

2. PROJECT DESCRIPTION AND LOGFRAME

CIAT PROJECT PE-2: INTEGRATED SOIL FERTILITY MANAGEMENT IN THE TROPICS

Rationale and Changes

Rationale:

Many soils in Africa are highly weathered, kaolinitic soils with large amounts of oxidic minerals. Such soils typically have a low potential to hold nutrients such as nitrogen, potassium, magnesium and calcium, which are easily leached and lost under climates with excessive rainfall. Large regions in Africa also cope with high soil acidity and toxic levels of Aluminium. In addition, many soils have a high phosphorus fixation capacity, rendering applied phosphorus unavailable to plants. Large amounts of potential nutrient resources are present in Africa to alleviate above constraints: many countries are richly endowed in terms of phosphate rock deposits, potassium- and sulphur-containing minerals and lime and dolomite deposits but these sources are highly underutilized and do not reach small-scale farmers. The high mining, processing and transportation costs involved, and the poor margins offered to retailers discourage investment to use these local resources for fertilizer production. Enhancing the utilization of these local nutrient sources could nonetheless remove a root cause of nutrient deficiency and low productivity in Africa.

The poverty trap preventing smallholders from using more fertilizers is formidable and overcoming it requires that farmers engage in greater, more profitable commercial activities, so that demand and means to purchase these fertilizers is created. The Double Demand and Fertilizer Summit scenarios offer promise but are also naïve because they assume universal farmer adoption that fertilizer use can become grow at unprecedented rates and that the capital required to purchase these fertilizers can be created through improved produce marketing. What these scenarios really represent is the upper limit for improvement through increased use of mineral fertilizers using current farming practices that must be adjusted by anticipated farmer adoption.

The ISFM reports are presented as sequential impacts drawn from four objectives 1) improving fertilizer use efficiency, 2), increased adoption of fertilizers through ISFM recommendations 3), improvement in fertilizer quality, supply and timing and 4). market innovations in farm input supply and produce marketing improved human nutrition through ISFM is not considered. The four factors appear as high land low estimates that adjust the baseline benefits through ISFM approaches. We suggest that ISFM, as described in these series of objectives, has the potential to increase the benefits from expanded fertilizer use by 18% to 57%.

We hypothesize that targeting soil fertility input recommendations along the Interstate Soil Fertility Management (ISFM) principles will result in greater fertilizer use efficiency; permitting farmers to better recognize the benefits from smaller applications of mineral nutrients. This recognition will further encourage farmers to increase fertilizer use by applying them at progressively higher rates and to new crops and marginally productive lands. Farmers' knowledge of fertilizers and their access to them must also be improved. The profits from external input use must be clearly demonstrated to farmers and incentives provided to increase investment in them. New crop varieties that are more responsive to external input, and more tolerant of other biotic and abiotic stress must be commercialized and promoted as well. Nonetheless, re-examination of fertilizer use within the context of ISFM leading to site-specific and flexible recommendations that are adaptable to small-scale farmers' biophysical and socio-economic conditions is a critical starting point for improving food security and rural livelihoods in sub-Saharan Africa

Project Changes:

Following the EPMR recommendations and new agricultural development in Africa TSBF-CIAT has developed a concept note on its renewed strategy:” *A forward-looking CIAT-TSBF Institute: actualizing the strategic direction*”. CIAT-TSBF has conceptualized its work around two outcome lines: 1) *ISFM-based crop production systems for major impact zones in sub-Saharan Africa*: support the livelihoods of people reliant on agriculture by developing profitable, socially-just and resilient agricultural production systems based on ISFM; 2) *Sustainable Land Management*: develop sustainable land management in tropical areas through reversing land degradation. These will be described in the MTP

CGIAR System Priorities:

CIAT's PE-2 Project (TSBF Institute) on Integrated Soil Fertility Management in the Tropics 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. The project contributes to Specific goals 1 (To develop analytical methods and tools for the management of multiple use landscapes with a focus on sustainable productivity enhancement), 2 (To enhance the management of landscapes through changing stakeholder awareness and capacity for social-ecological planning at landscape and farm levels) and 5 (Creating multiple benefits and improved governance of environmental resources through the harmonization of inter-sectoral policies and institutions). Considerable efforts are also dedicated to System Priority Area 4D: Promoting sustainable agro-ecological intensification in low- and high-potential areas. The project contributes to Specific goals 1 (To improve understanding of degradation thresholds and irreversibility, and the conditions necessary for success in low productivity areas), 3 (To identify domains of potential adoption and improvement of technologies for improving soil productivity, preventing degradation and for rehabilitating degraded lands), 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), and 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).

Impact pathways:

The 5 major outputs outlined above in the rationale section articulate the logical relationship of activities within the project logframe. Output 1 (*Biophysical and socioeconomic processes understood, principles and concepts developed for protecting and improving the health and fertility of soils*) encompasses our research developing principles and concepts that transcend the classical boundaries of the biophysical sciences through integration with economics, sociology and anthropology. Local and scientific knowledge interact to develop integrated “hybrid” knowledge for soil fertility management, improved food security, and environmental protection. The intended users of the ISFM principles and concepts are CGIAR, ARIs, researchers from NARS and local universities, NGOs, farmers, and regional consortia. These intended users are applying the principles, concepts and methods to improve technologies and system understanding. The final impacts of this output are resilient production systems and sustainable agriculture based on improved soil health and fertility.

The process and integrated knowledge generated under Output 1 activities is therefore applied as sustainable soil fertility and land management practices, shaped by and responding to the socio-cultural and economic environment. Research activities from Output 2 (*Economically viable and environmentally sound soil, water, and nutrient management practices developed and tested by applying and integrating knowledge of biophysical and socioeconomic processes*) 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. These activities provide general principles and methodologies for TSBF-CIAT and partners to enhance farmers’ capacity for applying best principles for sustainable soil, water and land management practices.

At the center of the research-outcome-impact chain, Output 3 (*Partnerships and tools developed and capacity enhanced of all stakeholders for improving the health and fertility of soils*) 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 the managing soil fertility for improved livelihoods requires an approach that integrates technical, social, economic and policy issues at multiple scales. To overcome this complexity, research and extension staff need the capacity to generate and share information that will be relevant to other stakeholders working at different scales (i.e., policy makers, farmers).

Output 4 (*Improved rural livelihoods through sustainable, profitable, diverse and intensive agricultural production systems*) represents the application of human and social capital and sound, socio-culturally and economically relevant biophysical principles for ISFM. The challenge of intensification and diversification of smallholder agricultural production is that meeting the food and income needs of the poor cannot occur without investment in natural resource management, especially soil fertility. Investment in improving soil fertility is not constrained by a lack of technical solutions *per se* but is more linked to lack of access to information for improved decision making and analyzing trade-offs, inputs and profitable markets.

The highest scale for our research-for-development activities is found within Output 5 (*Options for sustainable land management (SLM) practices for social profitability developed, with special emphasis on reversing land degradation*). These activities are dedicated to applying the findings of all the previous outputs for restoring degraded agricultural lands to economic and ecological productivity, enhancing ecosystem health and improving livelihoods by generating technology, institutional, and policy innovations.

Since soils play a central role for the provision of ecosystem services (e.g. regulation of water quality and quantity, carbon storage and control of net fluxes of greenhouse gases to the atmosphere), appropriate soil management at the landscape level should result in enhanced provision of environmental services.

The key assumptions for these 5 outputs are: security and political stability does not restrict access to target sites and continuation of on-going activities; poverty reduction strategies remain central to human development support and funding; TSBF-CIAT stakeholders remain engaged with TSBF-CIAT strategic priorities and/or TSBF-CIAT management continues to adapt and innovate in response to changing priorities; funding for research on globally-important issues continues; and linkages maintained among research and development organizations. The expected beneficiaries, target ecosystems and end users are principally small-scale crop-livestock farmers and extension workers, NGOs and NARES in tropical agroecosystems of Sub-Saharan Africa, Latin America and South-east Asia. The target ecoregions are East and Central African highlands (Kenya, Uganda, Ethiopia, Tanzania, Rwanda, DR Congo); Southern African savannas (Zimbabwe, Malawi, Mozambique, Zambia); West African region (Burkina Faso, Niger, Cote d'Ivoire, Nigeria, Benin, Togo, Mali, Senegal, Ghana); Central American hillsides (Honduras, Nicaragua); Andean hillsides (Colombia, Ecuador, Peru, Bolivia); Tropical savannas of south America (Colombia, Venezuela); and Amazon rainforest (Brazil, Colombia, Peru).

International Public Goods (IPG):

The IPG of the PE-2 project include:

- Improved knowledge on soil processes;
- Global inventory of below-ground biodiversity;
- Improved knowledge on nutrient and other resource flows;
- Improved knowledge on how different stakeholders use and manage landscapes;
- Tools and indicators to assess soil quality;
- Improved approaches and practices for managing soil, water and land resources;
- Innovative diversification options within farms;
- Decision support tools and models to analyze trade-offs among food productivity, ecosystem services and land conservation;
- Methods and tools for promoting effective collective action for improved soil fertility management and improved livelihoods;
- Novel forms of institutional innovations and policy options to reduce land degradation and to restore degraded lands.

The Institute's 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 research, it is also ready to support technology

dissemination and development activities with partners via regional networks and global projects. TSBF-CIAT 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 has successfully completed its Phase I and is about to start its Phase II activities. Much of the applied research and dissemination of findings, as well as NARSs capacity building, will be done via the Institute's regional partner networks/consortia — the African Network for Soil Biology and Fertility (AfNet). TSBF-CIAT also collaborates with the South Asian Regional Network (SARNet) on soil fertility research in that region.

Collaborators:

NARS: Kenyatta University, Kenya, VLIR project on food security in Central Kenya; RF soybean project; JKUAT, Kenya, RF banana project; NARO, Uganda and LZARDI, Tanzania, DfID project on striga management in the Lake Victoria Basin; NARO, Uganda, RF project on exploring soybean potential in East Africa; KARI, Kenya, DfID project on striga management in the Lake Victoria Basin; University of Zimbabwe, Zimbabwe, NSF project on soil aggregation; Soil Research Institute, Ghana, NSF project on soil aggregation; INERA, D R Congo, ISAR, Rwanda, DGDC project on legume integration in systems in Central Africa; DGDC project on banana management in Central Africa; ISABU and IRAZ, Burundi, DGDC project on banana management in Central Africa; University of Kinshasa and University of Bukavu, D R Congo, VLIR project on cassava in D R Congo; Forest Dept of CIRAD, France, Kenyan Forestry Research Institute, Kenya, FOFIFA, Madagascar INCO DEV FOREAIM on Bridging restoration and multi-functionality in degraded forest landscape of Eastern Africa and Indian Ocean islands; INERA-DPF, Burkina Faso and Forest Dept of CIRAD, France, project CORAF/Gomme Arabique on Impact de l'inoculation par les rhizobiums sur la productivite de gommeraiies plantees ou naturelles et la dynamique de facteurs lies au fonctionnement biologique des sols sous-jacents ; INERA, Burkina Faso, ISRA, Senegal, FOFIFA, Madagascar, project ANR/MICROBES project on microbial observatories for the management of soil ecosystem services in the tropic; KEFRI, Kenya, Forest Dept of CIRAD, France and Grassland Research Station, Zimbabwe, project INCO DEV SAFSYS on Symbionts in agroforestry systems: what are the long-term impacts of inoculation of *Calliandra calothyrsus* and its intercrops; Antananarivo University, Madagascar and University of Makerere, Uganda project INCO DEV FOREAIM on Bridging restoration and multi-functionality in degraded forest landscape of Eastern Africa and Indian Ocean islands; University of Niamey, Niger and University Cheikh Anta Diop, Senegal, project CORAF/Gomme Arabique on Impact de l'inoculation par les rhizobiums sur la productivite de gommeraiies plantees ou naturelles et la dynamique de facteurs lies au fonctionnement biologique des sols sous-jacents; Institut National de Recherches Agronomiques du Niger (INRAN); Niamey/Niger; Institut d'Economie Rurale (IER), Mali; ARS, Chilanga Zambia (Moses Mwale);

EARO (Ethiopian Agricultural Research organization), Ethiopia; Ahmadu Bello University, Nigeria; ARI Mlingano, Tanzania; Egerton University, Kenya; University of Nairobi, Nairobi (Kenya) (Rosemary Atieno); Makerere University, Kampala (Uganda) (Elizabeth K. Balirwa, Jonny Mugisha, John Baptiste, Mary Silver); Lake Basin Development Authority (Kenya) (Amos Ameya); Selian Agricultural Research Institute (Tanzania) (Sossi Kweka and Festo Ngulu); Southern Regions Research Institute, Ethiopia; ARES (Department of Agriculture Research and Extension), Zimbabwe

IIAM (Instituto Nacional de Investigacao Agronomica), Mozambique; Eduardo Mondlane University, Maputo, Mozambique; Universidade Católica de Moçambique, Beira, Mozambique and DARS (Department of Agriculture Research Services), Malawi

Advanced Research Institutes: J Six, University of California Davis, USA, NSF project on soil aggregation; R Merckx, Catholic University of Leuven, Belgium, VLIR project on food security in Central Kenya; E Tollens, Catholic University of Leuven, Belgium, DGDC project on legume integration in systems in Central Africa; R Swennen, Catholic University of Leuven, Belgium, DGDC project on banana management in Central Africa; S Recous, INRA, France, VLIR project on food security in Central Kenya; K Giller, WUR, Netherlands, EU project on Africa NUANCES; L Brussaard, L Stroosnijder, WUR, Netherlands, WOTRO project on soil fauna and soil aggregation; Institut de Recherche pour le Developpement, France, project CORAF/Gomme Arabe on Impact de l'inoculation par les rhizobiums sur la productivite de gommeries plantees ou naturelles et la dynamique de facteurs lies au fonctionnement biologique des sols sous-jacents; Institut de Recherche pour le Developpement, France, Centre of Ecology and Hydrology, UK' University of Norway, project INCO DEV FOREAIM on Bridging restoration and multi-functionality in degraded forest landscape of Eastern Africa and Indian Ocean islands; GSF-Munich, Germany and Institut de Recherche pour le Developpement, France project ANR/MICROBES project on microbial observatories for the management of soil ecosystem services in the tropic; Centre of Ecology and Hydrology and, Scottish Agricultural College UK, project INCO DEV SAFSYS on Symbionts in agroforestry systems: what are the long-term impacts of inoculation of *Calliandra calothyrsus* and its intercrops; BIOFORSK Soil, Water and Environment, Norway; JIRCAS (Japan International Research Center for Agricultural Sciences), Japan; Wye College, University of London (Colin Poulton); Kyoto University, Kyoto, Japan (Atsuyuki Asami); Ishikawa Prefectural University, Japan (Hiroshi Tsujii); University of Kiel, Kiel, Germany (Roll A.E. Mueller); Universite Catholique de Louvain (Eric F. Tollens); Swedish Univ. Agric. Sci (SLU), Uppsala, Sweden (Olof André). University of Natural Resources and Applied Life Sciences (BOKU), Vienna Project on Linking Farmers to Markets; University of Hohenheim, Germany, University of Firenze, Florence, Italy.

International Agricultural Research: IITA, Uganda, RF project on ISFM for bananas; DGDC project on banana management in Central Africa; IITA, Nigeria (Alene Arega, David Chikoye, Robert Abaidoo); ICIPE and CIMMYT Kenya, DfID project on striga management in the Lake Victoria Basin; CIMMYT, Kenya, AATF project on striga management in Western Kenya; IFDC, Togo, WOTRO project on soil fauna and soil aggregation; INIBAP, Uganda, DGDC project on banana management in Central Africa; ICRAF, Kenya,

RF project on soil fertility gradients and site-specific soil fertility management; ICRISAT (Niger); Centre d'Etude Régional pour l'Amélioration de l'Adaptation à la Sécheresse (CERAAS/ISRA); West African Rice Development Authority (Patrick M. Kormawa); African Highlands Initiative, Ethiopia.

International and Regional Agricultural Research Centers: CIMMYT, Kenya: Hugo de Groote, Mirjam Pulleman; CIP, Kenya: Charles Crissman; ICRAF, Kenya: Frank Place, Steve Franzel, Noordin Qureish, Bashir Jama, Richard Coe, Keith Shepherd; ICRISAT, Kenya: Ade Freeman; ICRISAT, Mali: Tabo; ICRISAT, Niger: Aboudoulaye, Abdoulaye and Mahamane; ICRISAT, Zimbabwe: John Dimes; IITA Ibadan, Nigeria- Abdou; IITA Uganda: Piet van Asten, Cliff Gold, Suleiman Okech; ILRI, Kenya: Patti Kristjanson, Steve Staal, Philip Thornton, Mario Herrero, Dannie Romney; ICIPE: Zia Khan; AATF: Mpoko Bokanga; West African Rice Development Authority – S. Oyke; International Institute for Tropical Agriculture – Alene Arega, David Chikoye, Robert Abaidoo

NGOs: FIPS, Kenya, RF project on soil fertility gradients and site-specific soil fertility management; SACRED-Africa, Kenya, RF soybean project; Diobass and Food for the Hungry, D R Congo, DGDC project on legume integration in systems in Central Africa; DGDC project on banana management in Central Africa; UR2PI, Congo ,ANR/MICROBES project on microbial observatories for the management of soil ecosystem services in the tropic; Hunger Project/Burkina Faso; Groupe d'Action pour le Développement Communautaire (GADEC) ; Tambacounda / Senegal; Union des Groupements Paysans de Mekhe (UGPM/ Senegal); Projet Intrants/Niger; Groupement Nabonswendé de Tougouri / Burkina; Entente des Groupements Associés de Toubacouta (EGAT) / Senegal; Caritas-Kaolack/Senegal; AfriAfya (Caroline Nyamai-Kisia); CRS (Tom Remington); Farmers' Own Trading Company (Tony Margetts) Africa2000 Network, UEEF, Africare (Uganda)

The Private Sector: TSBF-Africa is also working with a wide array of private sector and farmers associations. Some of those involved in Kenya as an example include: Western Seed Company (Kenya)– Saleem Esmail; BIDCO OIL REFINERIES LIMITED (Kenya) – Dileswar Pradhan, Ashish Mandlik; Mukwano Group of Companies (Uganda) – Ibnul Hassan Rizvi; NUTRO MANUFACTURING EPZ LIMITED – Simon Glover; Eubala Self-Help Group (Shianda Location of Butere Division, Kenya); Tushiauriane Self Help Group (Eluche Sub-location, Kenya); Nabongo Panga Self-Help Group (Matawa Sub-Location, Nabongo Location, Kenya); Jitolee Women Group (Lukohe sublocation, North Marama location, Butere Division, Kenya); Etako Women Group (Lukohe sublocation, North Marama location, Butere Division, Kenya); Bushe Women Group (Butere Division, Kenya); Shishebu farmers' Group (Shianda location, Butere Division, Kenya); Mabole farmers' field school (Shianda location, Butere Division, Kenya); Masaa Men and Women Group; Eluche Mwangaza Community Dev't Organization (Eluche Sublocation, Mumias Division, Kenya); Uriri farmers' cooperative society (Migori District, Kenya); Suna farmers' cooperative society (Migori District, Kenya). AMFRI farms (Uganda), Olivine Industries, Harare, Reapers (Pvt) Ltd, Harare

Project Funding:

Budgeting 2005-2009

Year	2005 (actual)	2006 (estimated)	2007 (actual)	2008 (plan)	2009 (plan)
US Dollars (millions)	6.405	7.253	7.710	7.800	8.000

CIAT PROJECT PE-2: INTEGRATED SOIL FERTILITY MANAGEMENT IN THE TROPICS (2007-2009)

Targets	Outputs	Intended User	Outcome	Impact
OUTPUT 1	Biophysical and socioeconomic processes understood, principles, concepts and methods developed for protecting and improving the health and fertility of soils	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Principles, concepts and methods inform technology and system development	Improved soil health and fertility contribute to resilient production systems and sustainable agriculture
Output Targets 2008	Practical methods for rapid assessment and monitoring of soil resource base status developed	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Partners are using the methods with farmers	
	The social, gender, and livelihood constraints and priorities affecting the sustainable use of soils have been identified, characterized, and documented through case studies using innovative methods	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Partners are working to overcome the identified constraints with new proposals and on-going research	
	Decision tools for soil biota and nutrient management developed and disseminated to stakeholders	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Partners involved in research for development are using the decision tools	

Targets	Outputs	Intended User	Outcome	Impact
Output Targets 2009	Knowledge on relationships between soil fertility status and the nutritional quality of bio-fortified crops is used by development partners to target production of these crops	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Stakeholders in research for development focus on food quality in addition to production	
	Sufficient knowledge on mechanisms driving tolerance to drought and low soil P is available to guide breeding efforts	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Breeders involve soil scientists in the breeding program	
Output Targets 2010	The role of soil organic matter in regulating soil-based functions underlying fertilizer use efficiency and crop production understood	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia		
	Functional interpretations of belowground biodiversity made and linked to ISFM and IPM	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia		
	Crop nutrient requirements, congruence of nutrient demand and nutrient supply and impacts on nutritional quality of food products understood	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia		

Targets	Outputs	Intended User	Outcome	Impact
OUTPUT 2	Economically viable and environmentally sound soil, water, and nutrient management practices developed and tested by applying and integrating knowledge of biophysical, socio-cultural and economic processes	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Technologies, systems and soil management strategies adopted and adapted through partnerships	Adapted technologies contribute to food security, income generation and health of farmers
Output Targets 2008	Communities in at least three countries demonstrate and test direct or indirect management options that enhance locally important ecosystem services using BGBD	BGBD network, CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, policy makers and global conservation organizations	Researchers, farmers, land users and policy makers and global conservation organizations increase their awareness of the benefits of conserving and managing BGBD	
Output Targets 2009	Local baselines and interviews show that farmers' understanding of soil processes is demonstrably enhanced within community-based experimentation in at least 5 benchmark sites	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Scientists blend local and new scientific knowledge in the experimental design	

Targets	Outputs	Intended User	Outcome	Impact
	The potential for occurrence of positive interactions between organic and mineral inputs is evaluated for the most common cropping systems in each mandate area.	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	Stakeholders appreciate the complementary role of both inorganic and organic inputs and use them judiciously	
	Throughout the Institute project life, new questions generated in the evaluation efforts of the different target outputs are addressed and fed back to these evaluation activities	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia	PM&E is institutionalized and used by all project partners	
Output Targets 2010	Cereal-legume systems with improved germplasm as entry point tested, adapted and validates to farmer conditions in savanna areas	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, and regional consortia		
OUTPUT 3	Partnerships and tools developed and capacity enhanced of all stakeholders for improving the health and fertility of soils	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	Strengthened and expanded partnerships for ISFM facilitate south-south exchange of knowledge and technologies	Improved institutional capacity in aspects related to ISFM and SLM in the tropics contribute to agricultural and environmental sustainability
Output Targets 2008	Farmer-to farmer knowledge sharing and extension through organized field trips and research activities result practices in at least two sites	Researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	Farmers realize benefits of knowledge sharing	

Targets	Outputs	Intended User	Outcome	Impact
	Web content in BGBD website enhanced to contain data and information on BGBD taxonomy and species identification			
Output Targets 2009	Profitable land use innovations scaled out beyond pilot learning sites through strategic alliances and partnerships, and application of alternative dissemination approaches.	Researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	Partners incorporating new knowledge and skills in new proposals and on-going research efforts	
	Strategies for institutionalizing of participatory NRM approaches and methodologies established	Researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	New institutional arrangement catalyse multidisciplinary work and enhance scaling up of technologies and best practices	
Output Targets 2010	Research on practical strategies and decision support tools for integrated water and nutrient management, including organic and mineral nutrient sources is further strengthened and added to the existing organic resources DSS/database			
	Social science aspects are included in the decision-making process and tools to better understand actionable management strategies, their knowledge requirements, and economics			

Targets	Outputs	Intended User	Outcome	Impact
OUTPUT 4	Improved rural livelihoods through sustainable, profitable, diverse and intensive agricultural production systems	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, 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 Targets 2008	Improved production systems having multiple benefits of food security, income, human health and environmental services identified	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	Market-led hypothesis is incorporated in systems experimentation; Different partners linking food security, environmental sustainability and income generation to health	
	Validated intensive and profitable systems are being demonstrated, promoted by partners and adopted by farmers in 10 countries	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	Increased sustainable productivity and profitability of major cropping systems	
	The contribution of multiple stress adapted germplasm in driving overall system resilience is understood for the conditions occurring in all mandate areas	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	Farmers pay more attention to the sustainability of their farming system in addition to productivity	

Targets	Outputs	Intended User	Outcome	Impact
Output Targets 2009	Products of the trade-off analysis are guiding the introduction and evaluation of alternative NRM options, better suited to the farmer production objectives and the environment of the actions sites	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	Farmers use results of trade off analysis to make appropriate choice	
Output Targets 2010	Improve linkages with the private sector to improve access to fertilizer and develop recommendations for its use by farmers and other stakeholders involved	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers		
	The impact of cultural and social differentiation on potential markets and product supply chains as well as on processes of information exchange evaluated	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers		
OUTPUT 5	Options for sustainable land management (SLM) for social profitability developed, with special emphasis on reversing land degradation	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, young professionals, policy makers	Principles of sustainable land management integrated in country policies and programs	Reversing land degradation contribute to global SLM priorities and goals

Targets	Outputs	Intended User	Outcome	Impact
Output Targets 2008	Methods developed for socio-cultural and economic valuation of ecosystem services developed and applied for trade-off and policy analysis in at least in 1 humid and 1 sub-humid agroecological zones	CGIAR, ARI, researchers from NARS and local universities, BGBD network, NGOs, farmers, regional consortia, policy makers	Methods of SLM are incorporated in the design and evaluation of landscape research	
	In at least four of the countries participating in the BGBD project, policy stimulated to include matters related to BGBD management, and sustainable utilization.	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, policy makers	Policy issues related to BGBD acquisition, exchange, intellectual property rights (IPR), benefits sharing, etc. included in local, national and regional government policies	
Output Targets 2009	30% of partner farmers in pilot sites used SLM options that arrested resource degradation and increased productivity in comparison with non-treated farms	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, policy makers	Increased productivity and conservation of degraded landscape	
	75% of 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	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, policy makers	Improved knowledge sharing and exchange to empower stakeholder to innovate with respect to technologies and best land conservation practices	

Targets	Outputs	Intended User	Outcome	Impact
	The benefits of community-based watershed management innovations quantified and disaggregated by wealth and gender	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, policy makers	Increased investment in beneficial conservation	
Output Targets 2010	Scale up research on soil fertility gradient to farm and landscape levels by conducting one or two carefully designed, integrated studies in collaboration with other CIAT scientists	CGIAR, ARI, researchers from NARS and local universities, NGOs, farmers, regional consortia, policy makers		