Partners in Research Cultivating the Future

CIAT's Medium-Term Plan 2009-2011

Submitted to the Science Council of the CGIAR

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Medium-Term Plan 2009-11

Submitted to the Science Council
of the
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Centro Internacional de Agricultura Tropical
Medium-Term Plan 2009-11

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MTP OVERVIEW

Introduction

CONTEXT

Because CIAT is in a period of major transitions, its detailed work program, organizational structure and actual partnerships may differ somewhat from what is presented in this document, especially for the latter two years of this plan. CIAT is currently developing a new strategic plan; recruiting a new Director General; and introducing changes in governance. Thus, this plan should be viewed not as a set of specific institutional commitments set in concrete, but rather as a somewhat provisional indicator of some broad likely general directions that will remain subject to revisions in its implementation.

CIAT's new strategic plan will take into account the outcome of the ongoing Change Management process of the CGIAR and the Independent Review of the CGIAR as well, of course, as the recommendations on the 2007 External Management and Program Review of CIAT. CIAT intends to complete its new strategic plan by the end of 2008, and in 2009, the first year of this MTP, to begin a transition towards the implementation of the new strategic plan in harmony with the implementation of the CG Change Process.

The development of the new strategic plan is guided by the following principles so that it will proactively:

- Consider **radical and novel** approaches. Not business as usual.
- Identify a research agenda fully in line with the **CGIAR change process**
- Give special attention to the role of the **CGIAR in LAC**
- Tightly link the outputs of research to the intended **end users**
- Do research **founded on partnerships** rather than as a discrete institution
- Look at **programmatic and institutional options**
- Involve **wide consultations** with stakeholders

In the interim, this MTP aims to serve as a useful picture of CIAT's ongoing research. This research program has been designed to be a relevant contribution to the CGIAR system priorities. The core of this research is highly consistent with the draft vision tabled by the CG Change Process Working Group and accepted for further development by ExCo14, and this research could be usefully carried forward in the variety of partnership, resource management, and governance alternatives being considered in the CG Change Process.

Highlights of Project Portfolio

NEW & TERMINATED RESEARCH

The MTP2009-2011 project portfolio is presented in a more disaggregated form than in the previous MTP. These changes are more presentational and reflect changes in internal organization rather than an expansion of program activities.

Genetic resources conservation work is now gathered into a single project Conserving Agrobiodiversity rather than presented as an output in each of the beans, cassava, and tropical forages projects as was the case in the MTP2008-2010. This change in presentation better reflects actual internal organization but does not represent a change in programmatic activities.
The work of the Tropical Soils Biology Fertility Institute of CIAT is now presented in two projects (generally called Outcome Lines) rather than as one heretofore. In recent years the budget, staff numbers and volume of research in TSBF has been increasing so that it was decided that this work could be better presented through two projects with 5 outputs each rather than as previously in single project with a correspondingly higher number of outputs. In addition, presenting TSBF as two projects, one focusing on integrated fertility management in sub-Saharan Africa, the other on sustainable land management preserves the essential underlying strategy of TSBF while setting a clearer identify of the main thrusts of its research.

Similarly, the research of the Markets, Institutions and Livelihoods Project in the 2008-2010 MTP has evolved into two Projects (CIAT Outcome lines) during the latter part of 2007: Linking Small Farmers to Markets and Agroecosystems Resilience. Outputs presented in 2008-2010 under the single project, Markets, Institutions and Livelihoods, are now reallocated to these two new projects. Work on Output 2 of the previous project, improving market value chain management, and Output 3, competitiveness of tropical fruits, have been assigned to the new Linking Farmers to Markets project in the 2009-2011 MTP. Output 4 of the old Markets, Institutions and Livelihoods project, mainly plant health and integrated pest and disease manage related to non-CIAT high value crops, is now embedded in output 2 of the new Linking Small Farmers to Markets project, while the work related to plant health of Forages, Beans and Cassava now appear in the MTP of those respective projects. A third new output, dedicated to methods and policy guidelines to prepare producers and actors in the value chain to become more adept at managing risks associated with increased income generation, has been developed for implementation in the Linking Small Farmers to Markets project. At the same time, research on innovations to adapt to risk and vulnerability, output 5 of the Markets, Institutions and Livelihoods project in the 2008-2010 MTP plan, and output 1, institutional arrangements for increasing impacts have been allocated to the new Agroecosystems Resilience project for 2009-2011. The purpose of this rearrangement was to form smaller more compact teams around more tightly related, less broad, research areas. Throughout this reorganization, total effort on research on rural institutions in CIAT projects has been substantially reduced since 2006.

Unrestricted investment in rice research has been reduced and a number of previous output targets have been dropped, for example, development of markers for rice blast resistance genes. Most activities on the use of anther culture and embryo rescue for enhancement of gene pools will be significantly reduced, and activities on gene flow analysis from rice into weedy rice came to an end in May 2008. Nevertheless, overall total effort in rice research has not fallen due to increases in restricted project funding.

Total forages research has also been reduced substantially since 2006 (Table 2 compared with Table 2 in the MTP 2008-2010), principally due to less effort on forage disease problems and to a lesser degree due to lower investment in economics. At the same time forages research has been revised so that output 1 now includes work on the selection of forage legumes while continuing to emphasize breeding of Brachiaria grasses.

There are no major changes in the directions of bean research, investment in which, like in cassava, remains at a similar level in the period 2008-2011 as in 2006. The increase in expenditures in 2007 was in part due to an unusual increase in restricted expenditures that is not projected to continue and also due to the one time distribution into the overhead across projects of a $2.8 million write off in fixed assets (see Financial Highlights below). In cassava breakthrough developments in the development of the protocol for the production of doubled-haploid (homozgyous) cassava lines will be introduced into cassava breeding with the prospect of achieving more rapid breeding progress.

CHANGES IN COLLABORATIVE ARRANGEMENTS

The endorsement by the Science Council of the Amazon Initiative (AI) as a Systemwide Program was one of the major partnership advances in 2008. While EMRAPA of Brazil provides the secretariat for the AI, within the CGIAR CIAT is the host center for the AI as a Systemwide Program. With the advance of the AI to the status of a Systemwide Program, CIAT's contributions to this partnership are no longer shown in the MTP as part of the work of CIAT projects but rather the AI now is presented as a CGIAR Systemwide Project with its own log frame and narrative in the MTP, thereby making its strategy and progress more visible.

The onset of the full implementation of the sub-Saharan Africa Challenge Program was another major partnership advance for CIAT. During the initial start up, CIAT is serving as the co-coordinator of the east Africa Pilot Learning Site. This has demanded a major effort in bringing together a very wide set of partners to initiate an integrated natural resource management research effort.

ALIGNMENT WITH SYSTEM PRIORITIES

CIAT's 2008 research agenda remains strongly aligned with CGIAR System priorities, with 89% of its work estimated to be fully directed to System Priorities. Much of the 11% in new research, training and development related activities are also in substance directed towards the achievement of the priorities, even if by the nature of the activities they are strictly classified as non-agenda.

Among System Priorities, as in 2007, CIAT's largest investment in 2008 is in priority 2, genetic improvement of staple crops, 23.6%. CIAT continues to have a major commitment to increasing the yields of staples, overcoming abiotic and biotic stresses, and improving the nutritional quality of beans, cassava and rice. Associated with this research is a major investment in priority 1A, conservation of staple crops, 20.2% of total effor. This work does not refer solely to conservation of diversity per se, but even more so to the study of genetic diversity in staple crops. Such understanding is a major pre-breeding international public good of value not only to national programs, but also contributing vitally to CIAT's work in priority 2. Taken together, CIAT investment in genetic improvement and conservation constitute half of its agenda research.

The biggest change in comparison to 2007 is a substantial increase in investment in integrated land and soils research, priority 4A. This increase of some $1 million reflects principally growth in the Tropical Soil Biology and Fertility program of CIAT. The major decrease in investment is for priority 5C, as with the dissolution of the Rural Innovation program, CIAT's work on rural institutions has declined nearly 30% from actual 2006 levels. Likewise, reductions in funding for CIAT's tropical forages research, has resulted in a fall of investment in priority 3B, livestock.

NON SYSTEM PRIORITY ACTIVITIES

The CIAT budget includes financing for a wide variety of activities by development partners to work on matters closely related to CIAT agenda research, including, for example, enabling the scaling up of outputs derived from CIAT research. For example, restricted funding that is reported as part of CIAT's budget finances the activities of a wide range of NGOs and CBOs that produce and distribute bean seed in Africa. This contributes both to disaster relief and in addition to the dissemination of improved technology from the work of CIAT and its national partners. Some 2,000,000 households in sub-Saharan Africa have had access to improved bean varieties through these efforts.

Similarly, significant quantities of forage seed has been distributed by partners in Colombia, Central America and the Caribbean and Southeast Asia through their role in restricted projects that form part of CIAT's budget. Likewise, CIAT-TSBF has been enhancing the access of farmers to fertilizers in Africa in many of its ongoing projects through a strategic alliance of all stakeholders including fertilizer dealers. CIAT-TSBF is closely working with private sector dealing with fertilizers through strong NGOs such as Agricultural Market Development Trust (AGMARK), Citizens Network for Foreign Affairs (CNFA) and the International Centre for Integrated Soil Fertility Management (IFDC).

In general, development partners are actively involved in complementary activities that contribute to understanding the bases for and diversity of current farming and market systems, and for subsequent targeting, participatory technology development, experimentation with seed systems, dissemination of innovations, monitoring and impact assessment. In many cases these local-level activities are implemented and led by development partners whose work is funded by restricted projects that form part of the CIAT budget. CIAT itself is not significantly involved in development activities, but within its budget, there are substantial resources that support the operations of partners who are conducting development activities that are related to CIAT's agenda research.

Dissemination of knowledge through internet based tools, web site and extension materials, capacity building, demonstration plots, pilot studies and learning alliances all are integral components of the Research to Development continuum. This frequently provides feedback from implementation of research results in the field to research thereby constituting a Research to Development to Research cycle.

Considerable exploratory research is conducted that is highly related to achieving the objectives of the system priorities but is not yet fully incorporated in project log frames, either because it is as yet too speculative or high risk to be set as an output target or because it is not of the highest priority for CIAT but it is so for research partners who are implementing the work in restricted projects that form part of CIAT's budget.

For example, research is being carried out by FLAR to understand better the inheritance of panicle length and grain weight in rice. This is a relevant issue for FLAR, which is trying to develop high yielding lines having long and heavy panicles combined with tolerance to main

diseases and pests, and good grain quality. Populations from two different crosses are being studied and this semester will start the fieldwork to get data.

CIAT continues to work with a Clean Development Mechanism (CDM) project with CORPOICA and Corporación Valle de Sinú y San Jorge (CVS) to recuperate degraded tropical savanna of northern Colombia. The project aims to enhance productivity and natural resources of 2,600 hectares by supporting the establishment of silvopastoral systems and reforested areas. The BioCarbon Fund of the World Bank acts as a broker for the carbon trades and certifies the Carbon Emission Reductions (CERs). More farmers can benefit from expanded environmental conservation efforts. Benefits are many. Landowners will increase income with these profitable land uses, while CVS will recover their initial investment in helping to establish the land use systems. Payments for environmental services enable these benefits.

CIAT remains engaged in some preliminary exploratory research on energy in agriculture. This work has focused on testing biofuel production processes for small farmers with cassava and coffee pulp. Working closely with CORPOICA of Colombia, the goal of this work has been to fill knowledge gaps in bioenergy, impact and processing while maintaining the emphasis on linking small farmers and providing opportunities to reduce rural poverty through small scale on farm or community based agro-energy initiatives.

CIAT is hosting an international public-private consortium (FLIPA) embracing Colombia, Ecuador and Venezuela, to conduct research on oil palm. This consortium is financed by the members and contracts various research organizations to conduct research of priority interest to the sector. CIAT is particularly interested in the environmental impacts of the palm oil sector. Although financed by the members rather than the CG, since CIAT serves as the host for this consortium, the resources for its activities form part of CIAT's budget.

Center Financial Indicators

FINANCIAL HIGHLIGHTS

FINANCIAL OUTCOMES FOR 2007

COMPARISON WITH 2006

Compared with 2006, total revenue increased by 21% in 2007, from US$38.0 million (Table 11 MTP 2008 –2010) to $46.0 million (Table 14), and total expenditures excluding the phase-out costs and adjustment in fixed assets increased 6% from US$39.1 million toUS$41.5 million. Changes in total revenue were mainly due to the high implementation of restricted projects, moving from US$24.8 million (Table 7 MTP 2008-2010) to US$32.8 million (Table 9) during 2007, 32% higher than 2006. Unrestricted contributions and other revenues remained stable at US$13.2 million (Table 14). Unrestricted expenditures declined from US$14.2 million to US$8.7 million a 39% reduction over 2006. The reduction in unrestricted expenditures is basically a result of the restructuring process implemented during 2006 and 2007. With the restructuring process more than 25 international and 100 national recruited staff positions were eliminated during the two years resulting in US$3.8 million phase out costs in 2007 compared to US$2.8 million in 2006.

Thanks to the continued effort to charge for true direct costs, recover appropriate indirect costs, implementation of savings measures including substantial downsizing in the research program, and a one time support from the World Bank of $0.75 million, the operational surplus, after phase-out costs, was US$0.7 million in 2007 compared to a deficit of US$3.9 million in 2006. Additionally during 2007 a change approved by the Board of Trustees in the accounting estimate on fixed assets represented a write off of US$2.8 million. This write-off did not affect the CIAT reserves. Consequently the net reserves increased from US$1.8 million at the end of 2006 to US$4.2 million in 2007.

Revaluation of the Colombian peso against the US$ continues to demand additional resources since over 50% of expenses of the center occur in local currency. Compared to any other CGIAR center, CIAT experiences by far the highest percentage of revaluation of its local currency that amounts to over 30% during the past 5 years. In order to offset the effect stronger local currency a provision in the amount of $2.2 million was required in 2007.

COMPARISON TO MTP 2007 AND OTHER ESTIMATES

Actual 2007 revenue of $46.0 million (Table 14) is 7% higher compared with the June 2007 estimated revenue of $43 million (Table 11 MTP 2008-2010). Expenditures including phase out costs and excluding the change in fixed assets were 9% higher than estimated, increasing to US$45.3 million compared to a projected $41.6 million. CIAT finished 2007 with an operational surplus of US$0.7 million compared with a projected net surplus of $1.4 million. The difference is a result of the World Bank's late November 2007 decision to move half of the promised one time support of $1.5 million into the 2008 Transition Plan.

The actual result achieved meet or exceed the commitments made in September 2007 in a letter to the Chair of the CGIAR in which specific improvement measures were laid out with the intention to improve financial indicators.

The top three donors in 2007 were CIDA, United Kingdom and USAID, while in 2006 they were CIDA, USAID and The World Bank.

EXPENDITURE ANALYSIS

Project expenditures: After the restructuring that took place in 2007 and early in 2008, CIAT moved to Outcome lines, which correspond to CGIAT MTP projects. Outcome lines are now aggregated in 3 Research for Development Challenges (RDCs): Sharing the Benefits of Agro-biodiversity (5 outcome lines, plus Harvest Plus CP), People and Agro-Ecosystems (2 outcome lines, plus PRGA and Amazon Initiative) and the TSBF Institute (2 outcome lines).

In 2007 Sharing the Benefits of Agro-biodiversity Program expenditure was US$28.2 million, or 59% of the total expenditures. People and Agro-Ecosystems expenditure was US$12.1 million, 25% of total and TSBF Institute was US$7.8 million, equivalent to 16%.

This report includes the Harvest Plus funds implemented by CIAT, however the program descriptions and log frames are reported separately by IFPRI and CIAT in the Harvest Plus MTP report.

The effect of the revaluation of the local currency can be appreciated in the total administrative cost development. A real savings of almost $0.1 million ended up in over expenditure of $1.4 million as a result of the strengthening Colombian peso.

Expenditures by Priorities: Based on the size of the outcome lines, main priorities for CIAT program for 2007 were: Conservation of staple crops 21%; Integrated land and water management 14%; Genetic improvement of yields of food staples, genetic improvement against abiotic stresses and genetic improvement of nutritional quality 9% each; Intensification and markets for the poor 6% each. The additional 12 priorities make up for less than 5%. All material changes in priorities were implemented prior to the 2007 MTP and as projected no significant additional priority changes took place after submitting the 2007 MTP.

Expenditures by Undertaking, Activities and Sectors: Increasing productivity represented 44%, Saving Biodiversity 22%, Protecting the Environment 18%, Strengthening NARS 12% and Improving Policy 4%.

Expenditures by region: From the regional perspective compared to 2006, expenditures in Latin America and the Caribbean remained stable at 46%, Sub-Saharan Africa increased from 35 to 37%, Asia decreased from 18 to 16% and Central and West Asia and North Africa (CWANA) remained stable at 1%.

Expenditures by object: Excluding reorganization phase-out and change in fixed assets costs, personnel costs amounted 45% in 2007 compared to 49% in 2006. Supplies and services net of indirect costs recovery amounted to 25% compared to 27% in 2006. Travel expenditures remained at 9% and depreciation costs at 4%. The Collaboration/Partnership Cost category, which shows the expenditures implemented by CIAT partners, represented 18% in 2007 compared with 11% in 2006. As a result of the restructuring process, personnel costs decreased by 4% against 2006.Reductions in staff costs were lower than planned due to the effect of the revaluation of the Colombian peso against the US dollar and the consequent dollar increase in the cost of a reduced number of national employees in Colombia.

Center Financial Indicators

Short-term solvency (liquidity) increased from 36 days in 2006 to 50 days in 2007.

Long-term financial stability (adequacy of reserves) increased from 18 days in 2006 to 39 days in 2007.

Financial Developments in 2008

Funding: It is anticipated that unrestricted funding will continue to decrease very much in line with system wide development. In 2007 CIAT's unrestricted income dropped to 30% of its total income in line with the CGIAR reported 36%. However, CIAT is taking measures anticipating further reductions of unrestricted funding over the coming years. As a result the operating model under which CIAT will operate in the future is very much geared towards matching direct and indirect recovery funds with actual expenses generated in order to appropriately run the center. The Grants Management group is instructed to control that all project proposals, as far as possible, include such costs prior to submission to donors.

Transition Plan: At the end of 2007 and early in 2008 CIAT submitted a Transition Plan to secure the resources needed firstly to carry out an in-depth, participatory strategic planning exercise, involving the full range of CIAT's partners and stakeholders around the world, and secondly to stabilize the situation and ensure that those critical elements of the current research program that will be needed in the future are not lost, whatever institutional arrangements emerge from the planning process. The full Transition Plan proposed one time support in the amount of $4.9 million and the reduced plan asked for $2.5 million. The 2008 ExCo 14 in Ottawa Canada approved a one-time support of $2 million including the $0.75 million of the World Bank contribution that the Bank in late November 2007 decided to move into the Transition Plan.

CIAT recognizes that it is not 'business as usual'. The planning exercise will take a hard look at the ongoing need for the Center's programs and will explore whether some or all of them, might be delivered more efficiently and effectively through alternative institutional arrangements. Determining the Center's future, however, cannot take place overnight or in a vacuum, and should not be based just on opportunism – a reaction to the current, temporary, financial situation. It needs to be fully embedded within the ongoing discussions of change and reform within the CGIAR system as a whole.

Thus this request is also for additional funds to ensure that the most important elements of CIAT's programs, widely recognized for their relevance, scientific excellence and positive impact, survive through the period it will take to determine the Center's institutional future. Funds are thus being sought, in particular, to bridge the contracts of key staff over periods when restricted funds are unavailable, underwrite further staff consolidation, help complete the reconstitution of senior management, maintain critical research and IT infrastructure, stabilize capacity in key program areas and regenerate relationships with Colombia and other Latin American countries.

EPMR administrative recommendation progress: The progress on the two administrative and finance recommendations made by the EPMR can be appreciated in the EPMR annex.

Colombian Ministry of Agriculture agreements: The Colombian Government has asked CIAT to administer funds for National Research projects in the amount of over $50 million

for which a special project unit was established. These funds will not be treated as CIAT revenue, but as trust funds, and carefully administered, will generate some additional self-generated income.

Revenue and income projections: Projected revenues for 2008 are at $45.02 million including $2 million from the Transition Plan support. Expenditures are projected at $45.27m also including $2million associated to the Transition Plan. This includes approximately 27% of unrestricted donor reductions resulting from reduced projections by USAID, Norway and the EC. Therefore, it is estimated that the CIAT operation in 2008 will be slightly negative with a projected deficit of $0.25 million, which will decrease the reserve level to $4 million. As a result, reserves expressed in days will continue well below of the CGIAR established target.

PROGRAM EXPENDITURES 2008

Expenditures by Priorities: Conservation of staple crops represents 21%; Integrated land and water management 15%; Genetic improvement of nutritional quality, Genetic improvement of yields of food staples and, Genetic improvement against abiotic stresses 8% each; and Intensification and Market Access for the poor 6%.

Expenditures by Undertaking, Activities and Sectors: Increasing productivity represents 43%, Saving Biodiversity 21%, Protecting the Environment 19%, Strengthening NARS 12% and Improving Policy 5%.

Expenditures by region: Compared with 2007 expenditures in Latin America and the Caribbean decrease from 45% to 43% in 2008 despite the continued strengthening of the local currencies. Sub-Saharan Africa increases from 40% to 42% and expenditures in Asia are projected to remain constant at 15% percent.

Expenditures by object: Excluding the reorganization phase-out costs supported by the Transition Plan package, Overall personnel increases from 45% in 2007 to 48% in 2008 as an effect of the strengthening of the Colombian peso and the approved IRS salary adjustment, the first after more than 7 years. Supplies and services net of indirect cost recovery decrease to 21%. Collaboration / Partnerships Costs, Travel and depreciation costs remain constant at 18%, 9% and 4% respectively.

FINANCIAL PROJECTIONS FOR 2009—2011

As with previous submissions, the MTP projection for the following 3 years is extrapolated on the basis of the current year. No additional reduction in unrestricted funding is expected while restricted projects based on the big number of contracts signed in 2008 are projected to increase by 10% in 2009 and 3% in the following years. These projects should be taken with precaution considering that CIAT is in the process of redefining its strategic future.

The following table summarizes the financial projections for the 4 years of the MTP:

CIAT Business Plan 2007 – 2011

	2007	2008	2009	2010	2011
Total Income	**45.952**	**45.020**	**45.800**	**46.800**	**47.800**
Total Expenditures	**48.098**	**45.270**	**44.800**	**45.300**	**45.800**
Surplus / (Deficit)	**(2.146)**	**(0.250)**	**1.000**	**1.500**	**2.000**
Net Reserves at the end of the year	**4.240**	**4.000**	**5.000**	**6.500**	**8.500**
Reserves indicator	**39 days**	**35 days**	**43 days**	**55 days**	**71 days**

PROJECT PORTFOLIO

PA1: Linking Smallholder Farmers to Growth Markets

Project Overview

This new Project (outcome line) is a result this year of dividing the interim project entitled Markets, Institutions and Livelihoods.
The outcome line will take a resource to consumer approach aiming at three key outputs:

Diagnostic, targeting and analysis tools that improve market value chain development and management for the benefit of smallholder farmers and the poor.

Production technologies and guidelines available to smallholder producers for more environment- and management-specific production in healthier supply chains.

Methods and policy guidelines available to rural producers and other actors in the value chain to assist them in becoming more adept at managing risks associated with increased income generation.

We will operate through collaborative partnerships in Latin America, Africa and Asia, mostly on a special project basis. The outcome line aims to understand the mechanisms and principles that will permit smallholder producers to have access to markets, by bringing to bear knowhow, technical and social knowledge and information, and by developing principles for sustainable value chains in which income is more equitably distributed and both women and men benefit. The overall goal is to improve livelihoods of the rural poor, and contribute to global poverty alleviation and malnutrition. Elements of geographic information services will be used to target locations for most effective interventions using CIAT crops, and other high value crops including Tropical Fruits, that will facilitate the access of smallholder farmers to dynamic markets. Access to biophysical technologies (seed systems, crop management, varieties), methodologies and institutional arrangements will be combined in a multidisciplinary approach that will strengthen the capacity of smallholder communities to engage and remain in market systems. Risks are also associated with a market driven approach; for example, in some societies, traditional house hold income distribution leads to male heads taking over a higher share of income and using it for non-food purposes, with some families then having to rely on cheaper less nutritious purchased food. Nutritional and other risks will be assessed as part of a strategy for sustainable engagement in pathways for improving livelihoods.

Research agenda and, in some cases staff costs associated with this outcome line, will be shared with teams of the two outcome lines of TSBF, Sustainable Land Management in the Tropics (SLM), and Integrated Soil Fertility Management (ISFM), and with the Outcome Line, Resilient Agroecosystems, as well as with Outcome lines of the SBA RDC. This represents a step forward in the integration of the research agenda across CIAT.

Project Rationale

Production of crops for subsistence is associated with low income conditions and poverty in rural areas of agriculture based countries. Since CGIAR inception in 1960s, research priorities have changed from just food security to consider poverty alleviation, aligning with the Millenium Development Goals. Global changes in food procurement systems, increased

urbanization and changes in diets represent opportunities for smallholder producers to develop market oriented production systems. However, small farmers are easily excluded from markets due to such factors as lack of competitiveness, poor product quality, incapacity to respond to market rules and regulations, and low negotiation power. Therefore, the overarching goal of this outcome line is addressing market-oriented production needs of the rural poor through contributions to an enabling environment that brings small holder producers into sustainable value chains and modern markets; and the development of biophysical and social strategies for implementation of sustainable production systems through partnerships, including public-private ones, that improve rural development and result in the wellbeing of poor rural communities. Research on social issues related to gender equity, income distribution and organizational aspects of smallholder producers also constitute core competences of this outcome line. Evaluation of risks of poor nutrition and of mining of the soil resource base that underpins sustainable production associated with market oriented farm production will be considered.

Alignment to CGIAR Priorities by Output

Output 1: Diagnostic, targeting and analysis tools that improve market value chain development and management for the benefit of smallholder farmers and the poor. Research towards this output is mainly relevant to System Priority 5B, Making national and international markets work for the poor. Current and future work will contribute to developing strategies and partnerships that have the potential for making systemic changes that could influence millions of smallholders aiming to engage in market supply and value chains. Scope for contribution of this work to System Priority 3A , Increasing income from fruits and vegetables, is also high.

Output 2: Production technologies and guidelines available to smallholder producers for more environment- and management-specific production in healthier supply chains. Research towards this output is mainly relevant to System Priority 3A, Increasing income from fruits and vegetables. Generation of production technologies for commodity crops of CIAT is the responsibility of the Outcome Lines of the corresponding commodities (bean, forages, cassava). This output will target generation of such technologies for non-mandate crops of CIAT as specified above. However, use of cross cutting technologies and disciplines, such as low propagation methodologies, would be applicable to all crops when required to link smallholders producers to supply chains. Given land scarcity, and new demands introduced by e.g. the global trend for biofuel production, we will extend this research to the agricultural intensification agenda of SP 4D, Sustainable agroecological intensification in low- and high-potential environments. Methodology and tools will be developed to target higher value products and species with potential for biofuel use in environmental niches that do not compete with food crop production, and evaluated it with a range of crops initially in Latin America.

Output 3: Methods and policy guidelines available to rural producers and other actors in the value chain to assist them in becoming more adept at managing risks associated with increased income generation. This output is mainly within the framework for SP 5C Improving rural institutions and their governance, but it also relates to SP 4D, Sustainable agroecological intensification in low- and high-potential environments, and to SP 3A, Increasing income from fruits and vegetables . Strengthening the organizational capacities of institutions and of farmer organizations (including women's producer organizations) and rural service providers, is considered extremely relevant to linking farmers to markets, and will be conducted in the context of research and output targets of Outputs 1 and 2 described above.

Outputs Description

Changes from previous MTP Outputs

Changes (since 2008-2010 MTP)

The RDC, People and Agroecosystems, evolved into two Projects (CIAT Outcome lines) during the latter part of 2007. Outputs presented in 2008-2010 under the single Outcome line, Markets, Institutions and Livelihoods, are now reallocated, and this document relates to the Linking Smallholder Farmers to Growth Markets Outcome Line. Outputs 1 and 2 presented in the MTP 2008-2010 have been retained in this Outcome Line, and other outputs are now under the Resilient Agroecosystems Outcome Line.

Some Outputs related to Plant Health (mainly Integrated Pest and Disease Management related to non-CIAT high value crops) are now embedded in the Output 2 of this Outcome Line. Outputs related to plant health of Forages, Beans and Cassava now appear in the MTP of those Outcome Lines. A third output, dedicated to methods and policy guidelines to prepare producers and actors in the value chain to become more adept at managing risks associated with increased income generation, has been developed.

Output 1: Diagnostic, targeting and analysis tools that improve market value chain development and management for the benefit of smallholder farmers and the poor.

Description: Research on value chains will encompass CIAT beans (e.g. snaps and canning), cassava (e.g. waxy, biofuels and other new products), forages (e.g. for monogastrics and other new products), rice and tropical fruits. Other judiciously selected higher-value crops will also be included for their importance to partners and where critical and widely relevant lessons concerning targeting, development of value chains, poverty alleviation and tradeoffs can be learned more readily than by exclusive focus on CIAT commodities (e.g. coffee, organic products, underutilized fruit species, fair trade products, and biofuels). Research will include: assessments of market opportunities that offer increasing potential for supply by male and female smallholder farmers; issues related to organization of rural institutions that enhances the competitiveness of smallholders (including their ability to innovate and compete with larger producers in volume and quality); open management of information through supply chains; chain governance; use of social networks in analysis of supply chains; private sector alliances with smallholders engaged in businesses (with social responsibility); and strategies that influence policies in favor of the poor. Research on targeting in particular will be carried out in conjunction with CIAT's Agroecosystem Resilience Outcome Line.

Output 2: Production technologies and guidelines available to smallholder producers for more environment- and management-specific production in healthier supply chains.

Description: Germplasm development in SBA RDC and in CIAT's model tropical fruits species will benefit from across-crops learning on approaches and methods for farmer assessments of market-oriented germplasm within this Outcome Line. Spatial analysis of market access and other socio-economic parameters, agroecological environments, and natural resource base and germplasm attributes will be intensified in ways that enable smallholders and their organizations to benefit more from site-specific management of agriculture and adaptive targeting of crops and technologies. Environmental sustainability of production will be enhanced by research outputs that raise product quality (e.g. of perishable fruits), while fostering innovation in addressing phytosanitary issues in production and market

acceptability. Coordination and joint research with Output 3 of the Outcome Line, Soil Fertility Management of TSBF, will address concepts of sustainable production systems at the landscape level, and how to link it to new business models that promote conservation of natural resources and biodiversity.

Output 3: Methods and policy guidelines available to rural producers and other actors in the value chain to assist them in becoming more adept at managing risks associated with increased income generation.

Description: Rural institutions need to support their membership in learning to work within markets that are often highly heterogeneous: action research and analysis across case studies will provide information on best practices useful to them. Increasing production for markets should lead to improvements in livelihoods, including investment of more household income in sustaining the natural resource base and family nutrition. However, we and our clients need to address also the potential outcomes of increased rates of environmental degradation, of gender inequity and of child malnutrition. Inputs from staff and collaborators of the TSBF Institute (e.g. in working with the soybean value chain in East Africa) will be incorporated in joint research to better understand the conditions that lead smallholders to reinvest in NRM (including soil fertility) for economic and environmental sustainability of the enterprises, and hence to their agricultural sustainability. CIAT's strengths in participatory research and in human nutrition (the latter housed in other CIAT outcome lines), reinforced by an increased capacity for impact assessment, will lead to better understanding of who benefits among the poor and how development efforts can foster broader and more gender-sensitive benefits.

Impact Pathways by Output

Output 1: Diagnostic, targeting and analysis tools that improve market value chain development and management for the benefit of smallholder farmers and the poor. Products and principles derived from this research are of a generic nature, based on analysis of multiple cases and also through action research to better understand specific circumstances, often through strategic alliances of the CG Centers and usually through collaborative projects with farmer organizations, NARS, NGOs or the Private Sector. Guidelines related to sustainable supply and value chain where the poor, both male and female benefit, will be developed, distributed and later scaled out through project partners, local and regional government institutions and the private sector. Options, both technical and institutional, to overcome trade barriers and regulations that could keep smallholder farmers out of dynamic and profitable markets will be identified -- often at pilot scale and then tested on multisite scenarios, aiming to exert pressure at critical points that result in systemic changes. The roles of CIAT in this Output are to coordinate actions, analyze multiple cases, promote sustainable supply and value chains through training, and extending reach to policy and decision makers and a wider range of practitioners for local adaptation and use. Later feedback will be catalyzed and this can be expected to further refine the output instruments.

Output 2: Production technologies and guidelines available to smallholder producers for more environment- and management-specific production in healthier supply chains. Generation of the products of this output is within a context of specific needs identified by partners, in other words, demand driven. Besides offering solutions to specific bottlenecks or problems, their IPG nature make adoptable and/or adaptable in other regions or agroecological regions. Publication of technical information in international reviewed journals and in freely accessed web-based platforms will expose the technologies to further adoption

beyond specific projects or interventions. Information would be of relevance to multiple local and international NGOs, NARS, local Universities and extension services. The final outcome is intended to be an innovative smallholder grower sector that is more competitive, has a capacity to respond to changes in market demand, has access to new varieties and methods for developing new clonally propagated planting material, and able to respond to phytosanitary barriers imposed by new and demanding markets.

International Public Goods by Output

Output 1: Diagnostic, targeting and analysis tools that improve market value chain development and management for the benefit of smallholder farmers and the poor. Much of the work on value chain and market linkages will have a component of local action research. Many initiatives at the local level conducted by local partners have implications for rapid synthesis and transferability of findings to other regions, cultures, and products. Analysis of multiple scenarios including both successful and unsuccessful cases is required to distill principles and generic lessons from interventions. Approaches and guidelines, for targeting commodities and high value crops to specific niches, tools and approaches for the sustainable linking of small farmers to markets, and analysis of supply and value chains, will be produced and made available to others for adaptation to local conditions and products. Generic lessons using staple crops and high value crops will be produced in different regions and working with farmer organizations under different levels of development. The products and principles learnt from this research constitute IPGs for use by practitioners of market research within local and international NGOs, as well as by farmer organizations.

Output 2: Production technologies and guidelines available to smallholder producers for more environment- and management-specific production in healthier supply chains. Products of this output are mainly IPGs, and include knowledge and characterization of genetic diversity of germplasm and of pest and pathogens affecting tropical fruits, innovative and pro-poor options for managing pest and diseases, generic methodologies and approaches for low cost propagation of planting material, basic research on generation of tissue culture technologies for plant woody species, and methodologies for participatory variety and elite clone selection of high value crops especially fruits.

Output 3: Methods and policy guidelines available to rural producers and other actors in the value chain to assist them in becoming more adept at managing risks associated with increased income generation. Most of the products of this output are innovations in the form of methods, tools and good practice guides. It is understood that methods generated should be applicable to other relevant regions, but application to development would depend upon subsequent local adaptation and translation. While many of these outputs will be published internationally, a large proportion of the potential users in the development community will not be reached directly by this means. Awareness of new and existing outputs will be raised through web-based and targeted email alerts, the widely disseminated CIAT-in-Africa Highlights series, and relevant externally published newsletters (international, regional and national) and partner communications.

Elaboration of Partners Roles

Partners roles Outputs 1, 2 and 3.

The type of partners and relationships established for all three outputs correspond to NARS, local government bodies, NGOs, local Universities, IARCs, ARIs, Private Sector (wholesaler, retailers, nurseries, service providers) and farmer organizations. Rather than presenting a

relatively long list of individual partners for each output, and for each region, only a few examples are shown below.

Research partners for each output will be selected strategically according to location and through forging of relationships based on comparative advantage in selected benchmark locations or agroecological situations used as pilot sites. Partners will usually be actively involved in collaborative research for targeting, participatory technology development, monitoring and impact assessment. In some cases they may be leading this work at least at local level and whenever possible at regional level too, on the principle of subsidiarity; in that event, CIAT's role would be to coordinate that work so as to arrive at conclusions at the higher level.

An examples, a few cases where alliances have been established that describe the modus operandi and the benefits for generation IPGs are described here. CIAT has found multi-institutional learning alliances, preferably with selected partners having regional reach, to be an effective mechanism for generating much of the knowledge-intensive IPG output across environments and situations. One particularly large multi-country learning alliance around agroenterprise development and natural resource management is led by Catholic Relief Services (CRS) in Central America and elsewhere, whose local partners become the local implementers and/or experimenters. CRS global and regional staff work with CIAT in deriving the IPG lessons that are converted to publications and best practice guides.

In the case of the Sub-Saharan Africa Challenge Program (SSA CP), for which linking farmers to markets is a particular research objective, a series of multi-institutional R&D partnerships serving as innovation platforms at local level will provide the primary level of learning in each participating country, with proof of concept of the CPs hypotheses being derived by CIAT, IITA, FARA and other leading institutions at supra-regional level.

Engagement with the Eco-regional program of the Amazon Initiative establishes a network of partners in that region which facilitates the implementation case studies for linking Amazonian fruits farmers to markets.

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Diagnostic, targeting and analysis tools that improve market value chain development and management for the benefit of smallholder			Policy-makers (public, private & donor), farmer organizations, NGOs, researchers in CIAT and partner	Improved conceptual and empirical understanding of how impact occurs is used to design more	R&D efforts lead to more effective, equitable and sustainable development in the tropics

farmers and the poor.			organizations	effective research and development interventions	
	Output Target 2009: At least three analytical frameworks and tools for assessing the benefits, costs and risks of targeted staple and high value crops on key production constraints (drought, pests, diseases) including GMOs (as required in CBD for LAC countries)	Policy strategies			
	Output Target 2009: One guide to improved knowledge management and innovation in agri-chains available to smallholder farmers wishing to link into higher value markets in LAC and Asia	Policy strategies			
	Output Target 2010: One spatial analysis related protocol for screening and selecting germplasm published and applied for 15 staple crops (globally), 5 high value crops (globally) and 4 GMOs (in LAC)	Policy strategies			

	Output Target 2010: A critical evaluation covering equity and environmental effects in at least five sustainable supply chains that link smallholders and key corporate buyers.	Policy strategies			
	Output Target 2011: Principals for building climate resilient small holder supply chains of targeted staple and high value crops identified and piloted in LAC and Africa.	Policy strategies			
Output 2: Production technologies and guidelines available to smallholder producers for more environment- and management-specific production in healthier supply chains.			Scientists and research managers; development planners and practitioners; producer associations; policy makers; donors	Decision-makers gain better understanding of high value crop systems and performance, and thereby take informed decisions on resource allocations	R&D efforts more effectively and systematically targeted. Increased productivity of high value, readily-marketed products
	Output Target 2009: A methodology for mass propagation of elite clones of naranjilla, Andean blackberry and avocado established	Policy strategies			
	Output Target 2009: A protocol for screening and selecting medicinal plants (developed, published and	Policy strategies			

	tested) in at least 3 supply chains in LAC				
	Output Target 2009: Disease management components for the major pest and disease constraints identified for the model tropical fruits for Latin America	Policy strategies			
	Output Target 2010: Elite clones of naranjilla, Andean blackberry and avocado available for adoption, multiplication and distribution by at least 10 rural nurseries run by farmer associations	Materials			
	Output Target 2010: One database containing information of environmental niches and performance of at least 4 high market value, underuti lized crops and/or tropical fruit species available.	Capacity			
	Output Target 2010: Robust disease manage ment strategies for the model fruit species (naranjilla, Andean blackberry and avocado) under a range of production conditions.	Policy strategies			

	Output Target 2011: Enabling rural enterprises for compost lixiviate marketing as a new biofungicide	Policy strategies			
	Output Target 2011: Proven procedures available for deriving bioethanol from commercial farm wastage as an energy and income alternative for new agricultural areas	Policy strategies			
	Output Target 2011: Evaluation of participatory variety selection and breeding methods effective for smallholder producers completed and available.	Materials			
Output 3: Methods and policy guidelines available to rural producers and other actors in the value chain to assist them in becoming more adept at managing risks associated with increased income generation.			National research and development agencies; and farmer associations in Latin America and Africa	Cost-effective and environmentally friendly practices and tools promoted by national R&D agencies and in use	Increased rural income through increased yield, higher market values and reduced production costs
	Output Target 2009: Guidelines available for risk monitoring through growth assessment of under fives as indirect data linked to increased income in hunger affected areas	Policy strategies			

	Output Target 2010: Mapping of nutritional status of population based on amino acids, micronutrient and protein deficiencies in the the area of greatest impact in the use of targeted staples and high value crops in Africa.	Policy strategies			
	Output Target 2011: Spatial analytical methodologies evaluated and promoted for dynamic pest and disease monitoring in HVCs in Africa.	Capacity			
	Output Target 2011: Guidelines available for risk and outcome monitoring (based on anthropometric and other assessments in case studies) of malnutrition linked to increased household income, and for designing appropriate interventions against obesity or hunger in affected instances.	Policy strategies			
	Output Target 2011: Lessons for income, gender, equity and environmental outcomes for effective and sustainable market linkage from case studies on target	Policy strategies			

	high-value crops with at least five farmer organizations involving at least five enterprises and various approaches				

PA2: Agroecosystems Resilience

Project Overview and Rationale

Project Rationale

The tropical world is characterized by considerable variation, at all scales from community to the region. Institutions at all levels from village to region tend to be numerous, and at varying levels of effectiveness, inclusiveness and governance. Small farmers livelihoods range from near-subsistence to small scale commercial (although pure subsistence is less common than is sometimes thought), and households may seek or have opportunities to emerge from poverty in ways that differ according to composition, agroecological situation and socioeconomic circumstances.

Development and research practitioners need tools that enable them to work at different scales, and to discriminate effectively among rural populations and environments. Outcomes tailored to specific social and biophysical contexts are needed to achieve widespread impact under these conditions. Many of the most appropriate tools will be interdisciplinary in nature, and in general need to be derived through iterative interdisciplinary research processes. Agricultural science practice cannot be successful if it is disconnected from development practice, and some of these research processes need to be embedded in development (research for development) in order to yield robust and international public goods.

This project (outcome line) is new to CIAT's portfolio of projects for 2008. It was established in late 2007, taking on components of the Markets, Institutions and Livelihoods project. The project is among the smaller ones of CIAT, and currently consists of two outputs:

1. Institutional arrangements and mechanisms for targeting, increasing and evaluating impacts
2. Policy guidelines, tools and innovations for adaptation to risk, high stress and vulnerability.

The emphasis of the project is on process-based research which supports other research activities within CIAT and with external partners (including CPs), with a thematic focus on generating better understanding of water-related processes and issues surrounding climatic risk. A common theme throughout the project is that of impact mapping, both geographically and institutionally.

Outputs from this project will increase the effectiveness of other projects of CIAT, as well as the wider R&D community. Output 1 specifically develops knowledge on how impact occurs in complex institutional, economic, environmental and geographic settings, and develops methodologies for monitoring and evaluating impacts. Output 2 focuses on the significant risks facing rural communities (especially from climate variability and change) through impacts on agricultural production and the natural resource base, and develops tools and methodologies for assessing and adapting to these risks from the local to the regional scale. This output specifically looks at the challenges of climate variability and change to rural communities, providing policy-relevant insights of impacts and potential adaptation mechanisms.

Cross-cutting between both outputs is the use of spatial analysis for characterizing the problems associated with rural development and for supporting ex-ante and ex-post impact assessments and supporting research decisions during the life of projects. This builds on CIAT's core competency in spatial analysis, and an important component of the projects strategy is one of service provision within CIAT and to key external partners.

The project operates through close collaboration with other projects within CIAT (both germplasm and natural resources) and with external partners, especially Challenge Programs. The project leads Theme 2 of the Water and Food Challenge Program, co-coordinates the Andes Basin Focal Project of the Water for Food Challenge Program, plays a coordination role in the Lake Kivu pilot site of the SSA-CP, and supports both Harvest Plus and GCP through geographic analyses of ex ante impact. Gender analysis will be applied systematically in the work described here.

Alignment to CGIAR Priorities

Agroecosystems Resilience aims to address several aspects of the System Priorities 3, 4 and 5, by addressing key research questions around systems approaches (where to do what?), organizational models and learning approaches. A detailed tally of alignment to the SPs is provided at the output level.

Alignment to CGIAR Priorities by Output

Output 1: Institutional arrangements for increasing impacts

This output refers most to system priority 5, including 5A, 5C and 5D. Specifically, the CGIAR's emerging framework for SP 5C Improving rural institutions and their governance recognizes that SP areas 1 to 4 cannot be achieved without strengthening the organizational capacities of farmer organizations (including women's producer organizations) and rural service providers. Many of the outputs presented here cut across these SPs. The outputs especially address the goal of SP5C Enhance the role that rural organizations and innovative institutional partnerships play in maximizing impact from agricultural research and in creating marketing platforms for smallholder producers.

Output 2: Innovations for adaptation to change and vulnerability

This output cross-cuts many of the SPs, but is especially relevant to SP2 and SP4. Research on evaluating the challenges to agricultural systems in the face of climate change contributes to setting the research agenda for activities within SP2a and 2b related to staple crops especially, and high value products in 3a. The work on ecosystem services and water-related processes and poverty alleviation contribute to many specific goals within SP4.

Outputs Description

Changes from previous MTP Outputs

Changes (since 2008-2010 MTP)

This is a new project for CIAT's project portfolio as of late 2007. The RDC, People and Agroecosystems evolved into two Outcome lines during 2007. Therefore, outputs initially presented under one single project last year, Markets, Institutions and Livelihoods, are now split, and this document relates to the Agroecosystems Resilience Outcome Line. Outputs 1 and 5 presented in the 2008-2010 have been included in this project, and the remaining outputs are now under the Linking Farmers to Markets Outcome Line. The project as presented here is a logical progression from Outputs 1 and 5 of the previous MTP. As CIAT

develops a new strategic plan, this project is likely to evolve to coherently support CIAT's new research agenda.

Output 1: Institutional arrangements for increasing impacts

Description: Better understanding is needed of how the roles of organizations in the rural R&D sector are changing, how they function best in different settings, and the most effective approaches to strengthening their capacities for innovation, resilience and to support rural people to break people out of the poverty trap. In this way, the CGIAR will also be better placed to facilitate or even help to organize the right partnerships, at national, regional and international scales.

We build on research by CIAT's former Project on Participatory research approaches, which carried out some of its work at the level of farmer groups, by elevating most of this research to the secondary and tertiary levels of rural institutions. A dominant lens that we will continue to use in assessments will be the effectiveness of approaches, methods and institutional arrangements as promoters of pro-poor interventions and change. Lessons will be drawn for strengthening the participation and influence of the poor in land and water management institutions and with service providers. Methods for improving the targeting and reach of agricultural research institutions will be examined, as well as how the poor can better contribute to the agenda of the formal research sector and lead some types of experimentation. The relevance, accountability and impacts of multi-stakeholder agricultural innovation platforms (partnerships between farmer/civil society organizations, and private and public sectors) will be examined in a range of settings.

Methods for tracking change, improving learning and assessing livelihood impacts for these purposes will be compared. Recognizing the close relationship between this area and SP areas 5B and 5D, research towards this Output will be closely linked with that of Outputs 2 of Agroecosystems Resilience, and other projects within CIAT (especially Linking Farmers to Markets). This will facilitate understanding of the institutional aspects of smallholder participation in market chains and in developing the potential of payment for environmental services generated from agriculture to both improve the environment and rural livelihoods.

Output 2: Innovations for adaptation to change and vulnerability

Description: We aim to make available policy guidelines, tools, and innovations for adaptation and resilience of agricultural systems to situations of risk, high stress and vulnerability. The outputs also cut-across many other SPs with climate change threatening the gains that might occur in other SPs.

It responds to the global challenge of adaptation to climate change, as well as providing insights into better management of natural resources as a component of agroecosystem resilience. The output also responds to the critical Sub-Saharan Africa regional challenges of soil degradation and of the need for incentives and processes that encourage farmers to invest in soil restoration. A number of activities within this output are collaborative in nature with TSBF.

The agricultural implications of current climatic variability will be estimated, and planning support provided for adaptation by small farmers and their R&D service providers to future climate change. Discrete products will include improved understanding of the natural and biological resource that provides the link to climate change, and guidelines that improve smallholder farmers adaptive behavior in the face of climate variability that is associated with longer term climate changes. An important component of the output also sets the research challenges brought about by climate change, specifically in the area of crop

improvement and natural resource conservation.

As contributions to the research agenda of Sustainable Land Management in the Tropics under TSBF and in collaboration with the Institute, we also aim to improve understanding of the environmental, social and market dynamics of soil degradation and recovery. Linkage with CIAT's Outcome Line on Linking Samllholder Farmers to Growth Markets is also explicit, with a number of outputs related to climate-risk analyses in value chains. Better tools are needed for the identification of effective development policies and associated investments that support the implementation of profitable and resilient land uses that enhance both welfare and environmental benefits. Protocols will be developed for evaluating how and under what circumstances farmer linkages to markets affect investments in NRM, positively or negatively. Research is focused in southern, central and eastern Africa.

An extension of this integrated approach to soil fertility will be to determine, from comparative studies and action research, the approaches and best practices that enable farming systems and landscapes to recover from acute stress whether caused by drought or other forms of emergency. This latter work is currently defined as one of four flagship research themes of the Alliance for Agricultural Research in Eastern and Southern Africa (AARESA).

Changes from previous MTP by output

Changes (since 2008-2010 MTP)

Output 1: Institutional arrangements for increasing impacts

This output in essence remains the same as Output 1 from the Markets, Institutions and Livelihoods project from the 2008-2010 MTP. However, it has evolved since this time last year with greater clarity in the long-term strategy. Hence, the specific outputs for 2009 remain the same as in the 2008-2010 MTP for Markets, Institutions and Livelihoods, but there are a number of new specific outputs for 2010 onwards. Specifically, the output target on An assessment of the potential of payment for environmental services generated from agriculture to both improve the environment and rural livelihoods (previously a 2010 output) has moved to Output 2 of this project, where the work on ecosystem services is explicitly within the strategy. Three new specific outputs have been added, which develop methods for mapping extrapolation domains, and institutional analyses of water and poverty issues in the Andes included.

Output 2: Innovations for adaptation to change and vulnerability

This output was included for the first time in the 2008-2010 MTP under the Markets, Institutions and Livelihoods project as Output 5. The three outputs for 2009 and 2010 remain, and six new output targets have been added across the three years of this MTP as this area of research is becoming increasingly important within CIAT and indeed globally.

Impact Pathways by Output

Output 1: Institutional arrangements for increasing impacts

The research results from this output are methods, tools, good practice guides for targeting, increasing and evaluating impact. These are developed within research projects and programs. Researchers develop these approaches such as participatory impact pathways analysis and multi-stakeholder platforms to make projects and programs more effective at what they do. At the same time researchers carry out research to understand what works (and doesn't work) so that the results of this output (the methods, etc.) are applicable across countries and regions. The co-development of these methods helps ensure wider ownership and adoption amongst the stakeholders in the projects and programs in which we work and our partners work. The methods themselves help project and program staff better visualize and manage networks and partnerships that are essential to scaling-out and up of agricultural innovations. They also help foster an impact culture including reflection and M&E to support adaptive management. Adaptive management is a requisite for effectively achieving pro-poor impacts.

Output 2: Innovations for adaptation to change and vulnerability

In most cases the direct clients of the research products are other researchers who are actively engaged during the research process, although there is significant policy relevance in the outputs. Efforts are therefore also made to reach policy makers through specific policy briefs and through effective collaboration with partners who can influence policy (e.g. ecosystem services work in collaboration with The Nature Conservancy, whereby they deliver CIAT generated policy-relevant results to key people in national and local government). Many of the methodologies generated are placed in easy-to-use software tools which allows uptake by other researchers and development practitioners who can adapt to their specific problems and contexts.

International Public Goods

International Public Goods by Output

Output 1: Institutional arrangements for increasing impacts

Outputs from Agroecosystems Resilience are generally knowledge-intensive innovations (methods, tools, good practice guides) and are derived from lessons learned systematically across environmental, socio-economic and geographical situations. Outputs are robust enough to be targeted subsequently at global and/or very broadly regional levels. Our IPGs constitute: internationally published good practice guides (and similar outputs) and peer-reviewed journal articles of research methodologies and policy relevant research results.

Output 2: Innovations for adaptation to change and vulnerability

The IPGs of this output include published papers and reports and policy briefs, software tools (e.g. Canasta, Homologue) which are made available permitting other users to adapt and apply them to their local conditions, and baseline spatial datasets on poverty, environment and society. These datasets are published online, whenever possible. Previously released global datasets on topography and climate have had demonstrated demand from other R+D agencies, and these IPGs will continue to be developed inside this project.

Elaboration of Partners Roles

Elaboration of Partners Roles by Output

Output 1: Institutional arrangements for increasing impacts

A large proportion of the research undertaken in this Output is performed within the context of the Water for Food Challenge Program (CPWF) and the Sub-Saharan African Challenge Program (SSA-CP), and the analyses themselves are performed in close consultation and involvement with a broad range of partners from upstream ARIs to downstream farmer organizations and natural researce managers.

Output 2: Innovations for adaptation to change and vulnerability

A range of partners are involved within the output, including UN agencies (FAO), ARIs, NARIs (in Latin America and Africa) and NGOs (e.g. TNC, local natural resource organisations). CIAT's role tends to be in developing the tools and methodologies in close collaboration with partners, and the results flow further downstream as our partners use these research results (tools and methodologies) to improve decisions in their specific field of work and geographic context.

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Institutional arrangements for increasing impacts			Agricultural and environmental research organizations, development and environmental organizations, civil society groups, policy makers at regional, national and local scales	Greater incorporation of the interests of the poor in the design and implementation of R&D projects	R&D investments have larger impacts, of which a larger share goes to the poorest beneficiaries
	Output Target 2009: An approach for strengthening and weaving effective	Policy strategies			

	networks for influence and pro-poor impact put into use in at least one R4D program				
	Output Target 2009: Methodological framework for testing and evaluating innova tion platforms (multi- stakeholder partnerships between private-public-CSOs) and other forms of partnerships for facilitating small holder participation in high value market chains	Policy strategies			
	Output Target 2010: Extrapolation domain analysis comprising biophysical and social parameters developed for supporting technology transfer	Policy strategies			
	Output Target 2010: Water-poverty interactions assessed in the Andes through expert knowledge and Bayesian network analysis	Policy strategies			
	Output Target 2011: Institutional priorities and arrangements identified with respect to water, poverty and agricul tural production in the Andes	Policy strategies			

Output 2: Innovations for adaptation to change and vulnerability			Policy-makers (public, private & donor), farmer organizations, NGOs, researchers in CIAT and partner organizations	Improved conceptual and empirical understanding of how policy enables effective research and development interventions	R&D efforts lead to effective, equitable and sustainable development in the tropics.
	Output Target 2009: Socio-economic and agronomic vulnerability hotspots identified under current climate variability and future climate change	Policy strategies			
	Output Target 2009: Standard protocol for valuation of ecosystem services (soil and water) developed and tested in at least 2 pilot sites	Policy strategies			
	Output Target 2009: Poverty assessments and crop-specific drought maps for priority areas of the Generation Challenge Program	Materials			
	Output Target 2010: A set of instruments (seasonal forecasting, insurance, policy), agricultural technologies and practices for coping and adapting to climate change identified and promoted in pilot sites	Materials			

	Output Target 2010: Assessment of drought phenotyping trial sites to provide information for future field trial planning and dissemination of drought tolerant genotypes.	Capacity			
	Output Target 2010: Breeding strategy recommendations to confront global climate change made for at least 3 crops on a global scale	Policy strategies			
	Output Target 2011: Community-based risk experimental methods developed to evaluate change scenarios at the local level in the context of global change	Materials			
	Output Target 2011: Weather insurance schemes based on sound climatological and agronomic science in place in at least two sites in two different countries	Materials			
	Output Target 2011: An assessment of the potential of payment for environmental services generated from agriculture to both improve the environment and rural livelihoods	Policy strategies			

PA3: Participatory Research and Gender Analysis (PRGA)

Project Overview and Rationale

Rationale

Phase III (2008-2012) of the System-wide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (PRGA Program) builds on and modifies the Programs revised strategic platform, developed in early 2007 on the basis of lessons from and achievements of the earlier phases (19972006), the recommendations of the Programs first external review in 20062007, and detailed annual planning meetings and discussions within the Programs Advisory Board (now known as the Program Advisory Committee, PAC).

The key factors that underpinned the Programs work at the beginning of Phase II still apply today:

o A majority of agricultural research systems still lack a critical mass of participatory research (PR) and gender analysis (GA) practitioners, including in the CG System
o There is still little recognition and practice of gender analysis
o There is still an unmet demand for capacity development in GA and PR methods
o Learning and change need to be institutionalized, so that PR and GA can be mainstreamed in agricultural R&D thinking and practice.

The PRGA Program continues to be guided by its programmatic goal to improve the ability of the CGIAR System and other collaborating institutions to develop technology which alleviates poverty, improves food security, and protects the environment with greater equity and its programmatic purpose to assess and develop methodologies and organizational innovations for gender-sensitive participatory research, and operationalize their use in plant breeding, and crop and natural-resources management. The objective of the Program is to improve the competencies of the CG System and collaborating institutions to mainstream the use of gender-sensitive participatory approaches in plant breeding and natural-resources research.

The strategic platform for Phase III focuses on three thematic areas: New developments in and institutionalization of participatory plant breeding (PPB) and in seed delivery systems, New approaches to measure the effectiveness of research processes that contribute to poverty reduction, and Supporting actions for gender mainstreaming; these constitute the Outputs of the revised logframe.

Alignment to CGIAR Priorities

The PRGA Program fits primarily into System Priority area 5 Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger, and more specifically Priority 5D Improving research and development options to reduce rural poverty and vulnerability. However, the use of gender-sensitive participatory research-for-development by the CG System and its partners, as promoted by the Program, should improve the efficiency of effort in all five Priority areas. For alignment of specific Outputs, see Description [of specific Outputs] below.

Alignment to proposed rationale and profile for Systemwide and Ecoregional Programs (SWEPs)

The PRGA Program welcomes the Science Councils clarification of the history, purpose and preferred characteristics of SWEPs as explicitly stated in the recent SWEPs assessment (*). The explicitness of the assessment criteria used (current and future SWEPs) has been helpful in assessing how the PRGA Program meets the stated SWEPs criteria. During the 20072008 Program Advisory Committee (February 2829, 2008, CIAT, Cali, Colombia), the staff and PAC members reviewed and evaluated the characteristics of the PRGA Program, as well as its contribution to the success of SWEPs delivery in the light of the Science Council Assessment (**). The PRGA Program has demonstrated leadership in building and nurturing communities of practice in the past, and fully meets the generic characteristics for the future Systemwide initiatives (***). The implications of this are as follows:

i. The international public goods (IPGs) catalyzed and nurtured by the PRGA Program are the joint outputs of a larger range of stakeholders and partners than is typical of a SWEP with a scientifically-focused purpose. The PRGA Program has demonstrated that an IPG can originate from within civil society (NGOs and farmers organizations) when these are effectively supported by NARS and the CG Centers.

ii. The PRGA Program and its partners explicitly address the way that research is performed and managed to achieve the CGs stated goals. It develops and tests how participatory research and gender analysis allow CGIAR priorities to be advanced or achieved.

iii. Robust research has demonstrated that institutional failure underlies the fact that millions of farmers remain poor, marginalized and unsupported by effective technology, after more than 40 years of effort. The gap between what science has to offer and the diverse problems that such farmers face remains very large. The PRGA Programs work seeks ways to help a range of organizational actors close the gaps through development and adoption of appropriate R&D approaches, methods and associated skills and conceptual understanding. The increasing feminization of poverty makes this all the more urgent.

iv. None of these concerns fall under the purview of the Challenge Programs. The PRGA Program is thus positioned as a generic facility that complements and adds value to work prosecuted under the CPs.

v. The PRGA Program meets the proposed criteria for category 1 SWEPS coordination.

[*] Science Council of the CGIAR. The Role of Systemwides in Implementing the CGIAR's Research Agenda. An Assessment of Current Systemwide and Ecoregional Programs (SWEPs). SC Secretariat, Febraury 7, 2008.

[**] In the Programs written response (March 3, 2008), the PRGA Program staff and Program Advisory Committee urged the Science Council to revise its assessment of the PRGA Program in the light of evidence that it may have overlooked or perhaps undervalues.

[***] See Appendix I for detail description of PRGA Programs outputs and SWEPs success factors and Appendix II for how PRGA Program fits the proposed characteristics of the future SWEPs.

Alignment to CGIAR Priorities by Output

Outputs Description

Summary of changes from previous Outputs and MTP Project_

The four Outputs of the 20082010 MTP have been consolidated into three. In addition, the

Output Targets have been refined (the 2008-2010 MTP was necessarily preliminary as the new strategic platform was only drafted in early 2007). More specifically, the former Output 2 (20082010) on Institutional Innovations in Africa's Seed and Seedling Revolution was merged into Output 1 as New developments … in seed delivery systems.

Overall, the 2009-2011 MTP is the result of further strategic thinking on and clarification of the Phase III strategic platform drafted in 2007. The changes have also been influenced by the projected funding situation. In terms of temporal linkages:

o Output 1 (PPB and seed systems) builds on previous Program activities and experience in the Plant Breeding Group (early Phase II)
o Output 2 (measuring research effectiveness) builds on a project started during Phase II, under Output 2 (Impact Assessment) in 2006
o Output 3 (gender mainstreaming) builds directly on Phase II Output 1, with a renewed focus on the CG Centers.

Output 1: New developments in and institutionalization of participatory plant breeding (PPB) and in seed delivery systems

Description:

Activities (*):
o Development and application of new methods within PPB for maximizing the use of agro-biodiversitySP2
o PPB to help sustain (and even support the broadening of) the genetic base of poor peoples cropsSP2 (1A)
o PPB as an implementation tool for farmers rightsSP5D (5A, 5B)
o Characterization of seed delivery systems effectively targeted to the poor in a marginal area in a specific, defined region (Africa, or the Middle East)SP5C
o Developing local seed systems delivery of PPB products within given legal frameworksSP5C (5A, 5B)
o Pilot to institutionalize a local seed delivery system for PPB products SP5C

Comparative & complementary advantages of the research
Recent studies show the current agricultural research scene in a very simplistic way: private agricultural research is narrowly focused geographically, on a narrow crop basis (especially soy bean, maize, cotton and rapeseed) and on production and not consumption traits. Some researchers argue that the current trend of amalgamation in global food systems (that is being driven by the process of globalization) is accelerating a two-tiered production system in which small-scale food producers will be neglected in future benefits from agricultural research (**). Moreover, globally the price of staple food crops is soaring, inter alia driven by the trend toward cultivating more cash crops (at the expense of staples) and the rising cost of fuel for transportation. Consequently, targeted research is vitally important to enable small-scale producers to provide food at an affordable price. In order to target their research better to serve the needs of the poor and to reach the Millennium Development Goals, many public agricultural research institutions have now adopted the use of participatory research models as a way of generating and sustaining a rapid rate of innovation, adoption and adaptation, especially in highly uncertain and variable environments and for benefiting the poor or hard-to-reach, and in some cases focusing on crops neglected by private sector

(*) The System Priority (SP) addressed by each activity is indicated after the em-dash.

(**) See, for example, Pingali P, 2007. Will the gene revolution reach the poor? Lessons from the Green Revolution. Mansholt Lecture, Wageningen University, January 26, 2007.

research. The fundamental rationale for the PPB Program is to refine our understanding of the situations in which joint efforts of farmers, scientists and others are most critical in effective and cost-effective delivery. Although many CGIAR Centers are applying participatory approaches in breeding, the reviews of the CGIAR PPB programs conducted by the PRGA Program show that PPB work in many Centers is highly fragmented and not institutionalized. Hence, the PRGA Program continues to have a clear role in helping to improve the institutionalization of PPB through development and adoption of appropriate PPB approaches, methods and associated skills.
Some more advanced farmer-breeding programs in CGIAR Centres exceed the gradual selection in landraces, and include the development and maintenance of major and rather uniform new varieties. Ensuring recognition of the collective innovation and breeding efforts of farmers, and keeping these materials freely available for use and further breeding forms major challenges, as do issues related to seed multiplication and seed policy.

Addressing priority goals
This research addresses Priority area 2: Producing more and better food at lower cost through genetic improvements; and Priority area 5: Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger.

Contributing partners
o CAZS Natural Resources (South Asia Bangladesh, India [Assam], Nepal)
o ICARDA (Africa or Middle East)
o NGOs: LI-BIRD, FORWARD, SUPPORT (Nepal); PROVA, FoSHoL (Bangladesh); CRS (India)
o Educational establishments: IAAS (Nepal); BAU (Bangladesh); AAU, NLRI (India)
o NARS: NARC/NRRP, DADOs (Nepal); BRRI, BARI, DAE (Bangladesh); IARI, DoA (India)
o Community-based seed producers; private-sector companies; grain millers and merchants; seed merchants (South Asia)
o Policy-makers and members of variety release committees (South Asia)
o Others to be identified (Africa or Middle East)

Output 2: New approaches to measure the effectiveness of research processes that contribute to poverty reduction

Description:

Activities:
o Practical case studies with lessons learned on the role of science and technology and innovation in poverty reduction and social inclusionSP5A (5C, 5D)
o Assessing measuring systems that can provide empirical evidence of effectiveness of research process in contribution in poverty reduction SP5D (5A, 5C)
o Increased understanding about the institutional gaps in applying measuring systems that provide evidence of effectiveness of research process contributing to poverty reductionSP5D (5A, 5C)

Comparative & complementary advantages of the research
There is growing evidence of limited impact of agricultural research impact assessment itself on project identification, approval and implementation management, or on poverty reduction itself (*). In the past, impact assessment results have served primarily as a management tool and an accountability measure to evaluate past investments in agricultural research and to set research priorities for future investment. With growing acceptance and mainstreaming of participatory and multi-stakeholder paradigms, however, impact assessment is increasingly seen as a tool for institutional learning and change that has close links to ongoing project monitoring and evaluation processes. The broader field of evaluation

research includes many different perspectives, including but not limited to economic assessment. This presents an opportunity for the PRGA Program to support and engage in the emerging collaborative efforts in the development of a set of measuring systems (complementary to existing economic measures) for impact assessment for a broader range of methodologies.

Addressing priority goals
This research targets Priority area 5: Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger.

Contributing partners
o University of East Anglia (UK)
o ILAC Initiative
o ILRI Innovation Works program
o Sustainability Science Program, Kennedy School of Government, Harvard University
o Nearly all CGIAR Centers

(*) This was the conclusion of the conference entitled Impacts of Agricultural Research and Development: Why Has Impact Assessment Research Not Made More of a Difference? hosted by the CGIAR Standing Panel on Impact Assessment, San Jose, Costa Rica, February 47, 2002.

Output 3: Supporting actions for gender mainstreaming

Description:

Activities:
o Establish an annual Gender Research Prize within the CGSP5A
o Policy briefs, covering the main lessons from the PRGA Program and its partners workSP5
o Short manuals on participatory research and gender research for key research areas within CG Centers research portfoliosSP5
o Taking stockcarrying out a re-inventory of (a) CG gender research and lessons that can be learned from this; (b) exploring the impact on the research agenda of women scientists in the CG CentersSP5
o Building advanced capacity for gender analysis in research within selected CentersSP5D

Comparative & complementary advantages of the research
Gender mainstreaming is a globally accepted strategy for promoting gender equality. Gender mainstreaming in agricultural research and specifically in the CGIAR and partner institutions is not an end in itself, but a strategy (approach, means) to achieve the goal of gender equality in research processes, as well as outcomes, and ultimately impacts. Mainstreaming involves ensuring that gender perspectives and attention to the goal of gender equality are central to all activities policy development, research, advocacy/dialog, legislation, resource allocation, and planning, implementation and monitoring of programs and projects. PRGA Program assessment has shown that gender research is not mainstreamed in most CGIAR Centers the major gap identified (which this research will fill) is the supporting activities for mainstreaming efforts.

Addressing priority goals
This research targets Priority area 5: Improving policies and facilitating institutional innovation to support sustainable reduction of poverty and hunger.

Contributing partners
o CIAT
o Gender & Diversity Program
o ASARECA/PAAP (Policy Analysis and Advocacy Programme)
o WOCAN (?)

Changes from previous MTP by output

Impact Pathways by Output

Output 1: New developments in and institutionalization of participatory plant breeding (PPB) and in seed delivery systems

Historically, the PRGA Program has sought the input of its stakeholders in identifying researchable problems in the fields of PR and GA. This process should be repeated in the future.

Participatory plant breeding research in a strategic context aims to identify and promote good-practice methods for use by plant breeders in defined contexts. These breeders in turn will develop varieties adapted to a wider range of farming contexts (social, cultural, farming systems, agro-climatic) that will be adopted and promoted by participant farmers, thereby reducing farming risks (through use of adapted varieties, improved systems and increased genetic diversity in the field). With reduced risks, farmers should achieve better yields with consequent improved incomes and livelihoods. Impact will be achieved mostly by use of these methods by NARS and also, in situations not well served by the formal research sector, by NGOs and farmer organizations.

By understanding how formally and informally developed varieties are integrated into the seed system, we should have a clearer overall view of the seed chain. With this knowledge, we will explore ways of influencing variety uptake into commercial seed systems and promoting the establishment of seed enterprise, including in situations where genetic diversity might otherwise become unduly narrowed. Consequently, farmers should benefit from prompt access to appropriate varieties, with consequent positive effects on incomes and livelihoods.

Output 2: New approaches to measure the effectiveness of research processes that contribute to poverty reduction

By studying successful development situations (not necessarily interventions), we aim to learn about what made them successful and feed these back to stakeholders. This should improve funding and resource use efficiency within newer programs and projects, thereby achieving positive results in a shorter timeframe and at reduced cost.

Output 3: Supporting actions for gender mainstreaming

In mainstreaming gender issues in their research, partners internalize what they learn, resulting in institutional change; more specifically, partners then routinely utilize appropriate elements of PR and GA whenever appropriate. This leads to improved, better-targeted research, and therefore better outcomes for the ultimate target audience, i.e. the poor.

International Public Goods

The Program is unique within the CG with its focus on PR and GA; it complements the Gender and Diversity Program, which focuses on staffing issues and capacity development among female scientists of many agricultural disciplines. The PRGA Program works alongside partners to develop methodologies that will be applicable over a much wider area. For the specific communities with which it works, there is also the benefit of direct Program input and Outputs (e.g. crop varieties), which themselves may be relevant in similar socio-economic and ecological situations.

Alongside the research, the Program plays an advocacy role in promoting the use of PR and GA techniques throughout the CG Centers and beyond.

Elaboration of Partners Roles (*)

CIAT (Convening Center) building on advantage of hosting PRGA Program
o Pilot Center for gender mainstreaming pilot study on gender audit
o Greater interaction with PRGA Program at senior scientist, management and Board levels
o Buy-in to PRGA Program raison d'etre
o Experimental case study in establishment of appropriate gender indicators in project review procedures and research evaluations (Output 3)

CIMMYT, ICARDA, IRRI (Co-Sponsors)
o As Co-sponsors of the PRGA Program, these Centers are prime targets for research partnerships under Outputs 1 and 2
o ICARDA PPB expertise in the Middle East and North Africa (Output 1) currently discussing issues toward preparation of funding proposal

S. Ceccarelli (formerly of ICARDA)
o PPB expertise in the Middle East and North Africa (Output 1) currently discussing issues toward preparation of funding proposal

CAZS Natural Resources (University of Wales)
o PPB expertise in South Asia (Output 1) currently drafting funding proposal

CGIAR Gender & Diversity Program
o Expanding the gender audit to other Centers
o Gender Prize

(*) Excludes recipient, network and potential future partners (see Appendix II).

Annex III: Progress Report on Implementation of External Review Recommendations

Name of Center or CP: Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation (PRGA Program)
Dates of External Evaluation Report Presentation and Discussion: February 2007
Science Council: MarchJune 2007
Executive Council: MarchJune 2007
CGIAR Annual General Meeting: December 2007

Recommendation as listed in the External Review report	**Response Accepted or Not accepted**	**Implementation**		
		Milestones	**Progress Achieved**	**Target Date of Completion**
1. The PRGAs past performance and its present and future relevance to the Science Councils priorities for the CGIAR warrant its continuation.	Accepted	▪ Develop strategy for Phase III (20072011) ▪ Develop revised Program description and logframe ▪ Funding secured for Phase III activities ▪ Recruitment of new Program Coordinator	▪ First draft Strategy developed by AB (March 2007) ▪ *New Strategic Platform* flyer published (April 2007) ▪ Revised logframe drafted for MTP 20082010 (May 2007) ▪ Draft 2 of Phase III logframe (herein) ▪ Coordinator vacancy announcement released (April 2008)	December 2008 for securing funding
2. The PRGA should stay the course and maintain its investment in participatory plant breeding [PPB].	Accepted	▪ Include PPB as a major theme in Phase III ▪ Develop working relationships and funding proposals	▪ Theme/Output 1 of new logframe is PPB (May 2007) ▪ Proposal prepared with CAZS-NR rejected by DFID; being redrafted for	December 2008 for securing funding

			Gates Foundation ▪ Ongoing discussion with former facilitator of PPB Working Group and ICARDA re institutionalization of PPB into NARS	
3. The PRGA should strategically reconsider its role and program in Participatory Natural Resource Management [PNRM].	Accepted	▪ PNRM dropped from PRGA portfolio ▪ *Research on PNRM be integrated into the Inter-Center INRM Working Group (Science Council, May 2007)*	▪ PNRM not included in first draft of Phase III logframe (May 2007) ▪ *IC-INRM-WG adoption of PNRM out of Programs hands*	*Completed*
4. The PRGA should accelerate its efforts to introduce gender analysis into the wider GCIAR system.	Accepted	▪ Maintain gender-mainstreaming activities, with renewed focus on CG Centers ▪ Initiate gender-mainstreaming pilot in one CG Center	▪ Output 2 of Phase III is all about gender mainstreaming (herein) ▪ GM project at CIAT initiated (October 2007) final report due in May 2008 Gender Prize drafted (March 2008)	Ongoing
5. The PRGA should renew its search for the funding of a competitive grants initiative to elicit greater cooperation from its partners particularly those in the CGIAR.	Not accepted			
6. The Convening Center [CIAT] should take steps	Accepted	▪ In 2007, the CIAT BoT representative position was included in the PAC.	▪ Louise Fortmann has been appointed as the CIAT BoT rep.	December 2008

to promote greater interaction with the PRGA in the areas of financial management, the PRGA Advisory Board [*now* Committee, PAC], and interdisciplinary research especially with biological scientists.		▪ The PAC chair was also welcomed to participate in CIAT's BoT meeting.	▪ PAC reps have sat in on CIAT BoT meetings in 2006 & 2007, so this is making the process formal	
7. The PRGA should continue to invest in impact assessment with greater emphasis on quantifying the benefits of PPB to different groups in society.	Not accepted fully (continue investment in impact assessment work in general not limited to PPB)	▪ Social inclusion study ▪ Collaborative impact workshop organized to produce case studies, analysis of impact assessment and evaluation methods, and institutionalization of these learning-oriented approaches ▪ Peer-reviewed publications	▪ Social inclusion study (January 2008) ▪ Workshop (March 2008) ▪ Updated versions of 7 (earlier) workshop papers published in *Experimental Agriculture* 44(1) Special issue (January 2008) ▪ Updated versions of a further 6 workshop papers to be published in *Development in Practice* Special issue (mid-2008). At the request of the editor, a call for practical notes was organized: 18 submissions were received, of which eight were able to be included in this special issue.	Completed/ongoing
8. We endorse recent PRGA efforts to publish more in	Accepted		▪ 3 titles in 2007 ▪ Several in press and in prep. in	ongoing

peer-reviewed journals, to solicit more graduate student participa-tion in the program, and to allocate more time to research.			2008	
9. We encourage the PRGA to publish good practice manuals for biological and social scientists in specialized areas of the programmatic expertise in PR and GA.	Accepted	▪ Gender manuals (see Output 3 in the current logframe: supporting actions for gender mainstreaming)	▪ Output of ASARECA project in prep.	June 2009
10.Management of the Program should become less hands-on and more strategic.	Accepted	▪ Recruitment of new Program Coordinator with revised, more strategic TORs	▪ Funds secured (April 2008) ▪ Vacancy advertised	August 2008
11. The Program should design an effective communications strategy.	Accepted	▪ Draft communications strategy presented to PAC	▪ No progress to date	Next PAC meeting (January 2009)

Appendices

Appendix I: Science Council SWEP assessment (pp. 56): Factors that have contributed to success of SWEPs delivery and PRGA Programs output

The PRGA has demonstrated leadership in building and nurturing communities of practice in the following fields and processes:

i. Building on existing successful initiatives:
(a) Participatory Plant Breeding: the sustained support offered by and through the PRGA Program for PPB to other CG Centers (notably ICARDA, but also WARDA, IRRI, Bioversity International, CIMMYT) and NARS (e.g. LiBird, ASARECA partners, EMBRAPA) has progressed from preliminary conceptual development and then state-of-the-art practice, from farmers and from breeders experience, small competitive grants to allow field teams based in CG Centers and NARS to develop their practice, stakeholder workshops to critically assess experience and further develop technical and conceptual understanding of best practice options, costs and benefits. A web-based community has been fostered, offering opportunities for web-conferencing on specific technical and management issues. A high standard of publications has been maintained, spanning scientific contributions to high-impact journals (e.g. Euphytica), practitioner manuals (e.g. Farnworth & Jiggins, 2006), policy analyses and workshop reports (for details see PRGA Program publications list). The current round of PPB activity and proposals include: ongoing PhD research (WUR & ICARDA) and development of women's inclusion in PPB; PRGA support to NARS/NGO breeders in South Asia, to develop the diversity and resilience of local cropping systems (with Biodiversity and the University of Wales, in association with a CIMMYT, IFPRI, IRRI proposal to the Gates Foundation); and exploration of the development of a participatory research unit at ICARDA to support regional initiatives to link mature PPB activity with sustaining agro-biodiversity, minor crop development and the registration and commercialization of PPB products.
(b) Impact Assessment: A recent example of collaboration with other successful initiative is the field of Programs impact assessment. The PRGA Program, the Institutional Learning and Change (ILAC) Initiative and the International Livestock Research Institutes (ILRI) Innovation Works Program have complementary objectives to promote research for poverty reduction and thus co-sponsored a workshop on March 2628, 2008 in Cali, Colombia, titled Rethinking Impact: Understanding the Complexity of Poverty and Change, to stimulate dialog, build capacity and address issues of institutionalizing new approaches to research and assessment of the impact of these approaches. The workshop was attended by 70 experts from the CGIAR, NARS and universities. A previous workshop co-organized with CIMMYT was highly effective in producing two special issue peer-reviewed journal issues; hence bringing the collective effort in impact assessment of participatory research and gender analysis to the public domain.

ii. Adopting partnerships and consultative planning: All PRGA Program activity is based on partnerships, with a range of stakeholders in the public sector and civil society. Nearly all activity is built on explicit requests and ideas submitted by its stakeholders and developed jointly with them. Plans were well advanced to hold, in association with CORPOICA, a fifth international stakeholder conference in 2006, but these were disrupted as a direct result of the host Centers difficulties. Draft MTPs are shared with its host Center and CG partner Centers, to harmonize log frames. This stakeholder-based planning and priority-setting process was recognized as one of the Programs sources of strength (EPMR, 2007; p. 4).

iii. Involving participatory research approaches within an INRM framework: NRM as an explicit theme of the PRGAs work ended at the conclusion of Phase I, except in relation to

ongoing partnerships with regional NARS. A strong focus on agro-biodiversity and resilience has always been a concern of the PPB work and has received increasing attention as awareness of likely climate change effects has developed (*).

(*) The PRGA Program places on record that Phase I concluded the NRM program, with numerous academic publications and evidence of effective incorporation of PR and GA in partners field activities (see, for example, the book commissioned by the PRGA and edited by Pound et al, 2003 Managing Natural Resources for Sustainable Livelihoods: Uniting Science and Participation). Following analysis by the PAC (then known as Program Advisory Board) of the comparative advantages of the PRGA programs work in this area, it was recommended that the NRM theme be dropped as a separate component of the Program and be incorporated under the GA and PPB theme. No separate NRM activity was carried out under Phase II.

iv. Engaging private sector and encouraging self-funded partners. The PRGA works intensively with the largest (but least powerful) actors in the private sector small farmers struggling to retain freedom to operate in the face of adversity, and to develop capacity to exercise their entrepreneurial rights in the face of unequal competitive pressures. The contributions of farmers, NGOs and part-funding contributions of NARS have been decisive to the PRGAs impact.

v. Adopting competitive grant funding: the PRGA pioneered the use of competitive grants in Phase I; funding allocated under Phase II for this support evaporated during the host Centers year of confusion.

Appendix II: Science Council SWEPs assessment (p. 9): Proposed characteristics for the future SWEPs and how the PRGA Program meets these characteristics

Characteristics of the PRGA Program

vi. Topics related to host Centers mainstream research. CIAT has historically been a champion of the added value that participatory research can secure, as well as a lead Center with respect to gender research. CIAT's current and future strategic focus is under development, in the light of emerging global agendas, priorities and opportunities, and following a prolonged hiatus in its commodity work that made it difficult for the PRGA Program to develop synergy with CIAT's commodity programs. Following the initial recovery period at CIAT, the PRGA Program has received a number of requests to assist in new CIAT proposals and these are under joint consideration. The interim DG has assured the PRGA Program that participatory research and gender analysis will remain core items in the mainstream program at CIAT as this is developed. The Program responded toward the end of 2007 to a request from CIAT's BoT to pilot a Gender Audit of gender research at CIAT. This builds on the previous exercise of gender-related data-gathering and interviews and analysis at ILRI and CIP, further generating interest that is likely to lead to invitations to conduct similar Gender Audits in at least two other Centers. The current phase of the work will conclude April 2008, when the recommendations resulting from the Audit will be considered by CIAT's senior management and BoT.

vii. Partnerships involve several centers that are engaged in the research of activity, quoting the Program EPMR (2007) directly (p. 4): The inclusive nature of the Program, resulting in a multiplicity of partners, is one of the hallmarks of the PRGA. Carefully documented inventories described 48 partnership projects in Phase I and 30 in Phase II. Many partnerships in Phase I were funded via a small grants program that operated from 19992001. This proved to be an effective way of engaging colleagues from the CGIAR: 15 different Centers, Eco-regional Programs, and Systemwide Programs from the CGIAR participated in the small grant program. More than 20 NARS and NGO partners also took part. Since the first workshop in September 1996, periodic stakeholder workshops have figured prominently in priority setting. This seems efficient and is one of the sources of strength of the PRGA.

viii. Synergy from Center collaboration is clear: The PRGA Program has demonstrated clear added value in its collaboration with other Centers with respect especially to PPB, NRM and impact assessment. The synergies developed through the PRGA Program with respect to gender research are most clearly developed in its collaboration with regional NARS (e.g. ASERECA) and multi-country programs (e.g. WOCAN), where the collaboration has led to continuing efforts to strengthen capacity, legal changes, and policy adjustments by science management. The synergy catalyzed with and through other CG Centers has had sporadic effect; sustaining the gains and building on them has been and will remain largely the responsibility of the CG Centers concerned.

ix. Serve a capacity-building role and foster effective communication to enhance NARS, CGIAR and public-awareness program content: Quoting the EPMR (2007) here again: Capacity building was carried out in Phase I primarily through the small grants programs and in Phase II through intensive work with NARS, aimed at organizational change. Concurrently with the small grants program, the PRGA organized a number of learning workshops aimed at promoting participatory research and gender and stakeholder analysis. The Program also organized 14 international meetings and workshops between 1996 and 2005, involving almost 900 participants.

Appendix IV: Secondary partners (*)

Recipients and objects of Program research
o Poor farmers, both men and women

Partners within established networks
PRGA Program listservs
o CG: Africa Rice Center; CIAT; CIFOR; CIP; ICARDA; ICLARM; ICRISAT; IFPRI; IITA; ILRI; IPGRI; IRRI; IWMI; World Agroforestry Centre, WorldFish Center (i.e. all the Centers); ILAC Initiative; Gender & Diversity Program
o ARI: ACIAR; Centre for Development Research (Denmark); CIRAD; CSIRO; Department of Rural Development Studies (Sweden); FAO; FDS; GTZ; IDRC; ILEIA; JIRCAS; KIT; Louis Bolk Instituut; NRI; ORSTOM; Swiss Agency for Environment, Forests and Landscape; USDA
o Donors: EC/EU; IFAD; UNDP; World Bank; WorldVision Canada
o Governmental/NARS: numerous
o NGO: numerous
o University: numerous
o SRO: ASARECA
o Private: companies; individuals.

Potential future partners
Learning from the positive project:
o CIP, ICARDA (PPB), ICRAF, ILRI, ILAC Initiative
Output 1 PPB and seed systems:
o INRA, CSOs (MENA)
o IPGRI, NARS, CSO (Asia)
o FARA, ASERECA, CORAF, SADDCC, CIAT, ICRISAT, WARDA, CIMMYT
o The Clinton Foundation, the Volkswagen Foundation and the African Women's Development Fund
Output 2 Measuring research effectiveness:
o IFAD and ASARECA
Output 3 Gender-mainstreaming
o Regional Development Banks (AfDB, ADB, etc.)
o CG Gender & Diversity Program
o CGIAR Systemwide Program on Collective Action and Property Rights (CAPRi)
This list will grow as new staff take post and work-plans are built around the new strategy.

(*) For major R&D partners, see Project Narrative.

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: New developments in and institutionalization of participatory plant breeding (PPB) and in seed delivery systems			Plant breeders (CGIAR, NARS), farmers	o Plant breeders adopt and adapt good-practices in PPB, thereby identifying adapted varieties for specific farming contexts o Farmers rights and gender equality increased o New seed policies in place	o Improved livelihoods of poor farming communities o Seed security of poor farmers
	Output Target 2009: Effective methods for maximizing agro-biodiversity by means of PPB demonstrated, and seed delivery systems targeted to the poor in a marginal area described in a specific, defined region (e.g. Africa, or Middle East)	Policy strategies			
	Output Target 2010: Methods to sustain the	Policy strategies			

	diversity of the genetic base of poor peoples crops through PPB demonstra ted; best practices for developing local seed systems delivery of PPB products identified; strengths, weaknesses and opportunities for local seed systems delivery of PPB products within given legal frameworks analyzed				
	Output Target 2011: Realistic options for seed policy development identified, and an example of an effort to institutionalize a local seed delivery system for PPB pro ducts analyzed	Policy strategies			
Output 2: New approaches to measure the effectiveness of research processes that contribute to poverty reduction			CG Centers, NARS, NGOs	Broader base of evidence is generated and used to assess effectiveness of research by CGIAR and partners	The research of the CGIAR and partners becomes more effective in contributing to poverty alleviation
	Output Target 2009: Practical case studies with lessons learned	Policy strategies			

	on the role of S&T and innovation in poverty reduction and social inclusion				
	Output Target 2010: Measuring systems assessed that can be used to provide empiri-cal evidence of effectiveness of research pro-cess in contribu tion in poverty reduction	Capacity			
	Output Target 2011: Increased understanding about the institutional gaps in applying measuring systems that provide evidence of effectiveness of research process contributing to poverty reduction	Policy strategies			
Output 3: Supporting actions for gender mainstreaming			CG Centers, NARS, NGOs	o The practice of gender analysis is mainstream med in CG Centers and partners o Research products relevant to the needs and priorities of the poor	Sustainable livelihoods and greater food security among margina-lized groups

	Output Target 2009: Lessons from gender audit and gender analysis of CIAT distilled and available to other centers; and gender audit methodology refined	Policy strategies			
	Output Target 2010: Gender audit methodology applied and critically reviewed in 3 other CG Centers	Policy strategies			
	Output Target 2011: Methods and lessons learned disseminated to wide range of partners and other interested parties	Policy strategies			

PA4: Amazon Initiative

Project Overview and Rationale

Project Overview

The AI-EP faces the challenge of contributing to research and development interventions that concurrently meet the short- and long-term needs of environmental conservation and the economic well-being of local populations. The Project carried out by the AI-EP partners will support the identification, development and dissemination of sustainable land use systems that avoid further deforestation; and support local governments and civil society in their goals related to human welfare, environmental services, and improved governance.

Rationale for the Project

The Amazon region poses several challenges. It contributes to global climate change and will become its victim. Poverty in the Amazon is linked to undeveloped market chains; insufficient financial mechanisms for the poor; conflicts over resource access; and weak policy foundations and institutional capacity.

Recent human impacts on the Amazon and its global environmental services are largely negative. Most land use change has been associated with substantial emissions of greenhouse gases, contributing to global climate change. Biodiversity has been lost where forests were converted to other uses. Nearly 70 million ha of Amazon forest were cleared over the last 30 years, mostly in Brazil. Drivers were road building, timber extraction, slash-and-burn agriculture, cattle, and large-scale commercial agriculture. Forests of the other Amazonian countries have also been affected. New roads and policies leading to their construction make forests more accessible. Smallholders clear more forest after soil nutrients are depleted and unmanageable weed infestation makes farming difficult and costly. Ranchers frequently open new areas after pastures degrade within a few years: more than 30 million hectares of Amazonian pasture have been abandoned or are severely degraded. Soybean production has pushed ranching deeper into forested areas. Expanded market demand for timber, beef and soybean contribute to deforestation, unsustainable agro-ecosystems, and natural resource degradation. Land pressure to grow crops for biofuels represents a new but powerful threat to the Amazon. In addition, soil erosion from slash-and-burn agriculture has led to leaching of naturally occurring mercury into rivers, eventually concentrating up the food chain in fish consumed by humans--bringing about significant human health problems.

Reviews of the policy-related drivers of deforestation and land degradation in the Amazon refer to colonization schemes, tax codes, fiscal incentives, interstate migration, monetary inflation, land prices, monetary policy, land tenure legislation, commodity price supports, forest reserve laws, and monitoring policies and devices. Much of the deforestation that has taken place in the Brazilian Amazon, for example, was carried out by middle and large-scale ranchers in the 1970s and 1980s, who converted the forest cover to pasture, often with the support of fiscal incentives from federal agencies. The government of Brazil is taking measures to slow deforestation, although results seem to follow market trends. Many financial incentives for cattle ranching have been withdrawn; and the proportion of land on a property that can be legally deforested was reduced to 20%. Fines have been imposed on landholders caught burning forest without appropriate permission. There is consensus that habitat conversion and resource degradation in the Amazon are driven by multiple factors including the combination of open access to land and forest resources and lack of secure rights to lands occupied and resources used. The AI-EP will address such Amazon challenges, reformulated as four Development Challenges. An Outcome Line of the AI-EP corresponds to each of the four Development Challenges.

Target Ecoregion

This is a new project resulting from the 2008 CGIAR endorsement of the AI-EP. The AI-EP area of intervention includes the Amazonian regions of the countries that comprise the AI Consortium, which are also the member countries of the Amazon Cooperation Treaty Organization (ACTO). Specifically, the project will work in locations where institutions associated to the Consortium are based, according to the list below:

Country	Region
Bolivia	Department of Pando, municipality of Cobija
	Department of Beni, municipality of Riberalta
	Department of Santa Cruz, municipality of Santa Cruz
Brazil	State of Acre, municipalities of Brasilia, Assis Brasil, EpitacioIndia
	State of Amazonas, municipality of Itacoatiara, Maues
	State of Maranháo: municipalities of Penalva, Lago do Junco, São Luís Gonzaga
	State of Pará: municipalities of Altamira, Anapu, Abaetetuba, Igarapé-Açu
	State of Rondônia: municipality of Ouro Preto d'Oeste
Colombia	Department of Caquetá, municipality of Florencia
Ecuador	Province of Napo, municipality of Tena
	Province of Francisco de Orellana, municipality of Coca
Peru	Region of Ucayali, municipality of Pucallpa
	Region of Madre de Dios, municipality of Puerto Maldonado
	Region of Loreto, municipalities of Yurimaguas, Iquitos
	Region of San Martin, municipality of Tarapoto
Suriname	Paramaribo
Venezuela	State of Amazonas, municipality of Puerto Ayacucho
	State of Bolivar, municipality of Puerto Ardáz

Alignment to CGIAR Priorities

The AI-EP agenda supports the CGIAR's core mission of improving the livelihoods of low-income people in developing countries by reducing poverty, food-insecurity, malnutrition, gender inequality and child mortality; and by fostering better institutions, policies, and sustainable management of natural resources. Research outcomes of the AI-EP will directly

contribute to the achievement of MDG1 (Reduction of Poverty and Hunger), MDG7 (Ensure Environmental Sustainability), and MDG8 (Development of a Global Partnership for Development). The AI-EP agenda is aligned with the CGIAR Science Priorities, and particularly with Priority Area 3 (Reducing Rural Poverty through Agricultural Diversification), Priority Area 4 (Poverty Alleviation and Sustainable Management of Water, Land, and Forest Resources), and Priority Area 5 (Improving Policies and Facilitating Institutional Innovation to Support Sustainable Reduction of Poverty and Hunger). Outcome Lines 1 and 2 are closely aligned to Priority 4A: Promoting integrated land, water and forest management at landscape level, and Priority 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas. Outcome Line 3 is closely aligned to Priority 3D: Promoting sustainable income generation from forests and trees, and Priority 5D: Improving research and development options to reduce rural poverty and vulnerability. Outcome Line 4 is closely aligned to Priority 3A: Increasing income from fruit and vegetables, and Priority 5B: Making international and domestic markets work for the poor.

Alignment to CGIAR Priorities by Output

Output 1: Mitigation and adaptation to climate change

Outcome Line 1 is closely aligned to Priority 4A: Promoting integrated land, water and forest management at landscape level, and Priority 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas.

Output 2: Adoption of sustainable land use systems in deforested and degraded areas

Outcome Line 2 is closely aligned to Priority 4A: Promoting integrated land, water and forest management at landscape level, and Priority 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas.

Output 3: Enhanced benefits from forests for livelihoods and the environment.

Outcome Line 3 is closely aligned to Priority 3D: Promoting sustainable income generation from forests and trees, and Priority 5D: Improving research and development options to reduce rural poverty and vulnerability.

Output 4: Fair, financially attractive, and effective market value chains for amazon products

Outcome Line 4 is closely aligned to Priority 3A: Increasing income from fruit and vegetables, and Priority 5B: Making international and domestic markets work for the poor.

Outputs Description

Output 1: Mitigation and adaptation to climate change

Description: The Amazon is of global importance in regulating climate change (CC), representing a significant storehouse of carbon reserves and source of greenhouse gas (GHG) emissions. At the same time, projections show that both peoples and the biodiversity of the Amazon will be at risk as climate changes. AI Outcome Line 1 will work on both climate change mitigation and adaptation.

Outputs:
o AI 1.1. Analysis of the carbon footprint of land use systems in the Amazon, including the implications for local and global climate change;
o AI 1.2. Resilient land use systems to maintain and increase carbon stocks;
o AI 1.3. Payment schemes for the management of ecosystem services (PES), including the exploration of carbon market opportunities;
o AI 1.4. International instruments that can reduce deforestation and forest degradation.
o AI 1.5. Innovative community based fire management;
o AI 1.6. Examination of current mechanisms used to cope with risk;
o AI 1.7. Adapted germplasm and land use systems;
o AI 1.8. Appropriate adaptation programs developed in collaboration with local and national governments.

Output 2: Adoption of sustainable land use systems in deforested and degraded areas

Description: Systems and technologies for sustainable production (or sustainable land use systems, SLUS) in deforested areas of the tropics have been developed in recent decades, e.g. improved, legume-based pastures, multistory agroforestry systems, small-scale timber plantations, silvopastoral systems, secondary forest management, and improved fallows. These technologies offer the possibility of harnessing the Amazons underutilized interspecific and intraspecific genetic diversity--a possibility favored by increasing awareness and concern for environmental issues among politicians, policy-makers, consumers and producers; new markets for previously untraded goods (environmental services); consumer interest in niche and novel products; and more accessible markets at national levels (due to infrastructure improvements) and international levels (due to removal of trade barriers).
Currently, the adoption of SLUS is limited by a series of constraints: poor targeting; lack of germplasm in sufficient quantity and/or quality or at accessible prices; market limitations, including but not limited to the lack of development of markets for environmental services; the combination of free access to forest frontiers and insecure land tenure; and lack of supporting systems (technical support, credit).
Outcome Line 2 aims at the removal of these constraints through biophysical, social science and synthesis research for generation of IPGs aimed at critical points in the adoption chain, supplemented by use of established AI communication channels to producers and policy-makers.

Outputs:
o AI 2.1: Technology targeting
o AI 2.2: Germplasm or seed supply system development
o AI 2.3: Policy research
o AI 2.4: Quantification of and payment mechanisms for environmental services
o AI 2.5: Support systems

Output 3: Enhanced benefits from forests for livelihoods and the environment.

Description: Forests and forest resources provide livelihoods for current forest dwellers and a temptation for loggers, ranchers, and perhaps future biofuel crop producers. As such, governance is an over-arching issue. Although the AI-EP will attempt to be stakeholder neutral, community forestry will be a major activity of this Outcome Line.

Outputs:
o AI 3.1: Potential of underutilized forest species
o AI 3.2: Multiple and diversified forest use and management
o AI 3.3. Property use and rights

Output 4: Fair, financially attractive, and effective market value chains for amazon products

Description: Products from forests and from deforested or degraded lands have the potential to improve the welfare of Amazon communities if appropriate products can be identified and developed, if seed and germplasm systems can be established, and if market value chains can be developed. Integration of such products in sustainable land use systems (SLUS) can have positive impacts in terms of environmental services. The Outcome Line dealing with forests and with deforested and degraded lands will work with this market innovation focus to develop products (e.g., tropical fruits and fruit products, non-timber forest products, agricultural outputs, sources of bio-fuels (with appropriate caution) and seed and germplasm needed in SLUS and systems (e.g., forest, agroforest, agro-silvo-pastoral) to produce those products. The central area of concern of this Outcome Line will be establishing innovative, successful ways to facilitate market value chain development.

Product and market development faces the constraints of poor infrastructure, lack of market information and access, lack of economies of scale, periodic rather than constant production, limited value added capabilities, lack of standards and quality control, post-harvest management problems, and limited investment capital. Competition for basic resources by ranchers and loggers, and the economic rationality of extensive slash-and-burn agriculture provide other barriers to product and market chain development.

Opportunities, however, include growing developed country consumer interest in green, fair trade, and equitable products coming from critical environments of global importance like the Amazon. In spite of negative effects, road-building can improve access to regional and even international markets. Free trade agreements may have positive implications for Amazon producers. Large corporations in developed countries have recently included departments or divisions of corporate responsibility--and such efforts to protect or enhance production ecosystems and to improve the welfare of producer communities are being taken very seriously. Communications have improved: increasingly, villagers can be counted on to have and use cell phones, and may even have access to the internet. Institutional arrangements provided by the AI-EP benefit from improved information on markets, detailed spatial and socioeconomic data bases for targeting and ex-ante impact analysis, and in general an information environment that has expanded greatly in the last five years.

Outputs:

o AI 4.1: Identification, ex ante impact analysis and targeting of potential products, especially but not limited to high value

o AI 4.2: Product development and seed and germplasm management (in collaboration with the degraded lands and forest innovation areas)

o AI 4.3: Production in SLUS (in collaboration with the degraded lands and forest innovation areas)

o AI 4.4: Market value chain development

Impact Pathways by Output

Output 1: Mitigation and adaptation to climate change

The overall expected outcomes of work on mitigation are the adoption of appropriate sustainable land use systems (SLUS) that provide positive impacts by increasing carbon (C) stocks through increases in biomass and, eventually, in soil C; and by decreasing GHG emissions through avoided deforestation.

(1.1) Analysis of the carbon footprint of land use systems. Outputs will be methods for and the measurement of carbon stocks associated with different land use systems, including sustainable systems tested and developed by the AI-EP; and of GHG emissions associated

with the conversion of land use systems--e.g., the conversion of forest to slash-and-burn agriculture. The expected outcomes will include the adoption of appropriate SLUS by smallholder and colonist communities in the forest margins, and achieving this is expected to have positive impacts in terms of carbon and decreased GHG emissions. Measurement techniques will be needed to institute PES schemes and to measure impact of the SLUS themselves.

(1.2) Development of resilient land use systems to maintain and increase carbon stocks. This work will be conducted in collaboration with Outcome Line 2, sustainable production on deforested and degraded lands. Outcomes will be systems and adoption of systems that represent carbon stock increases and reduction of GHG emissions due to avoided deforestation. Policy instruments will be developed and promoted in collaboration with the Amazon Cooperation Treaty Organization so as to foster this adoption. Impacts are thus the maintenance and increase in C stocks, reduced GHG emissions, and positive welfare impacts from the more sustainable systems (including PES and product market chain development).

(1.3) Development and testing of payment schemes for the management of ecosystem services (PES), including the exploration of carbon market opportunities. This will be a central area of innovation for the AI-EP, involving as partners CIFOR, ICRAF, NARS and other national agencies, with outcomes including adoption of schemes to reward local communities for adoption of practices that diminish GHG emissions and systems that increase C stocks; and enhanced effectiveness of organizations working on rights and compensation for environmental services. Impacts are essentially the same as those for 1.2: maintenance and increases in C stocks; reduced GHG emissions; and welfare gains to local communities via PES.

(1.4) Identification and application of international instruments that can reduce deforestation and forest degradation. This innovation area is expected to produce analyses of policy options and the promotion of a policy value chain that favor adoption of SLUS and of AI advocacy in support of appropriate policy instruments.

The overall expected outcome of work on adaptation is adoption of appropriate SLUS that provide positive impacts in terms of peoples and communities abilities to maintain and increase their welfare in the face of climate change. Welfare gains are expected through payments for environmental services generated by adoption of SLUS and through financial gains made from product and market chain development generated from the SLUS. Impacts stemming from adoption of appropriate SLUS will again be maintenance and increase in C stocks; and reduced GHG emissions.

(1.5) Examination of current mechanisms used to cope with risk. This innovation area will provide the outcome of understanding how communities have used their traditional knowledge to face risk related to production activities. Impact will be indirect: a building block to help in the development of local and national mitigation policies and programs.

(1.6) Testing of innovative community based fire management. Accidental and uncontrolled fire will be one of the more difficult problems people will face as the Amazon dries and heats up due to CC. The AI-EP will work with communities to develop fire prevention and management methods. While less fire will mean a decrease in GHG emissions, more important will be maintenance of the productive systems on which communities livelihoods depend.

(1.7) Testing of adapted germplasm and land use systems (in collaboration with Outcome Line 2). The outcome of this innovation area will be critical to success: development, testing, and adoption of appropriate SLUS that are adapted to the future hotter and drier conditions of the Amazon. More drought and heat adapted crops, varieties, and products will be needed. Successful germplasm development and systems adoption will have the positive impact of sustaining the livelihoods of the peoples of the Amazon.

(1.8) Work with local and national governments on appropriate adaptation programs. The AI-EP will have to work closely with local and national governments as they develop programs and policies to help those negatively affected by CC. Outcomes will be that local

and national governments formulate and then enforce programs and policies that lessen the negative effects of CC on Amazon communities. The impact would again be the maintenance of livelihood systems on which the peoples of the Amazon rely.

Output 2: Adoption of sustainable land use systems in deforested and degraded areas

Outcome Line 2 will primarily operate at national and sub-national level, with impacts at all levels. At the local level, i.e. in priority intervention zones, we envisage the following outcomes:
(2.1) Selection and adoption of SLUS and implementation of appropriate adaptive research.
(2.2) Improved germplasm supply; initiation of programs based on improved national technical capacity.
(2.3) Local policies (e.g. at state and regional government levels) formulated or reformulated.
(2.4) Innovative reward for environmental services schemes instituted.
(2.5) New practices and approaches to dissemination and scaling-up adopted.
The outcomes listed will produce the following impacts at local and national levels:
o land-use systems that prevent and reverse environmental degradation and that sustain environmental services; and
o more resilient livelihoods, including more stable incomes and greater food security.
At regional and global levels, in addition to the aggregate of the local and regional impacts, the following emergent impacts will be produced:
o Enhanced biostability of Amazonian ecosystem;
o Reduction in global levels of greenhouse gas emissions.
The achievement of these outcomes and impacts would also rely on the broader AI Consortium (i.e. as distinct from AI-EP) adding an explicit policy advocacy and dialogue component to its remit.

Output 3: Enhanced benefits from forests for livelihoods and the environment.

The forest Outcome Line will provide outcomes at the sub-national, national, and regional levels; and impacts at all levels from local to global. Several outcomes and impacts of the three sub-components are expected.
The sub-component working on the potential of underutilized forest species and populations will have the outcomes, first, of the dissemination of appropriate forest seed and germplasm; and of associated needed knowledge for the management of such germplasm; and, second, of the marketing of a wider range of forest products. The expected impacts of use of underutilized forest species would be greater income stability resulting from greater marketed product diversity; and increased income of forest resource users.
The sub-component of multiple and diversified forest use and management seeks the outcome that stakeholders recognize and support such management. In this case, stakeholders are policy makers, NGOs, foresters/forest managers, and end users. Impacts would be the maintenance of environmental services in terms of biodiversity and carbon stocks; and improved, more stable livelihoods of end-users.
A third sub-component would examine the issue of resource access and use. Outputs would be innovative systems that build on the traditional use rights of forest communities in the establishment of more formal land tenure and resource access rights. The expected outcomes would be increased and improved stewardship of forest resources and lands by local communities; and such stewardship would be expected to maintain and enhance the provision of environmental services.

Output 4: Fair, financially attractive, and effective market value chains for amazon products

(4.1) Identification, ex ante impact analysis and targeting of potential products, especially but not limited to high value crops. Outputs are to include identification and characterization of potential products, spatial and socio-economic targeting of geographical areas, communities, and expected markets, and ex ante impact analysis. Impacts will be positive in terms of welfare if successfully developed, targeted, and marketed; and if positive investments in failures are avoided.
(4.2) Product development and seed and germplasm management. Outcomes will include product development, including domestication and selection, and development of appropriate seed and germplasm systems. Positive welfare impacts will be obtained as new, marketable products are developed and if people have access to affordable needed seed and germplasm (and if market value chains are successfully developed, below).
(4.3) Production in SLUS. As an important outcome, crops, trees or other planted products, and forest products will be integrated into SLUS. Positive welfare impacts will be derived from production in sustainable systems. Positive environmental impacts are expected from these more intensive, often tree- and perennial crop based diverse systems.
(4.4) Market value chain development. The crucial outputs are methods to facilitate equitable, sustainable market value chains; and the development of the chains themselves in target communities. Outcomes will depend on intended users overcoming the constraints and taking advantage of the opportunities listed in the rationale. The innovation area will have to deal with information management, negotiation along value chains, problems of infrastructure, developing continuous production and economies of scale, product standards and quality control, resources access and land tenure, and financial mechanisms. Positive welfare impacts will be derived in terms of income, income stability, employment creation, and value added. Social and human capital gains will accompany successful market chain development and participation.

International Public Goods by Output

Output 1: Mitigation and adaptation to climate change

(1.1) Analysis of the carbon footprint of land use systems. Carbon balances can be accurately determined, but doing so is usually costly and not adapted to the practical concerns of evaluating different land use systems in terms of carbon and of basing systems of PES on such measurements. The knowledge gap is a practical system of measurement that can be implemented by national partners and that provides fair and transparent decision support data. The basics of such a system would be an IPG.
(1.2) Development of sustainable land use systems to maintain and increase carbon stocks. Such land use systems have been developed; but adoption is constrained by a number of factors (discussed in Outcome Line AI-2). Briefly, because adoption of SLUS represents land and resource use intensification, rational resource users will clear new forest areas if the land frontier is open and if security of tenure is lacking to the point that intensification cannot be privately justified. The knowledge gaps involve the policy instruments to close the forest frontier and to increase the private returns to intensification. Development of such instruments will constitute and important IPG.
(1.3) Development and testing of payment schemes for the management of ecosystem services (PES), including the exploration of carbon market opportunities. Once changes in the flow of environmental services can be practically measured, the question remains that of how to compensate land users for private investments made for public benefit. The basics of such a system will constitute an important IPG.
(1.4) Identification and application of international instruments that can reduce

deforestation and forest degradation. Ideas regarding sound policy are not lacking. Just as for forest product development, the real key is how to facilitate the formation of a policy value chain that spans from policy recommendations based on wide stakeholder consultation, to policy and program development, and to effective and equitable implementation. The method to facilitate such a policy value chain would comprise a significant IPG.
(1.5) Examination of current mechanisms used to cope with climate change risk. How do people and communities currently cope with risk? Also, what is the perception of communities to current climate change? Do they perceive climate change as a continuation of the historical climate variability they have experienced or are they willing to change attitudes? Answers to these questions will help form the basis of the development of risk mitigation strategies and policies.
(1.6) Testing of innovative community based fire management. Communities in most of the Amazon will be threatened by more accidental and uncontrolled fires as temperatures rise and climatic conditions become drier. How can people work together at the community level to reduce fire danger and losses and minimize the intrusion of these fires into production forests or otherwise protected forest areas?
(1.7) Testing of adapted germplasm and resilient land use systems. The argument here is the same as that for area 1.2. The additional significant challenge question in this case is will we be able to come up with germplasm, species, and crops sufficiently adapted to future conditions that they will sustain Amazon peoples? The methods by which this question is positively answered will constitute a globally important IPG.
(1.8) Work with local and national governments on appropriate adaptation programs. Local and national governments and agencies will bear the brunt of helping Amazon communities face the effects of climate change. As in the area of international policy development, the key is again how to facilitate the formation of a policy value chain that spans from policy recommendations based on wide stakeholder consultation, to policy and program development, and to effective and equitable implementation. The methods used to facilitate such a policy value chain would comprise a significant IPG.

Output 2: Adoption of sustainable land use systems in deforested and degraded areas

(2.1) Technology Targeting: Existing approaches and tools need to be applied for matching of appropriate technologies to their application domains (in all dimensions, including integration with local knowledge and conditions). There is also a need for site-specific adaptive research, which can be guided by regionally-formulated protocols for technology adaptation.
(2.2) Germplasm Supply Systems: Adoption of many SLUS depends on available seed or germplasm for multi-purpose trees, forages, legumes, and crops. The development of end-user oriented seed systems will be a Program priority. Many Amazonian species have underutilized potential for income generation and food security. Their use or marketability is limited by germplasm availability, cost, and quality. Many wild and semi-domesticated species are also threatened with genetic erosion due to deforestation. Due to the number of species involved and their high genetic diversity, it is unlikely that national research institutions can offer an adequate response to these problems. Approaches are needed that facilitate and enable local level action to harness the potential of Amazonian plant biodiversity. These approaches must take into account possible impacts of future climate change on relatively long-lived perennial crops.
(2.3) Policy Research: SLUS generally imply land use intensification. The pull of an open agricultural frontier, however, discourages land use intensification, as does land tenure insecurity. At present knowledge of appropriate policy approaches to these problems is lacking.
(2.4) Quantification of Environmental Services and Mechanisms for their Reward: Land-use intensification can lead to an enhanced flow of environmental services, such as increased

carbon stocks, habitat provision for biodiversity, and water quality or quantity. Producer interest in providing global environmental benefits is understandably minimal; but could be increased if they could be rewarded for generating public benefits. Practical methods for measuring changes in levels of environmental services related to specific land use systems in specific sites need to be developed; and mechanisms for rewarding these increased flows need to be identified and tested.
(2.5) Support systems: Well-targeted technologies and adequate germplasm supply will not in themselves secure widespread adoption. Establishment and maintenance of SLUS may require investments beyond the reach of smallholders. Innovative approaches to meeting farmers needs for initial financing--without trapping them in debt--are needed. Similarly, with diminishing public technical support and extension, new ways of making producers aware of technological innovations are needed.
Work under Outcome Line 2 will be aimed at generating IPGs, as outlined below.
IPG 2.1: Decision support tool (DST) for SLUS selection and for guiding local adaptive research: The DST will be based on GIS and ex ante impact analysis of experience to date with SLUS and will output (a) multidimensional (socioeconomic, biophysical, policy environment) application domains, and (b) suggested areas for local adaptive research, based on user input of local conditions, including information derived from local knowledge. The DST will be aimed at NARIs staff and other providers of support to technology dissemination.
IPG 2.2: Toolkit on approaches to local germplasm supply: Pilot local germplasm supply initiatives will be implemented that include participatory improvement, domestication and seed / plant supply. The toolkit will cover approaches to entrepreneurial organization for germplasm supply, a decision support tool aimed at guiding improvement and domestication strategies, and will be aimed at NARIs staff and other providers of support to technology dissemination. Best practice recommendations will be drawn up based on these pilot projects.
IPG 2.3: Policy recommendations for specific Amazonian regions: Policy lessons on access and use of land resources will be formulated based on Amazon-wide analysis. The process will be based on exhaustive review of impacts of past experience, based both on published information and field research. The policy recommendations will be formulated at different levels corresponding to policy-makers at Amazonian, national and sub-national levels, in the latter case with reference to specific countries / regions.
IPG 2.4: Toolkit for facilitating reward for environmental services of SLUS: This IPG will describe approaches to practical measurement of changes in levels of environmental services at plot and landscape levels and to institutional arrangements for securing rewards for smallholders engaged in positively impacting SLUS. The research team will formulate simple criteria, indicators and measurement variables that can be used to establish, within reasonable bounds of probability, levels of change in environmental services, based on synthesis review, consultations with organizations involved in basic research and comparative, coordinated field research (observational studies). It will also test local institutional arrangements for securing rewards for these services.
IPG 2.5: Lessons and recommendations on dissemination approaches: Research to generate this IPG will analyze success/failure stories drawn from diverse scenarios throughout the Amazon basin. This analysis, informed by a wider literature analysis, will be used in the formulation of pilot dissemination projects. The results of these pilot projects, together with the prior region-wide analysis, will be used in the formulation of lessons and recommendations.

Output 3: Enhanced benefits from forests for livelihoods and the environment.

(3.1) Underutilized forest species: Promising species and their products need to be characterized in terms of existing diversity and its potential, expected benefits and in terms of constraints to development of products and of successful market chains. Research would

then address how to overcome such constraints, i.e., how to develop successful, transparent and equitable value chains for the underutilized species. Formulation and subsequent implementation of adequate complementary conservation strategies (ex situ/in situ) should assure current and future use of the genetic resources.
(3.2) Diversified forest use and management: As mentioned, governance is at the heart of successful forest management. This and the next area (i.e., property rights and use) deal with influencing policy makers. A first step is to discover how to get different stakeholders to embrace diversified forest use and management as an overall strategy. Needed is the development of a communication strategy that reaches and allows participation of all stakeholders. These outcomes will contribute to the impacts of maintenance of ecosystem services and improved livelihoods of stakeholders.
(3.3) Property rights and resource access: The challenge is for the AI-EP to discover ways to work with government agencies responsible for controlling access and use of forest lands and resources--ways that lead to practical and appropriate end user rights and responsibilities. The Program will need to understand and then to build upon traditional systems of access and use rights. The research question will be how to avoid the problems associated with common property resource access, on the one hand, and how to provide incentives for sound management through innovative forms of secure access and tenure, on the other. The expected impacts would be increased investment in and care of forest resources with secure rights, and the maintenance of forest ecosystem services.
Work under Outcome Line 3 will be aimed at generating IPGs, as outlined below.
IPG 3.1. How to successfully improve welfare through use of underutilized species. The promise of underutilized forest species is seductive. There have, however, been few real successes. The IPG in this case will be in generating lessons from successful cases supported by the AI-EP. The lessons should deal with initial product identification, product and market value chain development based on new local, regional, and global opportunities. Lessons should also consider past failures in an attempt to not repeat them. Appropriate conservation actions will assure current and future use of the existing diversity.
IPG 3.2. How to facilitate adoption of a unified vision by multiple stakeholders. The innovation area will try to have multiple forest stakeholders accept and adopt a somewhat singular vision of multiple & diversified forest use & management. The IPG will be in discovering ways to make this happen. Analysis of potential impact pathways will be needed.
IPG 3.3. How to improve systems of resource access and land tenure that promote improved stewardship while avoiding problems of common access resource use. Work on innovative systems of rights and responsibilities regarding forest lands and resources will initially be conducted at pilot areas. Workable lessons learned that can be applied to wider areas within the Amazon (and elsewhere) will form a set of valuable IPGs.

Output 4: Fair, financially attractive, and effective market value chains for amazon products

(4.1) Product identification, ex ante impact analysis and targeting. Are there products from the Amazon awaiting discovery, development, and market chain development? Numerous projects have tried and failed to develop and market new products. Can the AI-EP combine its overall multi-foci approach to support successful market chain development? Positive methods to do so will constitute a much needed IPG.
(4.2) Product development and seed and germplasm management. It is known that products like tropical fruits need selection or domestication, propagation, and availability of seed and germplasm to potential producers. This area is a necessary but insufficient pre-condition to market chain development.
(4.3) Production in SLUS. Can new Amazon products fit into SLUS such that both welfare and environmental impacts are positive? This is not simple: SLUS imply land use intensification and higher private investments with some of the hoped for benefits being

global rather than local and private in nature. How can trade-offs be recognized and successfully balanced? How to successfully address trade-offs would provide a much needed IPG.
(4.4) Market value chain development. Quite simply, how can the numerous constraints to successful market value chain development be overcome? How can new opportunities be successfully factored into such development? Because success will depend on all of the Outcome Lines of the AI-EP, it is the development of a holistic, systems approach involving from PES to resource access rights to plant domestication to market chain development that will result in a key IPG.

Elaboration of Partners Roles

Partnerships and Collaboration
Through leadership of its CGIAR member centers, the AI-EP promotes the participation of member institutions of the AI Consortium in collaborative research activities implemented through the Program. The AI Consortium provides a platform for collaborative research and development by institutions working in the Amazon region. Scientists and development practitioners in seven countries of the Amazon participate in the AI. Formed and led by national and international research centers, the AI fosters broader collaboration between the member organizations and civil society organizations.
Initial participants of the AI Consortium were four CGIAR research centers: CIAT, CIFOR, ICRAF (World Agroforestry), and IPGRI (Bioversity International); a regional development organization: Instituto Interamericano para la Cooperación Agricola (IICA); and the National Agricultural Research Institutions (NARIs) of Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela. In the three years after the formal establishment of the Consortium (2004) the AI Steering Committee has invited national and local organizations representing diverse stakeholders involved in the sustainable development of the Amazon. By mid-2008, the following 30 institutions are members of the AI Consortium (in addition to the four CGIAR centers).

Country	Organization
Bolivia	Ministerio de Desarrollo Rural, Agropecuario y Medio Ambiente (MDRAyMA)
	Centro de Investigación Agrícola Tropical (CIAT)
	Universidad Autónoma de Pando (UAP)
	Universidad Autónoma del Beni (UAB)
	Instituto para el Hombre, Agricultura, Ecología (IPHAE)
	Fundación para el Desarrollo Tecnológico, Agropecuario y Forestal del Trópico Húmedo
Brazil	Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)
	Instituto de Pesquisas da Amazónia (INPA)

	Universidade Federal do Pará (UFPA)
	Universidade Federal Rural da Amazónia (UFRA)
Colombia	Corporación Colombiana de Investigación Agropecuaria (CORPOICA)
	Universidad de la Amazonía (UNAM)
	Instituto Amazónico de Investigaciones Científicas (SINCHI)
	Instituto de Investigación de Recursos Biológicos Alexander von Humboldt
Ecuador	Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP)
	Instituto para el Ecodesarrollo Regional Amazónico (ECORAE)
	Universidad Nacional de Loja
Peru	Instituto Nacional de Innovación Agrícola (INIA)
	Instituto de Investigaciones de la Amazonía Peruana (IIAP)
	Universidad Nacional de Ucayali (UNU)
	Universidad Nacional Agraria de la Selva (UNAS)
	Universidad Nacional Amazónica de Madre de Dios (UNAMAD)
	Fundación Pronaturaleza
	Instituto de Cultivos Tropicales (ICT)
Venezuela	Instituto Nacional de Investigaciones Agrícolas (INIA)
	Centro Amazónico para la Investigación y Control de Enfermedades Tropicales Simón Bolívar (CAICET)
	Universidad Nacional Experimental de Guyana (UNEG)
Suriname	Center for Agricultural Research in Suriname (CELOS)
Regional	Asociación de Universidades Amazónicas (UNAMAZ)
	Amazon Cooperation Treaty Organization (ACTO)

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Mitigation and adaptation to climate change			Policy makers from global to local levels; Regional organizations (ACTO); regional and global policy development agencies (IDB, IDRB). Climate change adaptation & mitigation specialists; university professors. NGOs active in CC adaptation & mitigation. Community-based organizations. Carbon market interme diaries. Negotiators for multi-lateral environmental agreements. National Agricultural, Forestry and Agroforestry Research Institutes, forestry agencies.	(a) Adoption of appropriate sustainable land use systems (SLUS) that provide positive impacts by increasing carbon stocks through increases in biomass and, in soil C; and by decreasing GHG emissions through avoided deforestation; (b) Adoption of appropriate SLUS that provide positive impacts in terms of peoples and communities abilities to maintain and increase their welfare in the face of climate change.	(a) Maintenance and increase in C stocks, reduced GHG emissions, and positive welfare impacts from the more sustainable systems; (b) Development of local and national mitigation and adaptation policies and programs that contribute to sustaining the livelihoods of the peoples of the Amazon.

	Output Target 2009: Policy options articulated, developed and disseminated for rewarding smallholder farmers for avoided deforestation in Amazonian countries.	Policy strategies			
	Output Target 2010: Framework including principles, criteria, indicators and verifiers for baseline assessments and monitoring of carbon stocks is validated through pilot locations in Amazonian countries, addressing voluntary mechanisms and alternative carbon markets.	Policy strategies			
	Output Target 2011: Analyses and policy recommendations to reduce the vulnerability of silvopastoral systems to climate variability and changing climates in Amazon.	Policy strategies			
Output 2: Adoption of sustainable land use systems in deforested and degraded areas			Policy makers from global to local levels; local government agencies; development planners.	(a) Policy and research and development communities are aware of the quality and extent	(a) Land-use systems to prevent and reverse environmental degradation and sustain

			Regional organizations (ACTO); regional and global policy development agencies (IDB, IDRB). Sustainable land use systems specialists; NGOs active in sustainable land use systems. Community-based organizations. Governmental extension systems and private service extension providers. National Agricultural, Forestry and Agroforestry Research Institutes. National land management and soil fertility programmes & projects.	of information available, and on gaps in information and knowledge on the determinants of ecosystem service provision; (b) local practitioners use approaches for practical measurement of changes in levels of ecosystem services at plot and landscape levels; (c) innovative institutional arrangements in place to secure rewards for smallholders engaged in positively impacting SLUS.	environmental services at local and national levels; (b) more resilient livelihoods, with more stable incomes and greater food security; (c) Enhanced biostability of the Amazonian ecosystem; (d) Reduction in global levels of greenhouse gas emissions.
	Output Target 2009: Situation analysis on the potential of enhanced ecosystem services provision for poverty alleviation and well-being in the Amazonian regions of Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela.	Policy strategies			

	Output Target 2010: Capacity building and technical backstopping on the design and formulation of programs for enhanced research support to ecosystem services and well-being.	Policy strategies			
	Output Target 2011: Rapid appraisal tools for agrobiodiversity, watershed functions, carbon stocks, and soil quality at landscape scale adjusted and validated to the Amazon context to support multi-sta keholder dialogue on sustainable land use systems.	Policy strategies			
Output 3: Enhanced benefits from forests for livelihoods and the environment.			Policy makers from global to local levels; local govern ment agen cies; deve lopment planners. Regional organiza tions (ACTO); regional and global policy develop ment agencies (IDB, IDRB). Natural resources, forestry and livelihood specialists.	(a) Strengthene d regional networking and institutional building, through joint, collaborative research; (b) Improved understandi ng of the extent to which Amazon natural resources contribute to poverty alleviation and	(a) Data and reports are used by govern ments & de velopment agencies to inform investment decisions at local, coun-try, regional levels, and beyond; (b) research findings linked into improved natural resource manage ment at farm and landscape

			Research and development partners: non-governmental organizations active in forests & livelihoods. Community-based organizations. National Agricultural, Forestry and Agroforestry Research Institutes, forestry agencies.	livelihood enhancement; (c) Improved understanding of the opportunities and risks associated with integrating agroforestry and smallholder agriculture in the Amazon into landscape approaches to natural resource management and rural livelihood security.	level in diverse Amazonian contexts; (c) local communities empowered to sustain these efforts.
	Output Target 2009: Solid regional dataset on smallholder households reliance on forests/agroforests, built through household and community surveys of a sample of approximately 2,200 households in 12 research sites of Bolivia, Brazil, Colombia, Ecuador, Peru, Suriname and Venezuela.	Policy strategies			
	Output Target 2010: Comprehensive baseline assessment of livelihood strategies and dependency on	Policy strategies			

	forests, agrofo-rests, and agriculture, and protocols to examine small-holder resource constraints and livelihood opportunities in Amazonian forested landscapes.				
	Output Target 2011: Principles developed and framework formulated for the understanding of the driving forces and tradeoffs associated to alternative land use systems, management regimes and policies in diverse Amazonian socio-natural contexts, and their impact towards conservation and development objectives.	Policy strategies			
Output 4: Fair, financially attractive, and effective market value chains for amazon products			Develop ment planners. Market specialists; university professors. Research and develop ment part ners: non-government al organiza tions active in value chain deve-lopment. Community-based	Enhanced and highly organized value chains of five Amazon fruit tree species, supported by improved germplasm, agronomic and mana gement practices.	(a) Economic benefits through higher yield & greater demand product for of smallho-l ders of the five priority species; (b) Wider application to these and other Amazon fruits of the model

			organizations. Private sector, agro-enterprises. Governmental extension systems and private service extension providers. National Agricultural, Forestry and Agroforestry Research Institutes.		generated; (c) rehabilitation of degraded areas through perennial production systems on deforested land; (d) agricultural stabilization and deforestation reduction.
	Output Target 2009: Highly efficient value chain development approach generated for the realization of the economic potential of Amazonian products, tested for five fruit tree species (aguaje, camu-camu, peach palm, cupuazu, and ungurahui) and collated through a toolbox.	Policy strategies			
	Output Target 2010: Methodology for participatory screening and selection of superior germplasm, enhanced propagation systems and improved agronomic techniques for the five selected species.	Policy strategies			

	Output Target 2011: Best practices for improved knowledge management and innovation systems for enhanced participation of Amazonian poor and vulnerable smallholder communities in agro-enterprises exploring new products developed from the five selected species.	Policy strategies			

SBA1: Improved Bean for the Developing World

Project Overview and Rationale

Rationale

The common bean (Phaseolus vulgaris L.) is the world's most important grain legume for direct human consumption. Its total production exceeds 12 million MT, of which 7 million MT are produced in tropical Latin America and Africa. Common bean is also one of the most diverse crops in terms of its cultivation methods and its uses. It serves as mature grain, as immature seed, and as a vegetable (both leaves and pods), and after harvest the stover is used as animal fodder. It is cultivated from sea level up to 3000 masl in monoculture, in association, or in rotations. Beans are the poor mans meat and are particularly important in the diet of the underprivileged. Beans, like other legumes, supply proteins, carbohydrates, vitamins and minerals, and complement cereals, roots and tubers that compose the bulk of diets in most developing countries. In light of the foregoing, much effort in this Output Line is directed toward System Priority (SP) area 2: Producing more and better food.

Apart from subsistence cultivation, beans have become increasingly commercial over the past thirty years in national, regional and international markets. In Central America beans are the #1 income generator among the traditional field crops. In Africa farmers tap into regional bean markets in Nairobi, Kinshasa and Johannesburg. With the onset of globalization, the past decade has seen a growing international market that reaches 2.4 million MT annually and that attract some large producers. This heightens issues of equity for the small bean producers, but some also see export markets as an opportunity. For example, bean represents 6% of external income for Ethiopia, and small farmers in Bolivia produce the large white and red mottled classes for export. Thus, issues of SP 5B are relevant for beans. Snap beans are a high value, labor intensive crop of small farmers in Kenya and the Andes, implying a small but significant role in SP 3A.

Besides the common bean, another four cultivated species are conserved in the CIAT gene bank, as well as wild relatives, contributing to SP 1A. This collection is the largest of the genus in the entire world, representing more than 35,000 accessions that have been declared as part of the designated collection before FAO. These other cultivated species fill niches that are unsuitable for the common bean, for example, P. acutifolius that thrives in desert environments.

The CIAT bean program has a long history of working with national partners through networks, of which two are active in Africa: ECABREN in East Africa and SABRN in southern Africa. In Latin America the working relations established under prior networks continue to facilitate interchange of materials. In recent years networks have been widened to include partners who complete our impact pathways, especially those who participate in seed systems. These efforts contribute to SP 5A.

Our primary mission is to contribute to household and global food security by assuring an adequate supply of beans as a culturally acceptable and traditional staple; and to improve the income of small bean producers of Latin America and Africa, by making bean production more profitable. We also seek to improve human nutrition, both by augmenting the supply of beans, and by improvement of their nutritional value.

Our Outputs are designed to respond in particular to the needs of small, resource-poor bean farmers in Latin America and Africa. Thus, we seek to create solutions to biotic and abiotic production limitations that require minimal inputs, and in the case of improved germplasm, with good market potential. Our research strategy focuses on the exploitation of the vast

genetic resources of bean that exist as a complex array of major and minor gene pools, races and sister species. CIAT's gene bank with 41,000 accessions of common bean and related species is our most unique resource, and has been the source of genes for disease and insect resistance, abiotic stress tolerance, nutritional quality and yield potential. Most traits are still selected by conventional means in field sites (in some cases backed up by greenhouse evaluations) where most important diseases, edaphic constraints and drought can be manipulated for purposes of selection. However, Marker Assisted Selection (MAS) is employed selectively but strategically, in most cases for disease resistance genes. CIAT pioneered participatory selection with farmers and this practice is being extended and systematized. While most Outputs are seed based, others involve agronomic practices or are knowledge based. Our research is strategic combined with both basic and applied elements, as called for by the particular challenge.

Alignment to CGIAR Priorities by Output

Output 1: Beans with improved micronutrient concentration that have a positive impact on human health
CIAT's bean Output 1 on improvement of nutritional quality is housed under CG System Priority Area 2: Producing more and better food at lower cost through genetic improvements.

Output 2: Beans that are more productive in smallholder systems of poor farmers
Output 2 on improving yields through control of diseases and pests, tolerance to abiotic stresses is likewise housed in SP 2.

Output 3: Beans that respond to market opportunities
Under output 3, there is potential to contribute to Priority Area 3A: Increasing income from fruits and vegetables, through the improvement of snap beans for both Africa and Latin America. Furthermore, under output 3 the bean team collaborates with marketing specialists (Priority Area 5B).

Output 4: Strengthened institutions that enhance bean product development and delivery
Output 4, strengthening national institutions (Priority Area 5A) continues to be important focus, both in Africa where novel institutional arrangements and relations have been productive to achieve wide impact, and in Latin America where staff reductions have weakened national programs. On both continents national programs seek support to incorporate modern selection techniques.

Outputs Description

Changes from previous MTP Outputs

After the reorganization of the 2008-2010 MTP, its approval by the CIAT Board of Trustees and the Science Council, and a positive review of CIAT's bean research by the EPMR in 2007, no major changes have been introduced into the outputs.

Output 1: Beans with improved micronutrient concentration that have a positive impact on human health

Description:

o Research activities: Breeding for higher iron and zinc concentration using intraspecific and interspecific crosses; characterization of GxE and crop managements effects on grain

mineral concentration; gene tagging for iron and zinc concentration; interaction with nutritionists on bioavailability and bioefficacy.
o Comparative and complementary advantage: Trained teams of assistants and workers for large scale breeding; laboratory facilities for mineral analysis (atomic absorption and NIRS); genetic resources; environments for management of interspecific crosses.
o How priority goals are addressed: Research is carried out under the HarvestPlus CP and associated projects. Standard breeding techniques are employed, combined with laboratory analyses of grain in several generations. Products are channeled through seed systems including partners with specific health interests.
o Contributing partners: NARS in Latin America: Mexico, Guatemala, Honduras (including EAP-Zamorano), El Salvador, Cuba, Brazil, Venezuela, Bolivia, and Colombia. NARS in East, Central and Southern Africa, including Kenya, Rwanda, Uganda, Tanzania; ARIs in Canada (U. Sascachewan) and USA (USDA-Cornell).

Output 2: Beans that are more productive in smallholder systems of poor farmers

Description:

o Research activities: Breeding for abiotic stress with emphasis on drought, aluminum toxicity and low soil P, including intraspecific and interspecific crosses and gene expression on first two priorities. For biotic constraints, maintenance breeding to sustain gains in viral and fungal resistance, plus emphasis on breeding for resistance to soil borne pathogens.
o Comparative and complementary advantage: Trained teams of assistants and workers for large scale breeding, and for physiological analysis (both greenshouse and field); genetic resources; environments for management of interspecific crosses
o How priority goals are addressed: Research is carried out under the Generation CP and associated projects. Standard breeding techniques are employed, combined with physiological analyses. Products are channeled through seed systems including diverse partners.
o Contributing partners: In Latin America, Mexico, Guatemala, Honduras (including EAP-Zamorano), El Salvador, Cuba, Brazil, Nicaragua, Bolivia, and Colombia. NARS in East, Central and Southern Africa, with emphasis in DR Congo, Ethiopia, Rwanda, Kenya, Tanzania, Malawi, Uganda and Zimbabwe; University of Hannover-Germany; Catholic University of Leuven-Belgium.

Output 3: Beans that respond to market opportunities

Description:

o Research activities: Testing of canning quality as added value to agronomically selected lines; improvement for resistance to storage insects; breeding for disease resistance in snap beans.
o Comparative and complementary advantage: Trained teams of assistants and workers for large scale breeding, and for entomological and pathological analysis; access to researchers in market analysis.
o How priority goals are addressed: Communication channels with private sector identify opportunities. Industry processing applied to elite lines. Products channeled through seed systems.
o Contributing partners: NARS in Latin America: Honduras, Nicaragua. NARS in Africa: Ethiopia and Uganda.

Output 4: Strengthened institutions that enhance bean product development and delivery

Description:

o Research activities: Seed systems including diffusion options studied and tested; participatory research methods, especially breeding, adapted; methods developed and applied for participatory M&E.
o Comparative and complementary advantage: More than 25 years experience in seed system research; capacity to take regional overview in comparative studies.
o How priority goals are addressed: Research is carried out under the regional networks in Africa. A project executed by ICRISAT on behalf of the Bill and Melinda Gates Foundation includes an explicit component on seed system research.
o Contributing partners: all NARS in East and southern Africa; NARS in Central America, the Caribbean, the Andean zone.

Output 5: More than 35,000 accessions are conserved, documented and available for distribution

Description:

o Research activities: Standard conservation activities contribute to long term storage of over 35,000 samples of common bean and relatives. Exploration, evolutionary, and taxonomical studies continue, especially on P. dumosus, P. persistentus, P. costaricensis and P. albescens, as support to potential use of genetic resources in breeding.
o Comparative and complementary advantage: CIAT holds the world collection of Phaseolus beans, now of 35,683 accessions for 44 taxa. GRU currently gives support to research ongoing in UC-Davis, Montana State U, UNAM-Mexico, Bari- Italy, Cork-Ireland, Kew-United Kingdom, and has germplasm safety duplication and common bean registry in progress with USDA Pullman and NBGB Meise.
o How priority goals are addressed: CIAT GRU is partner in the Project Rehabilitation of International Public Goods - Upgrading the CGIAR Genebanks Phase 2, as implemented through the Systemwide program SGRP. Other priority goals are addressed through regional efforts, for instance, explorations with national partners.
o Contributing partners: Universidad Nacional de Colombia, Bogota, Colombia; Universidad de Costa Rica, San Jose, Costa Rica; University College, Cork, Ireland; Herbaria of: Brussels, Guatemala, Leiden, Madison, Michigan, Mexico, Philadelphia and Wisconsin.

Impact Pathways by Output

Output 1: Beans with improved micronutrient concentration that have a positive impact on human health
Output 1 is targeted to small farmers and poor rural and urban consumers in Africa and Latin America. Targeting is developed in collaboration with nutritionists and with experts in GIS, to address human populations with nutritional deficiencies in iron and zinc. This Output involves both small seeded germplasm that is often targeted to warmer climates or more difficult environments in Central America, Mexico, Venezuela, East Africa and Brazil. Large seeded germplasm is usually cultivated in more temperate climates in the Andean zone, the East African highlands and southern Africa, although in the African highlands small and large seeded types overlap, sometimes differentiated by soil fertility gradients within the farm, prevailing biotic constraints and household preferences. Improved germplasm is shared or developed jointly with NARS partners, who supply basic seed to a range of organizations interested in production of seed (local seed companies, NGOs, CBOs, women's groups) who

in turn distribute to farmers. NGOs and health workers play a special role in delivery. Benefits accrue to farmers/consumers through stable food supply of more nutritious beans for home consumption, and potentially to poor urban consumers. Assumptions for the successful delivery of these Outputs include institutional and financial stability of partners, political stability, and institutional support. The role of CIAT is that of a primary research provider (of improved germplasm), at times a secondary research provider (backing up national bean improvement programs with technical expertise and training), and catalyser (to promote downstream alliances in the uptake chain). This Output is complementary to those of CIMMYT and CIP.

Output 2: Beans that are more productive in smallholder systems of poor farmers
Beneficiaries of Output 2 are in some cases researchers (both inside and outside of CIAT), and in some cases are bean producers. For example, molecular markers for resistance genes benefit researchers directly, and farmers indirectly as subsequent beneficiaries. Uptake pathway for such methodologies is direct communication through workshops and courses, and indirectly through publications, leading to benefits of more efficient and effective bean research. This assumes that partners are in a position to implement such technologies. On the other hand, crop management practices are of direct benefit to farmers as users, potentially across all bean ecosystems. Uptake chain for agronomic practices are similar to those for seed based technologies; results are communicated to NARS and other partners (NGOs, CBOs etc) who have successfully diffused practices to farmers, to the benefit of farmers who enjoy more stable productivity. Improved germplasm is diffused through many of the same channels as beans with improved nutritional value, with the exception that partners may have less specific interests, and may be more production oriented. The role of CIAT is that of primary source of research for development.

Output 3: Beans that respond to market opportunities
Output 3 benefit small farmers in both Latin America and Africa. Farmers in Ethiopia have already benefited from tapping into export markets for canning beans, and other countries are positioning themselves to follow suite. In Central America exporters are seeking to fill a niche created by the Latin population in the USA. This is a demand-driven activity, and in large part has generated its own impact pathway. Exporters and international grain buyers have established market chains that give them access to export quality beans. CIAT's role has been that of supplying germplasm in some cases, and in others to facilitate communication, and to give support in seed systems to avail quality seed to farmers of very specific varieties.

Output 4: Strengthened institutions that enhance bean product development and delivery
Output 4 seeks to benefit partners at multiple levels through facilitated interaction, including farmers who are at the end of the organizational chain. NGOs, government extension agencies, farmer organizations, local seed companies, and non-conventional seed actors such as women groups, people living with HIV/AIDS and tobacco companies all participate and benefit. The Output will generate impact on target beneficiaries through their participation in development of innovations, knowledge and technologies in strategic alliances with multidisciplinary research teams and NGOs. Scaling out of innovations and best practices to areas with similar environments will be done through strategic alliances of research and development actors. The latter will use their network and other communications mechanism to adapt knowledge and results relevant to them. Scaling up regionally and internationally will be done through international NGOs, advocacy, and communication. The outcome is enhanced communication and complementarity of actors with resulting cost efficiencies, and in the case of technology diffusion, increased and diversified adoption. Another dimension of this Output is support to NARS in development of projects, benefiting national program researchers and with the outcome of their integration into the Output line research mode. This assumes a degree of consistency in partner

personnel, while CIAT's role is that of facilitator.

International Public Goods

The IPG of the bean Output line include:
o Improved germplasm with biotic and abiotic stress tolerance, and/or enhanced nutritional value, drawing upon the genetic resources of CIAT's extensive gene bank, pathogen isolate collections, and 30 years of experience in bean improvement. CIAT's geographical position and access to varied altitudes and research sites facilitates study and selection of germplasm.
o Improved practices for the management of pests and diseases, including monitoring of pathogen populations with modern molecular tools developed at CIAT.
o Knowledge and tools that contribute to the development and implementation of the above IPGs. For example, molecular markers for useful traits, developed with CIAT's in-house resources of genetic maps and markers. Knowledge of the structure of genetic resources housed in the gene bank, and ways to exploit them. Screening methods to identify biotic and abiotic stress resistant genotypes. Participatory breeding methods with varying degrees of involvement of farmers, traders and other key actors.
o Methods for networking, both formal among official sector researchers, and less formal among a broader range of partners, with special emphasis on research partnerships and on effective and sustainable seed systems reaching a large number of households.

Elaboration of Partners Roles by Output

Output 1: Beans with improved micronutrient concentration that have a positive impact on human health
NARS in Latin America, including those of Mexico, Guatemala, Honduras (including EAP-Zamorano), El Salvador, Cuba, Brazil, Colombia and Bolivia participate in the AgroSalud project to improve nutritional quality and productivity of bean. NARS in South America, including those of Colombia, Bolivia collaborate in the improvement of disease resistance of Andean bean with better nutritional quality under the AgroSalud project. NARS in East, Central and Southern Africa, including those of Kenya, Rwanda, and Uganda, Tanzania are partners in the improvement of nutritional qualities in large seeded Andean beans. Linkage funds finance a project with one Canadian university.

Output 2: Beans that are more productive in smallholder systems of poor farmers
Nicaragua and Honduras partner in breeding for drought tolerance. NARS in East, Central and Southern Africa including those of Ethiopia, Rwanda, Malawi and DRCongo, participate in the improvement for low soil fertility, productivity and drought. The University of Hannover, Germany participates in a project seeking to define physiological mechanisms of aluminum tolerance and drought resistance, which also includes Malawi and Rwanda. Catholic University of Leuven is a partner to improve nitrogen fixation technology. NARS in South America, including those of Colombia, Bolivia collaborate in the improvement of disease resistance of Andean bean. NARS in East, Central and Southern Africa, including those of Kenya, Rwanda, and Uganda, Tanzania are partners in the development of disease resistance, medium altitude climbing beans (MAC), and productivity in large seeded Andean beans. NARS in Honduras (Zamorano), Colombia, Uganda, Rwanda, share in the use of markers for MAS, especially for resistance. South Africa participates in pathogen characterization, evaluation and validation of resistance sources.

Output 3: Beans that respond to market opportunities
Partners in Latin America with specific attention to breeding market quality include NARS in Honduras and Nicaragua. NARS in Africa with active participation in canning beans include

those of Ethiopia and Uganda. Partners in the development of snap beans include a university in Colombia, and one in Kenya.

Output 4: Strengthened institutions that enhance bean product development and delivery NARS as above plus a wide range of NGOS, CBOS, farmers groups, women's groups, totaling over 300 direct-link partnerships, to make users aware of technologies and to get these technologies widely disseminated.
The ECABREN and SABRN bean networks coordinate nine NARS in East Africa and ten NARS in southern Africa, respectively. These networks participate in Outputs 1, 2, 3 and 4 with input from African NARS cited above, plus NARS in Burundi, Sudan, Zambia, Zimbabwe, Mozambique, Lesotho and Swaziland.

HarvestPlus Challenge Program: IFPRI, CIMMYT, and CIP are immediate collaborators in the CP and the AgroSalud (Latin American) nutritional improvement project, working in the same agro-ecological zones, while ICRISAT, IITA, IRRI, and ICARDA are indirect collaborators under HarvestPlus. ECABREN and SABRN networks in Africa also participate in HarvestPlus.

Generation Challenge Program: Partners include EMBRAPA-Brazil (2), INTA-Cuba (1), Pairumani (an NGO) in Bolivia (2), National University in Colombia (2).

Sub-Saharan Africa Challenge Program: ICIPE, AHI and NARS in Rwanda, Uganda and D.R. Congo are immediate partners.

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Beans with improved micronutrient concentration that have a positive impact on human health			NARS, farmers & consumers in Central America, the Caribbean, Brazil, East and Southern Africa	Adoption of improved varieties by farmers	Better nutritional status, especially of rural consumers
	Output Target 2009: 50 improved lines with varietal potential and 80 ppm iron (ie, 60% more iron)	Materials			

	Output Target 2009: 15 new large seeded climbing beans with high mineral trait (HarvestPlus)	Materials			
	Output Target 2010: Marker assisted selection for one nutritional trait (iron) tested	Practices			
	Output Target 2010: Two large seeded lines with 50% more iron enter formal varietal release process in eastern Africa	Materials			
	Output Target 2010: 15 Andean advanced bush lines with high mineral trait (HarvestPlus)	Materials			
	Output Target 2011: Four micronutrient dense bean varieties disseminated and promoted in two countries in eastern and southern Africa	Materials			
	Output Target 2011: 20 F3.5 small seeded families with 100% more iron	Materials			
Output 2: Beans that are more productive in smallholder systems of poor farmers			Breeders and patholo gists in CIAT and NARS; farmers in E and S Africa, Andean zone, Caribbean	Adoption of improved varieties by farmers; Best bet IDPM practices and genetic combination s for stable resistance deployed.	More stable produc-tion, food availability and income

	Output Target 2009: An IDM system for bean root rots implemented and promoted in 2 major bean producing countries in Africa	Capacity			
	Output Target 2009: At least 30 lines combining drought resistance with resistance to BCMNV, , andr ALS available for testing in Africa	Materials			
	Output Target 2009: 2 molecular markers linked to ALS and Pythium root rot implemented in MAS	Materials			
	Output Target 2010: Resistance genes for anthracnose or ALS introgressed into 5 BCMNV resistant climbing beans	Materials			
	Output Target 2010: At least 10 genotypes combining drought resistance with aluminum resistance available for testing in Africa	Materials			
	Output Target 2011: Molecular markers for bc-3 linked in coupling identified	Materials			
	Output Target 2011: 10 interspecific lines with resistance to root rots with varietal potential	Materials			

	Output Target 2011: 5 interspecific lines that combine aluminium resistance with drought resistance with varietal potential	Materials			
Output 3: Beans that respond to market opportunities			NARS in Africa and Latin America	Adoption of commercial varieties by farmers, enhancing access to markets	Higher income, especially for the poor and women farmers
	Output Target 2009: At least 3 snap bean lines with resistance to rust and quality characteristics preferred in regional and export markets for Africa.	Materials			
	Output Target 2009: 4 bean genotypes with very high commercial or export quality made available to farmers in 4 countries in Latin America and Africa	Materials			
	Output Target 2010: 5 canning bean lines with acceptable quality characteristics in yield trials in two countries in eastern Africa	Materials			
	Output Target 2011: Classification of bean environments in at least 1 country in East Africa for environmental effects on quality traits.	Capacity			

Output 4: Strengthened institutions that enhance bean product development and delivery			NARS in Africa and Latin America	Improved institutional performance by NARS, NGOs and other partners, reflected in more effective technology development and dissemination	More stable production, improved food availability, income and nutrition, especially for the poor and women farmers
	Output Target 2009: A guide for mainstreaming and sustaining wider impact, developed and recommendations availed for 5 countries in East, Central and 4 countries in Southern Africa	Other kinds of knowledge			
	Output Target 2009: Three delivery channels strategies tested for reaching the poor and in marginal areas with new variety innovations and information	Capacity			
	Output Target 2009: At least 1 methodological frameworks/strategies for testing and evaluating multi-stakeholder networks and platforms (between private-public) for facilitating decentralized targeting for pro poor impact.	Capacity			

	Output Target 2009: Capacity to evaluate root sys tems in soil tubes established in Hon duras and Nicaragua	Capacity			
	Output Target 2010: Elements of Pro-poor seed delivery and production systems confirmed and such pro-poor seed enterprises established in 2 PABRA network countries.	Capacity			
	Output Target 2010: One strategy for wider utilization of non varietal bean technologies (IPM; soil management) developed and widely shared in 4 countries in Africa	Policy strategies			
	Output Target 2011: Nutritional network consolidated in Latin America	Capacity			
	Output Target 2011: Drought research infrastruc- ture firmly establi- shed in two countries	Capacity			
Output 5: More than 35,000 accessions are conser ved, docu mentted and available for distribution			Breeders, geneticists, and other bean scientists; national gene banks	Bean genetic resources are used directly or employed in breeding programs	More stable production , improved food availability , income and nutrition
	Output Target 2009: Another 1500 accessions conserved in long term storage and in back-up in CIMMYT	Capacity			

	Output Target 2009: Another 1000 samples of bean seed distributed	Materials			
	Output Target 2009: A plan formulated to establish a database of evaluation data	Policy strategies			
	Output Target 2010: Another 1500 accessions conserved in long term storage and in back-up in CIMMYT	Capacity			
	Output Target 2010: Another 1000 samples of bean seed distributed	Materials			

SBA2: Improved Cassava for the Developing World

Project Overview and Rationale

Project Overview

Cassava varieties, production systems and technologies for competitive and sustainable production and processing resulting in improved food security and higher income to farmers and rural communities.

Product lines:
o Technologies (from genetic stocks to cultural practices) for the sustainable production of cassava under resource limited farming systems of Africa, Asia and LAC.
o Technologies for the genetic improvement of the crop (from inbreeding, anther culture protocol and molecular markersfor MAS and transgenic products and protocols) to be shared with NARs and IITA.
o Development of high-value cassava clones for the food, animal feed, starch, or bio-ethanol industries.
o Sustainable and competitive value-adding technologies to maximize income and reduce the impact on the environment.

Rationale

Cassava is a very rustic crop that grows well under marginal conditions where few other crops could survive. Most cassava varieties are drought tolerant, can produce in degraded soils, and are resistant or tolerant to several of the most important diseases and pests. The crop is naturally tolerant to acidic soils, and offers the convenient flexibility that it can be harvested when the farmers need it. These characteristics make this crop a fundamental food security component in marginal agriculture lands. In addition to its important role in subsistence farming and food security, cassava is acquiring an increased role in rural development as source of raw material for many processing pathways. The most important uses of cassava are as a source of energy in animal diets in the feed industry, for the starch industry and, more recently, for the production of ethanol.

Cassava research at CIAT has traditionally focused in high and stable productivity through breeding and adequate cultural practices, which remains a fundamental goal for the varieties to be grown by resource-limited cassava farmers. However, there is an increasing interest in cassava as cash crop and processing it, from small, household operations up to large industrial ones, which not only require high and stable productivity but also would benefit from roots with specific properties. The globalization of economies and new technological breakthroughs offer a unique opportunity not previously available to the crop. Tropical production of maize is facing increasing problems to compete with maize from temperate regions. This situation has prompted government and private sectors of many tropical countries to turn to cassava as a competitive alternative to imported maize. In addition, advances in molecular biology, genetic engineering, plant-tissue culture protocols and processing technologies provide important tools that will allow bridging the main technological gaps between cassava and the cereals.

Our primary mission is to contribute to household and global food security in societies where cassava products are an important and traditional staple; to improve farmers income as well as those from rural communities and processing facilities; and to develop and promote sustainable production and processing systems. Our outputs are designed to adapt to the rapidly changing economic environment for cassava, its farmers and the communities that produce and/or process it. Cassava research at CIAT is aware of the cultural and ecological differences, challenges and opportunities that cassava offer in Latin America and the

Caribbean (LAC), Asian and African regions. There are three main approaches that have been implemented to face the new opportunities and challenges for cassava in the third millennium, which are described below. CIAT is aware that competition between cassava as raw material for different processing end-uses and its important food security role should be avoided. Processing cassava for large industrial facilities is occurring mostly in southern Brazil, Thailand, Vietnam or China where cassava is not an important food security crop. Nonetheless CIAT looks for a careful balance by the research team so the use new opportunities for cassava do not result in undesirable side effects compromising food security in rural or urban communities. We openly accept that the ultimate objective of the project is to turn cassava from a low-technology, subsistence crop into a cash crop that promotes technology adoption and offers better perspectives of improving farmers livelihood and reduction of poverty. This strategy is in full agreement with the conclusions of the Global Cassava Strategy initiative (FAO) and aligned with the strategies and priorities set by IITA as well.

Pre-breeding cassava. CIAT takes the advantage of hosting the cassava collection to screen it for useful traits. This activity resulted important discoveries, which in turn highlight the relevance of germplasm collection. Methodologies for the successful screening of landraces in germplasm collections have also been developed and shared with the scientific community.

More efficient breeding scheme. For cassava to remain competitive, a more efficient breeding scheme, particularly for low heritability traits such as yield, has been implemented. Changes introduced ranged from simple approaches such as the stratification of evaluation trials, quantification of general combining ability of progenitors, all the way up to sophisticated molecular approaches such as marker -assisted selection for resistance to the Cassava Mosaic Disease, which is not present in the Americas. In addition, Manihot gene pool is still largely unknown and needs to be further screened for an adequate exploitation of its genetic variability. Therefore an aggressive approach to screen the germplasm collection has been implemented.

Leading institution for development and application of biotechnology tools. In addition to the development and application of molecular markers which is already fully integrated into the breeding scheme, CIAT has assumed a leading role in the areas of genetic transformation, development of protocols for the production of doubled-haploids homozygous lines and efficient methodologies for in vitro propagation of clean planting materials

Qualitative traits. In addition to changes for a more efficient breeding system for quantitative traits, CIAT has shifted the objectives of cassava research to produce high-value cassava based on qualitative traits. The HarvestPlus program will produce clones with enhanced nutritional value particularly in relation to carotenoids. For the animal feed industry and human nutrition, increased protein content is the main objective. For the starch industry novel starch types are of huge economic relevance. Different strategies have been implemented to develop these novel types and recently yielded its first fruits with the discovery of the long sought after mutation for a waxy starch in cassava. For the production of bioethanol we are searching for a sugary cassava and other mutations that will reduce the costs of the fermentation process. Several promising mutations have been found and will be evaluated for their ethanol producing characteristics.

Sustainable and competitive production & processing. Cassava cultivation can lead to negative impact on the environment because it is typically grown in marginal environments, which are more susceptible to degradation; because it is grown by resource-limited farmers that have little flexibility or capacity to introduce sound agronomic practices that frequently increase production costs; and/or because of the scarcity of research that may contribute to

a more sustainable production of cassava. CIAT and the valuable intervention of CLAYUCA (Latin American Consortium for Cassava Research and Development) are conducting research to reduce the negative impact that cassava cultivation may have on the environment. This research has been particularly important in Asia where the introduction of contour hedgerows has been successful. In addition certain processing activities (such as starch extraction and modification) can have a negative impact on the environment, which in some cases can be reduced through research conducted at CIAT.

Alignment to CGIAR Priorities

CIAT's cassava project is housed principally under Priority area 2 (Producing more and better food at lower cost through genetic improvements). All the priorities listed within this area are considered by the project: Maintaining and enhancing yields and yield potential of food staples; Improving tolerance to selected abiotic stresses (in our case particularly drought, low-fertility and acid soils); Enhancing nutritional quality and safety (specifically cassava roots with enhanced protein, carotenoids, Fe and Zn); and genetically enhancing selected high-value species. The last priority somewhat relates to the concept of high-value cassava through the development of what could be considered a new crop such as sugary clones for the bioethanol industry. Cassava research at CIAT and CLAYUCA is also connected with Priority Area 4 (Promoting poverty alleviation and sustainable management of water, land and forest resources). Extensive research has been conducted for the last two decades to develop and promote sustainable production of cassava in Asia, particularly on sloped land (adequate fertilization and the use of hedgerows to prevent soil erosion). These activities can be seen as related to priority 4D (Promoting sustainable agro-ecological intensification in low- and high-potential areas). Our efforts to develop high-value clones relate to priorities 5B (Making international and domestic markets work for the poor); and 3B (Increasing income from livestock), for instance through the development of clones with enhanced nutritional value or developing systems for the competitive exploitation of cassava foliage for animal feeding. Cassava research at CIAT promotes conservation and characterization of staple crops (1A) and can be related to the conservation and characterization of underutilized plant genetic resources (1B).

Outputs Description

Changes from previous MTP Outputs

CHANGES (SINCE 2008-2010 MTP)
The new opportunities opened to cassava along with budgetary constraints have led the cassava product line at CIAT to reduce emphasis in worldwide breeding and emphasize more strategic pre-breeding activities to develop high-value genetic stocks that can be efficiently developed in spite of limited resources, or else would generate new resources to develop germplasm with enhanced nutritional quality. Other activities conducted at CIAT relate to more upstream research such as marker assisted selection, genetic transformation, identification of agents of biological control and ways to exploit them commercially, or development of new breeding methods such as the introduction of inbreeding through a protocol for the production of doubled-haploids (anther culture) also under development at CIAT. Validation and testing of new agronomic practices and the routine sharing of germplasm can be done by partners in Asia (basing our activities in Thailand and in close collaboration with the Department of Agriculture and Kasetsart University), Africa (where IITA plays an important role) and LAC (where CLAYUCA has proven to be key partner, in spite of its relatively recent creation). Therefore, the work related more to development, is conducted by these partners. The research conducted at CIAT will have to adapt to two

major changes that occurred recently: the increase in food prices and breakthrough developments in the development of the protocol for the production of doubled-haploid (homozgyous) cassava lines.

Output 1: Maintenance and distribution of accessions from the germplasm collection.

Description: This Output relates closely to the work conducted by the Genetic Resources Unit. Development of cassava genetic resources is a major activity within this product line. There are four categories of cassava genetic resources that CIAT develops and shares: a) relatively unimproved accessions from the germplasm collection which frequently are just old landraces; b) genetic stocks used as sources for specific traits that are the result of specific crosses or careful screenings; c) elite germplasm developed and evaluated for their adaptation to specific environmental conditions; and d) genes, gene sequences and molecular markers. One major competitive advantage that CIAT has is the benefit of the Manihot collection with about 6500 accessions including about 200 accessions from wild relatives. Manihot gene pools has been poorly screened and insufficiently exploited so far. Therefore the access to this wealth of genetic variability remains an important asset for CIAT, which is expected to benefit several of the outputs described below. Landraces of Manihot esculenta and other Manihot species proved to be important sources of high-value traits (such as high-protein in the roots), tolerance to abiotic (such as post-harvest physiological deterioration and drought) and biotic stresses (whiteflies, African Cassava Mosaic Disease, etc.) and they will be incorporated and delivered through the different product lines described herein. Landraces, genetic stocks and elite germplasm are routinely shared with NARs in Africa, Asia and LAC. IITA is an important bridge to introduce genetic variability for cassava research in Africa. Sharing of cassava germplasm is done only after the recipient has signed a Material Transfer Agreement form. This output is not only about providing services but also has important research components such as cryopreservation, development of molecular markers for diagnosis of diseases or the identification of duplicates in the collection and approaches for the proper preservation of genetic variability of wild Manihot relatives through true (botanical) seed.

Alignment to CGIAR Priorities: 1A: Promoting conservation and characterization of staple crops; 1B: Promoting conservation and characterization of underutilized plant genetic resources;

Output 2: Genetic stocks adapted to the most common cassava growing environments and their abiotic stresses, with emphasis in drought.

Description: This output describes the traditional breeding activities conducted by the project. A significant change in this activity has been the recent introduction of high-value traits in the list of objectives and this creates a connection with Outputs 1 and 3. Outputs 2 and 3 ultimately involve the same end-users but with varying emphases: national research programs; the processing sectors; cassava farmers and rural communities; and production chains. Whereas this is true for Asia and LAC, in the case of Africa, we have the strategic presence of IITA who actively introduce genetic variability generated at CIAT into African cassava germplasm. Another change in this activity is the recent introduction of molecular markers that allows CIAT to select for resistance to CMD and, therefore, makes the germplasm much more useful to NARs in Africa and India where the disease is present. Because of the diversity of environments where cassava is grown and the frequency of different production constraints, this germplasm has to have specific traits that allows it to adapt to these conditions characterized by biotic and/or abiotic stresses. The main outcome for this Output is the consolidation and strengthening of cassava based agriculture by

developing a germplasm that will allow for a high and stable productivity. A competitive production of cassava is a key factor to be able to compete with other commodities, typically (imported) maize, and allow for the transition of cassava from subsistence farming into a cash crop. CIAT is also developing technologies for properly identifying drought-tolerant cassava germplasm and from there to develop molecular markers that will facilitate its introgression and selection by NARs

Alignment to CGIAR Priorities: 1A: Promoting conservation and characterization of staple crops; 2A: Maintaining and enhancing yields and yield potential of food staples; 2B: Improving tolerance to selected abiotic stresses;

Output 3: Clones with high-quality traits for food, feed, starch and ethanol industries identified or bred.

Description: The end-users of this output are national research programs; the processing sectors; cassava farmers and rural communities; and production chains. The emphasis, however, are the processing sectors and production chains. A good example of the economic relevance of the outcomes of this output is when cassava is used as source of energy in animal feed (either from inter-specific crosses with Manihot tristis or from landraces of the germplasm collection). Its price cannot be higher than 70% of the price of maize. This is because of the lower protein content in the roots. A cassava clone with 8% protein in their roots (dry weight basis) would make the value of that root similar to that of maize (provided the quality of the protein was similar). The immediate consequences of deploying such cassava germplasm would be that the income of farmers will increase; the feed industry will be more interested in incorporating cassava roots in their feeds; and because there is an intermediate process (drying the roots) which typically takes place near the production fields, there will be enhanced economic activity in rural communities as well. IITA is an important partner for deploying this high-protein trait in Africa. Other high-quality traits that CIAT has succeeded identifying are: 1) Tolerance to post-harvest physiological deterioration (PPD) in inter-specific crosses with Manihot walkereae and from a mutagenized population. Cassava roots can be stored for up to three weeks without any visible symptoms of PPD; 2) Amylose free cassava starch; 3) High amylose/small granules mutation; 4) High carotenoids yellow cassava roots. This last type of cassava has been developed within the HarvestPlus initiative. CIAT has been very successful in the past few years increasing total carotenoids content: starting with a maximum of 8.5 g/g (fresh weight) in 2004, increasing successively up to 11.0; 13.0 and 19.2 g/g in years 2005, 2006 and 2007.

Alignment to CGIAR Priorities: 2C: Enhancing nutritional quality and safety; 3B: Increasing income from livestock; 5B: Making international and domestic markets work for the poor;

Output 4: Management of pests and diseases, likely to cause acute problems in large areas planted with cassava.

Description: Management of pests and diseases, likely to cause acute problems in large areas planted with cassava, has been an integral part of the cassava research at CIAT since its inception. There are three main type of products delivered through this output: sources of resistance to pests and diseases, agents for the biological control of pests and diseases; and diagnostic kits. The ultimate end-users of the results of this income are the farmers that grow cassava. However, the immediate beneficiary may be different. For the exploitation of genetic resistance to pests and diseases the breeding projects from CIAT, IITA and NARs are clearly the first one benefiting from these products. For approaches related to the biological control of diseases and pests NARs can promote their use but farmers can almost immediately benefit from implementing them. In addition to farmers rural communities benefit from the positive impact that these approaches have on the environment and human

health, by preventing or reducing the uses of agro-chemicals. These technologies also have a direct impact on the production costs and/or the sustainability of cassava productivity. CIAT's role is as a primary (in some instances as secondary) research provider. An interesting impact from this output could be a benefit to other crops grown in temperate regions. For instance, cassava is one of the few crops susceptible to white flies, which has genetic resistance to this pest. It is conceivable that the genetic source of the resistance can be identified, cloned and transferred to other crops so that an additional tool to control the pest of the century becomes available. This output reflects one of the main strengths that cassava research at CIAT has had since its creation: its integral approach. As more cassava is demanded by different processing facilities, larger areas and continuous growth for a constant supply of raw materials will be required. This in turn will certainly result in better conditions for pests and diseases to become more prevalent. An integral approach for cassava production will then become more relevant than ever. It has to be said that one of the challenges that cassava research at CIAT faces is the sharp weakening of our capacities in this area. Important progress in the area of cassava frog skin disease (CFSD) has been made.

Alignment to CGIAR Priorities: 2A: Maintaining and enhancing yields and yield potential of food staples; 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas;

Output 5: Organizational approaches, processing technologies and cultural practices for competitive and sustainable cassava production, processing and utilization systems.

Description: This output relates to cultural practices and processing approaches for a competitive and sustainable cassava production and/or processing. The expected impact is increased and more stable income and diversification of markets for cassava farmers (for example through improved nutrition and health of farm animals fed with cassava roots and foliage especially during the dry season); reduction of the negative impact on the environment of growing and/or processing cassava (for example by promoting hedgerows for the prevention of soil erosion or developing systems for processing industrial byproducts of agro-enterprises); and improved competitiveness of the bio-ethanol production based on cassava roots (for example optimizing the combination of germplasm and enzymatic processes or developing a decentralized production system). In addition to farmers, NARs are also beneficiaries because the participatory methodologies employed were introduced through this activity and is now used for other purposes. CIAT's role is as a primary (in some instances as secondary) research provider. Because of the very nature of this output, CIAT's role can also be envisioned as an advocate or catalyst for the development and deployment of sound agricultural practices. Assumptions for the successful delivery of these outputs include institutional and financial stability of partners, political stability, infrastructure, and institutional support. In the particular case of our operations in Asia, we are through an inter-phase because the scientist that has been working in cassava research during the last 20 years is close to retirement and a replacement (and the resources required for the position) will soon be needed. This output also relates to the activities conducted by CLAYUCA, which result in a productive and close collaboration between the two research groups. CLAYUCA also serves as a bridge between CIAT and NARs associated with CLAYUCA making available technologies and products to NARs. In this regard, therefore, CLAYUCA has been a key partner in the pathway to impact.

Alignment to CGIAR Priorities: 5B: Making international and domestic markets work for the poor; 5C: Improving rural institutions and their governance; 5D: Improving research and development options to reduce rural poverty and vulnerability;

Output 6: New breeding tools: genetic transformation, use of molecular markers, rapid multiplication and production of doubled-haploids

Description: New breeding tools: genetic transformation, use of molecular markers, rapid multiplication and production of doubled-haploids are closely linked to most of the previous outputs. For cassava to remain competitive, efficient breeding methods need to be developed and implemented. The intended users of this output are mostly NARs involved in cassava research. Eventually processing companies will make a significant jump and start using some of the technologies developed at CIAT. This is the case, for example, of starch companies in Colombia, Nigeria and South Africa, implementing rapid multiplication methods (including tissue culture protocols) for the production of clean planting material of elite germplasm. The product of this output is knowledge, which is shared with the intended beneficiaries through scientific publications, training courses, conferences and presentations at scientific meetings. An important vehicle is personal communication through internet, including CIAT Webpage. The products of this output range from introduction of inbreeding in cassava genetic enhancement and the development of a protocol for the production of doubled-haploids; the identification and use of molecular markers, tissue culture protocols for rapid multiplication and exchange of cassava germplasm, protocols and gene constructs for the genetic transformation of cassava. The outcomes of this output will be more efficient breeding system that will allow cassava to remain competitive in the global markets, but also a subtle consequence will be the stimulus for cassava breeders that a new era of advanced technologies has arrived for cassava. This is important because cassava is typically an undervalued crop within the NARs systems.

Throughout the many different activities the cassava research at CIAT and CLAYUCA are also paying special attention to the development of human capacity of its personnel and that of our collaborators. Training is achieved through individual visits, field days, demonstration plots, workshops, formal courses and scientific publications. These two institutions are committed to help cassava researchers, producers and processors world-wide gain access to all products and technologies developed.
Alignment to CGIAR Priorities: 2A: Maintaining and enhancing yields and yield potential of food staples; 2B: Improving tolerance to selected abiotic stresses; 2C: Enhancing nutritional quality and safety; 2D: Genetically enhancing selected high-value species;

Changes from previous MTP by output

Output 1: Maintenance and distribution of accessions from the germplasm collection.
The major change that affects the execution of this output is the implementation of the new SMTA agreement for the exchange of germplasm that affects all CG System centers.

Output 2: Genetic stocks adapted to the most common cassava growing environments and their abiotic stresses, with emphasis in drought.
There is no major change from the previous MTP except for the growing concern on climate change that further highlights the relevance of our work regarding drought tolerance.

Output 3: Clones with high-quality traits for food, feed, starch and ethanol industries identified or bred.
An important change from the previous MTP is the signing in March 2008 of an agreement between CIAT and Thai Tapioca Development Institute (TTDI) for the development of a waxy cassava variety for Thailand. Similar projects are likely to be developed for Colombia and, eventually, Brazil.

Output 4: Management of pests and diseases, likely to cause acute problems in large areas planted with cassava.
An increasing concern is the retirement of the two senior entomologists at CIAT and the departure of two pathologists (from the rice and forages program) that occurred during the last 12 month. Only one pathologist is left at CIAT (Elizabeth Alvarez from the cassava team) to attend to the four traditional commodities and tropical fruits in which she works actively.

Output 6: New breeding tools: genetic transformation, use of molecular markers, rapid multiplication and production of doubled-haploids
Breakthroughs in development of protocol for the production of doubled-haploids in cassava through microspore culture. Approval of field-testing of genetically modified cassava for enhanced carotenoids content.

Impact Pathways by Output

Output 1: Maintenance and distribution of accessions from the germplasm collection. Cassava is completing its domestication. This has important implications regarding the value of landraces. It has frequently been the case that landraces can be released as varieties. Contrary to developed crops like maize where landraces can hardly have any direct use in commercial production, there is still unexplored and therefore, unexploited genetic variability in the collection. NARs from Asia (particularly Thailand and China) have introduced large number of accessions from the collection to widen the genetic variability of their breeding populations. IITA also values openly the relevance of introgressing genetic variability into African cassava germplasm. Therefore, the impact pathways can be a direct release of a landrace as commercial varieties, widening the genetic base of breeding populations or else as a starting point for high-quality traits as described in Output 3.

Output 2: Genetic stocks adapted to the most common cassava growing environments and their abiotic stresses, with emphasis in drought.
Germplasm is shared through direct shipment of in vitro plants from elite germplasm identified in CIAT's breeding activities in the sub-humid, acid soils, or mid-altitude valleys environments. CLAYUCA has greatly facilitated the distribution of elite cassava germplasm through its stakeholders. In addition CIAT routinely produces and ships thousands of botanical seeds to NARs and IITA, who initiate evaluation and selection schemes with this seed. Assumptions for the successful delivery of these outputs include institutional and financial stability of partners, political stability, and institutional support. It is always a matter of concern the phytosanitary restrictions for the shipment of plants in vitro. The Cassava Mosaic Disease is not present in the Americas. The role of CIAT is that of a primary research provider of the improved germplasm or genetic stocks. At times, our role is of secondary research provider exploiting traits or elite germplasm developed (and generously shared) by NARs. Manihot esculenta originated and was domesticated in the region where CIAT is located. Consequently most pest and diseases have co-evolved with cassava in the region. This implies that CIAT has to be extremely cautious in the process of shipping germplasm outside the region by a thorough indexation process to prevent the shipment of pathogens and/or pests as well.

Output 3: Clones with high-quality traits for food, feed, starch and ethanol industries identified or bred.
The pathway to impact of high-value depends on the type of trait involved. For those related to high-protein source germplasm has already been shared with IITA. Other national programs have received (or will receive) these sources particularly through the Agrosalud project. PPD-tolerant germplasm will be introduced in Africa and has already been shared

with John Beechings Lab (University of Bath, U.K.). For the starch and bio-ethanol industries the successful negotiation with a consortium of Thai institutions for the development and deployment of a waxy-starch cassava variety adapted to Thailand (TTDI) illustrate not only a very direct pathway for impact, but also a novel one. The agreement implies a detailed scheme for deploying the germplasm on one hand, revenues for the cassava product line at CIAT on the other and the first example of large financial investment of the private sector in cassava germplasm development and enhancement. For the high-carotene germplasm they are currently used as source for the development of commercial varieties to be deployed (tentatively in year 2011) in Nigeria and D.R. Congo, the two target countries for HarvestPlus. High carotenoids cassava cultivars are also appealing to be deployed within Agrosalud in LAC and offer commercial advantages for the feed industry.

Output 4: Management of pests and diseases, likely to cause acute problems in large areas planted with cassava.
One interesting example of pathway to impact related to this output is the commercialization by a private company of different agents for the biological control identified at CIAT for major pests. However, the most typical pathway is through the sharing of germplasm with high degree of resistance to insects and pests. Recently, marker-assisted-selection for resistance to CMD for the deployment of germplasm in Africa with adequate levels and high frequency of resistance to the disease, has been successfully implemented.

Output 5: Organizational approaches, processing technologies and cultural practices for competitive and sustainable cassava production, processing and utilization systems.
Impact is attained through a close collaboration with NARs, particularly in Asia. Recently CIAT's agronomist in Asia received a high distinction in Thailand. He and the previous cassava breeder based in Thailand (K. Kawano) have been nominated for important prizes in recognition for their work in Asia, which has been supported by the Nippon Foundation for a number of years. In the case of LAC, CLAYUCA has been very successful positioning itself as an innovator particularly in the area of cassava post-harvest processing and interacting with other industrial processes in handling by-products.

Output 6: New breeding tools: genetic transformation, use of molecular markers, rapid multiplication and production of doubled-haploids
Most of the products related to this output will have indirect impact through facilitated breeding approaches either in work directly conducted at CIAT or by NARs and IITA. Of a huge relevance is the breakthrough success in overcoming a bottleneck in the process of developing doubled-haploids from microspore culture. The exine in the developing cassava microspore is very thick and did not let scientists to see through. This proved very difficult because it was not possible to identify treatments that promoted cell division and probably prevented any further development of multi-cellular structures by pure physical strength of the exine. By the end of 2007 CIAT cassava and biotechnology teams succeeded in digesting the exine. Now up to 30% success in the production of multi-cellular structures can be attained. Next step will be the regeneration of plants from these structures. When this happens a true revolution in cassava breeding will take place. Drastic changes in the genetic enhancement of the crop will be possible and the design of outstanding hybrids and predictable exploitation of heterosis finally a reality.

International Public Goods by Output

Output 1: Maintenance and distribution of accessions from the germplasm collection.
CIAT holds in trust under an agreement with FAO (Food & Agriculture Organization of the United Nations) the collection of cassava germplasm. The use of this germplasm and rights

to any and all Intellectual Property thereof are governed by the Trust agreement. Furthermore CIAT, as a recognized international organization, is bound by a number of International agreements and treaties, including, but not limited to the Convention on Biological Diversity.

Output 2: Genetic stocks adapted to the most common cassava growing environments and their abiotic stresses, with emphasis in drought.
Two kind of international public goods can be expected from these output. One is knowledge, particularly in relation to drought tolerance physiological traits and the other is improved germplasm adapted to the different environments with abiotic or biotic limiting factors.

Output 3: Clones with high-quality traits for food, feed, starch and ethanol industries identified or bred.
Except for the starch mutants, which are relevant for industrial processes, all genotypes are shared immediately with NARs and IITA, whenever they request them. In addition knowledge regarding processes and methodologies for the creation or identification of cassava genotypes with high-value traits is shared with the scientific communities through the publication of scientific articles and presentations at conferences. One very interesting and unique piece of information to be shared with the scientific community is the excellent response of cassava to the rapid cycling recurrent selection for increased carotenoids contents whose main results were described above.

Output 4: Management of pests and diseases, likely to cause acute problems in large areas planted with cassava.
As most of our activities there are two types of international public goods that the cassava team produces: 1) germplasm which is freely and actively shared with NARs and IITA; and 2) knowledge on processes and markers that are shared with the scientific community in publications and conferences.

Output 5: Organizational approaches, processing technologies and cultural practices for competitive and sustainable cassava production, processing and utilization systems. Knowledge, models for equitable partnerships.

Output 6: New breeding tools: genetic transformation, use of molecular markers, rapid multiplication and production of doubled-haploids
Most of the work related to this output turns around knowledge (i.e. protocol for the production of doubled-haploids, or sequence of a specific marker for marker-assisted selection or protocols for the production of transgenic cassava). This information is shared with the scientific community through scientific publications, presentations in meetings and, very importantly, through hands-on training in CIAT's facilities.

Elaboration of Partners Roles

A key partner for IP3 project is CLAYUCA with whom it interacts on a day-to-day basis, complementing or benefiting from its work and presenting join research proposals. This document does not mention specifically all and each one of the activities where CLAYUCA and IP3 collaborate but the reader should be aware of this close partnership.

Africa. IITA in Nigeria is a key partner in the deployment of knowledge and germplasm developed by CIAT in Africa. Since it is another CG Center we prefer not to mention their contributions to the different partnerships. National Research Programs of Africa include those of Tanzania (0.5); Uganda (0.5); Kenya; Ghana (0.5); Nigeria (0.5); Mozambique and South Africa. These countries contribute with access to field and laboratory facilities and, within parenthesis, the time of scientists directly involved with collaborative special projects.

Asia.Thailand: Department of Agriculture (0.25), Field Crops Research Institute (2) and Kasetsart University. Thai Tapioca Development Institute (TTDI) (2) Vietnam: Thai Nguyen University (1); National Institute of Soils and Fertilizers; Hue University of Agriculture and Forestry (0.25); and Institute of Agric. Sciences (1). China: CATAS Hainan (0.25). Laos: National Agric. and Forestry Research Institute (NAFRI) (1) and Provincial Agric. Forestry Offices (1). Cambodia: Cambodia Agric. Research and Developm. Inst. (CARDI) (1); Provincial Dept. Agric. For. Fish (1); CelAgric; C.J Cambodia Co. India: CTCRI (0.25). These countries contribute with access to germplasm, field and laboratory facilities and, within parenthesis, the estimated time of scientists directly involved with collaborative special projects.

Latin America and the Caribbean. Brazil: EMBRAPA-CNPMF (2); EMBRAPA-CENARGEN; IAC-Campinas. Colombia: CORPOICA (1); National University of Colombia (0.2);. Petrotesting (0.5); Venezuela: Agropecuaria Mandioca (0.5); Universidad Central de Venezuela; INIA (0.5). Cuba: INIVIT (0.5); and CLAYUCA (2). These countries/institutions contribute with access to germplasm, field and laboratory facilities and, within parenthesis, the estimated time of scientists directly involved with collaborative special projects.

Advanced Laboratories in Developed Countries. Wageningen University in The Netherlands (0.25); ETH Zurich, Switzerland (1); Ohio State University in USA; Danforth Center (0.5) in USA; Uppsala University in Sweden (0.25); Natural Resources Institute in England (0.5). Collaboration between CIAT and these Laboratories is in joint projects where a field worker or a post-doctoral fellow is involved.

Private Companies. National Starch Company (USA / UK). AVEBE Starch Company (The Netherlands); Corn Products (Colombia and Brazil) Cassava Starch Manufacturing Mill (South Africa); Nigeria Starch Mill (Nigeria); PETROTESTING (Colombia) (1); DESARGO Ltda (Colombia). In most cases, these companies have been supporting cassava research at CIAT and also benefiting from it. One assistant originally working under CIAT payroll is now paid by PETROTESTING to develop clones adapted to the acid soil environment specifically for the production of ethanol.

Elaboration of Partners Roles by Output

Output 1: Maintenance and distribution of accessions from the germplasm collection. Partners role is mainly as recipient of germplasm from the collection and technologies for properly evaluating it and extracting desirable traits. In addition partners periodically send new cassava accessions to be incorporated into the collection. This is, for example, the case of Indonesia (the richest country, regarding cassava variability, in Asia) who is in the process of sending about 200 new genotypes to be added to the collection.

Output 2: Genetic stocks adapted to the most common cassava growing environments and their abiotic stresses, with emphasis in drought.
An important part of the activities conducted for the execution of this output relate to two ongoing special projects within the Generation Challenge Program. Important partners in this initiative are EMBRAPA CNPMF (Brazil) and Cornell University (USA). IITA is also part of these initiatives which hope to identify sources for drought tolerance and resistance to pests and diseases, and transfer them to Africa through IITA.

Output 3: Clones with high-quality traits for food, feed, starch and ethanol industries identified or bred.
This particular output involves not only traditional partners like NARs but also the very relevant participation of the private sector industries which are the most direct beneficiaries

of the high-value traits (particularly starch and bio-ethanol industries). The role of partners is particularly to take advantage of the high-value traits and deploy them through the development of commercial varieties. -In addition we collaborate with BioCassavaPlus in the areas of high-protein and tolerance to PPD (particularly with University of Bath and ETH-Zurich/Shanghai). These two institutions will contribute for a better understanding of the molecular / biochemical causes of tolerance to PPD.

Output 4: Management of pests and diseases, likely to cause acute problems in large areas planted with cassava
As for other outputs, IITA is a relevant partner for this activity. Perhaps the best example of collaboration within the CG system is the successful deployment in Africa by IITA of agents for the biological control of the mealybug and mites identified by CIAT scientists and collaborators in LAC. The role of the partners is basically to introduce the sources of resistance into their breeding populations and to deploy them as commercial varieties. As it is frequently the case there is a very close and productive interaction with EMBRAPA-CNPMF (Brazil), exchanging germplasm (mostly from Brazil to CIAT), and knowledge. The valuable experience of three decades of research on cassava pests (A.C. Bellotti) is still highly appreciated in Brazil but remains a major problem to CIAT because of the time it is taking to replace this position.

Output 5: Organizational approaches, processing technologies and cultural practices for competitive and sustainable cassava production, processing and utilization systems. Members of CLAYUCA play an important role defining the research agenda. CIAT and CLAYUCA develop technologies that NARs and processing companies will incorporate into their activities or reaserch. Partners help identifying needs and opportunities for cassava to be a vehicle for reducing poverty.

Output 6: New breeding tools: genetic transformation, use of molecular markers, rapid multiplication and production of doubled-haploids
The role of the cassava project at CIAT in relation to the sixth output is mostly as primary research provider. Because of the strong links with partners there is a flow of information among us and, therefore, our role may also be of secondary research provider exploiting ideas developed by IITA and NARs. In the case of the activities related to the development of a protocol for the production of doubled-haploids there is an interaction with ETH (Zurich/Shanghai). CIAT role can also be to catalyze the promotion and incorporation of new ideas into cassava genetic improvement. Inbreeding cassava offers many advantages such as the identification of useful recessive traits, elimination of genetic load, making possible the implementation of back-cross, facilitated shipment and exchange of germplasm, facilitated genetic studies, etc. CIAT has been a pioneering research institution in the area of genetic transformation of cassava and is currently a member of a consortium involving several Advanced Research Laboratories in the USA and Europe to improve and apply this technology for the benefit of the cassava community. In the case of molecular markers, our role is clearly as a primary research provider. Of particular relevance is the fact that we can now select in Colombia for germplasm that is resistant to a disease not present in the Americas (CMD). This is very important because it facilitates greatly the flow of germplasm from CIAT to Africa, knowing in advance that it will possess a high frequency of clones with the critical trait for their survival in that target environment. Furthermore molecular markers facilitate the pyramiding of genes against the same disease or the accumulation of sources of resistance to different pests and diseases. Therefore, molecular markers are actually facilitating (even creating) a pathway for impact that allows NARs in Africa, as well as IITA, to introgress new genetic variability into their breeding projects.

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Maintenance and distribution of accessions from the germplasm collection.			Cassava scientists, breeders, geneticists, cassava networks and consortia, from both public and private sectors, interested in using cassava germplasm directly or in breeding or in other studies	o Cassava genetic resources are maintained for the future. o Genetic resources are better known and used. o High-value traits identified and exploited. o Training in conservation and exploitation of genetic resources.	o Useful traits identified and exploited for the benefit of farmers and processors. o Through genetic resistances to abiotic and biotic stresses, less negative impact on farm environment (less pesticides, less fertilizers). o Benefits of sharing germplasm support the International Treaty.
	Output Target 2009: 2009, 2010 and 2011 Accessions from the cassava germplasm collection maintained, made available, distributed to users following international standards (including certification to be free of frog skin disease) and	Practices			

	screened in search of useful traits.				
Output 2: Genetic stocks adapted to the most common cassava growing environments and their abiotic stresses, with emphasis in drought.			o National research programs and cassava farmers and communities in Nigeria, Uganda, Tanzania, Ghana, and India. o IITA Breeding Project. o Thailand (Kasetsart University).	o Increased productivity of cassava production systems from the introduction of elite cassava varieties from South America with CMD resistance. o Most important mechanisms for drought tolerance in cassava established. oIntroduction of germplasm in Thailand with high- and stable dry matter content	o Improved food security and processing opportunities for rural communities that depend on cassava. o Improved cooperation between CIAT and IITA. o CIAT germplasm more useful to cassava breeding projects in Africa and India. o Increased and stable income of cassava farmers and processing facilities.
	Output Target 2009: 2009, 2010 and 2011 Transfer of at least 300 CMD resistant, early dry matter yield, delayed PPD and/or high and stable productivity under drought, acid soils and/ or highlands cassava genotypes to National programs in LAC, Africa and/or Asia.	Materials			

Output 3: Clones with high-quality traits for food, feed, starch and ethanol industries identified or bred.			o Cassava breeding project in IITA. Scientists from national programs and universities in developing and developed countries. o Feed industry. o Farmers that use cassava on farm for animal feeding o NARs, private sector, processing companies and cassava farmers in Africa, Asia and Latin American and the Caribbean. Universities. o Advanced laboratories in developed countries. o Farmers of key regions in Nigeria and D.R. Congo. o Cassava breeding project at ITIA. o Cassava breeding projects Nigeria, D.R.	o Availability of high nutritional status cassava germplasm for evalua tion of its agronomic and nutritio-nal value. o Shift in breeding objectives and methods at NARs. o Protein quality in these high-protein clones determined. o Enhanced human capacity through training. o Enhanced interest of different processing industries in cassava.. o Apprecia-tion of the high-value traits concept o Specializa tion of cassa va farmers. o First steps for exploiting high-value traits through designed crosses o Demonstra tion of the usefulness of the prince-ples related	o Improved nutritional status of communities in target countries that rely on cassava as a staple o Enhanced industrial uses of the crop. o Stronger markets for cassava. " Rural development in cassava growing communities and reduction of poverty. o Alternative sources of financing cassava research in Africa, Asia and LAC. o Enhanced industrial uses of the crop. o Stronger markets for cassava. o Rural development in cassava growing communities and reduction of poverty. o Enhanced health of people consuming resistant starches, particularly

			Congo, Kenya, Tanzania, Ghana and Uganda	to HarvestPlus. o Bio-efficacy or bio-availability trials conducted.	those affected by diabetes o Improved nutritional status of communities in target countries that rely on cassava as a staple. o Demonstration of the power of traditional breeding approaches. o Enhanced collaboration with IITA.
	Output Target 2009: 2009 and 2010 30 genotypes with crude protein 2 standard deviations above the mean. Shipment to Africa of at least 50 genotypes combining high carotene or protein in the roots with CMD resistance. Shipment of botanical seed of high-protein genotypes to LAC and Asia. Production of new high-carotenoids clones.	Materials			

	Output Target 2009: 2009 and 2010 Identification and characterization of at least three new mutants for starch and/or root quality traits from the different strategies implemented. At least 500 new crosses made and evaluated to produce high-amylose clones.	Capacity			
	Output Target 2011: Deployment of the first bio-fortified cassava (high carotenoids content)	Materials			
Output 4: Management of pests and diseases, likely to cause acute problems in large areas planted with cassava.			o Breeders, entomologists and pathologists from national programs, IITA and universities in developping and developed countries. o Cassava farmers. o Curators of germplasm banks, breeders, pathologists and entomo-	o Better understanding and exploitation of the genetic variability in the Manihot gene pool. o Justification for the need of exploration & conservation of genetic resources. o Interaction with scientists working with other	o Proof of concept for cassava of the value represented by related Manihot species. o South-to-south collaboration o Improved health and productivity of cassava result in increased and more stable income of cassava

			logists from national programs, and universities in develop-ping and developed countries. o Farmers, researchers and private sector o Policy-makers, NGOs, farmer organiza tions, cassava researchers. o Smallhol-der farmers, local nurseries, national agricultural R&D agencies	crops o Molecular tools for detection. o Bioassays for trans-mission developed & implemented o DartT markers on genome-wid e basis for QTL mapping for molecular breeding. o QTL analysis of mapping populations for FSD resistance. o Diagnostic kits for the detection of FSD o Production of CFSD-free plantlets by thermal chambers. o Develop-ment and use of diagnostic kits for CFSD o Major gene QTL mapping of resistance to CFSD o Evaluation of elite clones for CFSD resistance	farmers and processing facilities. o Reduction in the negative impact on the environ-ment from the use of pesticides o Healthier cassava grown by farmers. o Enhanced exchange of germplasm. o Reduction of risk dissemina-tion of the disease in Colombia, LAC, Africa and Asia. Technologies available to these countries. o Wider and more rapid adoption and impact of preferred clones. o More effective targeting of germplasm leads to higher welfare and environment al benefits
	Output Target 2008: 2008 and 2009 Crosses no less than 7	Materials			

	wild Manihot species to introgress genetic variability in search of resistance genes for insects and diseases and development of at least one molecular marker for resistance to white flies.				
	Output Target 2010: Identification of the pathogen(s) and insect vector(s) responsible for the frog skin disease (FSD) and clones resistant to the disease.	Capacity			
	Output Target 2011: Technologies for detection and management of Frog Skin Disease (CFSD).	Other kinds of knowledge			
	Output Target 2011: A complete program of integrate management of CFSD, based on resistance, control of vector, host and inductors of resistant to the disease.	Other kinds of knowledge			

Output 5: Organizational approaches, processing technologies and cultural practices for competitive and sustainable cassava production, processing and utilization systems.			o Cassava agro-industrial projects in Asia, Africa and LAC. o IITA o Research and extensionists from NARs, cassava farmers and/or small scale processors in East Timor, Cambodia and Laos. o Small-holder farmers, Universities and NGOs in LAC, Asia and Africa o Private sector industries o Cassava projects for the produ-c tion of ethanol (from cassava and other starch crops) in Colombia and other countries in the world.	o Cassava foliage consolidated as a raw material for animal feeding systems. o Improved yields and more sustainable production of cassava in Laos, Cambodia, East Timor and Indonesia. o Promotion of balanced fertilization for cassava. o Enhanced engagement of farmers in all phases of the field-to-fuel value chain o Conversion rates from root to ethanol of at least 30 elite clones, including two starch mutations of reduction in production costs determined. o Enhanced human resources through training	o Higher income for cassava farmers. o Enhanced food security. o South-to-south cooperation o Reduction of the negative impact on the environ-ment of cassava cultivation, particularly in marginal sloped land. o Improved capacity of smallholder farmer organizations to participate in bio-etha-nol produc-tion chains o Reduced environmental impact o Rural development at village level o Market diversifica-tion for farmers. o Enhanced equity in the value chain o Higher economic value for cassava production systems.

	Output Target 2008: 2008 and 2009 Validation, under commercial conditions, of at least three productions systems for the production and exploita-tion of cassava foliage, inclu-ding the evaluation of at least five outstanding clones. Systematic evaluation of 20 elite clones to East Timor, Laos, Cambodia	Practices			
	Output Target 2010: Development, testing and dissemination of at least one decentralized approach to produce ethanol, based on enhanced participation of small-holder farmers in the value chain, two new mutants and at least 30 elite clones combined with at least 5 new enzymatic processes	Capacity			
Output 6: New breeding tools: genetic			o Scientists from Advanced	oCost-effecti ve markers aid breeding	o Improved nutritional status of

transforma-tion, use of molecular markers, rapid multiplication and production of doubled-haploids			Research Laboratories. o Ultimately farmers benefiting from more efficient breeding approaches o Scientists from Advanced Research Laboratories. o Field and molecular breeders from national programs, IITA and universities in develo-ping and developed countries.	for the transfer of root quality traits identified in wild relatives of cassava. o Enhanced identification of genes and genomic region for more efficient molecular breeding tool development o Better understandin g of cassava genome and more efficient breeding o Enhanced human resources through training. o Availability of high nutritional status cassava germplasm for evalua tion of its agronomic and nutritio nal value. o Introduc-tion of inbreeding in cassava is a key step for a more efficient breeding. o A true revolution in cassava genetic en-hancement.	rural and urban populations that rely on cassava as a staple o Cassava varieties with improved target traits by more efficient molecular breeding tool for people that rely on cassava as a staple o Faster and cost effective cassava breeding process by MAS and transgenic approach o Demonstra tion of the usefulness of genetic transforma-tion for enhancing nutritional quality of cassava. o Understan-ding of tissue specific promotors in cassava. o More efficient breeding methods leads to faster and more consistent genetic gains. o Increased and more

				o CIAT demonstrate its leadership in cassava research.	stable income of cassava farmers and processing facilities. o Enhanced food security. o Design of outstanding hybrids possible. o Heterosis properly exploited. o More dynamic exchange of germplasm between CIAT, IITA and NARs. o Faster and more consistent genetic gains. o Back-cross breeding scheme feasible highlighting the relevance of high-value traits.
	Output Target 2009: Development of markers associated with protein content and delayed PPD, from wild Manihot sp. Generation of 30,000 unigene full length cDNA collection that covers more than 50% of genes in	Capacity			

	cassava and development of cassava genomic database.				
	Output Target 2009: Results of the first field evaluation of transgenic cassava for enhanced nutritional quality.	Capacity			
	Output Target 2010: Production of at least 3 lines of homozygous tissue in the process of developing a protocol for the production of doubled haploids.	Capacity			
	Output Target 2011: Protocol for the production of doubled-haploids applicable to many different cassava genotypes.	Capacity			

SBA3: Improved Multipurpose Forages for the Developing World

Project Overview and Rationale

Rationale

Livestock development is recognized as a key element for increasing the income of poor smallholders given the increased demand for animal products that is being experienced in developing countries. Recent analysis indicates evolving market opportunities for forages as prices for alternative, mostly grain-based feeds are increasing and consumers request higher quality products. However, a high proportion of smallholder crop/livestock systems in the tropics are located in areas with prolonged dry seasons and with land in different stages of degradation. This leads to an inadequate supply of high quality feed for livestock in particular in the dry season. In addition, in many cases smallholders with livestock and limited land (i.e., in Southeast Asia) do not have easy access to fodder and have to walk long distances to harvest forages. On the other hand, tropical forages are one of the few opportunities available to a large number of smallholder farmers to produce high value or added value products, due to the fact that forages can be grown not only under favorable conditions but also in marginal environments. Improved tropical forages could play a key role in maintaining and improving agricultural productivity through their effects on soil fertility, restoring degraded lands, reducing deforestation and mitigating the effects of climate change. Thus, development and expansion of high yielding and high quality forages, particularly at the crop-livestock interface, can enable smallholders to be more competitive, with positive effects on poverty alleviation; improved food security and related effects on health are additional benefits. At the same time forages can contribute to nutrient cycling via animal manure, resource conservation and reversing land degradation, with further potential for adaptation to climate change through the provision of ecosystem services (e.g., carbon sequestration, inhibition of biological nitrification, improved soil and water quality).

To address the issues of scarcity of feed resources for livestock encountered by small producers and to capture emerging opportunities, the research portfolio of CIAT includes the Outcome Line entitled Improved Multipurpose Tropical Multipurpose Forages for the Developing World which is housed in the Sharing the Benefits of Agrobiodiversity Research for Development Challenge (RDC). The goal of the work on forages is to conserve and exploit the genetic diversity either the natural variation or through breeding of tropical grasses and legumes to improve the livelihoods of poor rural livestock producers. This is done by integrating improved forages in smallholder systems through linkages to traditional and emerging markets and by contributing to greater access of poor urban consumers to high quality animal products that are safe, while taking advantage of the potential of forages to enhance the natural resource base and provide environmental services.

To accomplish the objectives of the Tropical Forage Outcome Line, the research is being organized around three major outcomes: 1) Forage germplasm developed through selection and breeding, 2) Forages as high value products developed to capture differentiated markets for smallholders, and 3) Forages integrated into smallholder systems for realizing the benefits of improved grasses and legumes in crop/livestock (including cattle, small ruminants. pigs, and/or poultry) systems through adaptation, innovation and adoption, aiming at higher livelihood security through higher resource use efficiency.

Partnerships are formed with private seed industry, ARIs, universities and NARS to carry out strategic research to: breed Brachiaria hybrids; develop screening methods based on improved knowledge of mechanisms of adaptation of forage species to biotic and abiotic stresses; develop targeting, processing and evaluation techniques and employ operational research principles to define forages for specific production and market niches; and develop

improved and more sustainable crop/livestock and feeding systems using an innovation systems approach.

As an activity across outcomes to target and deliver our research products, we form partnerships with different groups to define environmental and market niches, document on-farm performance of released grass and legume cultivars, and quantify the impact of selected forages in improving livelihoods and protecting the environment.

Capacity building remains an important component of our agenda, to improve: a) our research capacity through pre- and post-graduate thesis research and strengthening/benefiting from the research capacity of partners, and b) our capacity to deliver research products in different environments. Capacity building includes group and individual training and activities in the area of knowledge management.

Alignment to CGIAR Priorities

Among the CGIAR Research Priorities (2005-2015), livestock is recognized as being crucial to improve the livelihoods of many poor rural and peri-urban farmers in tropical regions. It is recognized, however, that for poor farmers to capitalize on evolving commodity markets, there is a need to improve the availability of improved feed resources in areas of both low and high potential. This implies the challenge of developing forages capable of producing high quality biomass to feed ruminant animals in environments characterized by pest and disease pressures, low fertility soils, long dry seasons and/or poorly drained soils. Development of forage-based feeding systems for monogastric animals to complement existing home-grown feed resources and replace expensive commercial concentrates is also seen as an important research product to assure improved productivity and competitiveness of swine, poultry and fish production in smallholder systems.

To address the priorities of the CGIAR on livestock, the Tropical Forage Outcome Line of CIAT has the global mandate of developing forage-based technologies for extensive and intensive crop/livestock systems in diverse environments. Selected forages are expected to perform well in low fertility soils and to reduce seasonal variation in both feed quality and quantity and as a result reduce livestock mortality and increase productivity. In addition, grasses and legumes with broad adaptation to soils and climate in sub-humid and humid environments can contribute to better use of family labor (especially women) and to recuperate degraded soil/pastures in pastoral and crop/livestock systems through the capacity of grasses with deep root systems to improve physical structure of soils and of legumes to improve both soil structure and soil fertility through deep tap root systems and biological N2 fixation. Furthermore, improved forages, mainly legumes, contribute to i) soil improvement through improved soil organic matter quality thereby enhancing soil biological activity and below-ground biodiversity, and ii) nutrient cycling via improved manure quality thereby increasing productivity of subsequent crops.

The benefits of multipurpose forages are captured by forming strong research linkages with the RDC dealing with People and Agroecosystems, and with the TSBF (Tropical Soil Biology and Fertility) Institute of CIAT. These internal linkages together with external partnerships will contribute to better targeting of research products to environments and clients, thus facilitating improved and more equitable linkages of farmers to markets.

Specific activities carried out by the Tropical Forage Outcome Line to contribute to the CGIAR System Priorities (SP) are:

o Characterization of the genetic diversity in legume collections from the Gene Bank of CIAT,

other CG Centers and research institutions to select new alternatives with superior forage quality, yield and resistance to biotic and abiotic stress factors (SP 1b, 2b, 3b);
o Development of methodologies for screening forages for quality and major abiotic and biotic constraints (SP 2b);
o Breeding to develop superior grasses (Brachiaria) that combine quality attributes with adaptation to major abiotic and biotic constraints (SP 2b, 2c, 2d, 3b);
o Development of a molecular map of Brachiaria and discovery of genes associated with adaptation to abiotic stresses (SP 2b, 2d, 3b).
o Development of methods for evaluating forages in different production systems with farmer participation (SP 5b);
o Development of Data Bases and Decision Support Tools to help target forages to different environments and production systems (SP 5a);
o Income generation from livestock through improved forages for feeding ruminants and monogastric animals and improved equity in value chains (SP 3b, also 2c and 5b, and spillover effects on 3c);
o Analysis of trade-offs between use of legumes for soil enhancement or as animal feed resource on crop/livestock productivity and environmental quality (SP 4b); and
o Capacity building consisting of short and long term training of individuals, group training and knowledge management (SP 5a)

Outputs Description

Changes from previous MTP Outputs

To capture emerging market and research opportunities targeted to smallholder farmers, CIAT in 2007 refocused its forage research into the Tropical Forage Outcome Line entitled Improved Tropical Multipurpose Forages for the Developing World. The outcome line concept is now fully implemented. As stated in last years MTP this is an evolutionary change building on past experiences and competencies while responding to a changing external context. The products and outputs described in the former Mega Project entitled Tropical Grasses and Legumes: Optimizing Genetic Diversity for Multipurpose Use presented in the MTP 2007 - 2009 were maintained. However, they were reorganized under the newly defined outcomes, and from 2010 onwards will follow the new outcome line structure. The inclusion of targeting and delivery of research products, as integral parts across the new outcomes, and more concretely addressing emerging market opportunities for forage-based high value and added value products and livestock other than cattle (such as monogastrics), are receiving greater emphasis. To achieve the more focused targeting and delivery of research results, research work will integrate more strongly with the People and Agroecosystems RDC and emphasize current and new partnerships with the private sector and NGOs.

The major change in contrast to the MTP 2008 - 2010 is the revision of outcome 1, to include germplasm selection and breeding to develop superior forage options. While we continue our emphasis on breeding of Brachiaria grasses, the revision reflects better CIAT's work on selection of forage legumes and indicates opportunities for the selection and breeding of other forage grasses and legumes. CIAT intends to strengthen its work on forages and the environment. While recognizing that income generation to alleviate poverty remains the key driver in smallholder crop-livestock systems, environmental issues and resilience of systems become increasingly linked to achieve sustainable livelihoods. CIAT will capitalize on past and present accomplishments in the areas of abiotic stress physiology, soil-plant-animal relationships, nutrient cycling and biological nitrification inhibition to develop forward looking research for protecting the environment.

In 2008 we have consolidated our research for development activities, and our outputs are increasingly directed towards an outcome and market driven approach. In line with our mandate we are also strengthening the global reach of our work. Responding to the EPMR recommendations in 2007 we have recently employed a Forage Expert for Central America, and a Forage Expert for East Africa is being recruited, to be working with partners in the region by early 2009.

Budget limitations have required further prioritization of forage research and related consolidation of staff. However, funding for 2008 has stabilized, but as stated in last years MTP maintenance of core resources at the current level will be essential to deliver the outcomes stated in this document and also to respond to new challenges. Additional resources are sought to implement in consultation with other centers and partners our strategy in Eastern and Southern Africa to strengthen our work on the contribution of forages for more healthy agroecosystems. A key component in this approach is the improved collaboration with CIAT-TSBF, and the People and Agroecosystems RDC to integrate forages into production systems and to realize their economic and environmental benefits.

Impact Pathways by Output

Output 1: Forage germplasm developed through selection and breeding
To contribute to the improvement of livelihoods of poor rural livestock owners through high quality forages (outcomes 1 and 2) adapted to major biotic and abiotic constraints, forage researchers rely on natural genetic diversity from core germplasm collections housed in the Genetic Resources Unit of CIAT and other international and national centers. Artificial hybridization to create novel genetic variation is used when major limitations in successful commercial cultivars have been identified and when evaluation of large germplasm collections has failed to identify the required character combinations (e.g., spittlebug resistance and acid soil tolerance in Brachiaria). Screening methods and selected genotypes with superior forage quality, resistant to major pests and diseases and adapted to acid, low fertility soils, to poorly drained soils and to drought, are the outcome targets to be used by different partners engaged in research and development activities.

Output 2: Forages as high value products developed to capture differentiated markets for smallholders
To improve the efficiency of partners to better target forages to diverse environments, production systems and market niches, the forage team collaborates with the RDC on People and Agroecosystems to develop methods of participatory evaluation of forages, decision support tools and more effective and equitable market interactions. Selected forage genotypes are evaluated and disseminated with and by partners in different environments and production systems. The superior grass and legume genotypes are released and promoted by NARS and private seed companies, and adapted and adopted by farmers to intensify and diversify their production systems.

Output 3: Forages integrated into small holder systems
For its work in Sub-Saharan Africa, Southeast Asia and Latin America and the Caribbean, CIAT Tropical Forages Outcome Line is collaborating with ILRI and CIAT-TSBF, with complementary research priorities and expertise to integrate forages in diverse crop/livestock systems, particularly in Sub-Saharan Africa and Southeast Asia. This partnership and the interaction with the private sector have allowed us to amplify networks for delivery of research outcomes. Information sharing through knowledge tools such as SoFT (www.tropicalforages.info) reaches a wide audience ranging from researchers and

development practitioners to educational institutions, and complements our continued efforts of individual and group training. A particular objective for the revision of SoFT is the linkage of SoFT with forage germplasm distribution.

Adoption of new forage varieties results in more income to livestock farmers through more efficient use of land and labor, and more animal products for urban consumers, with impacts demonstrated in Latin America and the Caribbean and Southeast Asia.

International Public Goods

In the past a number of strong organizations in developed countries (e.g., Australia, USA) were involved in development of forages for sub-tropical and tropical environments. Currently the only suppliers of improved forages with an international mandate are CIAT, ILRI and ICARDA. The forage work carried out by these CGIAR Centers is complementary. For example, forages developed at ICARDA are mostly for the arid and semi-arid regions. ILRI is concentrating its work on maintaining and characterizing forage diversity, with forages integrated in systems through partners (including CIAT) along other feed components in Sub-Saharan Africa and Asia. Forages developed by CIAT are targeted for tropical lowlands and mid-altitude hillsides. EMBRAPA in Brazil is an additional important participant in tropical forage R&D, but with a national mandate.

The research products of CIAT's Tropical Forages Outcome Line are in line with the mandate of the CGIAR of producing international public goods (IPGs). The IPGs of the research products of the Tropical Forages Outcome Line can be grouped into the following categories:

1. Defining mechanisms/processes (to assist in the development of screening methods)
o Understanding how forage quality affects monogastric productivity and product quality
o Understanding how grasses resist pests (spittlebug) and diseases (Rhizoctonia)
o Understanding how forages adapt to acid soils with high levels of aluminum and low levels of phosphorus
o Understanding how forages adapt to drought and waterlogging
o Understanding how grasses inhibit biological nitrification in soil
o Understanding how and to what extent leguminous forages fix nitrogen and contribute to soil fertility and/or animal production

2. Developing screening and evaluation methods (to select improved genotypes)
o Forage quality (i.e., crude protein and in vitro digestibility) for ruminants and monogastrics
o Biotic constraints (i.e., spittlebugs and Rhizoctonia foliar blight)
o Abiotic constraints (i.e., adaptation of forages to low soil nutrient status and high Al; adaptation to drought and to poorly drained soil conditions)
o Selection of forages by farmers using participatory methods

3. Developing superior grass and legume genotypes and cultivars (for increasing livestock productivity and protecting the environment)
o Grasses and legumes selected from germplasm collections that have broad adaptation to environmental factors prevailing in target areas and with multiple functions in crop/livestock production systems
o Grasses and legumes with high forage quality and combined resistance to biotic and abiotic constraints
o Accessing new forage genetic resources remains of high priority though it is severely constrained under the current writing of the International Treaty and the Convention on Biological Diversity

o Understanding trade-offs between use of forages for soil enhancement or as animal feed

4. Targeting and delivery of research results through dissemination of forage germplasm and decision support tools
o Documented conservation and distribution of germplasm by the Genetic Resources Unit, with support for larger quantities of seed of selected materials from the forage seed unit.
o Protocols for indexing diseases of quarantine importance that limit the flows of germplasm between LAC, Africa and Southeast Asia
o Decision Support Tools with information on adaptation, uses and management of different forage species

Elaboration of Partners Roles

Through partnerships with different organizations from developed and developing countries, the Tropical Forage Outcome Line conducts research to develop improved grasses and legumes as feed resources. In what follows we present some key partnerships and the nature of the work being done as it relates to the three outcomes of the Tropical Forage Outcome Line shown in parenthesis.

1. Cambodia DAHP, DA Kampong Cham and RUA: (Outcome 3) Improved feeding systems for more efficient beef cattle production in Cambodia. Funds from ACIAR via UNE.

2. Colombia MADR IICA FEDEGAN: (Outcome 3) Development and use of forage resources for improving competitiveness and productivity in sustainable livestock production systems for the Cauca department in Colombia. Funds from MADR.

3. Colombia MADR: (Outcome 3) Implementation and transfer of technologies for restoration of degraded pastures for beef production systems in the departments of Córdoba, Sucre and Atlántico. Funds from MADR.

4. Colombia Universidad de Cauca, Fondo Ganadero del Cauca: (Outcome 3) Increase of productivity, competitiveness and sustainability of small and medium livestock producers in the watersheds of Patía and plateau of Popayán. Funds from MADR.

5. Australia CSIRO and QDPI; Germany U of Hohenheim; ILRI and FAO: (Outcome 3) Development of a tool - Selection of Forages in the Tropics (SoFT). Funds from ACIAR, DFID and BMZ.

6. Costa Rica SIDE; Guatemala ICTA and MAGA; Honduras DICTA; Nicaragua IDR; IICA and ILRI: (Outcome 3). Analysis of the beef chain in Central America. Funds from CFC.

7. Colombia CORPOICA-CVS-CARSUCRE-GANACOR-FEGASUCRE: (Outcome 3). Recuperation of degraded pastures. Funds from MADR.

8. France ANR: (Outcome 3) Biodiversity and environmental services at landscape level in the Amazon. Funds from ANR.

9. Germany CIM: (Outcomes 1 to 3) Forage Conservation and Feed Systems for Monogastrics; Forage experts for Central America and Eastern Africa. Funds from BMZ and CIM.

10. Germany U of Hohenheim; Colombia CORPOICA and U del Cauca, (Outcomes 2 and 3)

Development of multipurpose forage legumes for smallholder crop/livestock systems in the hillsides of Latin America. Funds from Volkswagen Foundation.

11. Germany U of Hohenheim; Nicaragua INTA; Honduras DICTA: (Outcomes 2 and 3) Demand-Driven Use of Forages in Fragile, Long Dry Season Environments of Central America to Improve Livelihoods of Smallholders. Funds from BMZ.

12. Germany U of Hannover; Nicaragua INTA: (Outcome 1) Developing Brachiaria hybrids with combined resistance to drought and aluminum toxicity. Funds from BMZ.

13. Honduras and Nicaragua MIS Consortium: (Outcome 3) Quesungual Slash and Mulch Agroforestry System (QSMAS): Improving Crop Water Productivity, Food Security and Resource Quality in the Sub-Humid Tropics. Funds from IWMI.

14. Lao PDR National Agriculture and Forestry Research Institute; Australia Queensland Department of Primary Industries and Fisheries; Canada Nutrition Prairie Swine Centre, Saskatoon: (Outcome 2) Forage legumes for supplementing village pigs in Lao PDR. Funded by ACIAR.

15. Mexico PAPALOTLA Seed company and national partners: (Outcome 1) Breeding and evaluation of Brachiaria hybrids. Funds from PAPALOTLA.

16. Switzerland ETHZ; Nicaragua INTA: (Outcome 3). Improved feeding systems for dairy cattle in tropical smallholder farms. Funds from ZIL-SDC.

17. Switzerland ETHZ; Nicaragua INTA: (Outcome 3). Realizing the benefits of cover crop legumes in smallholder crop/livestock systems. Funds from ZIL-SDC.

18. Switzerland ETHZ; Nicaragua INTA; ILRI-Colombia: (Outcome 3). Trade-off analysis of using legumes for soil enhancing or as animal feed resource. Funds from Systemwide Livestock Program (SLP).

19. Thailand World Vision Khon Kaen University: (Outcome 3) Improving the reliability of rain-fed, rice/livestock-based farming systems in North East Thailand. Funds from ACIAR via WorldVision.

20. Viet Nam ILRI, National Institute of Animal Husbandry and Tay Nguyen University: (Outcome 3) Enhancing livelihoods of poor livestock keepers through increasing use of fodder. Fund from IFAD via SLP.

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Forage germplasm developed through selection and breeding			CIAT and NARS researchers and seed companies	New forage cultivars (Brachiaria and legumes)	Increased efficiency of livestock production through

				are released by partners and adopted by farmers in LAC, Asia and Africa	feeding high quality grass and legume options
	Output Target 2009: At least 2 apomictic Brachiaria hybrids that combine high digestibility (>60%) and crude protein (>10%) with spittlebug resistance developed	Materials			
	Output Target 2009: At least 5 Brachiaria hybrids that combine resistance to spittlebugs with adaptation to acid soils released for regional testing	Materials			
	Output Target 2009: At least 5 Brachiaria hybrids with combined resistance to spittlebugs and tolerance to waterlogging developed	Materials			
	Output Target 2009: Diversity and agronomic value of a collection of Dendrolobium spp. assessed	Capacity			
	Output Target 2010: Screening method for selecting Brachiaria hybrids for combi-ned adaptation to drought and aluminum toxicity developed	Practices			

	Output Target 2010: One apomictic hybrid with phenotype similar to cv. Basilisk (stolonife-rous, spreading) with good spittle-bug resistance in advanced testing for commercial release	Materials			
	Output Target 2010: Two legume options for smallholder pig and poultry systems identified	Materials			
	Output Target 2011: A range of improved Brachiaria cultivars commercially available	Materials			
	Output Target 2011: At least 5 new Brachiaria hybrids with combined adaptation to drought and aluminum toxicity developed	Materials			
	Output Target 2011: Diversity and agronomic value of a collection of Tadehaghi spp. assessed	Capacity			
Output 2: Forages as high value products developed to capture differentiated markets for smallholders			CIAT and NARS researchers, and seed companies	New stress adapted cultivars of Brachiaria and high quality legumes with resistance to prevalent pests and	Improved livelihoods of small-holder farmers through increased efficiency of livestock production, return from

				diseases to capture emerging markets are released by partners and adopted by farmers in LAC and Southeast Asia	labor and income through planting forage grasses and legumes that are adapted to major production constraints and market opportuni-ties
	Output Target 2009: Methodology to correlate in vitro and in vivo scree-ning of legumes for monogastric utili-zation developed	Capacity			
	Output Target 2009: At least 3 legume varieties with high nutritio-nal qualities, capa-ble of improving village pig produc-tion in extensive production systems by at least 30% identified	Materials			
	Output Target 2010: Supplementation of village pigs with the legume Stylosanthes guianensis is practiced by at least 1,000 small farm households through effective partnership with government and donor-funded development projects in Laos	Capacity			

	Output Target 2010: At least one forage based feed for monogastric production adopted by smallholders in countries in Latin America and the Caribbean and/or Sub-Saharan Africa	Capacity			
	Output Target 2011: Alternative feed options tested in smallholder beef systems tested in 2 hillside regions in LAC	Capacity			
Output 3: Forages integrated into small holder systems			CIAT, ARIs and NARS researchers, and seed companies	New cultivars of Brachiaria and legumes with adaptation to production constraints released by partners and adopted by farmers in LAC, Asia and Africa	Increased profitability and sustainability of livestock/crop production and improved NRM through planting multipurpose forage species adapted to production constraints and climate change
	Output Target 2009: A revised version of SoFT (Selection of Forages for the Tropics) to target forages to different niches released	Other kinds of knowledge			
	Output Target 2010: Production vs environmental trade-offs determined between use of 2 cover legumes as feed supplement	Policy strategies			

	and for soil fertility improvement in maize-based systems in one hillside region				
	Output Target 2010: Production and soil quality improvement benefits from introducing 2 multipurpose forage grass and legume options to restore degraded pastures quantified in one savanna region	Materials			
	Output Target 2011: Contribution of nitrogen from a cover legume (Canavalia brasiliensis) to maize-bean system quantified in one hillside region	Materials			

SBA4: Improved Rice for Latin America and the Caribbean

Project Overview and Rationale

Rationale

There are opportunities for growth in the LAC rice sector, because land and water are more abundant than in other rice growing regions with more open markets and reduced production costs, LAC could became a major supplier in world rice markets. The Rice Outcome Line will focus on strengthening the rice sector, in the low and mid altitude regions of Latin America and the Caribbean. We concentrate great part of our activities on developing advanced materials with broad genetic diversity that incorporates a range of grain quality traits and resistance to the pest and diseases common in this region. Our rice breeding activities are for both irrigated and upland rice, focused on problems that are regionally important, especially in the area of pest and diseases. Many of these constraints are unique to Latin America and the Caribbean. On the other hand, climatic and soil conditions, consumer preferences, and social and cultural practices are different from those prevalent in Asia and Africa. To increase the genetic diversity of rice, we work with interspecific crosses, composite populations and we are developing biotechnology tools that allow the incorporation of traits more efficiently. These activities are generating both segregating populations and advanced lines, which are transferred to partners through either bilateral agreements or networks including FLAR, GRUMEGA, AgroSalud, and INGER. Jointly with the Biotechnology Research Unit and in collaboration with JIRCAS (Japan), gene technology is being explored as an alternative to incorporate increased efficiency in water use for the irrigated rice ecosystems targeting reduction of water consumption. Strategic research on nitrogen use efficiency and rice hybrids in collaboration with FLAR and IRRI will be initiated.

The CIAT Rice team is conducting research that is complementary to research carry out by both IRRI and WARDA. Through the Generation Challenge Program (GCP) and Harvest Plus (HP+) we have linkages with both of them, especially in the development of breeding populations via the utilization of wild rice species. IRRI has a long and successful history in the characterization, classification and utilization of wild rice species where a series of interspecific hybrids between rice and almost all wild rice species have been produced. This material is very useful as cytogenetic and genetic tools. One example of the introgression of a useful gene from wild species is the transfer of cytoplasmic male stererility (CMS) from O .sativa f. spontanea, to develop CMS lines for commercial hybrid rice production. This particular gene has been used by CIAT breeders to develop broad base populations via recurrent selection methods for both irrigated and upland rice, which are being used by several NARS in LAC; three rice varieties have been released out of recurrent selection in Bolivia, Brazil and Chile. Our Rice Team is focused in the utilization of O. rufipogon, O. glaberrima, O. barthii, O. meridionalis and O. latifolia as sources of new alleles associated with traits of agronomic importance for LAC, mainly yield potential and yield components, grain quality, resistance to RHBV and its vector Tagosodes, blast, Rhizoctonia, Rice necrotic virus (Entorchamiento), and more recently to improve the nutritional quality of milled rice. Interspecific breeding lines and populations are shared via GCP with IRRI and WARDA, as well as introductions from the germplasm banks as progenitors. Breeding lines are also exchanged via IRRIs network known as INGER. Additionally, regular visits by our scientists are made to IRRI. Both CIAT and IRRI played a complementary role in the interspecific hybridization project led by WARDA since 1996 that resulted in the development and release of the NERICA lines. CIAT also provided some training in anther culture and developed and shared with WARDA interspecific breeding populations for rainfed and irrigated conditions. Complementarity, collaboration and linkages were further analyzed, discussed and fine

tuned in a workshop held at WARDA at the end of June/2007 as a WARDA/IRRI/CIAT programmatic alignment for Africa.

Alignment to CGIAR Priorities

The Rice Product Line promotes the conservation and characterization of the relatives of rice. Many rice research activities are in accordance with the CGIAR system priorities 1A and 1B on sustaining biodiversity through promoting conservation and characterization of a staple crop and of underutilized plant genetic resources. The Rice Product Line develops breeding populations and advanced lines with traits that include high yield, good grain quality, early vigor, strong stems, tolerance to water stress, rice blast, Rhizoctonia, rice hoja blanca virus and the plant hopper T. orizicolus, as well as molecular tools (CSSLs, DHs, i-bridges, molecular databases), activities which are in accordance with the CG system priorities 2A and 2B on the genetic improvement of crops. More recently in collaboration with Harvest Plus-IRRI, we have started enhancing the nutritional quality of rice by developing lines that are higher in iron and zinc, activity within the system priority 2C on enhancing the crop nutritional quality. The pest and disease traits that are incorporated into the new varieties are helping to reduce the use of pesticides. Using integrated crop and pest management is central to producing a sustainable agro-ecological system, contributing to system priority 4D. The efforts to develop rice with better water use efficiency benefits the rice farmers with the least amount of infrastructure and should lead to the reduction of water in the irrigated systems, and to the promotion of integrated land and water management at landscape level as recommended in the system priorities 4A and 4C.

Outputs Description

Changes from previous MTP Outputs

Biotechnology tools for rice development are now shown for the sake of clarity as a separate output. This does not represent new work but rather makes more visible a body of work that was formally lumped into other outputs. Unrestricted resources for rice research have been significantly reduced. The strategy is to complement and strengthen the CIAT-FLAR platform with other institution(s). These changes are reflected in the consolidation or elimination of several of the Output Targets. For example, the 2007 and 2008 Output 1 and 2 targets Characterization and development of markers for 6 major rice blast resistance genes were dropped, Activities in rice Pathology in 2008-2009 will maintain some collaboration with US universities involved in the RiceCap project for sheath blight resistance (special Project funded by USDA), and between 2007-2009 on two projects funded by FONTAGRO: the identification of fungicide resistance problems in the rice blast and sheath blight pathogens, and on the characterization of the bacterial pathogen (Burkholderia glumae) associated to the mite-bacterium-fungus complex affecting rice production in Central America. In addition, most activities on the use of anther culture and embryo rescue for enhancement of gene pools will be significantly reduced, and activities on gene flow analysis from rice into weedy rice are coming to an end in May 2008. Some of these activities will be carried out as special projects if proposals already presented to potential donors are approved.

Output 1: Rice germplasm for improving human health and nutrition in Latin America.

Description: Micronutrient malnutrition, the result of diets poor in vitamins and minerals, affects more than half of the world's population. Women and children are especially susceptible to deficiencies in micronutrients, particularly vitamin A, iron and zinc. As a result, they are at risk of disease, premature death, lower cognitive capacity, and poor quality of life. The costs of these deficiencies are high. In Latin America and the Caribbean (LAC)

economic and health indicators have been deteriorating.
Consequently CIAT is working on both IRRI and the Biofortification Challenge Program on the development of and deployment of high iron and zinc rice lines. Rice has become the most important food grain in LAC, supplying consumers with more calories than other staple crops. Rice has become particularly important in the diets of poor people, who make up about 40% of LACs total population. Among the poorest 20% of the population, rice supplies more protein to the diet than any other food source, including beef and milk. However, people living in several areas where rice consumption is high have been suffering from a number of major nutritional problems. This is the result of vitamins and/or minerals naturally present in the rice grain but otherwise removed during the milling process or that naturally are not present in sufficient amounts. Preliminary data obtained at CIAT from 11 cultivars planted under irrigated conditions indicated that on average 59 and 26% of the total iron and zinc present in brown rice is lost after milling, respectively, and there were significant differences among genotypes tested. Research carried out at IRRI suggests that there is genetic variability in the rice genome to increase iron and zinc in the rice grain. More recently, it has been reported that consumption of biofortified rice, without any other changes in diet, is efficacious in improving iron stores in women with iron-poor diets in the developing world. In this project we plan to develop rice lines having 6-8ppm of iron and 22-25ppm of zinc in milled rice to combat malnutrition in Latin America and the Caribbean using different breeding strategies;a clean lab for preparing rice samples for iron and zinc analysis is available on campus.

Output 2: Broadening the genetic base of irrigated rice in Latin America

Description: CIAT is utilizing wild rice species to broaden the genetic base of cultivated rice in Latin America and to develop commercial rice cultivars with higher yields and resistance to pests. The strategy in place makes use of molecular maps in combination with backcrossing to elite breeding lines or commercial varieties to develop populations that are used to identify and transfer quantitative trait loci (QTLs) associated with traits of agronomic importance to cultivated rice. Results to date indicate that several traits of agronomic importance, including yield and yield components, and tolerance to biotic and abiotic stresses, have been transferred from Oryza rufipogon, O. glaberrima, and O. barthii to improved rice cultivars. A crossing program to recombine desirable agronomic traits identified in elite lines derived from diverse interspecific breeding lines is now underway, including parental lines with long/heavy panicles and stay green leaves.
Broadening the genetic base of irrigated rice is also conducted through the development of synthetic rice populations using recurrent selection. The main purpose of a breeding project is to create variability and develop breeding materials that may lead to identifying promising lines and new cultivars for release. Recurrent selection methods contribute to meeting the goals for continuous genetic improvement but should be integrated with other breeding methods to deliver superior breeding materials and improved varieties. Recurrent selection should not be considered a separate phase of an applied breeding program. Selfed progenies extracted from recurrent populations are evaluated and then recombined to obtain improved populations. Superior progenies also have to be included in the applied breeding program, passing through cycles of selection and agronomic evaluation. Advanced lines are the starting point for developing commercial varieties and are donors in crossbreeding programs. These lowland irrigated rice activities for rice improvement are carried out in close collaboration with partners in the LAC region via the newly established REDMEGA network. In Colombia, the CIRAD-CIAT rice project started developing basic populations targeting the various lowland rice ecosystems present in LAC, in partnership with scientists in Colombia, Venezuela and Cuba for the tropical ecosystem; Argentina for the subtropics; and Chile and France for the temperate zone. The basic populations were shipped to regional partners and evaluated locally. Most of the cooperators used this material to develop site-specific populations by introgressing additional variability to meet their specific breeding objectives.

They then use these populations in their rice-improvement programs by recurrent selection. A marker-assisted selection program for recurrent selection will further improve the efficiency of the method.

Output 3: Broadening the genetic base of upland rice in Latin America

Description: Since the 1960s, commercial rice cultivars have been developed by conventional crossbreeding, often from breeding populations derived by crossing two inbreed lines. This approach encourages inbreeding and so narrows the genetic base of breeding materials. Narrow genetic diversity is of major concern to breeders, geneticists and the agricultural community in general. In LAC, the genetic diversity of rice cultivars depends on a small core of landraces. This finding led the rice project at CIAT together with CIRAD, to direct efforts toward broadening the genetic base in rice.

This effort, in collaboration with rice breeders throughout LAC creates and shares synthetic populations, through the Working Group on Advanced Rice breeding (GRUMEGA) sponsored by the Food and Agriculture Organization of the United Nations (FAO). The leadership in networking activities of the group is assumed by the rice projects of CIRAD-CIAT and EMBRAPAs Arroz e Feijao Center. Population breeding by recurrent selection is efficient for traits that show low heritability. Through short cycles of selection and recombination, linkage barriers are broken down and favorable genes are accumulated. Upland composite populations are observed, characterized and improved by recurrent selection in Colombia, and improved lines are distributed to national programs in the region for further testing.

CIRAD and CIAT also collaborate in Nicaragua on participatory breeding of upland rice and sorghum for poor farmers in Central America. This project is developing and testing breeding schemes, including population improvement methods in which farmers are fully involved, to develop varieties that are better adapted to the farmers specific cropping conditions and needs. Early maturity, vigorous, high yielding varieties with adequate grain quality are some of the traits selected by farmers to assure the food security needed for their families.

After five years, the PVS strategy succeded in identifying four high performing lines that will be released by partners in 2008.

Output 4: Biotechnology tools for Rice Improvement

Description: For a number of crops, the process of domestication has led to the loss of a large proportion of the alleles from the wild species of origin. This is the case in cultivated rice. This loss of genetic diversity has been further aggravated during the last century with the development of modern agriculture, which led to the replacement of most of the traditional varieties by a limited number of elite, high yielding lines. This loss of genetic diversity has a direct consequence: breeders, who need to answer to the urgent need of creating new varieties that perform well under an increasing number of biotic or abiotic stresses, have few options to access sources of variability other than that which is already present in the cultivated species.

The genomes (Indica and Japonica) or the entire genetic makeup of rice have been decoded, and more than 15,000 SRMs markers are available in rice, providing scientists with the genetic foundation to create vastly improved crops. We can now figure out which genes are associated with desirable crop traits such as disease and insect resistance, seed size, yield components, protein content or depth of rooting, etc. This approach, called marker-assisted breeding, has already been implemented in developed countries, but a large cadre of trained scientists and plant breeders working in developing countries will be required if those countries are to reap the benefits of crop genomics.

Rice production faces the difficult challenge of obtaining reliable yields under variable conditions, notably due to the prevalence of biotic and abiotic stresses. Numerous genes of economic importance are transferred from one varietal background to another through

conventional breeding approaches, a time consuming effort . Sometimes, screening procedures are conversome and expensive, and require a large field area. Recent advances in plant molecular biology have greatly expanded our understanding of the molecular basis of plant stress responses, as well as our ability to genetically modify plants to enhance stress tolerance. Continued research in this area is needed in order to unravel the complexity of stress response networks at the molecular/cellular level, and to integrate molecular traits with breeding programs.
Advances in biotechnology, allow us to tag genes of interest by tight linkage with molecular markers saving time and money. The presence of absence of the associated molecular marker indicate, at the early stage, the presence of absence of the desired target gene, thereby increasing the efficiency of the breeding process. A lot of molecular data have been generated at CIAT in rice on different agronomic traits, an Anchor Marker Map have been produced and several mapping populations are available. There is a need to put all these data and knowledge together. The ultimate objective of this product line is not only to integrate molecular marker technology into the rice breeding program but to make use of numerous biolotechnology tools that are available from different sources, including tissue and cell culture techniques, molecular marker development for Marker Aided Breeding (MAB) by exploring genomics information, and genetic engineering.

Impact Pathways by Output

Output 1: Rice germplasm for improving human health and nutrition in Latin America.
This product is concerned with the development of high iron (6-8 ppm) and zinc (22-25 ppm) rice lines to combat malnutrition in Latin America and the Caribbean. The final intended users of these products will be the urban and rural consumers, especially poor sectors in Latin America, although in the development process, rice scientists and breeding programs from the region will benefit from the materials developed with high iron and zinc content as well as they will play an important role in the identification, evaluation, distribution, and adoption of the improved germplasm. Using GIS tools and socioeconomic studies we will identify the targeting areas and populations in Latin America suffering from malnutrition. Nutritionally improved staple food will provide an inexpensive, cost-effective, sustainable, long-term means of delivering micronutrients to the rural small resource poor farmers and the urban resources poor consumers. This project is carried out in close partnership with research institutions in Colombia (FEDEARROZ), Bolivia (CIAT-Bolivia, and ASPAR), Cuba (IIA), Brazil (EMBRAPA), Dominican Republic (IDIAF), Nicaragua (INTA and farmers associations), and more recently Panama (IDIAP).
After careful evaluation of the germplasm available in germplasm banks, seed of high iron and zinc rice lines or commercial varieties will be multiplied at CIAT-Palmira for distribution to our partners for evaluation /testing under local conditions in key sites selected via GIS and following participatory breeding approaches. Once results are confirmed, seed of promising lines will be multiplied by our local partners for further evaluation in several sites in demonstration plots. At the same time, in collaboration with AgroSalud nutritionist and economist, agronomic/efficacy and impact assessment studies will be conducted to assess the impact on human health of the promising lines in selected sites and urban/rural groups. Local health and nutrition people will be involved in these studies. Finally, lines with increased iron and zinc content will be named and release locally by our partners in AgroSalud.
Additional activities carried out by CIAT within the project include GxE studies to determine the influence of climatic and soil factors on the expression of iron and zinc in the rice grain, marker assisted selection, and visits and coordination of collaborative activities carried out by participating NARs.

Output 2: Broadening the genetic base of irrigated rice in Latin America
Wild species are valued as a unique source of genetic variation; however, they have rarely being used for the genetic improvement of quantitative traits. In this project we are utilizing wild rice species to broaden the genetic base of cultivated rice in Latin America as a breeding tool that will be further used by the rice community in LAC to develop commercial rice cultivars with higher yields and resistance to pests for the benefit of farmers in general, urban/rural consumers, and industry and seed producers. In the late 80s CIAT made the decision not to name and release rice varieties any more but leave this decision to NARS. So the impact pathway depends entirely on the local evaluation, testing and selection of the breeding nurseries (CIAT-ION) that are prepared and sent to our collaborators every year, based on local demand. Most of the time our breeding lines are used as progenitors in further crossing by national rice breeding programs. In some cases these lines are released as commercial varieties after further selection, purification and seed multiplication. Typically this process takes 10-12 years after receiving the CIAT-ION nursery.
The main role of CIAT at present in this product is to make use of molecular maps in combination with backcrossing to elite breeding lines or commercial varieties to develop populations that are used to identify and transfer quantitative trait loci (QTLs) associated with traits of agronomic importance to cultivated rice. Results to date indicate that several traits of agronomic importance, including yield and yield components, and tolerance to biotic and abiotic stresses, have been transferred from wild species to improved rice cultivars. CIAT's role is also broadening the genetic base of irrigated rice through the development of synthetic rice populations using recurrent selection. Advanced lines are the starting point for developing commercial varieties and are donors in crossbreeding programs. These lowland irrigated rice activities for rice improvement are carried out in close collaboration with partners in the LAC region. In Colombia, the CIRAD-CIAT rice project started developing basic populations using recurrent selection targeting the various lowland rice ecosystems present in LAC, in partnership with scientists in Colombia, Venezuela and Cuba for the tropical ecosystem; Argentina for the subtropics; and Chile and France for the temperate zone. The basic populations are shipped to regional partners and evaluated locally. Most of the cooperators used this material to develop site-specific populations by introgressing additional variability to meet their specific breeding objectives. They then use these populations in their rice-improvement programs by recurrent selection. Recurrent selection is an activity that has been promoted through the GRUMEGA network. CIAT is a member of FLAR and most of the FLAR germplasm is developed using some of the CIAT germplasm. FLAR includes some of the strongest rice research institutions in Latin America and this is also a valuable source for Germplasm Enhancement as well as other forms of collaboration. Again, our regional rice partners are responsible for the release of varieties, which is the main impact of this Product 2. The need for germplasm is highly variable(early segregating or advanced/fixed lines, parental lines) and depends on the production constraints affecting rice, and rice production systems used in a given country. In general, the less rice that is produced the more these programs need advanced materials. The larger rice programs use germplasm and segregating populations to make their own selections. At the end, our impact will be measured by an expected increase and more sustainable rice production in the LAC region, with improved rice competitiveness through lower production costs and higher yields.

Output 3: Broadening the genetic base of upland rice in Latin America
This product is related to the use of rice synthetic population breeding and participatory breeding of upland rice small farmers for the release of commercial upland rice varieties in LAC. Since the 1960s, commercial rice cultivars have been developed by conventional crossbreeding, often from breeding populations derived by crossing two inbreed lines. This approach encourages inbreeding and so narrows the genetic base of breeding materials. This problem led the rice project at CIAT to direct its efforts toward broadening the genetic base

in rice using different approaches. Upland composite populations are observed, characterized and improved by recurrent selection in Colombia, and improved lines are distributed to national programs in the region for further testing. The regional rice recurrent selection-breeding project has been adopted, developed and implemented in several countries.

In addition, a Regional Technical Cooperation Project (TCP): Capacitación en fitomejoramiento genético e intercambio de germoplasma para utilizar los recursos genéticos del arroz en America Latina y el Caribe involving 7 countries (Argentina, Bolivia, Chile, Cuba, Guatemala, Nicaragua, and Dominican Republic) and CIRAD and CIAT was funded by FAO for 2 years, starting in 2006. In this framework, workshops have been organized for the evaluation and selection of upland and irrigated segregating and fixed rice lines. The next step in rice population improvement is to take advantage of new molecular tools to increase the efficiency of recurrent selection breeding. Molecular tools are now used, for example, to better determine the level of genetic diversity in a population.

CIRAD and CIAT work together on participatory breeding of upland rice for poor farmers in Central America. This project is developing and testing breeding schemes, including population improvement methods, in which farmers are fully involved, to develop varieties that are better adapted to the farmers specific cropping conditions and needs. For the small farmers, jointly with our partners, we put in place participatory variety selection and breeding schemes in different agro ecosystems of Central America. Early maturity, vigorous, high yielding varieties with adequate grain quality are some of the traits selected by farmers to assure the food security needed for their families. It is expected that participatory breeding methods and the genetic materials developed with this approach in Nicaragua will be applicable to most Central American countries.

The main participatory rice breeding mechanism is working with farmer organizations. The small farmers generally have the least amount of land, equipment, irrigation systems, and credits (infrastructure) and need upland or aerobic rice varieties that use water and fertilizers efficiently. These activities integrate the advances in breeding methodology (recurrent selection), the use of diverse germplasm including the interspecifics and in the future the high iron and zinc rice lines using participatory methods to focus on the needs of the small rice farmers. These activities help the farmers by developing their organizational skills and can aid in their eligibility for credits and other assistance. These farmers need to be aware of other opportunities to include other crops into their agro ecosystems especially high value crops. Rice is a food security crop that also contributes to the farmers income. We expect at the end of this period to have an increased and more sustainable rice production highly competitive through lower production costs. This production system should also be friendlier to the environment and people through lower use of pesticides. Our impact should also be measured by developing a more robust rice sector that will generate employment and maintain low rice prices for the poor consumers. We also expect that the expansion of this broad genetic base will lead to yield stability and better adaptability for abiotic and biotic stresses.

Output 4: Biotechnology tools for Rice Improvement

This product relates to activities in biotechnology that were housed in the CIAT Biotechnology Unit but that were conducted in close collaboration between rice scientists in the IP-4 rice project and the SB-2 project. Although collaboration was very good people responded to different leaders; now people will have same leadership and this fact could facilitate interaction and collaboration. The main objective is to integrate biotechnology tools available at CIAT and advanced institutions collaborating with us into the rice breeding program, especially via marker assisted selection and genetic engineering. Our pathway to impact will be similar to those already describe in Products 1,2, and3 mainly through: (i) capacity building, including sharing of methodologies, databases, and software, (ii) germplasm development and sharing; (iii) workshops for germplasm evaluation and

selection, (iv) conferences to present results and advances, (v) publications with and by collaborators, and (vi) collaborative research projects with strategic partners on activities of common interest.

International Public Goods

The International Treaty on Plant Genetic Resources for Food and Agriculture is an international agreement governing many of the world's most important crop diversity collections. The treaty will ensure that this diversity, which is critical for the rice crop improvement will remain in the public domain. In the area of germplasm, CIAT has decided to place most of its elite lines into this system. To do this, we will use the database format of IRRI and these should become part of the Future Harvest genetic resources.
Most of the technologies including database management programs, breeding methodologies, and rice lines that are developed at CIAT enter into the public domain as international public goods.
One of the most relevant and important products of the CIAT Rice Product Line is the development and deployment of interspecific rice lines derived from crosses between wild rice species and cultivated rice. Most of our partners and NARs in LAC are not in a position to carry out this type of breeding work since they lack the expertise, resources and funding to do it. Besides, they are more concerned with the development of improved lines to address production problems that impinge on today's rice production but not on broadening the genetic base of rice or on problems for which no sources of genetic resistance are known. Additionally, the adaptation and use of biotechnology tools in rice breeding programs by our partners will add another strategic dimension to products coming out of the CIAT Rice Product Line.

Elaboration of Partners Roles

IRRI and WARDA are CGIAR institutions working on rice and with whom we collaborate in germplasm exchange and on problems of global importance through the IRRI-CIAT-WARDA strategic alliance. The Generation Challenge Program and INGER are two of the major joint activities.
We have an alliance with CIRAD and IRD of France, which is vital to our research activities. Two CIRAD scientists and one IRD scientist hold joint appointments with the CIAT rice project and contributes extensively to activities in Products 1, 2, 3 and 4.
To increase our impact, we are member of FLAR. This network includes members from fourteen countries. FLAR is a partnership of the private and public sectors for the international research of rice. Its mission is to generate new technologies to allow the Latin American rice sector to become more competitive, profitable and efficient with low environmental impact practices that propitiate lower unit costs and, as a consequence, lower rice prices to consumers. It generates both genetic resources and technology transfer of integrated crop management practices (contributing to Products 2 and 3).
The AgroSalud Project aiming at increasing the iron and zinc content in the rice grain includes partners throughout the region:
Brazil EMBRAPA & IRGA, Colombia FEDEARROZ, CORPOICA, U. Nacional U. del Tolima & U. de Antioquia, Peru INIA, Venezuela INIA, IVIC, FUNDARROZ & DANAC, Cuba IIA, Nicaragua INTA, Costa Rica CONARROZ, SENUMISA, INTA & U. Costa Rica, Guatemala ARROZGUA, Mexico Consejo Mexicano del Arroz, Bolivia CIAT Santa Cruz, ASPAR & CONARROZ, Dominican Republic IDIAF, Chile INIA, Panama U. de Panama, and IDIAP, Uruguay INIA, Argentina INTA, CIB-FIBA, U. Corrientes & U. Tucuman, Ecuador INIAP and Pronaca, are national institutions and we have activities many of which are carried out using the networks

of FLAR, GRUMEGA, RedMega, Fontagro, INGER and AgroSalud (Biofortification). Many of these institutions develop rice varieties while other are more involved in the transfer of technologies to the rice farmers.
Universities including KSU, Cornell, Purdue, LSU, U. of Arkansas, Texas A&M, U. Missouri, Rutgers, and Yale. We have collaborative projects and students (from Colombia, Japon and Mozambique) that work on research of mutual interest. IAEA collaborates in the use of induced mutations for crop improvement.

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Rice germplasm for improving human health and nutrition in Latin America.			o Rice scientists, breeding programs, nutrition, health and food aid programs o Urban and rural consumers, especially poor sectors in Latin America.	Agronomically superior rice varieties with 6-8 ppm iron/ 22-25 ppm zinc in use as an instrument for improving human health and nutrition as well as for increasing productivity for rice farmers.	Reduced micronu-trient deficiency and increased food and nutrition security among vulnerable populations living in Colombia, Bolivia, Brazil, Nicaragua, Cuba, Panama and Dominican Republic.
	Output Target 2009: At least 2 lines with increased iron and zinc identified and ready for release by NARs	Materials			
	Output Target 2010: At least two lines with increa-sed iron and zinc grown in demo	Materials			

	plots by collabora-tors in at least two countries.				
	Output Target 2011: At least one variety with increased Fe and Zn released in at least one country.	Materials			
Output 2: Broadening the genetic base of irrigated rice in Latin America			o Rice scientists, extension agents, rice farmers, seed industry and through them ultimately consumers	o Increased and more sustainable rice production. o Improved rice competitive ness through lower production costs and higher yields. o A more friendly rice production to the environment and people through lower use of pesticides.	o Lower rice prices o Improved nutrition for poor consumers o Reduced damage to environment
	Output Target 2009: A CIAT-ION nursery made up of about 120-150 rice lines carrying the Pi-1, Pi-2, and Pi-33 genes for durable resistance to rice blast.	Materials			
	Output Target 2009: Diagnosis of at least 50 rice panicles per country for the presence of the bacterial panicle blight associated to the mite-fungus-	Capacity			

	bacterium complex in Panama, Costa Rica and Nicaragua				
	Output Target 2009: Twenty fungicides evaluated for fungicide resistance levels in the rice pathogens causing rice blast and sheath blight	Capacity			
	Output Target 2010: A CIAT-ION nursery made up of about 120-150 rice lines carrying the Pi-1, Pi-2, and Pi-33 genes for durable resistance to rice blast and other desirable traits derived from wild rice species	Capacity			
	Output Target 2010: At least five crosses and populations developed for selecting rice lines tolerant to the bacterial panicle blight pathogen in Central America.	Capacity			
	Output Target 2010: Collection of at least 50 rice blast and sheath blight pathogen isolates for fungicide resistance studies.	Capacity			
	Output Target 2011: A CIAT-ION nursery made up of about 120-150 rice lines carrying genes introgressed from O. latifolia. and other wild rice	Materials			

	species, including lines derived from a marker assisted program for RHBV.				
	Output Target 2011: At least two molecular markers and protocols for the detection of the bacterial panicle blight pathogen identified and implemented in Central America.	Capacity			
	Output Target 2011: A fungicide resistance management program developed and published.	Materials			
Output 3: Broadening the genetic base of upland rice in Latin America			o FLAR, GRUMEGA, INGER-LAC and Rice breeding programs throughout the region	o Accelera-ted breeding progress o Increased and more sustainable rice production. o Improved rice compe-titiveness through lower production costs and higher yields. o A more friendly rice production to the environment and people through lower use of pesticides.	o Lower rice prices o Improved nutrition for poor o Reduced damage to environment
	Output Target 2009: One hundred advanced lines arising from recurrent selection	Materials			

	will have been widely distributed and tested in more than 11 countries throughout the region				
	Output Target 2009: Initial work on hybrid rice by CIRAD-CIAT-FLAR underway	Capacity			
	Output Target 2010: Integrated regional collaboration for the use and development of rice genetic resources through networking will result in at least 2 new varieties released by national breeders.	Policy strategies			
	Output Target 2010: Identification of CMS, restorer and maintainer lines for tropical conditions	Policy strategies			
	Output Target 2011: Integrated regional collaboration for the use and development of rice genetic resources through networking will result in at least 2 new varieties released by breeders.	Policy strategies			
	Output Target 2011: Evaluation of F1 hybrids for tropical conditions ; training of NARs personnel	Materials			

Output 4: Biotechnology tools for Rice Improvement			o FLAR, GRUMEGA, INGER-LAC, and rice breeding programs throughout the region. Our research partners and rice community in general	o Kits of molecular markers and molecular data available to our partners o NARS using marker kits in routine for MAS (RHBV) and starting to use them for other traits (Rice blast, Fe, Zn) o At least two NARS using marker assisted selection in their breeding program	o Accelera-ted breeding progress leading to increased innovation in rice sector thereeby lowering food prices, improving nutrition and reducing damage to environment.
	Output Target 2009: Fine mapping of S1 locus	Materials			
	Output Target 2009: Training of NARs personnel and students	Capacity			
	Output Target 2009: SNPs markers for iron and zinc	Materials			
	Output Target 2009: Kits of molecular markers and molecular data available to our partners	Materials			
	Output Target 2009: Genes associated with N use efficiency and water use efficiency identified	Capacity			

	Output Target 2009: Introgression lines with chromosome segments substitutions from wild species	Materials			
	Output Target 2009: BC lines resistant to RHBV via SRR markers	Materials			
	Output Target 2010: Physical map of S1 locus	Materials			
	Output Target 2010: Training of NARs personnel and students	Capacity			
	Output Target 2010: Introgression lines with chromosome segments substitutions from wild species	Materials			
	Output Target 2010: BC lines resistant to RHBV via SRR markers ready for release	Materials			
	Output Target 2010: Databases and kits of molecular markers	Materials			
	Output Target 2010: Lines with improved water use efficiency ready for testing	Materials			
	Output Target 2010: Lines with better nitrogen-use efficiency identified	Materials			
	Output Target 2011: High-throughput technology for fast	Other kinds of knowledge			

	genome scanning in marker assisted selection programs				
	Output Target 2011: Training of NARs personnel and students	Capacity			
	Output Target 2011: Databases and kits of molecular markers	Materials			
	Output Target 2011: Sets of fertile Introgression Lines with chromosome segments substitution from O. glaberrima accessions	Materials			
	Output Target 2011: Lines with improved water-use efficiency ready for field testing by our partners	Materials			
	Output Target 2011: Lines with better nitrogen-use efficiency identified and ready for field testing	Materials			

SBA5: Conserving Agrobiodiversity

Project Overview and Rationale

Rationale

The germplasm collections of Phaseolus beans, Manihot cassava and tropical forages maintained at and studied by CIAT Genetic Resources Unit (GRU) are for these respective crop commodities the largest and most diverse in the world. By December 31, 2007, 65,290 accessions were registered into the Multilateral System of the International Treaty of Plant Genetic Resources for Food and Agriculture (35,683 of Phaseolus beans, 23,140 of tropical forages, and 6,467 of Manihot cassava). In 2007 alone, GRU has distributed 4,882 samples of accessions registered into the Multilateral System, using the Standard Material Transfer Agreement of the International Treaty. As acknowledged in Art. 15 of the International Treaty, the germplasm collections of the ten Centers of the CGIAR are the starting cornerstone of the Multilateral System of the Treaty, with over 600,000 accessions maintained, evaluated, documented and distributed as international public goods. With a bit over 10% of all accessions kept in genebanks around the world, the CGIAR part is however unique by many aspects, cumulating the genetic diversity of most food crops, many of them listed in the Annex 1 of the Treaty, with high levels of evaluation, documentation, viability and availability and low level of redundancy. Not surprisingly, the germplasm collections of the CGIAR are the System Priority 1 A.

The breeding efforts by CIAT projects and those by the partners on beans, cassava and tropical forages, are all eventually supported by GRU that provides in due time the needed variation. The diversity of the collections explains such resort. CIAT GRU holds in trust the largest collection of Phaseolus beans, since the collection of number 2 in the world is of 12,000 accessions. Similarly, number 2 for cassava in the world keeps 1,200 accessions. The tropical forage collection is indeed unique, since Australia has no longer an active genebank, and ILRI specializes in mid-altitude forages for tropical Africa. As recent examples of use of CIAT GRU collections, one can mention Phaseolus costaricensis serving as source of white mold resistance in the western states of the US, Manihot walkerae as source of tolerance to root deterioration in cassava, and Cratylia argentea as a drought resistant shrub legume in Central America. The return of popping beans to farmer communities in Cusco, Peru, is an example of social equity when farmers can exploit a niche market with their traditional varieties (restored and cleaned by the genebank). The resort to dwarf genotypes of cassava makes possible the mechanical harvesting in large-scale cassava production for industry.

With oil at US$ 130.oo and six billion people and more to feed by the next decade, one can just expect an increasing pressure to produce more food at lower environmental cost and under lesser acreage. Meeting the challenge just means higher use of a wider genetic diversity, be with the same crops or with new crops (for which agronomists, extensionists and breeders will have to be trained). For GRU and its partners in genetic diversity conservation, the challenge means to keep as much options available at any time, which means the collecting of all genetic variants, the efficient conservation, a comprehensive evaluation, and the availability at all times with proper documentation. Biotechnology tools applied to crop genepools and their wild relatives will tell us whether the right variability is indeed maintained, and informatics tools will contribute to the prompt retrieval of the appropriate variant with the desired trait if there is an urgent need for it.

While our vision is the conservation of genetic resources of Phaseolus beans, Manihot cassava and selected tropical forages for the benefit of human societies, our strategy is to identify, and organize the necessary partnerships in the human societies, and to carry out

with them the pertinent activities for the conservation and sustainable use of such genetic resources. Given the written agreement between CIAT and the International Treaty signed on October 16, 2006, the responsibilities and drivers of GRU activities are: i) the Conservation of the in-trust collections to make them available to users worldwide, particularly for hunger and poverty alleviation, and for the protection and restoration of the environment; ii) an international Service of distribution of germplasm and information along international standards (viability, health, IP law) set by countries, and iii) the Generation of scientific knowledge, technology, and information to improve the biological and social relevance and the efficiency of conservation. Through the later and through research we seek to make sure that the variability existing in Phaseolus beans, Manihot cassava and selected tropical forages is properly collected, maintained and evaluated, so that farmers, agronomists, breeders and geneticists can find at any time the variation they need for specific purposes.

Our five Outputs are in line with CIAT (and CGIAR) obligations towards the International Treaty, and also with the conservation agendas of many actors involved in the saving of the Earth biological heritage. Several areas of research using the genetic collections of beans, cassava and forages as models, have applications in many more crop commodities, and neglected agricultural species, and offer many opportunities for technology transfer and training. Our Outputs are also in line with a sense of urgency and priority: there are many things including in genomics that can be done later on once the agricultural biological heritage is safely conserved.

Changes
After the reorganization of the 2008-2010 MTP, its approval by the CIAT Board of Trustees and the Science Council, and a positive review of CIAT GRU by an external review in October 2006 and by the EPMR in May-July 2007, no major changes but several updatings have been introduced into the Outputs. Also because of the entry-into-force of an amended SMTA by the Governing Body on February 1, 2008 (for in-trust non-Annex 1 collections).

Alignment to CGIAR Priorities

CIAT GRU Outputs line up directly with CGIAR priority 1A. Outputs 1 and 2 result in increasing the variability basis for the breeding programmes, within (System Priority 2) and outside the CGIAR (namely beans in Latin America and Africa, cassava in South East Asia, and tropical forages in all lowland tropics). Research components in Outputs 1, 2, 3, and 5 of GRU have broad applicability, and can contribute to other System Priorities (for instance when in-trust forage germplasm such as Arachis pintoi is used as cover crop in Central America against soil erosion, or when cryoconservation protocols developed by GRU is used by Colombian institutes to conserve palm germplasm).

Output 1: The in-trust collections of Phaseolus beans, Manihot cassava and selected tropical forages are maintained by CIAT GRU up to international standards.

Description:
o Research activities: these are related to the improvement of germplasm conservation methodologies and technologies (such as seed drying, slow-growth in vitro) in order to increase the longevity of seeds, or the time lag between each subculturing, and thus reduce costs. DNA banking is another topic of research since increasingly genomics projects request germplasm for DNA extraction. In some cases, research focuses on management efficiencies (e.g. bar coding to handle the 30,000 test tubes of the in vitro collection). Economics of

conservation protocols and methodologies.
o Comparative and complementary advantage: Trained teams of assistants and workers for large scale conservation and handling of genetic resources. In selected cases, partnerships with other IARCs through SGRP, USDA, and EMBRAPA.
o How priority goals are addressed: Research is carried out because of internal necessities. For instance, the need for a safety back-up of the cassava collection at CIP forced us to explore the slow-growth in vitro. Or the need to keep seeds of many legumes and forage grasses forced to understand pollination mechanisms and embryogenesis.
o Contributing partners: other International Centers of the CGIAR in activities coordinated by SGRP, namely towards the definition of international standards. Other genebanks share with us information, namely Politécnico de Madrid, Spain, and U Reading, United Kingdom, for the seed behaviour of selected species. IFPRI in joint economic studies on conservation protocols to look for efficiencies.

Output 2: The germplasm of Phaseolus beans, Manihot cassava and selected tropical forages is made available to users, is restored to NARS, and is safely duplicated.

Description:
o Research activities: disease indexing for safe transfer of germplasm. Research in cryoconservation for safety back-up of the cassava collection at INIBAP. Restoration activities with interested NARS. Development of the Bean, Cassava and Forages common registries with USDA-Pullman, IITA/ EMBRAPA, and ILRI, respectively, in order to know which accessions are shared (and thus already safely duplicated). Duplication of information towards SINGER for the one-stop entry CGIAR germplasm consultation. Identification of genetic copies in order to lower conservation costs. Refinement of core collections. Development of an electronic web based platform for the handling of SMTAs.
o Comparative and complementary advantage: Virology/ pathology units; crop commodity programs in beans, cassava and forages with unique expertise. Trained teams of assistants and workers for large scale genebank operations. Good lab facilities for identification of genetic copies. USDA-Pullman, IITA/ EMBRAPA, and ILRI have good databases and well trained personnel to advance quickly on the common registries. Staff has been hired recently by Bioversity International for SINGER.
o How priority goals are addressed: part of the research is carried out under the GPG2 Re-habilitation of international public goods projects, in consultation with CGIAR Secretariat and Science Council (logframe for System Priority 1A). Feedback is provided by plant quarantine officers and users for addressing phytosanitary problems limiting exchanges of germplasm.
o Contributing partners: the Nordic Genebank for the Svalbard Global Seed Vault and GRU of CIMMYT for the seed collections; CIP for the in-vitro cassava collections maintained under slow-growth; INIBAP for the coming cryo-conserved collection of cassava. USDA-Pullman, IITA/ EMBRAPA, and ILRI for the crop registries, and some of the disease indexing work. Bioversity and SGRP for the SINGER updating.

Output 3: The in-trust collections are genetically and socially relevant.

Description:
o Research activities: studies on the genetic structure of crop genepools and wild relatives. Phylogenetic studies of Phaseolus and Manihot in order to increase efficiency and success in pre-breeding efforts. Acquisition of unique/ endangered germplasm. Monitoring of genetic erosion so that germplasm collections are timely carried out.
o Comparative and complementary advantage: Trained teams of assistants in GRU and Biotechnology Unit. The large size and diversity of the in-trust collections documented in databases make easy a search for (non) represented variability. Work with USDA-Pullman

for beans, with CENARGEN-EMBRAPA and Thai Tapioca Development Institute for cassava.
o How priority goals are addressed: needs in terms of genetic diversity communicated by breeders in projects such as the Generation Challenge Program, or through crop networks such as CBN for cassava. Crop Strategies of the Global Crop Diversity Trust, for Phaseolus beans and Manihot cassava.
o Contributing partners: NARS in Latin America: from Canada, USA, Mexico down to Argentina for Phaseolus beans and from Mexico down to Argentina for Manihot cassava. NARS in Africa: for germplasm of forage grass species (Kenya, Uganda).

Output 4: Strengthened institutions that expand the scope of the conservation effort for agricultural biological heritage

Description:
o Research activities: specialized courses, production of training/ public awareness materials, supervision of thesis works at BSc, MSc and PhD levels.
o Comparative and complementary advantage: 30 years of experience in running a genebank exposed to all conservation technologies and methodologies; GRU has run with Bioversity Americas the first electronic distance education in the CGIAR. Participation into MSc degrees in plant genetic resources (University of Birmingham, UK; Universidad Nacional de Colombia).
o How priority goals are addressed: every special project includes a training component. When a funding source has been identified, a course is organized, or a training material is produced (as CTA in 2007). Hands-on and personalized training is also offered to trainees at GRU, usually for 1-4 weeks. Lectures are offered in symposiums and congresses such as the SIRGEALC, and regional workshops.
o Contributing partners: open to all NARS in Latin America (Colombia has been continuously a beneficiary), Africa, and South/ South East Asia. Bioversity International, namely its Americas Regional Office.

Output 5: Conservation ex situ at CIAT links with in situ conservation on farm and in the wild for larger numbers of populations of landraces and wild relatives effectively conserved

Description:
o Research activities: documentation of exact coordinates for accessions of the in-trust collections. Geographic mapping of particular populations/ species in relation to existing/ planned protected areas. Documentation of potential distribution of wild/ weedy species through studies of herbaria (53 to date for Phaseolus beans) / other collections. On-farm conservation of landraces: documenting the importance of gene flow for future crop evolution.
o Comparative and complementary advantage: size and diversity of the in-trust collections kept at CIAT. CIAT with products such as FloraMap and Analog has a good capacity in GIS for biological application. Biodiversity institutes in Latin American countries are willing to expand towards wild/ weedy species of agricultural significance.
o How priority goals are addressed: consultations with partners such as CONABIO of Mexico, INBio of Costa Rica, The Nature Conservancy, particularly its Latin American programme.
o Contributing partners: Royal Botanic Gardens, Kew, England; CONABIO of Mexico; INBio of Costa Rica; Instituto von Humboldt of Colombia; The Nature Conservancy. Major international herbaria (K, MICH, NY, UC, US) and national herbaria of the western hemisphere (COL, EAP, MEXU, SI, USM).

Impact Pathways by Output

Output 1: The in-trust collections of Phaseolus beans, Manihot cassava and selected tropical forages are maintained by CIAT GRU up to international standards.

Output 1 is both an international obligation towards the International Treaty and a condition for fulfilling Output 2, that is, distribution of quality germplasm to any user worldwide is not possible if the collections are not upgraded first and maintained to international standards. The role of CIAT is that of a primary research provider (participation in the definition of international standards; improvements of conservation protocols), and often a secondary research provider (backing up national genetic resources programmes with technical expertise and training). The documentation of standards is often used by national programmes of plant genetic resources in their own upgrading efforts. This Output is complementary to those of the other nine CGIAR Centres in charge of in-trust collections. Benefits accrue to genebank managers through the supply of information, improved conservation protocols, and research on technologies for conserving and handling germplasm. Assumptions for the successful delivery of this Output include institutional and financial stability of CIAT GRU, and that of the partners.

Output 2: The germplasm of Phaseolus beans, Manihot cassava and selected tropical forages is made available to users, is restored to NARS, and is safely duplicated.

Output 2 has through germplasm distribution beneficiaries inside CIAT (for instance the crop commodity breeding projects and the Biotechnology Research Unit), inside the CGIAR (for example the Generation Challenge Programme), and worldwide (above all the NARS and university departments). DNA banking will speed up efforts of gene tracking but also molecular phylogenies; it will also serve as a reference for the long-term for GRU but also for its partners. The safety back-ups and restoration efforts are in line with the international responsibilities of CIAT towards the International Treaty, and generate benefits to many other genebanks (the Nordic genebank, CIMMYT, CIP, INIBAP, national genebanks). The role of CIAT is that of a primary research and service provider, in the form of documented germplasm, but also in research products related to safe distribution (plant quarantine) and specialized distribution (genetic stocks, DNA samples). This assumes that partners are in a position to receive samples of different kinds and to implement such technologies for major conservation impact. This Output is also complementary to those of the other nine CGIAR Centres in charge of in-trust collections, so collectively the CGIAR can provide at anytime options for agricultural development worldwide.

Output 3: The in-trust collections are genetically and socially relevant.

Output 3 benefit directly and indirectly breeders, agronomists, extensionists, and farmers in Latin America, Africa and Asia. The research effort here is targeted to what has to be conserved so that these user communities find the diversity they need. Selected collecting increases the diversity of the in-trust collections, while studies on that diversity generate benefits by disclosing new traits, by informing breeders about probabilities of success in wide-crossing, or by providing farmers with options for niche markets. These research efforts benefits NARS involved in the conservation by disclosing new variability within their borders that they are not aware of (a recent example is the exploration for wild Phaseolus in NW Nicaragua), also by the experimental approaches developed by CIAT GRU and other scientists within the CGIAR. The role of CIAT GRU is that of a primary research provider, and often a secondary research provider (backing up national genetic resources programmes with technical expertise and training). An important assumption here is that countries that have ratified the International Treaty will provide facilitate access for the Annex 1 crops.

Another assumption is a continuing funding for this type of work, so that collaborative arrangements with NARS can be maintained and young professionals can be hired. This Output is complementary to those of USDA Pullman for beans, and of EMBRAPA Cenargen for cassava.

Output 4: Strengthened institutions that expand the scope of the conservation effort for agricultural biological heritage

Output 4 seeks to benefit partners at multiple levels through training, and the production and diffusion of training materials and public awareness products. CIAT GRU role is that of a primary provider, given its expertise in genebank handling, and in studies about crop gene pools of the Neotropics, but also that of a facilitator, specially in regional specialized courses. It is important to note that the drivers of GRU research a better definition of the genetic diversity to be conserved in order to face future breeders needs, and the refinement of conservation technologies are shared by many genetic resources conservation programmes across Latin America. In this context, training efforts can be developed and have been - together with other CGIAR Centres based in the Americas (Bioversity, CIMMYT, and CIP). An important assumption is the continuity of and at the NARS involved, so that trained personnel can apply learned technologies in the running of their own ex situ facilities.

Output 5: Conservation ex situ at CIAT links with in situ conservation on farm and in the wild for larger numbers of populations of landraces and wild relatives effectively conserved Output 5 benefits Latin American countries because it links through agricultural biodiversity two sectors - agriculture and the environment - that have been rarely involved together towards a common goal. It does so because of Outputs 1 and 2: the quality of the passport information of the accessions kept ex situ, that help locate biological materials, either landraces or crop wild relatives. That information communicated to biodiversity institutes such as CONABIO of Mexico, Instituto von Humboldt of Colombia and INBio of Costa Rica help them to strengthen further their own conservation work, namely in making protected areas more relevant and more comprehensive by including wild relatives of crops. CIAT GRU is a primary provider because of the information about geographic location of landraces and wild relatives, also in conjunction with work by CIAT GIS Unit. CIAT GRU is also an emulator because this approach can and has been already be extended to other crop gene pools. That direction has been also welcomed by international wildlife institutions such as the Nature Conservancy. The assumption here is that national partners are willing and prepared to take that responsibility. It is already the case for Mexico, Costa Rica and Brazil, and it is hoped that others will join.

International Public Goods

The IPG of the GRU Output Line include:
o Germplasm of Phaseolus beans, Manihot cassava and selected tropical forages, that have been distributed at a rate of 5-6,000 samples yearly over the last years. Interestingly, in recent years, university departments are recipients of forage germplasm before forage agronomists.
o Data of evaluation of the crop commodity germplasm against pests and diseases of economic importance, and for technological traits when relevant (e.g. starch quality in cassava).
o Knowledge and tools that contribute to the development and implementation of the above IPGs. For example, molecular markers for useful traits, developed with CIAT's in-house resources of genetic maps and markers. Knowledge of the structure of genetic resources housed in the genebank (e.g. phylogenies of Phaseolus and Manihot), and ways to exploit them. Screening methods to identify biotic and abiotic stress resistant genotypes.

Conservation technologies (e.g. for intermediate seeds, DNA bank, cryoconservation, pollen conservation).
o Training products (e.g. handbook of procedures, best practices). Methods for networking, both formal among official sector researchers, and less formal among a broader range of partners (e.g. national genebanks, biodiversity institutes, botanic gardens).

Elaboration of Partners Roles

Output 1: The other CGIAR Centres responsible for in-trust collections, in the framework of the GPG1/ GPG2 projects coordinated by SGRP, are the first partners. There are ongoing activities on the definition of best practices, or the review of guidelines, namely that controlling the safe movement of crop germplasm (i.e. plant quarantine technical regulations). The USDA-NGRPC of Fort Collins, the University of Reading, UK, and the Politécnico de Madrid, Spain, are partners in seed conservation in order to find the most efficient and safe protocols for the long-term conservation of seed germplasm of many tropical legumes and grasses. IFPRI is a partner for the part dealing with conservation economics, first of all for an updating to the costing work done in 2004. The Audit Unit of CGIAR based at IRRI has been a partner on the part dealing with risk appraisal and management.

Output 2: The other CGIAR Centres responsible for in-trust collections, in the framework of the GPG1/ GPG2 projects coordinated by SGRP, are the first partners too, and next the No. 2 genebanks for the respective crop commodity germplasms. For instance, with IITA and EMBRAPA there is a common registry for cassava under development, and as a consequence the accessions that are shared can be considered as safely replicated. The Nordic genebank that manages the Global Seed Vault at Svalbard is our natural partners for the safe duplicate of the seed collections of beans and forages, while other duplicates are maintained at CIMMYT, INIBAP and CIP. SGRP and SINGER are partners on germplasm information, namely for two services: i) access to germplasm distribution data at the higher level (information to the Conference of the Parties of the Convention on Biological Diversity, for instance), and ii) one-stop entry for the request of crop germplasm.

Output 3: Partners in Latin America with genetic resources of the crop commodities are the first partners, namely Mexico (INIFAP and UNAM), Colombia (UNAL and Corpoica) and Peru (INIA and U La Molina) for Phaseolus beans, and Mexico (INIFAP and UNAM) and Brazil (CENARGEN) for Manihot cassava. Different pieces of research and will continue - have been carried out with the U San Carlos and U Valle of Guatemala, the University of Costa Rica, a NGO such as CIPRES of Nicaragua, the University of Buenos Aires Argentina. Different pieces of research and will continue - have been advanced with advanced research institutes such as U. Reading UK, Royal Botanic Gardens Kew UK, U California Davis USA, U Hannover Germany, U Oslo Norway, and the National Institute of Agrobiological Resources Tsukuba Japan.

Output 4: NARS of Latin America as above, plus Bioversity International Americas Office, and specialists in different university departments and other genetic resources programmes in the USA (USDA Pullman, USDA Fort Collins) or in Germany (Gatersleben). The University of Birmingham UK and particularly the MSc programme in plant genetic resources is a partner for graduate thesis work in plant physiology, in GIS analysis, and in crop taxonomy. The AGP of FAO and the Organization of the American States have been natural partners in the coordination of international courses in seed physiology and in in vitro conservation.

Output 5: NARS of Latin America as above, but especially the national biodiversity institutes

such CONABIO of Mexico, INBio of Costa Rica, and Institute von Humboldt of Colombia. The Nature Conservancy, namely their Latin American programme, is also a partner to that Output. Different Herbaria (identified hereafter by their international acronyms: A, AGUAT, ARIZ, BAA, BAFC, BM, BR, BRIT, CHAPA, CICY, COL, CPUN, CR, CUZ, DES, EBUM, ENCB, F, G, GH, HAO, HNMN, HUT, IBUG, IEB, INB, K, L, LIL, LOJA, LPB, M, MA, MEXU, MICH, MO, MOL, MSC, NA, NEBC, NY, O, OXF, P, PH, PRG, QCA, SGO, SI, UC, US, USJ, USM, WIS, and where collections have been studied) have been and continue to be partners in this initiative to identify all populations of Phaseolus and Manihot in the western hemisphere.

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: The in-trust collections of Phaseolus beans, Manihot cassava and selected tropical forages are maintained by CIAT GRU up to international standards.			All users of the three commodity germplasms worldwide, namely in Central and South America, Africa and South East Asia	Adoption or use designated germplasm in breeding/ agronomy programs	Better varieties, requiring less expensive inputs
	Output Target 2009: 25% of bean backlog on introduction cleared	Materials			
	Output Target 2009: 25 % of designated accessions with increased characterization (recovery of institutional memory)	Materials			
	Output Target 2009: 50% of designated accessions	Materials			

	documented with digital images				
	Output Target 2009: Bar coding implemented for all GRU operations	Practices			
	Output Target 2009: Protocols for conservation of botanic seeds of cassava and wild Manihot species defined	Practices			
	Output Target 2009: DNA bank: protocols and database established	Practices			
	Output Target 2010: 50% of bean backlog on introduction cleared	Materials			
	Output Target 2010: 50% of designated accessions with increased characterization (recovery of institutional memory)	Materials			
	Output Target 2010: Protocols for conservation of botanic seeds of cassava and wild Manihot species tested	Practices			

	Output Target 2010: Protocol for cleaned production of Brachiaria seed germplasm	Practices			
	Output Target 2010: DNA bank: 25% of in-trust bean and cassava accessions included	Practices			
	Output Target 2011: 100% of bean backlog on introduction cleared	Materials			
	Output Target 2011: 75% of designated accessions with increased characterization (recovery of institutional memory)	Materials			
	Output Target 2011: Protocols for conservation of botanic seeds of cassava and wild Manihot species implemented	Practices			
	Output Target 2011: DNA bank: 50% of in-trust bean and cassava accessions included	Practices			

Output 2: The germplasm of Phaseolus beans, Manihot cassava and selected tropical forages is made available to users, is restored to NARS, and is safely duplicated.			Users, including countries of origin, worldwide can obtain quality germplasm from CIAT GRU; that germplasm is systematically safely duplicated	The Global System foreseen by the Trust is getting concrete for beans, cassava, and tropical forages, and the NARS can rely on the CGIAR for a full back-up of their national collections.	More benefits in the society (farmers, breeders, agronomists, but also university departments) because of access to genetic resources at anytime; stable and secure access because of the safety duplicates
	Output Target 2009: On average 4-6,000 samples of the designated collections of beans, cassava and tropical forages are distributed to users annually	Materials			
	Output Target 2009: 3,000 accessions are replaced at CIP for the safety back-up of the cassava collection in vitro	Materials			
	Output Target 2009: 3,000 accessions are shipped to CIMMYT for the safety back-up of bean and tropical forages collections	Materials			

	Output Target 2009: 5,000 accessions are shipped to the Svalbard Global Seed Vault for the safety back-up of bean and tropical forages collections	Materials			
	Output Target 2009: Advances in detection of diseases of quarantine importance using the Real-Time PCR	Practices			
	Output Target 2009: Handling of SMTAs implemented electronically	Practices			
	Output Target 2010: On average 4-6,000 samples of the designated collections of beans, cassava and tropical forages are distributed to users annually	Materials			
	Output Target 2010: 3,000 accessions are replaced at CIP for the safety back-up of the cassava collection in vitro	Materials			

	Output Target 2010: 3,000 accessions are shipped to CIMMYT for the safety back-up of bean and tropical forages collections	Materials			
	Output Target 2010: 5,000 accessions are prepared for shipping to the Svalbard Global Seed Vault for the safety back-up of bean and tropical forages collections	Materials			
	Output Target 2010: Methods for the detection of diseases of quarantine importance using the Real-Time PCR implemented	Practices			
	Output Target 2011: On average 4-6,000 samples of the designated collections of beans, cassava and tropical forages are distributed to users annually	Materials			
	Output Target 2011: 3,000 accessions are replaced at CIP for the safety	Materials			

	back-up of the cassava collection in vitro				
	Output Target 2011: 3,000 accessions are shipped to CIMMYT for the safety back-up of bean and tropical forages collections	Materials			
	Output Target 2011: 5,000 accessions are shipped to the Svalbard Global Seed Vault for the safety back-up of bean and tropical forages collections	Materials			
Output 3: The in-trust collections are genetically and socially relevant.			Users worldwide can obtain the genetic variation they need in due time, now and in the future	Varieties of beans, cassava, and tropical forages that make a breakthrough in farmers fields	Higher income for farmers, better nutrition for users, lower costs to the environment
	Output Target 2009: Secondary gene pools of cultivated Phaseolus species better defined.	Practices			
	Output Target 2009: Monitoring of genetic erosion implemented so that germplasm explorations	Practices			

	are carried out in due time and at the right place.				
	Output Target 2009: Selected explorations are taking place for Phaseolus and cassava germplasm in countries that have ratified the Treaty	Practices			
	Output Target 2009: Selected sets of germplasm are collected and restored to NARS/ farmers so that they can have access to niche markets (e.g. popping beans)	Practices			
	Output Target 2010: Better appraisal of genetic relationships among Manihot species	Practices			
	Output Target 2010: Monitoring of genetic erosion implemented so that germplasm explorations are carried out in due time and at the right place.	Practices			
	Output Target 2010: Selected explorations	Practices			

	are taking place for Phaseolus and cassava germplasm in countries that have ratified the Treaty				
	Output Target 2010: Selected sets of germplasm are collected and restored to NARS/ farmers so that they can have access to niche markets (e.g. popping beans, colored cassava)	Practices			
	Output Target 2011: Selected explorations are taking place for Phaseolus and cassava germplasm in countries that have ratified the Treaty, or that allow access and registration into the Multilateral System of the Treaty	Practices			
	Output Target 2011: Selected sets of germplasm are collected and restored to NARS/ farmers so that they can have access to niche	Practices			

	markets (e.g. popping beans, colored cassava)				
Output 4: Strengthened institutions that expand the scope of the conservation effort for agricultural biological heritage			NARS in Latin America and Africa (primary target, although experience has shown that GRU training materials have been used by many other players, including Spain)	Improved capacity of NARS to tackle conservation problems of other sets of agrobiodiversity beyond the crop commodities handled by CIAT and the IARCs, namely along the two research drivers of GRU	More conservation for minor cereals, pulses, root crops and tropical fruit species, and hence diversification of the diet and of incomes for farmers worldwide
	Output Target 2009: Updated handbook of GRU procedures that can serve as a basis for future training (e.g. hands-on training, distance education through e-learning)	Practices			
	Output Target 2009: Documents with best practices (joint activity involving several IARCs coordinated by SGRP) produced	Practices			
	Output Target 2009: Distance education course re-run	Policy strategies			

	for Latin America (pending on funding availability)				
	Output Target 2010: Documents with best practices (joint activity involving several IARCs coordinated by SGRP) further diffused	Policy strategies			
	Output Target 2010: Distance education course run for Africa/ Asia (pending on funding availability)	Policy strategies			
	Output Target 2010: Participation of GRU Staff in MSc programmes including genetic resources conservation	Policy strategies			
	Output Target 2011: Distance education course run for Africa/ Asia (pending on funding availability)	Policy strategies			
	Output Target 2011: Participation of GRU Staff in MSc programmes including	Policy strategies			

	genetic resources conservation				
Output 5: Conservation ex situ at CIAT links with in situ conservation on farm and in the wild for larger numbers of populations of landraces and wild relatives effectively conserved			National genebanks (e.g. USDA, EMBRAPA); biodiversity institutes; major conservation agencies; national and international herbaria and museums of natural history; NGOs interested in on-farm conservation	Genetic resources of Phaseolus beans and Manihot cassava are better conserved, and hence used directly or employed in breeding programs	Improved conservation at lower costs for the societies; link between the environmental sector (i.e. protected areas) and the agricultural sector
	Output Target 2009: Populations of Phaseolus beans documented in herbaria (two institutes not yet visited per year)	Practices			
	Output Target 2009: Populations of Manihot wild species documented in herbaria (two institutes not yet visited per year)	Practices			
	Output Target 2009: GIS mapping for at least one species of bean for all populations ever mentioned in the western hemisphere	Policy strategies			

	Output Target 2009: Gene flow documented for beans/ or cassava in view of on-farm conservation	Practices			
	Output Target 2010: Populations of Phaseolus beans documented in herbaria (two institutes not yet visited per year)	Practices			
	Output Target 2010: Populations of Manihot wild species documented in herbaria (two institutes not yet visited per year)	Practices			
	Output Target 2010: Matching all populations mapped versus those conserved ex situ in genebanks worldwide for that bean species; conclusions about conservation priorities	Practices			
	Output Target 2010: GIS mapping for another species of bean for all populations	Policy strategies			

	ever mentioned in the western hemisphere				
	Output Target 2011: Populations of Phaseolus beans documented in herbaria (two institutes not yet visited per year)	Practices			
	Output Target 2011: Matching all populations mapped versus those conserved ex situ in genebanks worldwide for that second bean species; conclusions about conservation priorities	Practices			
	Output Target 2011: Populations of Manihot wild species documented in herbaria (two institutes not yet visited per year)	Practices			

TS1: Integrated Soil Fertility Management in Africa (TSBF)

Project Overview and Rationale

Rationale

SOIL FERTILITY DEPLETION has been described as one of the major constraints to food security and income generation in sub-Saharan Africa. Despite proposals for a diversity of solutions and the investment of time and resources by a wide range of institutions it continues to be a major problem. The rural poor are often trapped in a vicious cycle between land degradation, fuelled by a lack of relevant knowledge and/or appropriate technologies to generate adequate income and opportunities to overcome land degradation. Intensification and diversification of agricultural production is required to meet the food, feed, and income needs of the poor and this cannot happen without sustainable investment in soil fertility management.

To achieve sustainable investments in soil fertility rehabilitation, this current Outcome line, referred to as the ISFM Outcome line, accepts the INTEGRATED SOIL FERTILITY MANAGEMENT paradigm. We define ISFM as The application of soil fertility management practices, and the knowledge to adapt these to local conditions, which optimize fertilizer and organic resource use efficiency and crop productivity. These practices necessarily include appropriate fertilizer and organic input management in combination with the utilization of improved germplasm. This definition is in line with the goals of the African Fertilizer Summit (AFS), recently held in Abuja, Nigeria, which aims at increasing fertilizer use from an average of 8 to 50 kg nutrients ha-1 by 2015. In the march to generate solutions to farmers problems, research has generated a wide variety of technologies, such as fertilizer formulations, improved legume germplasm and crop rotations. ISFM arose because of the recognition that addressing the interactions between components (e.g., water, pests and soils) is as important as dealing with the components themselves. In this context, ISFM targets improved productivity, with fertilizer as en entry point, at the PLOT AND FARM SCALE.

Improving the natural resource base without addressing issues of HEALTH AND NUTRITION AND INCOME GENERATION (e.g. the resource-to-consumption logic) is often the reason for a lack of adoption of improved technologies and other farming practices. Maximum benefits from ISFM practices and technologies can only be obtained within an enabling context, where such factors as viable farm input supply and produce markets, improved health and nutrition, functional institutions, and good policy are in place.

The following target CROPPING SYSTEMS and IMPACT ZONES will form the focus of the current Outcome line: (i) millet and sorghum-based systems in dry-lands in Sahelian West-Africa, (ii) cereal-legume intercropping and rotations in moist-savannas of West, East and Southern Africa, (iii) cassava-based systems in humid lowland areas of West and Central Africa , (iv) upland rice-based systems in West and Central Africa, with a special focus on New Rice for Africa, (v) banana-based systems in East and Central African highlands, and (v) conservation agriculture in cereal croplands of West, East, and Southern Africa. The impact zones and cropping systems have been identified based on the large population depending on these systems for food and nutrition security and income (Table 1). Some ISFM-based technologies have shown a high potential for large-scale adoption and a relatively high increase in input use efficiency while further research for development investments are needed to fully assess the adoption potential of other technologies and their impact on resource use efficiencies.

These cropping systems and impact zones are partly based on the strategy of the ALLIANCE FOR THE GREEN REVOLUTION IN AFRICA (AGRA), that is expected to launch its Soil Health Program half 2008. This program has adopted ISFM as a guiding framework for improving the soil health status of African soils and the present Outcome line is expected to backstop investments in this area.

Table 1: Selected characteristics of the targeted impact zones.

Impact zone	**West African Sahel**	**West, East, and southern African moist savannas**	**West and Central African humid lowlands**	**East and Central African mid-altitude savannas**
Major cropping systems; presence of legumes	Millet-sorghum based systems, cowpea, beans	Maize-legume intercrop/rotations; conservation agriculture; groundnut, beans, soybean	Cassava- and upland rice-based systems, groundnut, soybean, cowpea	Banana-based systems, beans, soybean, groundnut
Approximate land area under these cropping systems	23 million ha	32 million ha	18 million ha cassava; 1 million ha upland rice	6 million ha
People living from these cropping systems	38 million	157 million	163 million cassava; 2 million rice	30 million
Major constraints to increased productivity[a]	Drought, low water use efficiency; low nutrient stocks; low crop-livestock integration; large distance to markets	Within-season drought (changing climate); small land size; lack of livestock; market volatility.	Chemically degraded soils; lack of improved production systems; poor infrastructure	Very small land holdings (highest population); lack of technologies; poor infrastructure and market access
Fertilizer use	Limited; good progress with micro-dosing	Moderate fertilizer use on maize	Virtually none on cassava; moderate levels on rice	Virtually none

Occurrence of poverty[a]	Extensive and severe	Moderate incidence of chronic poverty	Limited to moderate	High poverty (in severity and numbers)
Potential for agricultural growth[a]	Modest; important challenges	Relatively good; high potential for poverty reduction	Moderate; good market potential for cassava and rice	Fairly low

a) Farming systems and Poverty. Improving Farmers Livelihoods in a Changing World. 2003. FAO, Rome, Italy.

The GOAL of the ISFM Outcome line is to improve the livelihoods of people relying on agriculture in the impact zones by developing and creating an enabling environment for disseminating sustainable, profitable, socially just, nutrient-dense, and resilient agricultural production systems based on Integrated Soil Fertility Management (ISFM).

To achieve this Goal, a set of activities will be implemented of which the level and nature during the period 2009-2011 will vary according to progress made over the past years. For all systems, appropriate characterization and problem diagnosis has been achieved. DESIRED OUTPUTS related these activities are:
Output 1. Processes and principles underlying the functioning of ISFM within the above cropping systems, with a special focus on fertilizer use and resilient germplasm.
Output 2. Management practices adapted to the resource-base and socio-economic environment of smallholder farmers.
Output 3. Enabling environments for dissemination of ISFM practices, focusing on viable input and output market linkages and appropriate nutritional knowledge and health.
Output 4. Effective partnerships along each step of the value chain for innovative, effective and efficient dissemination and impact.
Output 5. Stakeholder capacity to advance the development and adaptation of above outcomes.

The current Outcome line will require specific inputs from the SLM OUTCOME LINE under TSBF-CIAT and various Outcome lines from the two OTHER RDCS, in terms of access to improved germplasm, which forms an essential component of ISFM, and in terms of value addition opportunities and active partnerships to create an enabling environment for large-scale uptake of ISFM technologies (Figure 2).

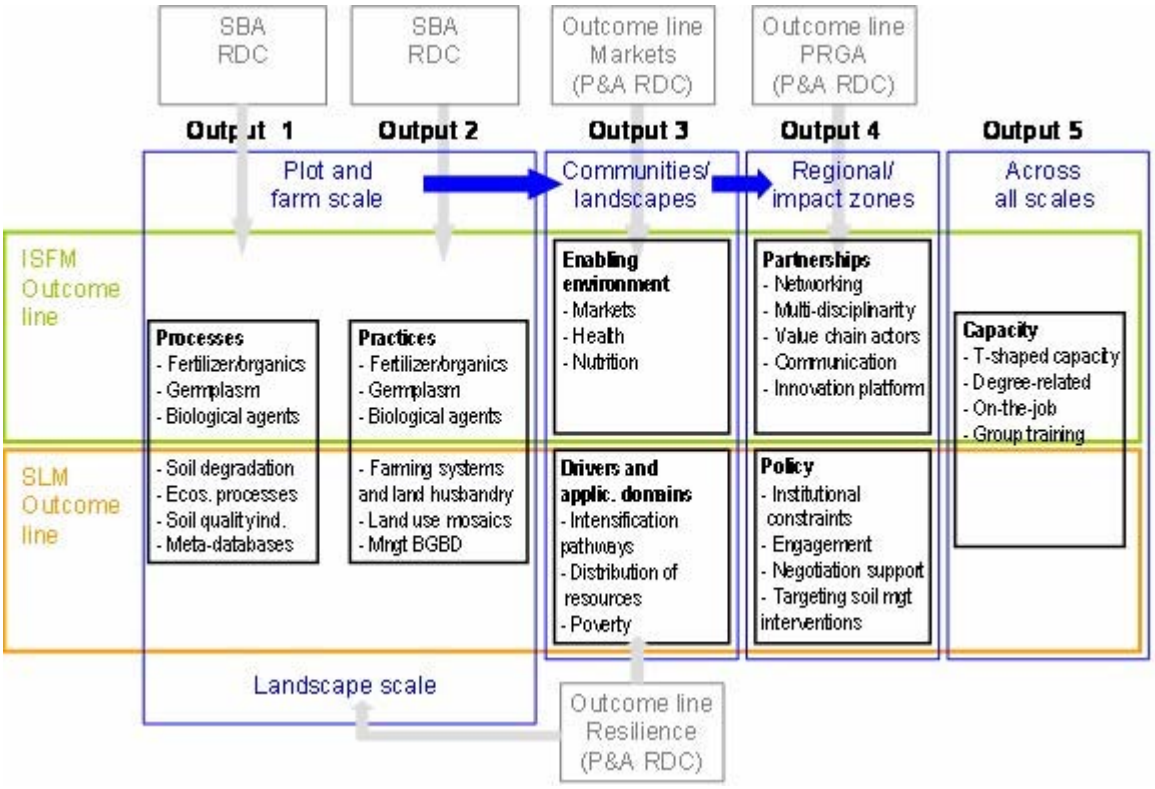


Figure 2: Specific focus areas of the ISFM and SLM Outcome lines and potential linkages between these and the other CIAT Outcome lines under the Sharing the Benefits of Agro-biodiversity (SBA) the People and Agroecosystems (P&A) RDC.

Alignment to CGIAR Priorities

The ISFM Outcome line housed mainly under CGIAR System PRIORITY AREA 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas. Most efforts are related to the following SPECIFIC GOALS:

Specific goal 1: To improve understanding of degradation thresholds and irreversibility, and the conditions necessary for success in low productivity areas.

Specific goal 3: To identify domains of potential adoption and improvement of technologies for improving soil productivity, preventing degradation and for rehabilitating degraded lands.

Specific goal 4: Evaluate the production potential of high-productivity systems and their constraints and trends.

Specific goal 5: To improve soil quality to sustain increases in productivity, stability, and environmental services through greater understanding of processes that govern soil quality and trends in soil quality in intensive system.

Specific goal 7: To optimize productivity at high input use (e.g. labor, nutrients, pest control practices, water, seed, and feed) through understanding and managing spatial and temporal variation.

Specific goal 8: Identify social, economic, policy, and institutional factors that determine decision-making about managing natural resources in intensive production systems and target interventions accordingly.

Outputs Description

Changes from previous MTP Outputs

Since the 2008-2010 MTP, the following changes have been integrated in the current MTP:
Impact zones: Activities in this Outcome lines will be focused around target impact zones that have been identified based on the presence of a relatively large population depending on agriculture for food and nutrition security and income and on the presence of widespread soil fertility-related problems.
Priority cropping systems: The choice of priority cropping systems is driven by the existence of ISFM-based technologies with demonstrated and potential large-scale impact and the targeted impact zones (see above). Obvious linkages with other CGIAR centers will be required to access the latest adapted germplasm and the most current knowledge on soil fertility management for certain target crops.
Partnerships: The proposed partnerships have been broadened to include partners along the complete value chains, including stockists. In the latter context, TSBF-CIAT has initiated a limited range of activities with Citizens Network for Foreign Affairs (CNFA) and the International Centre for Integrated Soil Fertility Management (IFDC). Obviously, more traditional partnerships will be strengthened further.
Decentralization of activities: In order to be more present in the various impact zones, offices are staffed in Kinshasa, Bukavu, Kigali, and Maseno in East and Central Africa and Maputo, Harare, and Lilongwe in southern Africa. Representation in West Africa is hosted by ICRISAT in Niamey.
Dissemination strategies: Inherent to the revised definition of ISFM, a lot of progress with enhancing system productivity can be made through dissemination of relatively simple seed and fertilizer-based technologies. Simultaneously, more complex farmer-science interaction formulas need to be started, e.g., through farmer field schools, to ensure that the required knowledge to implement full ISFM is gaining sufficient ground. In other words, two simultaneous avenues for dissemination will be formed, both leading towards the same goal but via different dissemination and capacity building channels. Dissemination channels will include strategies to link farmers to viable input and output markets and increase their knowledge on health and nutrition.

Output 1: Processes and principles underlying the functioning of ISFM within the above cropping systems, with a special focus on fertilizer use and resilient germplasm.

Description: All Outputs need to result in Outcomes for the Goal to be achieved. In the current Outcome line, the major Outcome is related to Output 2 where a large number of farmers are going to evaluate, adapt, and adopt ISFM practices, ultimately resulting in improved rural livelihoods (Figure 1). All other Outputs and Outcomes will create the necessary knowledge, capacity, partnerships, and conditions for Outcome 2 to be achieved in the target impact zones.

Output 1. The adapted definition of ISFM is based on obtaining optimal use efficiencies of investments made in agricultural production and valorizing positive interactions between production factors. Processes and principles will look into (i) the supply side of nutrients through understanding interactions between fertilizers, organic inputs, and water management practices and (ii) the demand side of nutrients through understanding the functioning and mechanisms driving the potential of improved (legume) germplasm to thrive under unfavorable conditions (e.g., drought, low soil P, acidity). Substantial emphasis will be put on the diagnosis of site-specific soil constraints. Another major strategic research issue is related to the linkages between the soil fertility status and the nutritional quality of the produce. The major Outcome of Output 1 is related to the processes and principles being used in developing ISFM-based management practices in Output 2.

Major research questions are:
o Which quick, cheap, and widely applicable approaches can be used to diagnose soil fertility-related constraints to enhanced productivity?
o Which interventions that increase resource use efficiencies are available for evaluation?
o What is the role of improved germplasm in regarding the soil fertility status, relative to the use of mineral and organic inputs?
o Which are the mechanisms underlying interactions between various growth factors (water, fertilizer, organic resources, etc) resulting in enhanced use efficiencies of each of those factors?
o Which food quality indicators are sensitive enough to assess yield quality?

Output 2: Management practices adapted to the resource-base and socio-economic environment of smallholder farmers.

Description: Knowledge generated in Output 1 needs to be translated in ISFM-based management practices for the target cropping systems and impact zones. Those practices can contain appropriate nutrient and water management strategies and improved agronomy and system design. Specific attention will be given to farmer-lead diagnosis and decision making in relation to best-fit practices, taking into account available resources, biophysical heterogeneity, and the overall social and economic environment. The major Outcome of this Output is a large number of farmers that are evaluating, adapting and adopting such improved practices. This Outcome is the most crucial Outcome of this Outcome line.

Major research questions are:
o Which are the major drivers affecting the identification of ISFM practices that are adapted to the target cropping systems and impact zones?
o Which levels of heterogeneity within communities and within farms affect the identification of best-fit ISFM practices?
o Which soil fertility indicators are sufficiently sensitive to allow farmers to adapt ISFM practices to the soil fertility status of their various plots?
o How can decision support tools, simulation modeling, and optimization models be integrated to develop improved productivity management options with farmers?
o Which interventions that reduce production risks are available for evaluation?

Output 3: Enabling environments for dissemination of ISFM practices, focusing on viable input and output market linkages and appropriate nutritional knowledge and health.

Description: Major components of ISFM practices require an in vestment in inputs, be it fertilizer, organic matter, beneficial organisms, or improved germplasm. As such, linking farmers to output and input markets is going to be essential to ensure sufficient revenues for investing in ISFM. This logic also underlies the market-led hypothesis which states that ISFM research will have more leverage if the apparent gaps between investment in the natural resource base and income generation can be bridged. Another factor that can create the required environment for large-scale dissemination of ISFM is an increased knowledge about good health and nutrition, especially related to an enhanced inclusion of legume germplasm in existing cropping systems. Besides engaging in the practice of implementing market and health/nutrition-related activities, such activities are supported by specific research questions. The major Outcome of this Output is related to farmers generating more revenue and being knowledgeable about health and nutrition and using that income and knowledge to implement ISFM practices within their farms.

Major research questions are:
o How does access to input and output markets and to knowledge on improved health and nutrition affect the investment of farmer communities in ISFM practices?

o How does the role of access to input and output markets and to knowledge on improved health and nutrition in fostering ISFM practices vary with changes in human, social, and infrastructural capital?
o Which combinations of technological, institutional, policy, and market innovations work for expanding smallholder farmer investments in agricultural systems and under what circumstances?
o What are the implications of farmer-market linkages on farming systems, livelihood assets and intra-household dynamics?

Output 4: Effective partnerships along each step of the value chain for innovative, effective and efficient dissemination and impact.

Description: Effective partnerships are needed to ensure that all segments of the value chain are actively engaged in linking farmer to markets and to ensure that all aspects of ISFM are addressed. Included in the former partnerships are farmer associations, active governmental or non-governmental extension systems, private sector entrepreneurs, policy makers, and research for development partners. The latter partnerships include research for development partners that have expertise in the various dimensions of ISFM development and dissemination, including technical, social, economic, and policy issues. Important to address will be to find ways to fully engage the required partners from project initiation and identify the necessary incentives for those partners to remain engaged, e.g., through innovation platforms. Specific attention will be given to appropriate communication channels and planning and evaluation activities. The major Outcome of this Output is related to active engagement of all required partners in developing, evaluating, and disseminating appropriate ISFM practices within the target impact zones.

Major research questions are:
o Which are the most efficient and effective means, e.g., in terms of cost per farmer reached, to scale up ISFM practices throughout the target impact zones?
o What is the specific role of various partners along each step of the value chain in promoting ISFM practices and how important is this role in reaching the end-users?
o How do partnerships evolve as adoption of ISFM practices is moving from a set of principles to be adapted by local communities to a set of proving practices that can move quickly to a lot of farmers?

Output 5: Stakeholder capacity to advance the development and adaptation of above outcomes.

Description: All partners that are required to reach the Outcome line goal need to have the required capacity to implement current initiatives aiming at developing and disseminating ISFM and to continue such activities beyond the timeframe of specific projects. Institutionalization of the approaches required for backstopping ISFM development and dissemination is going to be crucial to sustain such activities. Capacity building will include degree-related training, preferably with active linkages with Advanced Research Institutes, and covering all Outputs of the ISFM Outcome line, on-the-job training of staff involved in ISFM activities, group training on specific topics, and networking between the various partners. All training efforts will be based on formal capacity needs assessments and tightly linked to the above Outputs and focused on the target cropping systems and impact zones. Degree-related training that is often focused on specific research topics will also include the various dimensions of ISFM towards the development of T-shaped capacity that includes detailed expertise on a few topics and a general knowledge on all aspects of ISFM. The major Outcome of this Output is related to the various stakeholders leading the development and dissemination of ISFM practices.

Impact Pathways by Output

Output 1: Processes and principles underlying the functioning of ISFM within the above cropping systems, with a special focus on fertilizer use and resilient germplasm.
The impact of ISFM within the target cropping systems will be visible through improved production, income, human health and nutrition, soil fertility, and C sequestration and reduced nutrient mining and conversion of natural fallow to agriculture. If successful with the expected AGRA investments, projected impact figures are empowerment of 545,000 households (or approximately 3.8 million persons) to produce an additional 321,000 tons of additional food worth about $52 million per year. Similar improvement could be expected through year 5 as the number of cumulative participating households increases to 10.4 million. In this case, agronomic efficiencies of mineral fertilizers are increased by 50%, organic inputs provide the fertilizer nutrient equivalent of 12.5 kg per ha, food supply in increased to 103 million tons per year and the net annual return of $495 million is realized from an annual investment of $33 million, resulting in a benefit to cost ratio of 15. Food supply among the eleven cooperating nations is increased by 72% through a 50kg/ha nutrient application target with 46% of the increase resulting from ISFM as a farmer-empowering, accompanying technology.

As detailed above, the various Outputs are logically linked towards reaching impact through widespread adoption of ISFM practices. Each of the Outputs aims at reaching specific users who are then geared towards common outcomes and impact through effective partnerships.

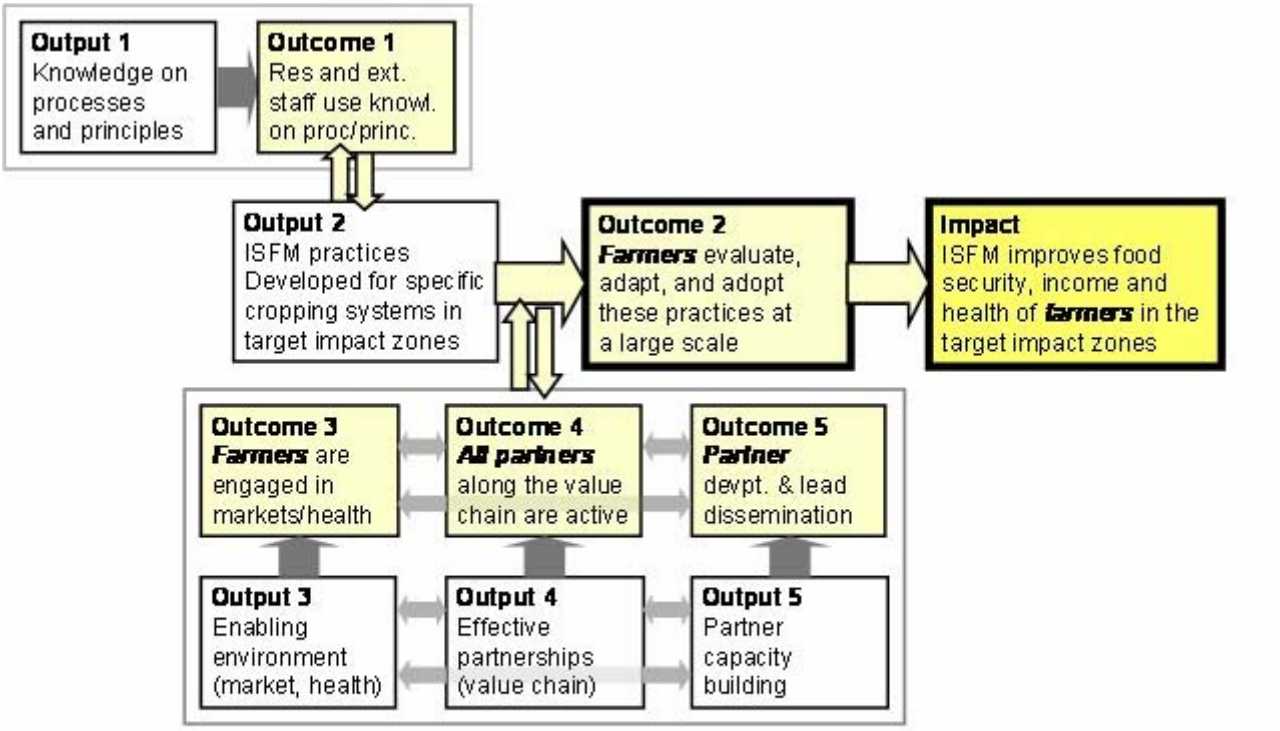


Figure 2: Linkages between the different Outputs, resulting in Outcomes and their relation to the overall goal of the ISFM Outcome line. Light grey arrows show linkages between Outputs/Outcomes and dark grey arrows indicate the translation of Outputs into Outcomes.

The intended users of OUTPUT 1 (PROCESSES AND PRINCIPLES) outcomes are mainly CGIAR, Advanced Research Institute (ARI), National Agricultural Research System (NARS), and Regional Consortia researchers who are envisaged to derive processes and principles

based on applied research activities. The final impacts of this output are ISFM-based and sustainable production systems.

Output 2: Management practices adapted to the resource-base and socio-economic environment of smallholder farmers.
Research activities from OUTPUT 2 (MANAGEMENT PRACTICES) address the social, economic, and gendered dynamics of local knowledge generation and exchange, the nature of the interface between research-extension, local community institutions/social networks, and evaluate the economic and environmental impacts of current or proposed practices. The intended users of the outcomes of this output are development practitioners and farmers who are envisaged to apply the principles, concepts and methods to adapt and improve technologies to the prevailing production environments.

Output 3: Enabling environments for dissemination of ISFM practices, focusing on viable input and output market linkages and appropriate nutritional knowledge and health.
An enabling environment for adoption of ISFM options is created in OUTPUT 3 (ENABLING ENVIRONMENT), focusing on improved market access and knowledge on health and nutrition of farming communities. These interventions will not only create motivation for adoption of ISFM technologies but contribute directly to improved income and health and nutrition after adoption of such technologies. The intended users of the outcomes of this output are development partners and farming communities with specific attention given to enlightening the ISFM research community on these issues.

Output 4: Effective partnerships along each step of the value chain for innovative, effective and efficient dissemination and impact.
The required networks for ensuring that outcomes generated in a specific output reach the intended users and logically linked to reach the ultimate Goal of this Outcome line are addressed in OUTPUT 4 (EFFECTIVE PARTNERSHIPS). As outcomes move from Output 1 to Output 3, networks of stakeholders become more and more complex and encompassing and ultimately, all value chain actors will be required to achieve the impact that this Outcome line is aiming at.

Output 5: Stakeholder capacity to advance the development and adaptation of above outcomes.
At the center of the research-outcome-impact chain, OUTPUT 5 (STAKEHOLDER CAPACITY) addresses the building of human and social capital of all TSBF-CIAT stakeholders for effective research and sustainable management of tropical soils. This is particularly necessary since managing soil fertility for improved livelihoods requires the integration of technical, social, economic and policy issues at multiple scales. To overcome this complexity, research and extension staffs need the capacity to generate and share information that will be relevant to other stakeholders working at different scales (i.e., policy makers, farmers).

Since most operations in this Outcome line are supported by specific projects, the operationalization of specific impact pathways will be dependent on the goals and objectives of these projects and will not necessarily cover the entire value chain within a specific project. The overall importance of this Outcome line is then to oversee that the necessary **LINKS ARE CREATED BETWEEN VARIOUS INITIATIVES** operating in similar impact zones to ensure a continuity of partner networks to deliver the required impact. **VARIOUS STAKEHOLDERS** that are currently involved in this Outcome line are detailed in the section of partners.

The **KEY ASSUMPTIONS** for the 5 Outputs are: (i) security and political stability does not restrict access to target sites and continuation of on-going activities; (ii) Poverty reduction strategies remain central to human development support and funding; (iii) TSBF-CIAT

stakeholders remain engaged and show limited staff turnover, (iv) TSBF-CIAT management continues to adapt and innovate in response to changing priorities, and (v) linkages remain maintained among research and development organizations. Other important assumptions are: (i) investments in various aspects of the outcome line are linked in time and space, (ii) large-scale capacity building initiatives are implemented sufficiently fast and in close relationship with development-related investments, and (iii) rural service providers are operational and rural infrastructure is sufficiently developed.

International Public Goods

International and regional public goods (IPG) that will be generated through the ISFM Outcome line include:
o Improved knowledge on soil processes, including the role of improved germplasm in regulating input use efficiency.
o Tools to take into account farm heterogeneity and farmer typologies in devising ISFM options.
o Best-fit ISFM practices for the target cropping systems and impact zones.
o Decision support tools and models to analyze trade-offs among various livelihood realms.
o Innovative approaches for sustainable crop utilization and enterprise promotion, including linking farmers to market, and rural poverty reduction.
o Effective approaches to engage various stakeholders in ISFM technology evaluation and dissemination.
o Technological, institutional, market, utilization, and policy options for increasing delivery of benefits and broader impact

The Institutes comparative advantage is in conducting IPG research on ISFM in farming systems where soil degradation undermines local livelihoods and market opportunities. However, while TSBF-CIAT will focus primarily on strategic, applied, and adaptive research, it is also ready to support technology dissemination and development activities with partners via regional networks and global projects. Much of the research as well as NARES capacity building, will be done via the Institutes regional partner network, the African Network for Soil Biology and Fertility (AfNet). Dissemination of findings will happen through effective partnerships with development partners.

Elaboration of Partners Roles

NARES: These are important local partners that contribute staff time and operational resources to all 5 outputs of the Outcome line. NARES will build the capacity of rural communities and collaborating NGOs to improve their technical skills on ISFM technologies, and will provide technical backstopping in methods and sources of technology NARES will establish the demonstration field and conduct adaptive research. NARES currently involved in the ISFM Outcome line activities include: INERA, CRSN, UNIKIN, UCB (DR Congo); ISAR, UNR (Rwanda); KARI, KEFRI, UoN, JKUAT, Moi University, Kenyatta University, NMK (Kenya), NARO, Makerere University (Uganda); ARI, Sokoine University (Tanzania); University of Ife, Ile-Ife, Nigeria; AREX, UZ, MSU (Zimbabwe); INRAN (Niger); INERA (Burkina Faso); SRI, CRI, UL (Ghana); ITRA (Togo); INRAB (Benin); IER (Mali); IIAM, UCM, UEM (Mozambique); DARS, Bunda College (Malawi); Université de Cocody (Côte d'Ivoire); ZARI, UNZA (Zambia); FOFIFA, Université d'Antananarivo (Madagascar).

Advanced Research Institutes: These are important international partners that contribute mostly to strategic research in Outputs 1 and 2. Institutes include universities in the North

and other CGIAR institutes. At the international institute level, ARI partners include: CIMMYT, ILRI, CIP, IFDC ICRAF, IITA, ICRISAT, ICIPE, IRD, CIRAD, JIRCAS. At the university level, ARI partners include: Ishikawa Prefectural University, Kyoto University (Japan), Catholic University of Leuven, University of Ghent (Belgium), University of Bayreuth, Hohenheim University (Germany); SLU (Sweden); Cornell University, Wisconsin-Madison, U.C. Davis, Ohio State University, Colorado State University, Michigan State University, Purdue University (USA); East Anglia University, University of Exeter (UK); ITC, Wageningen University and Research Centre (The Netherlands). University of Natural Resources and Applied Life Sciences (BOKU) (Austria), University of Natural Resources and Applied Life Sciences (BOKU) (Austria),.Baylor Children Hospital, Houston, USA; International Soybean Program, University of Illinois, Urbana Chapiagn, USA; EMBRAPA, Brazil; World Economic Forum, Switzerland.

Regional Consortia: These partners play a key role in building capacity in the regions for ISFM research and also for dissemination of tools and technologies to promote ISFM. These include AFNET for Sub-Saharan Africa, including SoFeCSA and African Highlands Initiative for the African highlands. The ISFM Outcome line is also actively involved in the Sub-Saharan Africa and Water and Food Challenge Programs.

NGOs: These partners play a key role in dissemination of tools and technologies for ISFM in the regions. NGOs will build social and human capital to enable rural communities to benefit from the technology and market options identified through participatory research. This draws upon the skills and knowledge of NGOs in community mobilisation, organisation and in management of social change processes. They will assist in monitoring, implementing and evaluating experiments and enterprise development; and provide other services needed by the communities and will also work with the communities to scale-up promising technology options. NGOs include CARE (Kenya), CRS, ROP (Kenya), VACID-Africa, Technoserve (Kenya), Heiffer (USA), Diobass (DR Congo), RWARRI (Rwanda), RDO (Rwanda), HAART HIV Group (Uganda), World Vision (Rwanda), CNFA (Kenya, Tanzania), and Food for the Hungry International (DR Congo).

The Private Sector: The private sector will contribute to the widespread dissemination of ISFM options by providing input and output market opportunities that will assist in creating an enabling environment for ISFM. Private sector involvement includes agro-dealers (Kenya, Tanzania, DR Congo), Bidco, Leldet, Western Seed (Kenya).

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Processes and principles underlying the functioning of ISFM within the above cropping systems,			CGIAR centers, ARIs, researchers from NARES and local universities,	Principles, concepts and methods inform technology and system	Knowledge on principles, concepts, and methods underlying

with a special focus on fertilizer use and resilient germplasm.			and regional consortia	develop ment (Output 2).	ISFM is used to inform the develop-ment of improved ISFM-based soil manage ment practices and cropping system design.
	Output Target 2009: Knowledge on mechanisms responsible for tolerance to drought and low soil P is available to guide breeding efforts in legumes rotated or intercropped with cereals in the moist savanna impact zone.	Capacity			
	Output Target 2009: The role of organic matter in regulating water, nutrient-limited and actual yield levels underlying cereal and legume production quantified in the Sahel and moist savanna impact zones.	Capacity			
	Output Target 2009: Mechanisms underlying the agronomic efficiency of applied fertilizers in the context of ISFM understood for cereal-legume systems in the Sahel and moist	Capacity			

	savanna impact zones and for conservation agriculture in the moist savanna zone, taking into account variability in soil fertility status at different scales.				
	Output Target 2009: Relationships between soil fertility status and the nutritional quality of (bio-fortified) legumes quantified within the Sahel and moist savanna impact zones.	Capacity			
	Output Target 2010: Modeling tools (e.g., DSSAT, APSIM, NUANCES) for ISFM-based nutrient management used and adapted for cereal-legume systems in the Sahel and moist savanna impact zones.	Capacity			
	Output Target 2010: Mechanisms underlying the agronomic efficiency of applied fertilizers in the context of ISFM identified and understood for cassava and rice-based systems in the humid lowland impact zone and for banana-based systems in the	Capacity			

	mid-altitude impact zone, taking into account variability in soil fertility status at different scales.				
	Output Target 2010: Relationships between crop nutritional quality and soil fertility status quantified for the major crops in the different impact zones.	Capacity			
	Output Target 2011: Cassava, rice, and banana nutrient requirements and impacts on nutritional quality of respective food products quantified within the respective impact zones.	Capacity			
Output 2: Management practices adapted to the resource-base and socio-economic environment of smallholder farmers.			CGIAR, ARI, researchers from NARS and local universities, NGOs, farmer groups, private sector agents, extension services, and regional consortia	A large number of farmers in the target impact zones evaluate, adapt, and adopt improved technologies and systems.	Improved technologies and systems, based on ISFM, improve food security, income and health of farmers in the target impact zones.
	Output Target 2009: Local diagnosis of soil fertility constraints and farmer understanding of important soil	Capacity			

	processes underlying ISFM for all impact zones				
	Output Target 2009: ISFM practices for cereal-legume systems tested, adapted, and validated to farmer conditions in the Sahel and moist savanna impact zones, including issues of conservation agriculture	Capacity			
	Output Target 2009: Trade-off analysis is informing the identification of best ISFM practices for cereal-legume systems in the Sahel and moist savanna impact zones.	Capacity			
	Output Target 2010: Decision support systems for locally adapted ISFM practices for cereal-legume systems in the Sahel and moist savanna impact zones	Capacity			
	Output Target 2010: ISFM practices for cassava and rice systems tested, adapted, and validated to farmer conditions in the humid lowland impact zone	Capacity			

	Output Target 2011: Decision support systems for locally adapted ISFM practices for cassava and rice-based systems in the humid lowland impact zone	Capacity			
Output 3: Enabling environments for dissemination of ISFM practices, focusing on viable input and output market linkages and appropriate nutritional knowledge and health.			CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young profe ssionnals, extension services, policy makers	Farmers are generating more revenue and are knowledgea ble about health and nutrition and using that income and knowledge to imple- ment ISFM practices within their farms.	Improved income and health and nutrition for the farmers in the target impact zones through adoption of ISFM-based production systems.
	Output Target 2009: Linkages with the private sector to improve access to fertilizer and develop recommendations for its use by farmers and other stakeholders involved in the Sahel and moist savanna impact zones.	Policy strategies			
	Output Target 2009: Knowledge of extension staff and farmers that are involved in adaptation and dissemination of ISFM practices on	Capacity			

	appropriate nutrition and health practices sufficiently developed in the Sahel and moist savanna impact zones.				
	Output Target 2010: Linkages with the private sector to improve access to fertilizer and develop recommendations for its use by farmers and other stakeholders involved in the humid lowland impact zone.	Policy strategies			
	Output Target 2011: Linkages with the private sector to improve access to fertilizer and develop recommendations for its use by farmers and other stakeholders involved in the humid lowland impact zone.	Policy strategies			
Output 4: Effective partnerships along each step of the value chain for innovative, effective and efficient dissemination and impact.			CGIAR, ARIs, researchers from NARS and local universities, NGOs, farmers, regional consortia, young profe ssionals, private sec-tor agents, extension services, po-licy makers	Partners are involved in addre-ssing all components of the value chains related to the ISFM-based production systems.	Improved ISFM-based production systems contribute to food and nutrition security and income and health of farmers in the target impact zones.

	Output Target 2009: Strategic alliances formed for disseminating ISFM practices within cereal-legume systems in the Sahel and moist savanna impact zones.	Policy strategies			
	Output Target 2009: Best approaches developed for disseminating ISFM practices within cereal-legume systems in the Sahel and moist savanna impact zones.	Policy strategies			
	Output Target 2010: Strategic alliances formed for disseminating ISFM practices within cassava- and rice-based systems in the humid lowland impact zone.	Policy strategies			
	Output Target 2010: Best approaches developed for disseminating ISFM practices within cassava- and rice-based systems in the humid lowland impact zone	Policy strategies			
	Output Target 2011: Strategic alliances formed for disseminating ISFM practices within banana-based systems in the mid-altitude impact zone.	Policy strategies			

Output 5: Stakeholder capacity to advance the development and adaptation of above outcomes.			CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young profe ssionals, private sector agents, policy makers	Stakehol-ders are leading the develop-ment and dissemina-tion of ISFM practices in the context of initiatives lead by them.	Large-scale impact of ISFM practices in the target impact zones.
	Output Target 2009: Capacity of agro-input dealers to support farming communities for implementing ISFM strengthened in all impact zones.	Capacity			
	Output Target 2009: Farmer-to-farmer knowledge sharing and extension on ISFM through various facilitated activities in all impact zones	Capacity			
	Output Target 2009: Knowledge on principles and processes underlying ISFM practices embedded in soil fertility management networks and regional consortia	Capacity			
	Output Target 2010: Curricula and technical manuals for developing,	Materials			

	adapting, evaluating, and disseminating ISFM practices, applicable to all impact zones.				
	Output Target 2010: Extension materials for ISFM developed that are specific to the various aspect of drivers of ISFM and for the different impact zones	Capacity			
	Output Target 2011: Institutionalization of knowledge and approaches for evaluating, and disseminating ISFM practices within the governmental and non-governmental extension systems.	Policy strategies			

TS2: Sustainable Land Management in the Tropics (TSBF)

Project Overview and Rationale

Rationale

Land degradation is considered to be one of the major constraints of food security and income generation in developing countries. Despite proposals for a diversity of solutions and the investment of time and resources in combating reversing land degradation, it continues to prove to be a substantially pervasive problem. The rural poor in Africa, Asia and Latin America often find themselves trapped in a vicious cycle of poverty and land degradation fuelled by lack of relevant knowledge or appropriate technologies and opportunities to overcome land degradation and generate adequate income to improve their livelihoods. Intensification and diversification of smallholder agricultural production systems is required to meet the food, feed and income needs of the rural poor in a sustainable manner.

The impact pathways and interventions will achieve sustainable intensification and diversification of agricultural production only if they take environmental and socio-economic conditions into account, including the physical, service and market infrastructure and policy environment. Intensification and diversification requires land management solutions and technologies that are adapted to local circumstances to make them feasible. Information on the local circumstances needs to inform the type of interventions that are considered and proper targeting of interventions is of primary importance to assure best fit and workable solutions and herewith enhance adoptability of proposed soil and land use management options and technologies. Decisions regarding intensification and diversification of agricultural production need to take cognisance of the fact that different agro-ecological zones are of varied agricultural potential that will inform the definitions of achievable objectives of the planned intervention.

Addressing land degradation problems effectively requires a focus on the larger agricultural production landscape rather then using the cropping field or the farm as unit of reference. The aim is to look at the processes that drive land use change and land degradation that will allow better understanding of landscape dynamics and enable us to identify the entry points for possible intervention (whether at plot, farm or landscape level). Such a strategy will create the synergy required to effectively deal with different levels at which land degradation manifests it self. The production landscape needs to be understood in terms of environmental (or ecosystem) goods and services provided to satisfy the needs for food security, shelter, water, and a clean and healthy environment. The SLM outcome line will observe these in relation to the soil resource base. The eroding soil resource base is as such a concern to the wider rural community and trade-offs need to be considered in serving the interest of the various stakeholder groups.

We embrace the concept of soil health as a guiding paradigm that indicates the capacity of the soil ecosystem to provide soil related ecosystem goods and services (nutrient cycling, carbon sequestration and green house gas emissions, soil structure modification and regulation of soil water balance, and control of soil born pest and diseases). The productive capacity of the landscape is directly linked to its resource base. We aim to understand what the implications are of soil erosion in terms of loss of soil biodiversity, nutrient depletion (including reduction in soil organic matter) and soil structural degradation in terms of provision of the above mentioned ecosystem goods and services. The emphasis will hereby be on the biological processes that are least understood. Based on this understanding, technologies and integrated production systems will be investigated for their effectiveness and applicability in maintaining the soil resource base.

A farmer can compensate for the eroding resource base and consequent loss of soil ecosystem functions by applying fertilizer, mechanization of the tillage operations etc. (i.e. through intensifying the production system). However, these options are not always available to the farmer and it is especially for the low and medium external input systems that we want to investigate options and opportunities for biological intervention as means to intensify the production system. At the same time use of agrochemicals and mechanisation may be viable options to restore or maintain soil productivity and should not be discarded in considering possible strategies to restore and maintain soil health. As options are available to the farmer to compensate for loss of ecosystem services, the challenge might actually be to look at the organisation and structure of the landscape to secure ecosystem goods and services, to minimize trade-offs and to react to treats of climate changes (mitigate effects of climate change on the soil ecosystem). We intend to apply the concept of integrated natural resource management (INRM) to the larger landscape in order to achieve this.

The SLM outcome line aims to assess of soil health related problems, diagnose these, and recommend treatments to prevent and restore soil degradation and to validate the options and technologies for improving soil productivity. It will do so by defining problem domains and domains for application of particular technologies and land and soil management options. One major output is expected to be the tools and methods for the assessment and diagnoses of soil health related problems and prognoses for the response of system to recommended treatment. This requires identification of criteria and definition of thresholds for assessing soil health status. In general we want to be able to distinguish between soils in terms of whether they are responsive to particular treatments and base management recommendation on that, with particular relevance to fertilizer application.

To be able to better manage our soils we need to better understand the soil ecosystem as a nested hierarchical system and of the processes that govern soil quality, taking place at the various levels in the system. It requires looking into spatial and temporal variation of soil quality indicators and into the scale levels at which particular soil processes take place. Research challenges relate to the characterization of the landscape as a production system in terms of its configuration and composition of agro-ecosystems and land uses as well as how to conceptualize and model the interactions between the various components of this nested hierarchical system.. The relevance of below-ground biodiversity for agricultural production landscapes is still virtually unchartered terrain and will remain a focus of the outcome line. TSBF is not in the position to carry out this type of research independently and we will seek implementation of these research activities through collaboration with our research partner institutions.

The sustainable land management outcome line aims to contribute to the Research for Development Challenge (RDC) on People and Agro-ecosystems. The SLM outcome line will link and build upon results obtained from the outcome line on Markets, Institutions and Livelihoods, to improve the effectiveness of agricultural research and development and the uptake of research results by small scale farmers and will solicit support especially in the field of successful targeting, reaching end users and impact assessment. Strengthening the organizational capacities of farmer organizations (including women's producer organizations) and rural service providers will be instrument to the success of the SLM outcome line. Issues related to social capital will be addressed mainly through this outcome line.

The goal is to contribute to improved management of tropical ecosystems for human well-being, to reduce hunger and poverty in the tropical areas of Africa, Asia and Latin America through scientific research leading to the development of new technologies and knowledge that promotes sustainable use of environmental resources with particular emphasis on the biology and fertility of tropical soils, through improved targeting of

interventions, building scientific capacity and through contributions to agricultural policy formulation and development.

The objective of the SLM outcome line is to enhance knowledge and understanding of soil health important to sustainable agriculture in tropical landscapes and to demonstrate that by appropriate targeting of land use and soil management interventions at the landscape level, progressive trends in the erosion of the soils resource base can be reversed and benefits derived in terms of sustainable agricultural production and enhanced provision of soil ecosystem goods and services.

The ISFM and SLM outcome lines are strongly interlinked and both aim for sustainable agricultural productions systems, however with ISFM outcome line putting an emphasis on the nutrient management for enhanced agronomic efficiency and production, focusing on plot and farm scales, whereas the SLM outcome emphasizes the management of soil biological resources with focus at the landscape level. The SLM outcome line will rely on inputs from (or links with) the Markets OL as far as research on market value chains on tropical fruits and other crops are concerned, as alternative crops may constitute an important element of a strategy to improve land and soil management. Research in decision making at farm household and institutional level in relation to risk management may provide relevant information on willingness to invest in soil resources base.
Inputs from the Agro-ecosystems and climate change OL will be important in shaping decisions in landscape, water and soil management. Work on sustainable (integrated) production systems and collective action; trade-off analyses, payment schemes for ES will be important complementary activities; Work on climate risk and vulnerability will be relevant to indicate effect of climate change on the incidence and vulnerability of crops to soil borne pest and diseases for example which will have direct implication for sustainable management of the soil biological resources. Support in also expected in the development of decision support tools and formulation of policy options. The connections of the SLM outcome line with other outcome lines is depicted in the figure below.

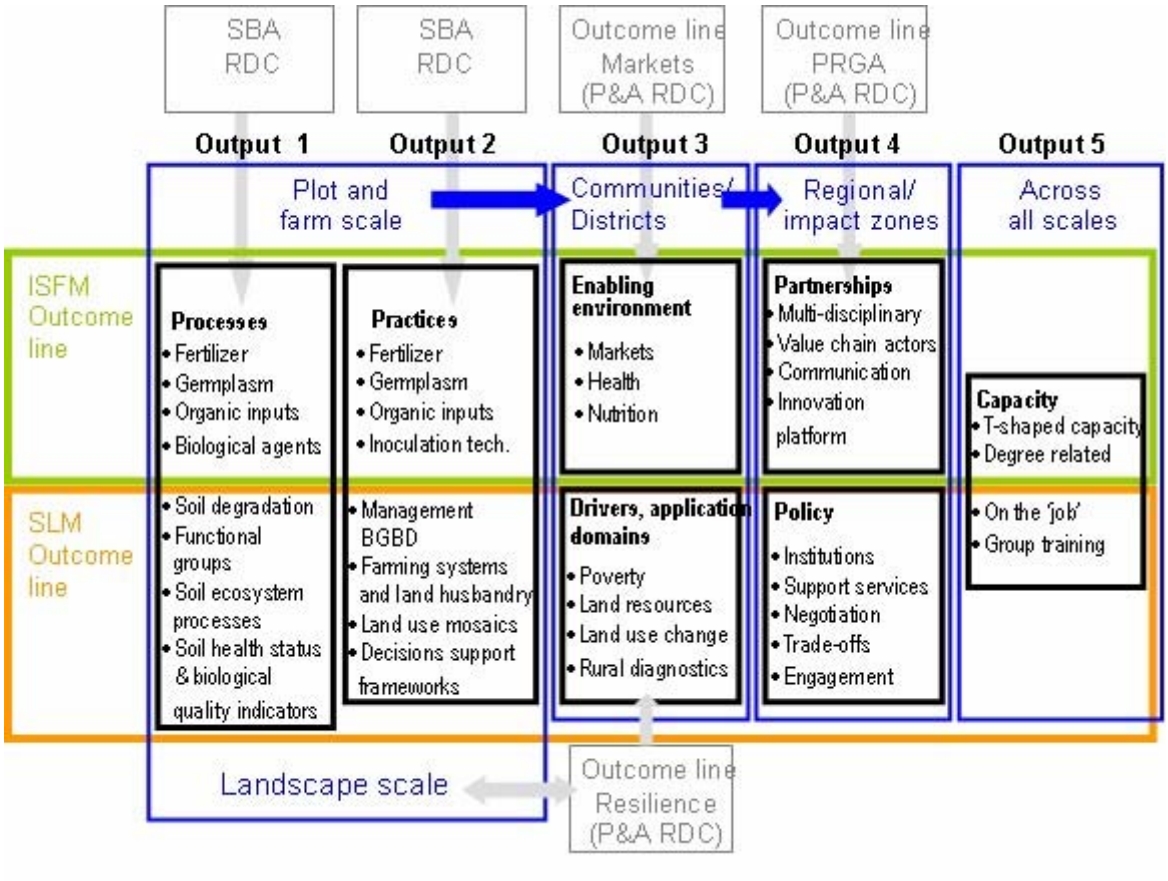


Figure 2: Specific focus areas of the ISFM and SLM Outcome lines and potential linkages between these and the other CIAT Outcome lines under the Sharing the Benefits of Agro-biodiversity (SBA) the People and Agroecosystems (P&A) RDC.

Alignment to CGIAR Priorities

CIAT-TSBFs outcome line on Sustainable Land Management is housed mainly under CGIAR System Priority Area 4: Promoting poverty alleviation and sustainable management of water, land, and forest resources. Majority of the efforts are dedicated to System PRIORITY AREA 4A: Promoting integrated land, water and forest management at landscape level, and PRIORITY AREA 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas. With activities contributing to the following specific goals of PA 4A:

o Specific goal 1: To develop analytical methods and tools for the management of multiple use landscapes with a focus on sustainable productivity enhancement
o Specific Goal 2: To enhance the management of landscapes through changing stakeholder awareness and capacity for social-ecological planning at landscape and farm levels
o Specific Goal 5: Creating multiple benefits and improved governance of environmental resources through the harmonization of inter-sectoral policies and institutions.

With respect to the System Priority Area 4D the following specific goals are being served:
o Specific Goal 1: To improve understanding of degradation thresholds and irreversibility, and the conditions necessary for success in low productivity areas
o Specific Goal 3: To identify domains of potential adoption and improvement of

technologies for improving soil productivity, preventing degradation and for rehabilitating degraded lands
o Specific goal 5: To improve soil quality to sustain increases in productivity, stability, and environmental services through greater understanding of processes that govern soil quality and trends in soil quality in intensive systems
o Specific Goal 7: To optimize productivity at high input use (e.g. labour, nutrients, pest control practices, water, seed, and feed) through understanding and managing spatial and temporal variation.

Outputs Description

Changes from previous MTP Outputs

Reduced core support to CIAT by donors resulted in downsizing of the TSBF program in Latin America in recent years. However, activities in the Amazon basin as well as in Mexico have continued under the umbrella of the CSM-BGBD project and the aim is to continue work in the context of the sustainable land management outcome line within the Amazon basin and Central America, as well as in South and South East Asia.

One of the major recommendations of the CCER was for CIAT-TSBF to improve access to fertilizer and develop recommendations for its use that are of mutual benefit to all stakeholders involved.. These will incorporate: data on soils, cropping and land use systems, optimal fertilizer formulations for balanced crop nutrition, details on fertilizer packaging and information provided to farmers, practical ISFM concepts, the decision support tools needed for their implementation, and socioeconomic research on needs for fertilizer marketing infrastructure, integration with local knowledge to enhance adoption, economic benefits for farmers, and societal costs as a whole.

Important aspects of this recommendation are being implemented. CIAT-TSBF is playing a key role in the implementation of the recommendations of the African Fertilizer Summit taking specific action to improve farmers access to fertilizer, quality seeds, extension services, market information and soil nutrient testing and mapping to facilitate effective use of inorganic and organic fertilizers, while paying attention to the environment and especially below-ground biodiversity (BGBD). Enhanced fertilizer use will be an important consideration in the strategy for sustainable land management. The SLM outcome line will therefore work in close collaboration with the ISFM outcome line on the above activities, with the emphasis for the SLM outcome line on the (improved) targeting of soil management recommendations and development of decision support tools.

New projects have been designed to:
a) Test various ISFM options (including increase of fertilizer application) on the effects of BGBD and soil health status in general
b) Mapping soil health status in SSA and constraints and opportunities for application of fertilizers to improve soil and crop management.
c) Collate information on ISFM and SLM technologies and management options and information on fertilizer response and ISFM trials, soil management and conservation experiments to determine the application domain and the improve prediction of response to fertilizers application and ISFM under various conditions
d) Develop a framework for developing soil management recommendations that target different stakeholder groups at different levels of spatial detail.
e) Conducting ISFM and fertilizer response trials to test soil management recommendations under field conditions for a variety of soil health conditions as indicated by the soil health

status inventory
f) Develop a major project on the role of fertilizer on the environment in SSA with GEF-UNEP.

CIAT-TSBF is already enhancing the access of farmers to fertilizers in many of its ongoing projects. An example is the soybean project (through a strategic alliance of all stakeholders including fertilizer dealers). With respect to the provision of scientific information to the fertilizer and other farm input industry and to complement the activities of biophysical scientists in generating and fine-tuning fertilizer recommendations in line with the socioeconomic and cultural realities of the smallholder farmers, CIAT-TSBF recently completed a study on farm and agro-inputs (including fertilizers) in 40 markets in Western Kenya and plans to carry out a similar study in Uganda, Malawi and Tanzania in the near future. Strong links are developed with Citizens Network for Foreign Affairs (CNFA) and the International Centre for Integrated Soil Fertility Management (IFDC). That said, aspiring to the leading position as provider of market information to the fertilizer industry is not likely to be a feasible or desirable objective for CIAT-TSBF.

Output 1: Concepts, principles and processes

Description: Biophysical processes and principles that underlie soil health; processes of soil degradation and drivers and proximate causes of soil degradation understood, principles for restoring soil biological quality and soil health defined, with emphasis on soil biological processes and the interaction with soil physical and chemical components (including soil organic matter) in agro-ecoystems.

The processes that underlie soil erosion and chemical degradations and the direct causes or drivers of these processes are fairly well understood. This may be less so in case of soil physical and biological degradation. Moreover, relatively little is known how to describe land degradation at a landscape level and what the consequences are for the provision of ecosystem goods and services. Sustainable land management requires a concept of sustainable production landscapes and indicators of sustainability. Developing the concept will be done through inventory and characterization of the heterogeneity at land- and soilscape level and investigating (positive and negative) interactions between landscape components (understood both in terms of horizontal and vertical dimensions) within the context of the provision of ecosystem goods and services.. Emphasis will be put on the diagnosis of sustainable land management and identification of constraints for maintaining the soil resource base, and will devote attention to the proximate and root causes (both in the bio-physical and socio-economic domain) of a degrading soil resource base. Much of these processes of land degradation have to be understood in terms of land use change, referring to land use intensification and land use conversion within the context of the bio-physical and socio-economic environment, and these will provide the entry points for s soil and land management interventions and improved targeting of these interventions. A better understanding how the provision of ecosystem goods and services depend on the resource base (including the soil biological resources) will help targeting interventions and indicators will need to reflect the importance of the soil based processes and functions.

Output 2: Soil health management practices; landscape management

Description: Economically viable and environmentally sound soil management practices developed and tested, integrating knowledge of biophysical, socio-cultural and economic processes, with emphasis on direct and indirect management of soil biological resources for low- and medium external input agricultural systems.

Intensification pathways for low input agriculture will have to target investment in

maintaining and improving the natural resource base, i.e. aim to restore ecological functioning especially where intensification of farming practices is to be achieved without increasing the need for external inputs. To this end options for direct and indirect management of below-ground biodiversity will be investigated and evaluated. This will refer to the crop diversification strategies, improved organic matter management, reduced tillage operations and inoculation with beneficial soil organisms in various forms. Sustainable land management practices (or ISFM technologies for that matter) generally target field operations and therefore adaptation of the technologies that takes account of the resource allocation on farm and the consequently possible soil fertility gradients within farm is often considered as necessary step for the adoption of the technologies. However this may be true, large scale adoption will remain problematic because of other constraints to the investment in sustainable land management (viz lack of resources or security in various forms). Therefore, other options and strategies need to be considered and these will have to include the allocation of resources at the landscape level. Attention will be devoted to optimal allocation of resources that are available on farm and within the landscape. Tools and techniques for evaluation of ecosystem services from output 1 will result in improved appreciation of critical elements or components within the land use system and the landscape and soil conservation including below-ground biodiversity.

Output 3: Application domains and enabling environment

Description: Socio-economic and cultural drivers for land degradation identified and constraints mapped; Options for sustainable land management and reversal of soil degradation for social profitability developed and application domains identified

ISFM and INRM technologies have been widely researched, but adoption has been generally poor. This is especially true for INRM technologies that require relatively high investments that do not give immediate returns. This requires critical evaluation of the constraints that hinder the adoption of these technologies and management options and careful mapping of the application domains. This relates not only the farmers context, but also to the wider socio-economic context and policy environment as well as the bio-physical environment. The enabling environment relates to the converse of the drivers and pressures that result in land degradation. Functioning markets and adequate market access will play an important role as well as market prices for agricultural inputs and outputs. However, there may other structural constraints that are equally important in the adoption of alternative land and soil management options, like access to land (size of the land holdings) and other resources as well as poverty and wealth distribution. These drivers will be investigated for each of the applications sites and ex-ante analyses will be carried out for each of the considered technology options and interventions and possible impacts will be determined. Also, reward mechanisms for investment in sustainable land management will be investigated. This activity will define and describe the application domains of ISFM and INRM technologies and systems within the landscape context and will contribute to the improved targeting of management interventions and policy recommendations.

Output 4: Targeting of management interventions and policy recommendations

Description: Decision support tools for improved targeting of recommendation for sustainable land management and negotiation support; institutional environment and support services required for sustainable land management identified and policy recommendations made.

Outputs 1, 2 and 3 will provide input for the targeting of interventions. The targeting will build on the diagnoses to determine priority solutions for sustainable land management. The requirements for the successful implementation of recommended management interventions are matched with the locally prevailing conditions to identify a number of alternative

solutions to land degradation. This process of matching results in some kind of suitability rating (aptitude) of proposed land uses and management regimes given the local conditions and circumstances. The targeting requires that possible impact of the interventions on the environment and livelihoods of the people are assessed and that trade-offs are analyzed, within the confines of the particular landscape. This output will conduct cases studies within each of the major agro-ecological zones (or impact zones) that will result in recommendations for targeted intervention to improve sustainable land management. Policy interventions are required to put the necessary support functions in place to establish and enabling environment. Insights in the constraints for the adoption of SLM practices by the various stakeholder groups, and policy recommendations will results from considering what actions are required to lift these constraints and to put the support functions in place. Policy recommendations will be elaborated for the selected landscapes within the impact zones for various scale levels or interventions domains, in deliberation with the various stakeholder groups within the area. Analyses of trade-offs will help in the negotiation of the preferred solution.

Output 5: Capacity building

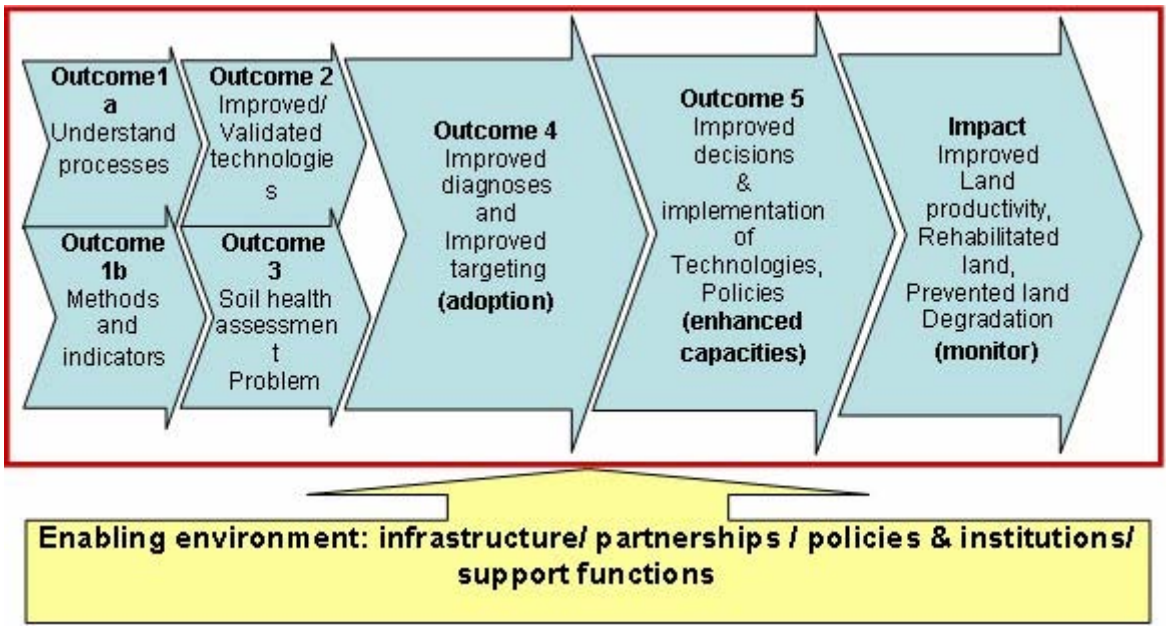
Description: Stakeholder capacity to advance the development and adaptation of recommendations for improved land management enhanced; effective dissemination of results and advocacy for sustainable land management

Capacity building will be cross cutting through each of the outputs listed. Capacity building will done through graduate and post-graduate training, on the job-training of NARS and University staff that directly participate in the implementation of the projects, through short term training courses and stakeholder meetings and workshops. The graduate and post graduated training will be mostly associated with output 1, whereas on the job-training will be associated mainly with output 2 and output 3 to some extent. The training workshops and stakeholder meetings/workshop will be the main modus of capacity building for outputs 3 and 4. Most of the graduate and post-graduate training will be done through direct supervision of CIAT-TSF staff though most of the training will be provide through the universities that participate in the CIAT-TSBF SLM research projects. Otherwise Afnet will play an important role in the provision of informal training. For stakeholder workshop and meetings we will increasingly try to involve and interest n0n-governemental organizations.

Impact Pathways by Output

Output 1: Concepts, principles and processes

The outcomes of the 5 major outputs described above define the pathway through which the SLM outcome line aims to generate impact. All the 5 outputs/outcomes represent enabling conditions that need to be met to affect change in land use and soil management. These conditions include: 1) appropriate information and on status of land degradation, accurate diagnosis and understanding of causes, constraints and opportunities surrounding to land degradation, 2) appropriate land and soil management technologies and options for the various stakeholders for intervention at plot and landscape level, 3) enabling environment that addresses the drivers of land degradation and provides incentives for the adoption of improved soil and landscape management practices, which may refer to proper market infrastructure, access to markets, reward mechanisms for environmental goods and services, access to land and other resources, 4) government policies and support structures (institutes) that allow for the implementation of sustainable soil and land management and finally 5) Capacity building through formal training components as well as stakeholder workshops and generation of international public goods.



International Public Goods

The IPG of the SLM outcome line include the following:
o Improved understanding on soil (biological) processes;
o Inventory of below-ground biodiversity in major tropical eco-regions;
o (Standard) methods for the inventory and characterization of BGBD
o Improved understanding of loss of BGBD in relation to the intensification of land use;
o Improved knowledge on how different stakeholders use and manage landscapes;
o Indicators of soil (biological) quality;
o Improved approaches and practices for managing soil, water and land resources at a landscape level;
o Innovative diversification options of land use within agricultural production landscapes;
o Decision support tools and models to analyze trade-offs among food productivity, ecosystem services and land conservation;
o Institutional innovations and policy options to reduce land degradation and to restore degraded lands.
o Three-tier-approach for sustainable crop and livestock enterprise promotion, linking farmers to market, and rural poverty reduction.

The Institute has a comparative advantage in conducting and coordinating IPG research on soil biology and fertility in a farming system and land use system context, where land degradation undermines local livelihoods. However, while CIAT-TSBF will focus primarily on strategic research, it will support technology dissemination and development activities with partners via regional networks and global projects. CIAT-TSBF SLM will continue research on below-ground biodiversity as a means of beneficially managing soil biology, through the GEF-UNEP funded global project on below-ground biodiversity (BGBD) which is in its second phase of project implementation. Much of the applied research and dissemination of findings, as well as NARSs capacity building, will be done via the Institutes regional partner network the African Network for Soil Biology and Fertility (AfNet). CIAT-TSBF also collaborates with the South Asian Regional Network (SARNet) on soil fertility research in that region. Efforts will be undertaken to build a similar network for soil biology and fertility research in Latin America

Elaboration of Partners Roles

The partners play an important role in the research, the dissemination of results of this research and in development activities as CIAT-TSBF is a relative small institute and activities can only be implemented through its partners. To this end the SLM outcome line maintains a large network of collaborators through which its activities are implemented. The partners include National Agricultural Research and Extension services (NARES), the international Agricultural Research Institutes (ARI) and many universities in the various countries. Increasingly partnerships with international as well as local NGOs are established to cater for and link with development oriented activities.

NARES: These are important local partners that contribute staff time and operational resources to all 5 outputs of the project. NARS will build the capacity of rural communities and collaborating NGOs to improve their technical skills on SLM technologies, and will provide technical backstopping in methods and sources of technology. NARES will establish the demonstration field and conduct adaptive research. In all countries where SLM projects are implemented work is carried out through, or in collaboration, with the NARES. The countries are the following: Brazil, Mexico, Honduras, Côte d'Ivoire, Mali, Nigeria, Kenya, Uganda, Tanzania, Zimbabwe, Malawi, Mozambique, Zambia, India and Indonesia

ARIs: These are important international partners that contribute mostly to strategic research in output 1 on biophysical and socioeconomic processes and output 2 on natural resource management strategies. These include CIMMYT, ICRAF, IITA, ICRISAT, IRD (France), CIRAD (France).

Universities: These are local and international partners that participate mostly in co-supervision of students that work on SLM and below-ground biodiversity and beneficial organisms. University of Nairobi, Maseno University (Kenya), Makerere University (Uganda), Islamic University (Uganda), Kenyatta University (Kenya), Zimbabwe (Zimbabwe), Sokoine (Tanzania-1), Universidade Federal de Lavras (Brazil), Instituto Nacional de Pesquisas da Amazonia (INPA, Brazil), Centro de Ensino Luterano de Manaus CEULM/ULBRA, Brazil), Universidade Federal do Amazonas (UFAM, Brazil), Universidade de Brasilia (UNB, Brazil), Centro de Energia Nuclear na Agricultura (CENA, Brazil), Universidade Regional de Blumenau (FURB, Brazil), Jawaharlal Nehru University (India-1), University of Agricultural Sciences (India-1), Kumaon University (India-1), Sambalpur University (India-1), Universitas Lampung (Indonesia-1), Brawijaya University (Indonesia-1), Gadjah Mada University (Indonesia-1), Bogor Agricultural University (Indonesia-1), Université de Cocody (Côte d'Ivoire), Université DAdobo-Adame (Côte d'Ivoire), Universidade Veracruziana (Mexico), Instituto Polytécnico (Mexico), Instituto de Ecología (INECOL, Mexico), SLU (Sweden-3), Cornell (USA-2), U.C. Davis (USA-1), Colorado State University (USA-1), East Anglia (UK-1), Queen Mary University (USA-1), Michigan State University (USA-1), Purdue University (USA-1), ITC (The Netherlands-1) University of Exeter (UK-1), Wageningen University and Research Centre (Netherlands-3), and KU-Leuven University (4).

Regional Consortia: These partners play a key role in building capacity in the regions for SLM research and also for dissemination of tools and technologies to promote SLM. These include AFNET for Sub-Saharan Africa and African Highlands Initiative for African highlands, SARNET for South Asia.

NGOs: These partners play a key role in dissemination of tools and technologies for SLM in the regions. NGOs will build social and human capital to enable rural communities to benefit from the technology and market options identified through participatory research. This draws upon the skills and knowledge of NGOs in community mobilisation, organisation and

in management of social change processes.

They will assist in monitoring, implementing and evaluating experiments and enterprise development; and provide other services needed by the communities and will also work with the communities to scale-up promising technology options. The NGOs include a wide list of local NGOs (e.g. RED that operates in Los Tuxtals benchmark area (Mexico), and WATALA (the same for the benchmark site in Indonesia), national NGOs like NATURINDO in Indonesia, and international NGOs like IUCN, CRS, CNFA and others..

In addition to the above partners, SLM outcome line participates with Systemwide Programs and Ecoregional programmes (ASB, Amazon Initiative) and Challenge Programs (Water and Food CP, SSA-CP).

Logical Framework

Output	Output targets	Output target types/Verification (optional)	Intended users	Outcomes	Impacts
Output 1: Concepts, principles and processes			CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Understanding of soil processes important to provide soil ecosystem services informs the develop-ment of technologies and management options (see output 2)	Standard methods and indicators help assessment of soil health status in uniform and consistent manner and allows for identification of soil health problem and creates awareness of severity of the problem and generates action preparedness among stakeholders

	Output Target 2009: Practical methods for rapid assessment and monitoring of the soil resource base status in relation to soil nutrients, organic matter, aggregation and soil structure	Practices			
	Output Target 2009: Standard methods for the inventory of BGBD documented (handbook published)	Practices			
	Output Target 2009: BGBD assessed in 11 benchmark sites across the Tropics and loss of BGBD as result of land use intensification determined; Assessed of soil health status in agric prod. landscapes of major agro-ecological impact zones	Capacity			
	Output Target 2009: Indicators of soil (biological) quality identified and documented	Capacity			
	Output Target 2009: Concepts of valuating the contribution of soil biota and biotic processes to the provision ecosystem goods and services applied in case studies	Capacity			

	Output Target 2010: Modelling tools to predict effect of soil management interventions and technologies on soil health status developed and validated	Capacity			
	Output Target 2010: Methods for evaluating soil health status (provision ecosystem goods and services) developed and accepted	Capacity			
	Output Target 2011: Decision support framework for targeting soil management recommendation (ISFM and INRM technologies) at landscape level established	Capacity			
Output 2: Soil health management practices; landscape management			CGIAR, ARI, researchers from NARS and local universities, NGOs, farmer groups, private sector agents, extension services, and regional consortia, conservation agencies	Technolo-gies and soil manage-ment strategies available for range of agro-ecologi cal and socio-econo mic condi tions provides viable options for various stakeholder groups and increases adoption of improved technologies	Increased sustainabilit y of productions systems and improved security of farmers in target impact areas.

	Output Target 2009: Local baselines and interviews show that farmers understanding of soil biological processes and soil health status is demonstrably enhanced in at least 5 benchmark sites	Practices			
	Output Target 2009: Direct and indirect options to manage BGBD that enhance locally important ecosystem services demonstrated	Capacity			
	Output Target 2009: Alternative production systems like Conservation Agriculture tested and evaluated for effectiveness in maintaining and restoring soil health and with respect to adoptability	Capacity			
	Output Target 2010: The role of soil organic matter in regulating BGBD and soil health tested across a number of experimental sites in at least 5 countries in the tropics	Capacity			
	Output Target 2010: Species/strains identified with potential for inoculants development;	Practices			

	Direct inoculation in various cropping systems and for various purposes (enhancing productivity, control of soil borne pest and diseases and improving soil structure) tested on persistence, affectivity and competitiveness				
	Output Target 2011: Tools for modeling resource allocation within agricultural productions landscapes and optimization of resource reallocation suggested for selected agricultural production landscapes.	Materials			
Output 3: Application domains and enabling environment			CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, policy makers	Improved diagnosis of soil health problems informs identification of entry points and targeting of soil and land manage-ment intervene-tions.	
	Output Target 2009: Methods, protocols and indicators developed to characterize socio-cultural and	Capacity			

	economic environ-ment and for valuation of soil ecosystem services				
	Output Target 2009: Socio-economic constraints to soil health management assessed in some agricultural productions landscapes and forest margins of the BGBD project; diagnostic carried out	Capacity			
	Output Target 2009: Methods developed for socio-cultural and economic (participatory) valuation of ecosystem goods and services developed and implemented in BGBD project sites	Capacity			
	Output Target 2010: 30% of partner farmers in pilot sites use SLM options that arrested resource degradation and increased productivity in comparison with non-treated farms	Capacity			
	Output Target 2011: Landscape dynamics assessed, social and economic constraints to improved land and soil management assessed, application	Capacity			

	domains and options for improved soil and land management identified for the majority of the TSBF project sites				
Output 4: Targeting of management interventions and policy recommendations			Researchers from NARS, NGOs, Extensions services, policy makers, donor community	Principles of sustainable land mana gement integrated in local and country policies and programs and investment plans;	Strategy documents inform Donor community on possible investment options and ultimately reversed land degradation contributes to global SLM goals
	Output Target 2009: Farmer-to farmer knowledge sharing and extension through organized field trips and participatory M&E activities conducted in TSBF SLM project sites	Practices			
	Output Target 2009: Trade-off analyses conducted and policy recomm endation issued for the BGBD bench mark areas	Capacity			
	Output Target 2010: Profitable land use innovations scaled out beyond pilot learning sites through strategic alliances and partnerships, and application of	Capacity			

	alternative dissemination approaches				
	Output Target 2011: Social science aspects are included in the decision-making process and tools to better understand actionable management strategies for landscape management, their knowledge requirements, and economics.	Policy strategies			
Output 5: Capacity building			CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, young professionals, policy makers	Partners promoting resilient production systems with multiple benefits (food security, income, human health and environmental services)	Improved resilience of production systems contribute to food security, income generation and health of farmers
	Output Target 2009: Web content of the BGBD website enhanced to contain data and information on taxonomy and species identification, methods for inventory and characterization of BGBD, Synthesis reports on inventory, indicators of BGBD	Capacity			

	loss and soil biological quality indicators and management option and techniques for managing BGBD				
	Output Target 2009: Documentation on integrated approach to the management of agricultural production landscapes with respect to soil health and conservation of the soil resource base	Materials			
	Output Target 2010: Validated intensive and profitable systems are being demonstrated, promoted by partners and adopted by farmers in 10 countries	Capacity			
	Output Target 2010: Stakeholders in target areas have an improved capacity for collective action and local policy negotiation and implementation of integrated land use practices using integrated agricultural research for development	Capacity			

	Output Target 2011: Improve linkages with the private sector to improve access to fertilizer and develop recommendations for its use by farmers and other stakeholders involved.	Policy strategies			

ANNEXES

Implementation of EPMR/CPER Recommendations

Name of Center: INTERNATIONAL CENTER FOR TROPICAL AGRICULTURE (CIAT)

Recommendation As listed in the EPMR report	**Centers Response** Accepted or not accepted	**Implementation**		
		Milestones	**Progress Achieved**	**Target Date of Completion**
#1 CIAT management initiate as a matter of urgency a strategic planning process	Accepted	New Strategic Plan adopted by BOT.	Initial consultations with partners; studies of key issues; and consultation with BOT.	December 31, 2008.
#2 CIAT implement its research for development agenda via a small number of outcome lines	Accepted.	New research structure in MTP 2010-2012 based on new strategic plan.	Strategic plan under development.	June 15, 2009.
#3 CIAT support at least one entomologist, one pathologist, one plant physiologist, and one virologist	Accepted	All positions filled.	Two positions currently filled and other two under recruitment	December 31, 2008.
#4 CIAT strengthen its forage research efforts in Africa and Central America	Accepted	Effective forage research functioning in Africa and Central America reported in Annual Report and part of current MTP.	Forage scientist appointed in Central America and being recruited for Africa.	June 15, 2009
#5 CIAT continue to support the rice program in LAC	Accepted	Rice research functioning as part of current MTP.	Done.	June 15, 2008.

#6 CIAT revisit its contracts with i) the Fund for Irrigated Rice in LAC (FLAR), on access to rice germplasm and ii)with Papalotla for forages in line with CGIAR's guidelines and the Standard Material Transfer Agreement of the International Treaty on Plant Genetic Resources;	Accepted	New agreements negotiated.	New agreement reached with FLAR. New agreement on use of SMTA reached with Papalotla.	September 21, 2007. January 2008.
#7 CIAT and IITA develop a common, coordinated cassava research agenda and work closely to implement their joint agenda in Africa.	Accepted.	New umbrella agreement reached with IITA. Effective joint research activities shown in respective MTPs.	Draft agreement circulated and under discussion between DGs and BOT Chairs.	December 31, 2008. June 15, 2009.
#8 CIAT commission a task force of key stakeholders to assist the Center in developing a regional LAC strategy.	Accepted.	Consultations documented as part of the strategic planning process.	Consultations with Colombia, CATIE, and IICA done. Consultations with EMPRAPA, FORAGRO, and special task force being planned.	December 31, 2008.
#9 CIAT's global orientation be operationalized through strengthened Regional Programs (Africa, Asia, LAC)	Partially accepted.	Regional strategies in 1) new strategic plan and 2) new MTP.	Part of strategic planning process.	1) December 31, 2008. 2) June 15, 2009.

#10 CIAT fully implement the Fifth EPMR (2000) recommendation on IP and add operational capacity to manage IP	Partially accepted.	Operational capacity in IP 1) documented in strategy paper and 2) included in new MTP	Expanded cooperation with CAS IP. Possibilities with other centers being explored.	1) BOT meeting #59, May 2009. 2) June 15, 2009.
#11 The TSBF Scientific Advisory Committee be discontinued.	Accepted	TSBF SAC dissolved	Done	October 9, 2007
#12 CIAT adopt the research organizational structure and reporting lines presented in Figure 7.11.	Partially accepted.	New research structure in MTP 2010-2012 based on new strategic plan.	Strategic plan under development.	June 15, 2009.
# 13: The Panel recommends (Strongly) that the CIAT Board take rapid and bold actions to reconstitute CIAT leadership and management in the short term.	Accepted.	Full new Management Team in place.	Recruitment for DG and DDG-R under way.	December 31, 2008.
#14: The Panel recommends that: (i) CIAT established a Finance Director position and (ii) The recently established Grants Management Unit (GM) should be abolished and its functions disaggregated.	Partially accepted.	(i) New Finance Director appointed. (ii) Grant Management functions reorganized.	(i)Recruitment for Finance Director under way (ii) GM function will be moved to finance. Restricted budgeting function will be combined with unrestricted budgeting function into one budgeting office. Resource	(i) December 31, 2008. (ii) GM functions to be fully reorganized by April 1, 2009. Resource Mobilization Office set up under DG from June 1, 2008.

			Mobilization function outside of GM is being established.	
# 15: The Panel recommends that Human resource management become a priority at CIAT	Agreed	Expand HR systems capability to include regions. Revise HR policies. Overhaul IRS compensation policy and category structure establishing clear parameters for promotions. Implement a force ranking PA system.	(i) Personnel Policies for IRS revised and new category structure and promotion criteria established. (ii) Other policies under review.	(i) New IRS policies and categories approved April 2008 (ii) December 31, 2009.
# 16: The Board, in consultation with management, should institute measures to strengthen Board operations and strategic focus; address information shortcomings, the Boards heavy workload and agenda, and priority performance indicators	Agreed.	With the lessening of the financial crisis, the Boards workload has significantly reduced. Its' November 2008 and 2009 agendas will be focused on the issues of leadership and strategy planning.	In addition to maintaining a firm overview of the financial situation of the Centre, the Board spent considerable time on the selection of the new DG and the development of the new Strategic Plan in its April 2007 meeting. These topics will also dominate the BOT58 agenda in November 2008.	Board meeting #59, May 2009.
# 17: The panel strongly recommends that	Agreed.	The Board expects to operate in a	As of January 2008 the Board has intervened	Board meeting #58, November

the Board lay out parameters and a timetable to end its intervening mode.		normal engaged mode following BOT57.	less, although it has maintained a high level of vigilance.	2008.
# 18: The panel strongly recommends that CIAT strengthen the boards expertise in finance/accountancy, establish an internal control policy framework, hold closed sessions of the Audit Committee to probe deeper on the functioning of internal controls, and make risk management a standing agenda item of the board.	Agreed.	Board operating with strengthened financial expertise and recommended procedures.	The Board has made sustained efforts to strengthen its expertise in finance, and has identified a second expert. In January 2008 Mr. Gordon MacNeil joined the CIAT Board. He has a wide expertise and experience in financial and management matters. He has worked with several other centers and was a member of the CGIAR Secretariat staff. Mr. McNeil was appointed as a CGIAR nominee. An internal control policy framework was developed for approval at the Board November 2007 meeting. Closed sessions of the Audit Committee have been instituted and will contiue. Risk management will continue to be a standing agenda item, as	Board meeting #58, November, 2008.

			decided in 2006	
# 19: The panel strongly recommends that the board reflect critically on lessons learned from the recent period of distress and move expeditiously, in consultation with the CGIAR, to reinvigorate the leadership of the board and its committees, as needed.	Agreed.	New Board members appointed.	The current Board has spent a large amount of time analyzing the roots of CIAT's crisis and, with management and external consultants discussed the changes to be implemented. A joint statement by the CIAT BOT Chair and the Chair of the CGIAR committed to move forward with changes in CIAT governance&As a next step the CIAT Board will work with the CGIAR Chair to determine new Board membership.	July 30, 2008.

FINANCING PLAN

CIAT-Table 1: Allocation of Project Costs by Priority Area and Priorities, 2009 in $millions

	Priority Area 1		Priority Area 2				Priority Area 3			Priority Area 4			Priority Area 5				Non-Priority Area			
Project	1A	1B	2A	2B	2C	2D	3A	3B	3D	4A	4C	4D	5A	5B	5C	5D	Development Activities	New Research Areas	Stand-alone Training	**Total**
CP-1 HarvestPlus	1.320	0.110	0.110	0.110	0.110	0.286												0.044	0.110	**2.200**
PA-1 Markets		0.559					1.213					0.337		2.694	1.111	0.135	0.067	0.350	0.270	**6.736**
PA-2 Agroecosystems Resilience										1.396	0.399	0.598	0.399		0.399	0.399	0.040	0.200	0.160	**3.990**
PA-3 PRGA															0.441	0.063	0.050		0.076	**0.630**
PA-4 Amazon Initiative							0.018		0.018	0.124		0.053	0.035	0.018	0.036		0.018	0.018	0.018	**0.356**
SBA-1 Beans	1.899		1.519	1.367	1.368	0.760											0.152	0.304	0.228	**7.597**
SBA-2 Cassava	1.822		0.911	1.154	1.397												0.182	0.365	0.243	**6.074**
SBA-3 Forages	1.357							0.910									0.082	0.191	0.191	**2.731**
SBA-4 Rice for LAC	1.108		1.065	0.852	0.639												0.128	0.298	0.171	**4.261**
SBA-5 Conserving Agrobiodiversity	1.540																	0.081		**1.621**
TS-1 ISFM-TSBF										3.859		1.484					0.119	0.178	0.297	**5.937**
TS-2 SLMT - TSBF										1.867		0.534					0.053	0.080	0.133	**2.667**
Total	**9.046**	**0.669**	**3.605**	**3.483**	**3.514**	**1.046**	**1.231**	**0.910**	**0.018**	**7.246**	**0.399**	**3.006**	**0.434**	**2.712**	**1.987**	**0.597**	**0.891**	**2.109**	**1.897**	**44.800**

CIAT-Table 2: Allocation of Project Costs to CGIAR Priorities, 2007-2011

in $millions

Projects / Priorities	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
SBA-1 Beans					
1A	2.077	1.883	1.899	1.926	1.953
2A	1.662	1.506	1.519	1.540	1.563
2B	1.496	1.355	1.367	1.387	1.406
2C	1.496	1.355	1.368	1.386	1.406
2D	0.831	0.753	0.760	0.770	0.781
Development Activities	0.166	0.151	0.152	0.154	0.156
Stand-alone Training	0.249	0.226	0.228	0.231	0.234
New Research Areas	0.332	0.301	0.304	0.308	0.313
Total Project	**8.309**	**7.530**	**7.597**	**7.702**	**7.812**
SBA-2 Cassava					
1A	2.461	1.898	1.822	1.846	1.871
2A	1.230	0.949	0.911	0.923	0.936
2B	1.558	1.202	1.154	1.169	1.185
2C	1.887	1.455	1.397	1.415	1.434
Development Activities	0.246	0.190	0.182	0.185	0.187
Stand-alone Training	0.328	0.253	0.243	0.246	0.250
New Research Areas	0.492	0.379	0.365	0.369	0.374
Total Project	**8.202**	**6.326**	**6.074**	**6.153**	**6.237**

Projects / Priorities	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
SBA-3 Forages					
1A	1.836	1.423	1.357	1.363	1.370
3B	1.230	0.954	0.910	0.914	0.918
Development Activities	0.111	0.086	0.082	0.082	0.083
Stand-alone Training	0.259	0.200	0.191	0.192	0.193
New Research Areas	0.258	0.200	0.191	0.192	0.193
Total Project	**3.694**	**2.863**	**2.731**	**2.743**	**2.757**
SBA-4 Rice for LAC					
1A	1.243	1.103	1.108	1.125	1.143
2A	1.195	1.060	1.065	1.082	1.099
2B	0.956	0.848	0.852	0.865	0.880
2C	0.717	0.636	0.639	0.649	0.660
Development Activities	0.143	0.127	0.128	0.130	0.132
Stand-alone Training	0.191	0.170	0.171	0.173	0.176
New Research Areas	0.335	0.297	0.298	0.303	0.308
Total Project	**4.780**	**4.241**	**4.261**	**4.327**	**4.398**
CP-1 HarvestPlus					
1A	0.966	1.320	1.320	1.320	1.320
1B	0.081	0.110	0.110	0.110	0.110
2A	0.080	0.110	0.110	0.110	0.110
2B	0.081	0.110	0.110	0.110	0.110
2C	0.081	0.110	0.110	0.110	0.110
2D	0.209	0.286	0.286	0.286	0.286
Stand-alone Training	0.081	0.110	0.110	0.110	0.110

Projects / Priorities	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
New Research Areas	0.032	0.044	0.044	0.044	0.044
Total Project	**1.611**	**2.200**	**2.200**	**2.200**	**2.200**
PA-1 Markets					
1B	0.577	0.570	0.559	0.565	0.571
3A	1.251	1.235	1.213	1.225	1.238
4D	0.347	0.343	0.337	0.340	0.344
5B	2.779	2.745	2.694	2.722	2.752
5C	1.146	1.133	1.111	1.123	1.135
5D	0.139	0.137	0.135	0.136	0.138
Development Activities	0.070	0.069	0.067	0.068	0.069
Stand-alone Training	0.278	0.275	0.270	0.272	0.275
New Research Areas	0.361	0.357	0.350	0.354	0.358
Total Project	**6.948**	**6.864**	**6.736**	**6.805**	**6.880**
PA-2 Agroecosystems Resilience					
4A	1.527	1.425	1.396	1.409	1.424
4C	0.436	0.407	0.399	0.403	0.406
4D	0.655	0.611	0.598	0.604	0.610
5A	0.436	0.407	0.399	0.403	0.407
5C	0.436	0.407	0.399	0.403	0.407
5D	0.436	0.407	0.399	0.403	0.407
Development Activities	0.044	0.041	0.040	0.040	0.040
Stand-alone Training	0.175	0.163	0.160	0.161	0.163
New Research Areas	0.218	0.203	0.200	0.201	0.203
Total Project	**4.363**	**4.071**	**3.990**	**4.027**	**4.067**

Projects / Priorities	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
PA-3 PRGA					
5C	0.341	0.579	0.441	0.441	0.441
5D	0.049	0.083	0.063	0.063	0.063
Development Activities	0.039	0.066	0.050	0.050	0.050
Stand-alone Training	0.058	0.099	0.076	0.076	0.076
Total Project	**0.487**	**0.827**	**0.630**	**0.630**	**0.630**
PA-4 Amazon Initiative					
3A	0.015	0.016	0.018	0.018	0.018
3D	0.015	0.016	0.018	0.018	0.018
4A	0.103	0.113	0.124	0.129	0.129
4D	0.045	0.048	0.053	0.056	0.055
5A	0.030	0.033	0.035	0.037	0.037
5B	0.015	0.016	0.018	0.018	0.018
5C	0.030	0.033	0.036	0.037	0.037
Development Activities	0.015	0.016	0.018	0.018	0.018
Stand-alone Training	0.015	0.016	0.018	0.018	0.018
New Research Areas	0.015	0.016	0.018	0.018	0.018
Total Project	**0.298**	**0.323**	**0.356**	**0.367**	**0.366**
SBA-5 Conserving Agrobiodiversity					
1A	1.560	1.767	1.540	1.534	1.530
New Research Areas	0.082	0.093	0.081	0.081	0.081
Total Project	**1.642**	**1.860**	**1.621**	**1.615**	**1.611**

Projects / Priorities	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
TS-1 ISFM-TSBF					
4A	3.482	3.662	3.859	3.991	3.966
4D	1.339	1.408	1.484	1.535	1.525
Development Activities	0.107	0.113	0.119	0.123	0.122
Stand-alone Training	0.268	0.282	0.297	0.307	0.305
New Research Areas	0.161	0.169	0.178	0.184	0.183
Total Project	**5.357**	**5.634**	**5.937**	**6.140**	**6.101**
TS-2 SLMT - TSBF					
4A	1.685	1.772	1.867	1.813	1.919
4D	0.481	0.506	0.534	0.518	0.548
Development Activities	0.048	0.051	0.053	0.052	0.055
Stand-alone Training	0.121	0.126	0.133	0.130	0.137
New Research Areas	0.072	0.076	0.080	0.078	0.082
Total Project	**2.407**	**2.531**	**2.667**	**2.591**	**2.741**
Total	**48.098**	**45.270**	**44.800**	**45.300**	**45.800**

CIAT-Table 3: Summary of Project Costs, 2007-2011

in $millions

Project	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
CP-1 HarvestPlus	1.611	2.200	2.200	2.200	2.200
PA-1 Markets	6.948	6.864	6.736	6.805	6.880
PA-2 Agroecosystems Resilience	4.363	4.071	3.990	4.027	4.067
PA-3 PRGA	0.487	0.827	0.630	0.630	0.630
PA-4 Amazon Initiative	0.298	0.323	0.356	0.367	0.366
SBA-1 Beans	8.309	7.530	7.597	7.702	7.812
SBA-2 Cassava	8.202	6.326	6.074	6.153	6.237
SBA-3 Forages	3.694	2.863	2.731	2.743	2.757
SBA-4 Rice for LAC	4.780	4.241	4.261	4.327	4.398
SBA-5 Conserving Agrobiodiversity	1.642	1.860	1.621	1.615	1.611
TS-1 ISFM-TSBF	5.357	5.634	5.937	6.140	6.101
TS-2 SLMT - TSBF	2.407	2.531	2.667	2.591	2.741
Total	**48.098**	**45.270**	**44.800**	**45.300**	**45.800**

CIAT-Table 4: Summary of Priority Costs, 2007-2011
in $millions

Priorities	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
1A	10.143	9.394	9.046	9.114	9.187
1B	0.658	0.680	0.669	0.675	0.681
2A	4.167	3.625	3.605	3.655	3.708
2B	4.091	3.515	3.483	3.531	3.581
2C	4.181	3.556	3.514	3.560	3.610
2D	1.040	1.039	1.046	1.056	1.067
3A	1.266	1.251	1.231	1.243	1.256
3B	1.230	0.954	0.910	0.914	0.918
3D	0.015	0.016	0.018	0.018	0.018
4A	6.797	6.972	7.246	7.342	7.438
4C	0.436	0.407	0.399	0.403	0.406
4D	2.867	2.916	3.006	3.053	3.082
5A	0.466	0.440	0.434	0.440	0.444
5B	2.794	2.761	2.712	2.740	2.770
5C	1.953	2.152	1.987	2.004	2.020
5D	0.624	0.627	0.597	0.602	0.608
Development Activities	0.989	0.910	0.891	0.902	0.912
Stand-alone Training	2.023	1.920	1.897	1.916	1.937
New Research Areas	2.358	2.135	2.109	2.132	2.157
Total	**48.098**	**45.270**	**44.800**	**45.300**	**45.800**

CIAT-Table 5: Investments by Undertaking, Activity and Sector, 2007-2011 in $millions

	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
Increasing Productivity	21.122	19.286	19.181	19.458	19.650
Germplasm Enhancement & Breeding	14.772	13.034	12.864	13.018	13.181
Production Systems Development & Management	6.350	6.252	6.317	6.440	6.469
Cropping systems	3.993	3.954	3.993	4.071	4.093
Livestock systems	2.357	2.298	2.324	2.369	2.376
Tree systems	0.000	0.000	0.000	0.000	0.000
Fish systems	0.000	0.000	0.000	0.000	0.000
Protecting the Environment	8.717	8.658	8.675	8.735	8.878
Saving Biodiversity	10.436	9.674	9.356	9.429	9.517
Improving Policies	2.147	2.125	2.096	2.116	2.135
Strengthening NARS	5.676	5.527	5.492	5.562	5.620
Training and Professional Development	1.502	1.488	1.472	1.488	1.504
Documentation, Publications, Info. Dissemination	1.320	1.317	1.304	1.319	1.332
Organization & Management Couselling	0.789	0.788	0.771	0.779	0.788
Networks	2.065	1.934	1.945	1.976	1.996
Total	**48.098**	**45.270**	**44.800**	**45.300**	**45.800**

CIAT-Table 6: Project Investments by Developing Region, 2007-2011

in $millions

Project	Region	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
CP-1 HarvestPlus	Asia	0.551	0.752	0.752	0.752	0.752
	LAC	0.255	0.348	0.348	0.348	0.348
	SSA	0.805	1.100	1.100	1.100	1.100
	Total Project	**1.611**	**2.200**	**2.200**	**2.200**	**2.200**
PA-1 Markets	Asia	1.598	1.579	1.549	1.565	1.582
	LAC	3.474	3.432	3.368	3.403	3.440
	SSA	1.876	1.853	1.819	1.837	1.858
	Total Project	**6.948**	**6.864**	**6.736**	**6.805**	**6.880**
PA-2 Agroecosystems Resilience	Asia	0.436	0.407	0.399	0.403	0.407
	LAC	2.182	2.036	1.995	2.013	2.033
	SSA	1.745	1.628	1.596	1.611	1.627
	Total Project	**4.363**	**4.071**	**3.990**	**4.027**	**4.067**
PA-3 PRGA	Asia	0.146	0.248	0.189	0.189	0.189
	CWANA	0.097	0.166	0.127	0.127	0.127
	LAC	0.073	0.124	0.094	0.094	0.094
	SSA	0.171	0.289	0.220	0.220	0.220
	Total Project	**0.487**	**0.827**	**0.630**	**0.630**	**0.630**
PA-4 Amazon Initiative	LAC	0.298	0.323	0.356	0.367	0.366
	Total Project	**0.298**	**0.323**	**0.356**	**0.367**	**0.366**
SBA-1 Beans	CWANA	0.017	0.015	0.015	0.016	0.015
	LAC	3.814	3.456	3.487	3.535	3.586
	SSA	4.478	4.059	4.095	4.151	4.211
	Total Project	**8.309**	**7.530**	**7.597**	**7.702**	**7.812**
SBA-2 Cassava	Asia	2.871	2.214	2.126	2.154	2.183
	LAC	3.281	2.530	2.430	2.461	2.495
	SSA	2.050	1.582	1.518	1.538	1.559
	Total Project	**8.202**	**6.326**	**6.074**	**6.153**	**6.237**

CIAT-Table 7: Summary of Investments by Developing Region, 2007-2011

in $millions

Region	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
SSA	19.145	18.901	19.076	19.326	19.524
Asia	7.051	6.506	6.250	6.293	6.360
LAC	21.785	19.678	19.329	19.535	19.771
CWANA	0.117	0.185	0.145	0.146	0.145
Total	**48.098**	**45.270**	**44.800**	**45.300**	**45.800**

CIAT-Table 8: Expenditure by Object, 2007-2011

in $millions

Object of Expenditure	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
Personnel	22.351	22.000	21.600	22.248	22.915
Supplies and services	13.225	10.070	8.700	8.191	7.698
Collaboration/ Partnerships	7.513	8.000	9.000	9.250	9.500
Operational Travel	3.500	3.600	3.700	3.811	3.887
Depreciation	1.509	1.600	1.800	1.800	1.800
Total	**48.098**	**45.270**	**44.800**	**45.300**	**45.800**

CIAT-Table 9: Member and Non-Member Unrestricted Grants, 2007-2009

in $millions NC = National Currency

Member	Type NC	Actual 2007 (US$)	Actual 2007 (NC)	Estimated 2008 (US$)	Estimated 2008 (NC)	Proposal 2009 (US$)	Proposal 2009 (NC)
Unrestricted Grants							
Member							
Australia	AUD	0.000	0.000	0.000	0.000	0.230	0.250
Belgium	Euro	0.452	0.308	0.301	0.194	0.301	0.194
Brazil		0.000	0.000	0.000	0.000	0.000	0.000
Canada	CAD	1.386	1.487	1.520	1.542	1.175	1.187
Germany	Euro	0.449	0.330	0.511	0.330	0.511	0.330
Japan	Yen	0.013	1.401	0.000	0.000	0.000	0.000
Netherlands		0.000	0.000	0.000	0.000	0.000	0.000
New Zealand	NZD	0.334	0.450	0.391	0.500	0.391	0.500
Norway	NOK	1.295	7.300	0.863	4.500	0.863	4.500
Sweden	SEK	0.512	3.400	0.541	3.400	0.541	3.400
Switzerland	CHF	0.885	1.000	1.062	1.100	0.962	1.000
Thailand	US$	0.020	0.020	0.020	0.020	0.020	0.020
United Kingdom	Pound	1.546	0.755	1.495	0.755	1.495	0.755
United States	US$	1.756	1.756	0.000	0.000	0.000	0.000
World Bank	US$	2.800	2.800	3.606	3.606	2.050	2.050
Subtotal		**11.448**		**10.310**		**8.539**	
Total Unrestricted		**11.448**		**10.310**		**8.539**	

CIAT-Table 9a: Member and Non-Member Unrestricted and Restricted Grants, 2007-2009

in $millions

Member / Non-Member	Actual 2007	Estimated 2008	Proposal 2009
Unrestricted Grants			
Member			
Australia	0.000	0.000	0.230
Belgium	0.452	0.301	0.301
Brazil	0.000	0.000	0.000
Canada	1.386	1.520	1.175
Germany	0.449	0.511	0.511
Japan	0.013	0.000	0.000
Netherlands	0.000	0.000	0.000
New Zealand	0.334	0.391	0.391
Norway	1.295	0.863	0.863
Sweden	0.512	0.541	0.541
Switzerland	0.885	1.062	0.962
Thailand	0.020	0.020	0.020
United Kingdom	1.546	1.495	1.495
United States	1.756	0.000	0.000
World Bank	2.800	3.606	2.050
Subtotal	**11.448**	**10.310**	**8.539**
Total Unrestricted	**11.448**	**10.310**	**8.539**
Restricted Grants			
Member			
ADB	0.283	0.111	0.100
Australia	0.156	0.235	0.272
Austria	0.719	0.504	0.353
Belgium	1.179	0.989	0.850
Brazil	0.048	0.079	0.163

Member / Non-Member	Actual 2007	Estimated 2008	Proposal 2009
Canada	4.671	3.847	4.435
CGIAR	0.149	0.268	0.249
Colombia	0.341	0.619	1.078
European Commission	3.129	1.550	1.850
FAO	0.098	0.047	0.054
France	0.270	0.280	0.276
Germany	1.104	0.725	0.863
IDRC	0.968	0.569	0.395
IFAD	0.380	0.309	0.309
Italy	0.201	0.200	0.260
Japan	0.179	0.160	0.160
Kellogg Foundation	0.471	0.394	0.364
Netherlands	0.028	0.000	0.000
OPEC Fund	0.051	0.027	0.026
Peru	0.017	0.039	0.063
Rockefeller Foundation	1.194	0.799	0.901
Spain	0.236	0.216	0.270
Switzerland	1.668	1.196	1.278
Thailand	0.000	0.160	0.240
UNEP	0.933	1.369	1.350
United Kingdom	2.460	2.734	2.076
United States	1.843	1.724	1.013
World Bank	0.300	0.388	0.392
Subtotal	**23.076**	**19.538**	**19.640**
Non-member			
AATF - African Appropiate Tecnology Foundation	0.032	0.000	0.000
Accenture Limited	0.044	0.013	0.003
ASARECA	0.330	0.005	0.009
Bill and Melinda Gates Foundation	0.219	0.256	2.695
Bioversity International	0.136	0.285	0.036

Member / Non-Member	Actual 2007	Estimated 2008	Proposal 2009
Catholic Relief Services	0.013	0.047	0.019
CERAAS	0.014	0.097	0.005
CIP	0.019	0.023	0.002
Citizens Network for Foreign Affairs (CNFA)	0.141	0.236	0.050
CLAYUCA	0.072	0.039	0.090
Common Fund for Commodities - CFC	0.100	0.046	0.303
Compania Agricola Colombiana (COACOL)	0.094	0.094	0.041
Cornell University	0.006	0.006	0.002
Corporacion Autonoma Regional del Cauca CRC	0.000	0.000	0.000
CTA	0.031	0.117	0.085
Den Kongelige (KVL)	0.050	0.041	0.025
ETH	0.078	0.107	0.039
Federacion Nacional de Cafeteros de Colombia	0.093	0.000	0.000
FIDAR	0.000	0.000	0.000
FLAR	0.786	0.485	0.562
Fondo Latinoamericano de Innovaciones en Palma de Aceite	0.015	0.143	0.163
FONTAGRO	0.475	0.581	0.578
Forum for Agricultural Research in Africa FARA	0.025	0.062	0.058
Generation/CP	0.827	1.183	1.152
GENOPLANTE	0.232	0.034	0.011
Global Crop Diversity Trust (GCDT)	0.002	0.265	0.272
Global Environment Facility (GEF)	0.000	0.000	1.000
HarvestPlus/CP	1.611	2.200	2.200
ICRISAT	0.140	1.585	1.634
IICA	0.126	0.107	0.118
IITA	0.088	0.392	0.020
ILRI	0.264	0.135	0.000
Institut de Recherche pour le Developpement	0.023	0.045	0.033
International Atomic Energy Agency (IAEA)	0.000	0.008	0.003
International Fertilizer Development Center (IFDC)	0.366	0.184	0.009

Member / Non-Member	Actual 2007	Estimated 2008	Proposal 2009
Iowa State University	0.011	0.012	0.001
IPICS	0.007	0.000	0.000
IRRI	0.015	0.000	0.000
IWMI	0.000	0.079	0.026
Japan International Research Center Agricultural Sciences	0.294	0.064	0.021
Kilimo Trust	0.090	0.217	0.319
Mas Inversion para el Desarrollo Alternativo Sostenible	0.000	0.000	0.400
Monsanto Fund	0.000	0.225	0.254
Nigerian Starch Mills (NMS)	0.016	0.003	0.001
Nippon Foundation	0.315	0.402	0.499
North Carolina University	0.043	0.000	0.000
Ohio University	0.155	0.006	0.002
Others	0.272	0.449	0.422
RSSP - Rural Sector Support Project - Rwanda	0.132	0.000	0.000
Semillas Papalotla	0.329	0.178	0.281
SSA/CP	0.113	0.961	1.046
Sustainable Food Laboratory	0.046	0.005	0.000
The Nature Conservatory	0.127	0.021	0.019
University of Arkansas	0.028	0.000	0.000
University of California	0.019	0.000	0.000
UNIVERSITY OF ZIMBABWE	0.048	0.014	0.036
Wageningen University	0.077	0.024	0.056
Water & Food/CP	1.105	0.691	0.770
World Agroforestry	0.024	0.000	0.000
Subtotal	**9.718**	**12.172**	**15.370**
Total Restricted	**32.794**	**31.710**	**35.010**
Total Grants	**44.242**	**42.020**	**43.549**

Summary and Statement of Activities	Actual 2007	Estimated 2008	Proposal 2009
Total Grants	44.242	42.020	43.549
Center Income	1.710	3.000	2.251
Revenue	45.952	45.020	45.800
Total Investment	48.098	45.270	44.800
Surplus (Deficit)	-2.146	-0.250	1.000

CIAT-Table 10: Allocation of Member Grants and Center Income to Projects, 2007-2009

in $millions

Project	Member		Actual 2007	Estimated 2008	Proposal 2009
CP-1 HarvestPlus	Non Member	HarvestPlus/CP	1.611	2.200	2.200
	Unrestricted + Center Income		0.000	0.000	0.000
		Project Total	**1.611**	**2.200**	**2.200**
PA-1 Markets	Member	Belgium	0.120	0.000	0.000
		Colombia	0.103	0.308	0.312
		European Commission	0.032	0.000	0.000
		FAO	0.063	0.047	0.054
		France	0.016	0.017	0.022
		IDRC	0.185	0.020	0.002
		IFAD	0.000	0.073	0.106
		Kellogg Foundation	0.387	0.360	0.332
		Rockefeller Foundation	0.002	0.020	0.002
		Switzerland	0.715	0.713	0.798
		United Kingdom	1.395	2.130	1.807
		United States	1.138	0.132	0.011
	Non Member	Catholic Relief Services	0.013	0.047	0.019
		CIP	0.000	0.023	0.002
		CTA	0.006	0.000	0.000
		Fondo Latinoamericano de Innovaciones en Palma de Aceite	0.015	0.143	0.163
		FONTAGRO	0.156	0.379	0.352
		Generation/CP	0.074	0.060	0.065
		IICA	0.044	0.051	0.044
		Iowa State University	0.011	0.012	0.001
		Mas Inversion para el Desarrollo Alternativo Sostenible	0.000	0.000	0.400
		North Carolina University	0.043	0.000	0.000
		Others	0.113	0.058	0.108
		RSSP - Rural Sector Support Project – Rwanda	0.132	0.000	0.000
		Water & Food/CP	0.059	0.000	0.000
	Unrestricted + Center Income		2.126	2.271	2.136
		Project Total	**6.948**	**6.864**	**6.736**

Project	Member		Actual 2007	Estimated 2008	Proposal 2009
PA-2 Agroecosystems Resilience	Member	Austria	0.196	0.034	0.082
		Canada	0.023	0.000	0.000
		CGIAR	0.149	0.268	0.249
		Colombia	0.087	0.008	0.007
		European Commission	0.037	0.000	0.000
		Germany	0.284	0.101	0.095
		IDRC	0.015	0.000	0.000
		IFAD	0.328	0.105	0.098
		Kellogg Foundation	0.084	0.034	0.032
		Switzerland	0.005	0.002	0.002
		United Kingdom	0.115	0.130	0.121
		World Bank	0.000	0.025	0.024
	Non Member	ASARECA	0.000	0.005	0.009
		Bioversity International	0.019	0.019	0.018
		CIP	0.016	0.000	0.000
		Federacion Nacional de Cafeteros de Colombia	0.072	0.000	0.000
		Forum for Agricultural Research in Africa FARA	0.000	0.062	0.058
		Generation/CP	0.000	0.121	0.162
		Others	0.012	0.131	0.127
		SSA/CP	0.113	0.961	1.046
		Sustainable Food Laboratory	0.046	0.005	0.000
		The Nature Conservatory	0.127	0.021	0.019
		Wageningen University	0.036	0.018	0.053
		Water & Food/CP	0.837	0.563	0.690
		World Agroforestry	0.024	0.000	0.000
	Unrestricted + Center Income		1.738	1.458	1.098
		Project Total	**4.363**	**4.071**	**3.990**

Project	Member		Actual 2007	Estimated 2008	Proposal 2009
PA-3 PRGA	Member	Canada	0.126	0.328	0.216
		IDRC	0.029	0.006	0.051
		Italy	0.201	0.200	0.260
		Switzerland	0.093	0.000	0.095
	Non Member	Bioversity International	0.000	0.066	0.008
	Unrestricted + Center Income		0.038	0.227	0.000
		Project Total	**0.487**	**0.827**	**0.630**
PA-4 Amazon Initiative	Member	Brazil	0.015	0.007	0.021
		Spain	0.236	0.216	0.270
		United Kingdom	0.037	0.087	0.052
	Unrestricted + Center Income		0.010	0.013	0.013
		Project Total	**0.298**	**0.323**	**0.356**
SBA-1 Beans	Member	Canada	2.537	1.980	2.890
		Colombia	0.001	0.000	0.000
		European Commission	0.630	0.775	0.925
		Germany	0.541	0.470	0.455
		IDRC	0.140	0.000	0.000
		Japan	0.057	0.051	0.051
		Rockefeller Foundation	0.096	0.032	0.026
		Switzerland	0.764	0.481	0.383
		United States	0.124	0.382	0.304
		World Bank	0.024	0.097	0.078
	Non Member	ASARECA	0.330	0.000	0.000
		Bioversity International	0.000	0.000	0.000
		FIDAR	0.000	0.000	0.000
		FONTAGRO	0.077	0.008	0.006
		Generation/CP	0.187	0.545	0.592
		ICRISAT	0.026	1.021	1.290
		Others	0.023	0.035	0.028
	Unrestricted + Center Income		2.752	1.653	0.569
		Project Total	**8.309**	**7.530**	**7.597**

Project	Member		Actual 2007	Estimated 2008	Proposal 2009
SBA-2 Cassava	Member	Australia	0.067	0.023	0.006
		Brazil	0.000	0.000	0.030
		Canada	1.275	0.338	0.693
		Colombia	0.088	0.154	0.285
		European Commission	0.379	0.775	0.925
		France	0.038	0.049	0.050
		IDRC	0.089	0.318	0.329
		Japan	0.065	0.058	0.058
		Netherlands	0.028	0.000	0.000
		Rockefeller Foundation	0.243	0.213	0.253
		Switzerland	0.091	0.000	0.000
		Thailand	0.000	0.160	0.240
		United Kingdom	0.913	0.387	0.096
		United States	0.554	1.210	0.698
	Non Member	Accenture Limited	0.044	0.013	0.003
		Bioversity International	0.072	0.000	0.000
		CLAYUCA	0.072	0.039	0.090
		Common Fund for Commodities - CFC	0.000	0.000	0.100
		Compania Agricola Colombiana (COACOL)	0.094	0.094	0.041
		Den Kongelige (KVL)	0.050	0.041	0.025
		ETH	0.000	0.016	0.004
		FIDAR	0.000	0.000	0.000
		FONTAGRO	0.000	0.000	0.060
		Generation/CP	0.257	0.220	0.254
		IICA	0.071	0.055	0.074
		IPICS	0.007	0.000	0.000
		Monsanto Fund	0.000	0.225	0.254
		Nigerian Starch Mills (NMS)	0.016	0.003	0.001
		Nippon Foundation	0.315	0.402	0.499
		Ohio University	0.155	0.006	0.002
		Others	0.048	0.000	0.000
	Unrestricted + Center Income		3.171	1.527	1.004
		Project Total	**8.202**	**6.326**	**6.074**

Project	Member		Actual 2007	Estimated 2008	Proposal 2009
SBA-3 Forages	Member	ADB	0.283	0.111	0.100
		Australia	0.089	0.212	0.266
		Brazil	0.033	0.037	0.070
		Colombia	0.018	0.013	0.185
		European Commission	0.632	0.000	0.000
		Germany	0.091	0.114	0.300
		IFAD	0.000	0.116	0.104
		Japan	0.057	0.051	0.051
	Non Member	Common Fund for Commodities - CFC	0.000	0.037	0.200
		Corporacion Autonoma Regional del Cauca CRC	0.000	0.000	0.000
		ETH	0.078	0.091	0.035
		ILRI	0.264	0.135	0.000
		Institut de Recherche pour le Developpement	0.023	0.045	0.033
		Others	0.046	0.206	0.015
		Semillas Papalotla	0.329	0.178	0.281
		Water & Food/CP	0.209	0.128	0.080
	Unrestricted + Center Income		1.542	1.389	1.011
		Project Total	**3.694**	**2.863**	**2.731**
SBA-4 Rice for LAC	Member	Brazil	0.000	0.035	0.042
		Canada	0.645	1.191	0.636
		Colombia	0.044	0.136	0.289
		European Commission	0.343	0.000	0.000
		FAO	0.025	0.000	0.000
		France	0.176	0.169	0.152
		Germany	0.188	0.040	0.013
		Peru	0.017	0.039	0.063
		Rockefeller Foundation	0.000	0.000	0.000
		United States	0.027	0.000	0.000
		World Bank	0.092	0.000	0.000
	Non Member	CIP	0.003	0.000	0.000
		Common Fund for Commodities - CFC	0.100	0.009	0.003
		Federacion Nacional de Cafeteros de Colombia	0.021	0.000	0.000
		FLAR	0.786	0.485	0.562
		FONTAGRO	0.242	0.194	0.160
		Generation/CP	0.309	0.237	0.079
		GENOPLANTE	0.232	0.034	0.011

		Global Environment Facility (GEF)	0.000	0.000	1.000
		IICA	0.011	0.001	0.000
		IRRI	0.015	0.000	0.000
		IWMI	0.000	0.079	0.026
		Japan International Research Center Agricultural Sciences	0.294	0.064	0.021
		Others	0.013	0.000	0.126
		University of Arkansas	0.028	0.000	0.000
	Unrestricted + Center Income		1.169	1.528	1.078
		Project Total	**4.780**	**4.241**	**4.261**
SBA-5 Conserving Agrobiodiversity	Member	European Commission	1.076	0.000	0.000
		World Bank	0.184	0.266	0.290
	Non Member	Bioversity International	0.022	0.000	0.000
		Global Crop Diversity Trust (GCDT)	0.002	0.265	0.272
	Unrestricted + Center Income		0.358	1.329	1.059
		Project Total	**1.642**	**1.860**	**1.621**
TS-1 ISFM-TSBF	Member	Austria	0.432	0.385	0.193
		Belgium	1.059	0.989	0.850
		Canada	0.065	0.010	0.000
		France	0.040	0.045	0.052
		IDRC	0.510	0.225	0.013
		IFAD	0.052	0.015	0.001
		OPEC Fund	0.046	0.027	0.026
		Rockefeller Foundation	0.778	0.534	0.430
	Non Member	AATF - African Appropiate Tecnology Foundation	0.032	0.000	0.000
		Bill and Melinda Gates Foundation	0.116	0.256	2.695
		Bioversity International	0.023	0.200	0.010
		CERAAS	0.014	0.097	0.005
		Citizens Network for Foreign Affairs (CNFA)	0.000	0.100	0.005
		CTA	0.025	0.117	0.085
		Forum for Agricultural Research in Africa FARA	0.025	0.000	0.000
		ICRISAT	0.067	0.564	0.292
		IITA	0.088	0.392	0.020
		International Fertilizer Development Center (IFDC)	0.366	0.184	0.009
		Others	0.000	0.000	0.000
	Unrestricted + Center Income		1.619	1.494	1.251
		Project Total	**5.357**	**5.634**	**5.937**

Project	Member		Actual 2007	Estimated 2008	Proposal 2009
TS-2 SLMT - TSBF	Member	Austria	0.091	0.085	0.078
		FAO	0.010	0.000	0.000
		OPEC Fund	0.005	0.000	0.000
		Rockefeller Foundation	0.075	0.000	0.190
		UNEP	0.933	1.369	1.350
	Non Member	Bill and Melinda Gates Foundation	0.103	0.000	0.000
		Citizens Network for Foreign Affairs (CNFA)	0.141	0.136	0.045
		Cornell University	0.006	0.006	0.002
		ICRISAT	0.047	0.000	0.052
		International Atomic Energy Agency (IAEA)	0.000	0.008	0.003
		Kilimo Trust	0.090	0.217	0.319
		Others	0.017	0.019	0.018
		University of California	0.019	0.000	0.000
		UNIVERSITY OF ZIMBABWE	0.048	0.014	0.036
		Wageningen University	0.041	0.006	0.003
	Unrestricted + Center Income		0.781	0.671	0.571
Project Total			**2.407**	**2.531**	**2.667**
Total Resticted			**32.794**	**31.710**	**35.010**
Total Unrestricted + Center Income			**15.304**	**13.560**	**9.790**
Total			**48.098**	**45.270**	**44.800**

CIAT-Table 11: Internationally and Nationally Recruited Staff, 2007-2011

in $millions

	Actual 2007	Estimated 2008	Proposal 2009	Plan 1 2010	Plan 2 2011
NRS	683	670	660	660	660
IRS	87	87	91	91	91
Total	**770**	**757**	**751**	**751**	**751**

CIAT-Table 12: Currency Structure of Expenditure, 2007-2009

in millions of units and percent

	Actual 2007			Estimated 2008			Proposal 2009		
Currency	**Amount**	**$ Value**	**% Share**	**Amount**	**$ Value**	**% Share**	**Amount**	**$ Value**	**% Share**
COP	4,7929.000	23.087	48	4,0150.000	22.182	49	4,0320.000	22.400	50
Others	0.000	2.405	5	0.000	2.264	5	0.000	2.240	5
USD	0.000	22.606	47	0.000	20.824	46	0.000	20.160	45
Total		**48.098**	**100 %**		**45.270**	**100 %**		**44.800**	**100 %**

CIAT - Table 13: Statement of Financial Position (SFP), 2007-2009
in $millions

Assets, Liabilities and Net Assets	2007	2008	2009
Current Assets			
Cash and Cash Equivalents	24.814	31.000	28.000
Investments	0.000	0.000	0.000
Accounts Receivable			
- Donor	9.231	8.660	8.890
- Employees	0.427	0.450	0.450
- Other CGIAR Centers	0.051	0.100	0.100
- Others	2.379	2.640	2.600
Inventories	0.139	0.100	0.100
Pre-paid Expenses	0.074	0.080	0.080
Total Current Assets	**37.115**	**43.030**	**40.220**
Non-Current Assets			
Net Property, Plan and Equipment	5.190	5.200	5.200
Investments	0.000	0.000	0.000
Other Assets	0.031	0.000	0.000
Total Non-Current Assets	**5.221**	**5.200**	**5.200**
Total Assets	**42.336**	**48.230**	**45.420**
Current Liabilities			
Overdraft/Short Term Borrowings	0.000	0.000	0.000
Accounts Payable			
- Donor	14.297	14.300	13.500
- Employees	0.887	1.011	1.000
- Other CGIAR Centers	4.899	4.500	4.000
- Others	10.280	16.180	13.180
Accruals and Provisions	1.284	1.500	1.700
Total Current Liabilities	**31.647**	**37.491**	**33.380**

Assets, Liabilities and Net Assets	2007	2008	2009
Non-Current Liabilities			
Accounts Payable			
- Employees	1.264	1.564	1.865
- Deferred Grant Revenue	0.000	0.000	0.000
- Others	0.000	0.000	0.000
Total Non-Current Liabilities	**1.264**	**1.564**	**1.865**
Total Liabilities	**32.911**	**39.055**	**35.245**
Net Assets			
Unrestricted			
- Fixed Assets	7.964	7.964	7.964
- Unrestricted Net Assets Excluding Fixed Assets	1.461	1.211	2.211
Total Unrestricted Net Assets	**9.425**	**9.175**	**10.175**
Restricted	0.000	0.000	0.000
Total Net Assets	**9.425**	**9.175**	**10.175**
Total Liabilities and Net Assets	**42.336**	**48.230**	**45.420**

CIAT-Table 14: Statement of Activities (SOA), 2007-2009

in $millions

		Unrestricted	Restricted		Total		
			Temporary	Challenge Programs	2007	2008	2009
Revenue and Gains	Grant Revenue	11.448	28.917	3.877	44.242	42.020	43.600
	Other revenue and gains	1.710	0.000	0.000	1.710	3.000	2.200
	Total revenue and gains	13.158	28.917	3.877	45.952	45.020	45.800
Expenses and Losses	Program related expenses	5.790	28.422	3.854	38.066	38.662	39.900
	Management and general expenses	6.342	0.495	0.023	6.860	7.608	8.600
	Other losses expenses	6.879	0.000	0.000	6.879	2.400	0.300
	Sub Total expenses and losses	19.011	28.917	3.877	51.805	48.670	48.800
	Indirect cost recovery	-3.707	0.000	0.000	-3.707	-3.400	-4.000
	Total expenses and losses	15.304	28.917	3.877	48.098	45.270	44.800
	Net Operating Surplus / (Deficit)	-2.146	0.000	-0.000	-2.146	-0.250	1.000
	Extraordinary Items	0.000	0.000	0.000	0.000	0.000	0.000
	NET SURPLUS / (DEFICIT)	-2.146	0.000	-0.000	-2.146	-0.250	1.000
Object of Expenditure	Personnel	12.043	9.190	1.118	22.351	22.000	21.600
	Supplies and services	1.577	9.993	1.655	13.225	10.070	8.700
	Collaboration/ Partnerships	0.120	6.654	0.739	7.513	8.000	9.000
	Operational Travel	0.573	2.585	0.342	3.500	3.600	3.700
	Depreciation	0.991	0.495	0.023	1.509	1.600	1.800
Total		**15.304**	**28.917**	**3.877**	**48.098**	**45.270**	**44.800**