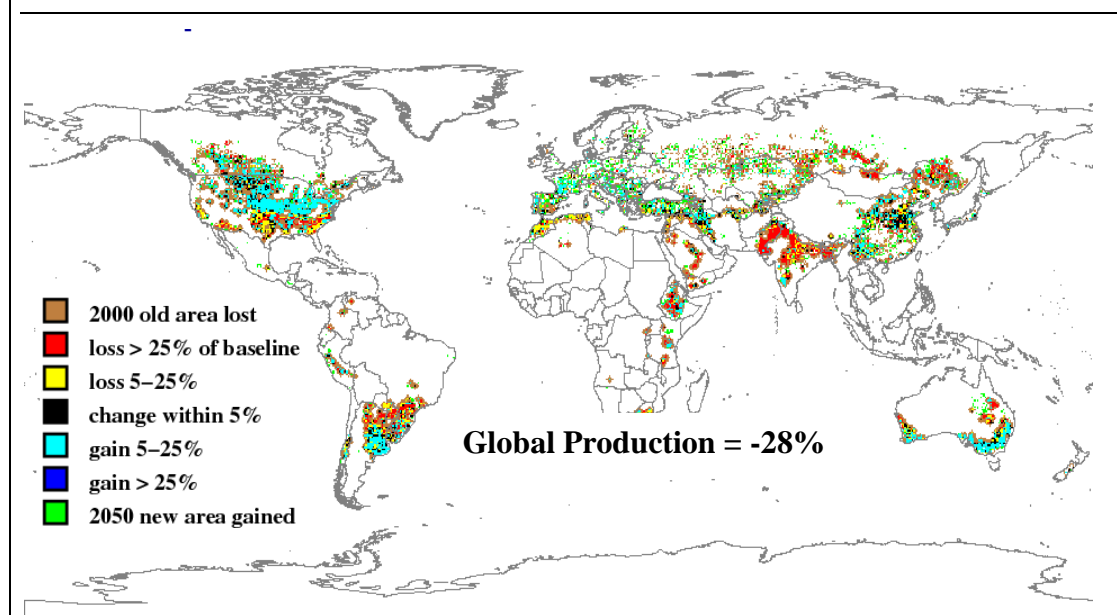
¹⁹. This section draws on a recent IFPRI study by G. Nelson et al., *Climate Change Impact on Agriculture and Costs of Adaptation* (2009); and on the background paper by M. Rosegrant et al. on the Alliance Web site.

Figure 3.9(a). Impact of climate change on irrigated rice production, 2050



Source: G. Nelson and M. Rosegrant, IFPRI (2009).

Figure 3.9(b). Impact of climate change on rainfed wheat production, 2050



Source: G. Nelson and M. Rosegrant, IFPRI (2009).

Summary of the MP

This MP will for the first time ensure that the CGIAR and key partners have an integrated, systemic approach to how the world will deal with potentially the

greatest threat to poverty alleviation and food production. The MP will have its own research agenda, but also serve as a locus of information and resources for all climate change-related work in the CGIAR. Working closely with all the MPs, this MP will be tasked with telling a coherent story of how CGIAR research, collectively, is responding to needs for climate change adaptation and mitigation related to agriculture and forestry.

This MP will take an integrated and holistic view of what, where, and how severe climate change will be with respect to environmental and related agricultural impacts. It will develop a research agenda that looks at optimum adaptation strategies for different areas. This MP will build on the platform provided by the Climate Change Challenge Program and other work being conducted in the CGIAR Centers and with partners to develop a comprehensive approach to helping agriculture cope with the impacts of climate change to ensure ongoing food security. It will develop strong links with other MPs dealing with adaptive management responses and mitigation of climate change.

Design of the MP

Particular emphasis will be given to four thematic components:

- **Component A: A knowledge base on climate change and models to assess its impact.** Work will focus on analyses of potential development scenarios under changing climate and differing pathways of economic development. Research will also identify climate trends and variability and assess methods for scaling up climate change information for agriculture and natural resources management. It will develop an integrated assessment framework and advanced modeling that links climate change modeling with global and regional agricultural production and systems modeling with a dual focus on resources and poor people. This analysis will include the likely effects of specific adaptation and mitigation options.
- **Component B: Adaptation options for agricultural and food systems.** Work will focus on identifying natural resources management strategies, as well as rural livelihood portfolios that buffer climate shocks and enhance livelihood resilience. The MP will analyze and evaluate index-based risk-transfer products to protect and enhance rural livelihoods and identify improved approaches for managing climate risk through food storage, trade, and distribution.
- **Component C: Mitigation technologies and policies from the perspectives of different sectors and cross-MP activities on institutions (such as payments for environmental services).** Work will include the development of tools to examine the synergies and trade-offs between adaptation and mitigation and among multiple goals (such as food security, carbon abatement, and livelihood improvement).
- **Component D: CGIAR “flag carrier” in global and regional climate change discussions.** The MP will play a convening role at global and regional levels for the links between agriculture and forestry and climate

change, through stakeholder engagement to develop scenarios, engage in global policy processes, and understand stakeholder needs for new types of information.

Expected Results

Results expected from this MP include the development of an international lead role for the CGIAR in describing how agriculture and food production will be affected by, and in turn may affect, climate change. The MP is expected to produce authoritative, comprehensive scenarios that other researchers and policy makers can use to understand how agriculture both adapts to and mitigates climate change. It is not possible at this stage to quantify how many people and livelihoods will be affected. Specific measurable results in terms of accelerated adaptation and mitigation will be developed in the future. It may be possible to aim for a particular result, such as achieving carbon neutrality of developing-country agriculture by 2030 or soon thereafter. For that result, agriculture needs to be included in a strong incentive regime for mitigation. A policy research component will address this need and aim for that result.

Links to Other MPs

This MP will require strong links to other MPs because climate change research is expected to be mainstreamed through the whole portfolio. On adaptation to climate changes, links to MP 3 on crop genetic enhancement, MP 1 on agricultural systems, and MP 5 on water will be especially critical, because most of the adaptation research will be done in those programs. Climate change requires institutional and policy change, linking this MP closely to methods and models being developed in MP 2 on institutions. Equally important will be close links to MP 6 on forests, which will have a strong component on mitigation of climate change through avoided deforestation.

Total Annual Cost

US\$60 million to US\$90 million

Regional/Domain Dimensions

This MP will be global, with a particular focus on poor areas most affected by climate change (such as Southern Africa and South Asia) and agro-ecological systems that contribute or potentially contribute most to GHGs (such as intensive livestock systems).

Partnerships

The emphasis in this MP will be to develop strong partnerships with the broader research community on climate change to ensure that the CGIAR has the latest data, tools, and research findings, as well as to enhance the visibility of agriculture and agricultural research in international discussions and agreements on climate change.

The Platforms

Platform on Gender in Agriculture

A well-resourced, systemwide, gender-mainstreaming platform will work to articulate critical gender issues as they apply to the CGIAR's mandate and help build capacity among MPs to integrate these issues into their research, capacity-strengthening, and outreach activities. No such global platform on gender in agriculture currently exists, so the CGIAR will take a lead in establishing this platform, in partnership with other organizations that have relevant expertise and activities, thereby not only serving the CGIAR, but also providing global public goods. A broad and inclusive consultation process of experts and stakeholders developed the concept, and the Strategy Team adopted it after reviewing it (see report on the gender consultations on the Alliance Web site).

The Platform on Gender in Agriculture will serve as a support unit for integrating gender and providing the latest research findings and results to the MPs across the CGIAR system. The platform will not serve as a substitute for gender experts within each MP. Specifically, this effort entails establishing best practices for sex-disaggregated data collection, analysis, and reporting; ensuring that related successes and failures in gender-responsive R&D are broadly shared and learned from; helping to identify and build the necessary partnerships for strengthening skills and capacities for gender-responsive technology development; and ensuring that gender is integrated into all MPs from their inception.

The platform will also be involved in formulating short courses and training to build the capacity of all researchers and leaders within the CGIAR to design and manage gender-responsive programs and to manage workplaces where both women and men are comfortable and can contribute their best. These materials will also be provided to NARSs for use in their own training programs, and materials will be developed for universities to train agricultural scientists with stronger awareness of the importance of gender issues.

Besides serving as a support unit to assist CGIAR units and the development research community, the Platform on Gender in Agriculture will also undertake original research, including in-depth analysis of gender issues critical to the CGIAR and its partners to ensure that the research-for-development agenda addresses women's specific priorities. It will include strategic participatory action research and deliver rigorous research findings, exemplary practices, and information exchange.

The Platform on Gender in Agriculture will have a broad range of partners (beyond those within the CGIAR), from researchers in NARSs, advanced research institutions, universities, and think tanks to implementers in nongovernmental organizations and the private sector. The work of the platform will also serve to inform donor strategies about gender in agriculture.

Because gender issues and appropriate approaches and strategies will play out differently in different regions, clusters may be created to work in particular

regions. The regional scope could include region-specific research and synthesis as well as deepening regional partnerships.

Results expected from this platform include:

- a narrowing in gender disparities in the adoption of new technologies;
- resource management practices and marketing opportunities, leading to increased income for women producers;
- improved gender equity in access to and control of benefits from natural resources, leading to increased incomes for women;
- policies that promote women's control of assets;
- an increase in the number of women and children eating more nutritious diets; and
- impacts on an estimated 200 million people from ensuring women's participation in agriculture.

Platform for Capacity Strengthening among Partners in Mega Programs

The benefits of the CGIAR's agricultural research will be realized through partnerships that involve capacity strengthening. The Strategy Team considers this platform essential to a results-oriented CGIAR. By design, this platform is not yet fully developed, since developing a comprehensive platform will require partner involvement.

Partnerships begin with the design of research projects and carry on through their implementation to eventual impact. Although this effort involves many different kinds of partners, key partnerships for the CGIAR in delivering MPs will be research partnerships with NARSs. NARSs include not only public sector research institutions, including government institutes and universities, but also increasingly private sector and civil society players as well. Strengthening the capacity of these partners in international agricultural research, and particularly helping weaker national partners to increase their agricultural research capacity, will be a core function of the CGIAR and a cross-cutting activity of the Strategy and Results Framework.

Capacity strengthening in the CGIAR faces two challenges. The first is to develop and support global agricultural research networks. Many of the CGIAR's national partners operate at the cutting edge of international agricultural research but still value the role of the CGIAR in networking research across countries and regions and championing and building global research capacity to generate international public goods. In building stronger international agricultural research networks, the CGIAR and its MPs can help stronger NARSs contribute to the development of weaker NARSs.

The second challenge concerns the urgent need to strengthen capacity in particularly weak NARSs, through dedicated programs to help them become more effective and independent agricultural research partners. This need must be addressed in all MPs but is especially relevant to MP 1 on Agricultural Systems for the Poor and Vulnerable, which will focus on regions, particularly Sub-Saharan Africa and South Asia.

The Platform for Capacity Strengthening will establish a support unit on capacity strengthening to serve MPs, Centers, and partners. The platform will not serve as a substitute for capacity-strengthening activities to be built into each MP, as already described, or those under way already in CGIAR Centers. CGIAR Centers will continue to contribute to national capacity strengthening through:

- formal short-term and graduate training;
- networking activities;
- support to specific countries that integrates training, technical assistance, and institutional and infrastructural support; and
- less formal activities such as mentoring of scientists.

Acting as a Consortium and through its MPs, the CGIAR, however, has the potential to integrate and focus resources more efficiently and to increase its portfolio of capacity-strengthening activities. The support unit will do this by collecting, analyzing, and sharing the latest research findings and results on capacity strengthening. It will provide MPs with best-practice advice and tools to support communications and capacity strengthening. It will also organize specific support to capacity strengthening that benefits from a cross-system approach, including formulating short courses and training to build skills of all researchers and leaders within the CGIAR in strengthening agricultural research capacity.

A new emphasis will be placed on platform support to agricultural universities, which are responsible for developing tomorrow's researchers, and making available to them the knowledge and products of CGIAR and MP research.

The platform will also help MPs develop and use advanced information and communications technologies and knowledge management and innovation systems in capacity-strengthening activities with NARSs. This effort will include providing MP partners with access to applications and resources such as databases.

Besides serving as a support unit to assist MPs, CGIAR Centers, and the development research community, the Platform for Capacity Strengthening will undertake original research on the "how to" of capacity strengthening, including in-depth analysis of successes and failures in capacity strengthening and the factors that determine success and failure.

The Strategy Team proposes that the platform have a strong focus on capacity strengthening for agricultural research in Africa. Support to human capital development will be tied to strong efforts to revamp the incentive structures of NARSs so that they provide a dynamic and exciting environment in which young scientists can develop their careers.

Capacity strengthening is by its very nature a partnership, and the design of this cross-cutting platform must be a joint effort between the CGIAR and its research partners, represented by GFAR and its constituency. These suggestions, therefore, are intended only as an initial contribution to this joint exercise.

We propose that the Platform for Capacity Strengthening be developed through a process of consultations between CGIAR and GFAR representatives

and their subregional and university partners, as well as in a session at the Global Conference on Agricultural Research for Development (GCARD). These consultations should draw on capacity-building expertise in the CGIAR Centers, including the Knowledge, Capacity, and Innovation Division (former ISNAR) of IFPRI, FAO, and other international and national organizations. Given the growing potential of the private sector in outreach and capacity strengthening along agricultural value chains, this platform will be particularly inviting to the private sector as well.

Results expected from this platform include:

- enhanced participation of national scientists in global innovation systems and partnerships with agricultural research institutions;
- effective participation by NARS partners in MPs, including increased contributions to outcomes and impact arising from research outputs;
- development and use by NARSs of new information and communications technologies and knowledge management tools for development of innovation systems in agricultural research; and
- greater engagement of universities to ensure that capacity-strengthening efforts in MPs build an agricultural research workforce for the future.

4. Organizational Design for Operating the Strategy and Results Framework

The Overall Conceptual Framework and Its Implementation

Managing the Strategy and Results Framework

The CGIAR is to deliver effective outcomes articulated in the Strategy and Results Framework in the most efficient manner.

The CGIAR Consortium Board is expected to be responsible for overall MP portfolio arrangements and is, in that respect, accountable to the “Fund” of the CGIAR. The Board’s specific role will include ensuring that individual MPs are aligned with the Strategy and Results Framework and that the milestones and outputs specified in a performance contract are delivered with the agreed-upon funding.

In the past, the CGIAR has experimented with different management practices for Challenge Programs, Systemwide and Ecoregional Programs, and other programs. The Centers have systems and processes in place for scrutinizing performance internally and externally. Although these established systems provide a basis for governance and management of MPs, they must be adjusted for greater scale and complexity and improved accountability.

Managing the Mega Programs

The proposed governance and management arrangements for MPs may have the following components:

- Each MP will have a performance contract between the Consortium and the lead Center that specifies milestones and outputs against funding on a multiyear basis for the proposed life of the MP. Rolling annual contracts will adjust future funding to individual programs contingent on the MP’s performance against the contract.
- Each MP shall be managed by one or more lead Center(s), and the lead Center’s Board will be responsible for ensuring that MP management practices conform to the best international standards of financial management, ethical and legislative requirements, and research

management. The management of MPs as proposed here rests with the lead Center(s); an alternative—not proposed by the Strategy Team—would be an MP manager in the Consortium office, but that would reduce the CGIAR’s effort to achieve decentralized, nimble management with clear accountability.

- MP proposals with business plans (see below) will be prepared with performance contracts that clearly specify the required inputs and financial disbursements to each partner on an annual basis. Financial accountability for the MP will rest with the lead Center. To cover these and associated human resources, communication, and other MP delivery costs, MPs must be designed using full cost recovery principles.
- Lead Centers will have the option of appointing small (three- to five-person) scientific advisory panels comprising leading international experts in the MPs’ areas of research or of using informal approaches to obtain such advice. Their function will be restricted to scientific advice rather than governance functions.

All programmatic funding, whether through MPs or through restricted projects that support the Strategy and Results Framework and form part of the MPs, must be fully costed. Because personnel expenses are likely to represent the largest single component of expenses for participating CGIAR Centers, the financial systems of Centers will have to include time allocation processes that are fully integrated with financial systems. The traceability of level of effort across multiple Centers is essential when there are many sources of funding, in order to ensure the overall integrity and “auditability” of an MP. The Activity-Based Costing approach adopted by the CGIAR in December 2008 provides the foundation for this accountability. These operational and accountability guidelines may require more detailed consideration from a legal perspective once the format for performance contracts is developed. Most ongoing systemwide activities will be folded into appropriate MPs.

Establishing Mega Programs with Business Plans

The MP descriptions (in the section on Mega Programs and Platforms) form concept notes for detailed MP proposals for investment. The Strategy Team proposes a set of principles for business plans to be followed for each MP, once lead Centers are identified for the task:

- Each MP shall have its own results framework, linked to the Partnership’s Strategy and Results Framework.
- MPs’ priorities should be guided by the system-level results criteria described by the Strategy and Results Framework related to productivity and poverty reduction, hunger and nutrition, and sustainability, and they should integrate gender and capacity strengthening.
- The results for each MP must be clearly tied to the system-level results of the overall CGIAR Partnership.

The Strategy Team has started to lay out a number of tools for the systemwide strategy that should be equally applied at the MP strategy level. The results of the survey of scientists will provide useful input on specific research topics and potential results. The decision-support system, based on the agreed-upon criteria, can assist in choosing among competing programs within MPs. And the poverty mapping combined with mapping of biophysical constraints can assist in focusing on regions and systems. These tools will be on hand for MP developers.

Work within each MP must be prioritized so that investors in the MP can clearly see which work will be funded first, if sufficient funds are not available to fund an entire MP. At the same time, it is essential that expected results from each level of investment are clear and transparent.

The proposal and business plan for each MP must include outputs, outcomes, and results, as well as timelines and milestones. Important elements of the MP proposal and business plan will include

1. background and rationale,
2. MP objectives,
3. MP design and implementation plan,
4. potential risks,
5. monitoring and evaluation,
6. organizational capacity and management plan, and
7. budget narrative.

The concept of SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) goals is particularly appropriate to MP business plans. Because achievability is a big risk factor in terms of research, the plans should seek to identify ambitious but achievable results during their life cycle. MPs should include routine mechanisms to help identify “nonachievement” in subcomponents of a program and stop a research approach that is unlikely to yield results, but not too early, in view of uncertainties. Some of the most important breakthroughs in agricultural research took many years, even decades, to yield results.

Design and Management of Platforms

Gender and capacity strengthening are proposed as cross-cutting platforms serving all MPs. These cross-cutting programs will be supported by the Consortium management. Given that they will cut across all the work of the Strategy and Results Framework, and thus all MPs, their strategic governance would rest with the Consortium Board.

In the same way, effective capacity building requires a research program as well as a small group of experts to develop best practices and assist the MPs in implementation. The Platform for Capacity Strengthening will also serve as a major connection point for facilitating partnerships of the CGIAR at Partnership level with GFAR and others.

Creating a small group of staff in each of the two platforms that serve the entire CGIAR will supplement the staff within the MPs and will reduce costs by

not requiring each MP to hire extensive expertise in each of these important areas. The platforms will also facilitate learning across all the MPs.

Managing Core Assets and Maintaining the Innovation Capacity of Centers

For Centers to be effective in implementing the Strategy and Results Framework and to take on their roles in MP governance and management, it is essential that they maintain access to institutional funding based on sound performance. In the Strategy and Results Framework as designed here, this need for institutional funding is narrowly defined to include core functions for the programmatic work, such as germplasm conservation, information and databases, and critical research and network infrastructure.

CGIAR Centers are independent institutions. Collective action under the envisioned Consortium of CGIAR Centers requires joint strategizing and mega-programming. Although such collective action requires Centers to follow some rules, it does not require them to give up their individual freedom to operate. As long as they *effectively deliver* on their MPs, they should remain free to pursue other agendas, as long as that work is implemented at full coverage of costs.

The nimbleness of the CGIAR and its capacity to innovate depends on creative space. Future MPs may spring from Centers' smaller pilot activities. To remain innovative, the CGIAR must maintain space for individualistic researchers who prefer to work in small teams and who may be better suited to smaller Center-based exploratory research than to research under the umbrella of an MP. Obviously, the future research activities of the CGIAR would also be exposed to suitable scientific peer-review mechanisms at the Partnership level, the MP level, and the science output level.

Managing Funding for Mega Programs

Prioritizing the work across and within MPs will challenge CGIAR scientists and managers, as well as investors, to operate in new ways. Priorities must be set in a clear and transparent manner, based on the agreed-upon criteria, and—given the nature of research—commitments need to be long term. Ideally, priorities would be driven not by individual donor interests, but rather by scientific analysis and best judgments on research programs most likely to contribute to the CGIAR's vision. The Strategy and Results Framework must, however, be designed in such a way that it functions under realistic investor behavior constellations—that is, it accommodates investor interests without unduly compromising the strategic orientation of the system as a whole. Such a pragmatic approach would point investors toward opportunities *within* the Strategy and Results Framework and will guarantee delivery of these segments of research opportunities while maintaining the crucial synergy and scale benefits of the Strategy and Results Framework approach.

Communications Strategies for the Strategy and Results Framework and the Mega Programs

A vision has impact only when it stimulates people and gets them engaged. By definition, research programs have no impact without communications. Innovations, research results, policy assessments, and policy recommendations are not useful if they are not communicated to those who can use them.

This role of agricultural research must be communicated to all staff as well as to key external stakeholders of the new CGIAR. An “umbrella” communications strategy will make clear what the CGIAR’s vision means in concrete terms and what the CGIAR will do to achieve its goals.²⁰ Undertaking an extraordinary communications effort to convey these key messages will raise expectations and give stakeholders confidence that not only structures, but also attitudes and mindsets, are supportive of the Strategy and Results Framework. State-of-the-art communications is a necessary prerequisite for achieving this reputational goal; the outcome will be higher impact.

Increased coordination of this work, together with stronger use of innovative new approaches and technologies, will better enable the new CGIAR to:

- shape the global agenda toward more equitable and pro-poor development;
- build stronger relationships with donors, partners, and other stakeholders; and
- translate agricultural research more directly into sustainable reductions in poverty, hunger, and malnutrition.

The MPs are the means by which the research strategy will achieve the CGIAR vision. Each MP thus needs a defined communications strategy that outlines the key messages to be conveyed, the key target groups, and the media and channels for communicating with the key target groups. When the research components of a specific MP are developed, the communications strategy will be developed as well. This coordination will ensure that MPs reach the stakeholders and thus increase impact. To achieve maximum synergistic effects, the MP communications strategies will be coordinated with the “umbrella” communications strategy for the vision.

Improved CGIAR communications will:

- develop an umbrella strategy for communications that will link all components of the CGIAR;
- invest in coordination of CGIAR communications and provide support for such coordination at the high levels of leadership throughout the Partnership;
- communicate about major development issues, not individual institutions or problems, and ensure consistent messaging on these issues;

²⁰. This section draws on a discussion paper prepared by a group of communications experts in CGIAR Centers: “CGIAR communicators” (2009).

- create incentives for collective communications, rewarding communicators for multi-Center initiatives focused on issues rather than institutions;
- integrate communications from the start of all MPs, making it a dynamic and interactive part of the work rather than an afterthought;
- tell compelling stories to showcase research impact by vividly describing how the CGIAR's work makes a difference in the daily lives of individuals; and
- scale up the use of new information and communications technologies to build high-level capacity in communications for rural development and mainstream knowledge management in the CGIAR.

The CGIAR has an opportunity to position itself as a global leader in agricultural research and to greatly magnify the development impact of its collaborative work. Communications should occupy a strategic place in the Consortium Office, gain efficiency from shared services across the CGIAR Centers, and figure importantly in the work of the MPs. This is not to say that CGIAR communications should be more centralized but, on the contrary, that this work can best be improved through a networked approach, aimed at achieving high-quality communications at all levels.

5. Moving Forward: Transition to the Future

The concrete task of developing and implementing a Strategy and Results Framework for the CGIAR system must take account of the challenge of transition management, which will involve moving from the current system activities to the new activities under the Strategy and Results Framework and MPs. Part of the challenge stems from the fact that the CGIAR is a “complex system,” because research in international agriculture is by nature complex. The theoretical and managerial issues of managing transitions in so-called complex systems are generally of tremendous weight.

The Strategy Team emphasizes that change should take place rapidly but incrementally—not in a “big bang.” Although the Strategy Team takes note of ongoing assessment and discussion about managerial aspects of the Strategy and Results Framework and the MPs, the following are the Strategy Team’s preliminary ideas regarding implementation and transition issues.

Transition Issues

The Fund, Consortium, and Centers must contemplate three major transition issues: existing commitments of Centers, existing systemwide activities, and the phasing in of MPs.

Protecting Existing Commitments of Centers

At present, all Centers operate with significant proportions of bilateral funding. Although some work funded in this manner fits in with the overall Strategy and Results Framework, it means that most of the Centers’ staff are committed to delivering outputs over the next two to three years. External partners presumably face the same situation. Thus, the Centers will not have large numbers of staff who can be immediately committed to new activities spelled out by the Strategy and Results Framework and funded by MPs. An orderly transition of funding and research directions must be managed without the need to renege on existing contracts.

Including Existing Systemwide Activities

A second issue relates to Systemwide and Ecoregional Programs and Challenge Programs. The management models used by Systemwide and Ecoregional

Programs generally fit well within the CGIAR, and if those programs continue, it should be relatively easy to roll them into new MPs.

The five Challenge Programs have all evolved different governance and management models. Most, if not all, of these programs are expected to contribute significantly to MPs, and we suggest a case-by-case approach to handling and possibly adapting their governance functions and modes of operation to the context of the Strategy and Results Framework and the MPs. Well-functioning current Challenge Programs will have a future in the MP framework and can in principle be program components of MPs.

To continue ongoing programs under an MP, however, existing work must demonstrate a clear link to the outcomes required and defined under the Strategy and Results Framework. If this link cannot be shown clearly and explicitly, the work should be terminated upon completion of existing contracts. Work that continues must be clearly included in the new MPs and subject to the implementation and accountability framework.

Phasing in Mega Programs

The Strategy Team proposes a phasing in of the MPs in the following five steps:

1. Once broadly endorsed by the Consortium (Alliance), the MPs immediately become *communications and consultations domains* (not-yet-managed entities). The research communities inside and outside the CGIAR will start identifying with them. Opportunities for constructive engagement by Centers and partners are to be established.
2. The Consortium Board identifies *lead Centers*, which manage the MP proposal and business development with partners. This decision about leadership needs to be taken swiftly to prevent collective action failures resulting from interest group formations that divert from evidence-based MP developments. The Strategy Team may indicate in a separate communication to the Alliance its suggestions for lead Centers to be considered. The Strategy Team also recommends that, for each MP, the Consortium appoint one outside chair who is not a member of any Center's management or governance to provide oversight of the MP proposal and business plan development.
3. *Existing CGIAR activities are assessed* by the Consortium Board, in cooperation with MP-leading Centers and partners, against the selected portfolio of MPs as part of MP development and mapped as follows:
 - Research identified in the Strategy and Results Framework and MP portfolio that is already reasonably *well established and organized* within the system could initially be mapped into MPs with a light touch.
 - Research identified in the Strategy and Results Framework and MP portfolio that already exists within the system but in a *fragmented* form would require a significant effort to remap it into a coherent MP and fill gaps.

- Research identified in the Strategy and Results Framework and MP portfolio that is *only partially or hardly covered* by existing CGIAR activities would require a new initiative to design the MP, or portion of an MP, from scratch.
 - Research and other activities within the system that do *not fit* the portfolio of the Strategy and Results Framework would be phased out, unless independently funded by Centers at full cost.
4. *Full-fledged implementation and operation of MPs* takes place as part of the Strategy and Results Framework, with approval by the Consortium and Fund.
 5. *MPs undergo early review and monitoring* to maintain learning environments around the MPs and their results orientation. Given the diverse nature of MPs, this monitoring should not take a one-size-fits-all approach.

The Strategy team advises against fast-tracking a few MPs. While this would be feasible with MPs 2, 3, 4, and 6, it could undermine the synergies and innovation of the portfolio of proposed MPs. All MPs have components that can be fast tracked and early business plan development will be able to identify these components without jeopardizing the strategic portfolio and results orientation.

Strengthening the CGIAR's Capacity to Strategize

The challenge to develop a new strategy caught the CGIAR by surprise and unprepared. The process was delayed until clarity regarding action was achieved. The analytical basis needed to be assembled from scratch. In a rapidly changing world characterized by continually emerging challenges, scientific advances, and ever-greater complexity, the CGIAR needs to be able to anticipate and effectively respond to new challenges, harnessing the best of science to address global food, agricultural, and environmental problems. The “new CGIAR” must have the capacity to look ahead and work with partners to undertake strategic studies so that it can adjust its research portfolio and reinvigorate its strategic plan at regular intervals. The Consortium, in conjunction with the International Science and Partnerships Council, will need to explore options for establishing and institutionalizing such capacity. The toolbox developed by the Strategy Team will allow the Consortium to update its strategy and revisit the strategizing process; it will require maintenance and further strengthening in the future.

Conclusions

The recent food crisis—combined with the global financial crisis, volatile energy prices, natural resources depletion, and emerging climate-change issues—undercuts and threatens the livelihoods of millions of poor people and destabilizes the economic, ecological, and political situation in many developing countries. These challenges require coordinated, multifaceted, science-based technological, economic, and policy approaches.

The CGIAR has a key role to play in addressing these challenges. The CGIAR system will effectively tackle these global challenges with a new results-oriented strategy. Developing a results-oriented research system must be handled with due attention to the unpredictable outcomes of research undertakings and the tendency of science to be full of surprises. Freedom of research and space for “blue-sky” innovation and experimentation are necessary to tap the power of research for development.

There can be no doubt about the strong role of agricultural research in concert with other development investments for poverty reduction and growth: investments in agricultural research typically rank first or second in terms of returns to growth and poverty reduction, along with investments in infrastructure and education. Fortunately, a new and broad based consensus is emerging that investment in agriculture and in related research-based innovations must be accelerated.

The Strategy and Results Framework as designed here is for the Partnership as a whole, not a partial program, and ambitious but realistic results are being defined. Investors should know what they can expect when they invest in the CGIAR and what they miss when they do not.

The Strategy and Results Framework–driven CGIAR will reach billions of people. A reformed and more efficient CGIAR, working with partners, will not only help increase productivity, improve the natural resources base, and strengthen policies and institutions through its own research, but also be better able to link with partners, from the private sector to end users, especially farming communities. The result will yield high payoffs to development investments and contribute significantly to global food security and poverty reduction.