TSBF Institute

PROJECT PE-2:

INTEGRATED SOIL FERTILITY MANAGEMENT

IN THE TROPICS

Annual Report 2005

Executive Summary

CIAT
Centro Internacional de Agricultura Tropical
International Center for Tropical Agriculture

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1. PROJECT DESCRIPTION AND LOGFRAME

A. Research for development strategy of TSBF-CIAT

The 2005-2010 TSBF-CIAT strategy is aligned with the **Millennium Development goal:** "to help create an expanded vision of development that vigorously promotes human development as the key to sustaining social and economic progress in all countries, and recognizes the importance of creating a global partnership for development." The strategy encompasses the **CGIAR's agriculture and environment mission:** "to contribute to food security and poverty alleviation in developing countries through research, partnerships, capacity building and policy support, promoting sustainable agricultural development based on environmental sound management of natural resources." The strategy is also aligned with the CIAT's three research for development challenges: 1) improving management of agroecosystems in the tropics; 2) rural innovation research; and 3) enhancing and sharing the benefits of agrobiodiversity.

TSBF-CIAT's Program has three main goals. These are: (1) to strengthen national and international capacity to manage tropical ecosystems sustainably for human well-being, with a particular focus on soil, biodiversity and primary production; (2) to reduce hunger and poverty in the tropical areas of Africa and Latin America through scientific research leading to new technology and knowledge; and (3) to ensure environmental sustainability through research on the biology and fertility of tropical soils, targeted interventions, building scientific capability and contributions to policy.

TSBF-CIAT utilizes a range of approaches to achieve program goals in collaboration with its partners, with particular emphasis on the following:

Catalysis: Ensuring that partners are kept at the forefront of conceptual and methodological advances by conducting and promoting review, synthesis and dissemination of knowledge. This is done through workshops, training courses and sabbatical and short exchange visits.

Collaboration**:** Developing appropriate alliances with institutions across the research, educational and developmental spectrum, including linkages between institutions in the North and South.

Facilitation**:** Coordinating actions among partners to achieve progress and success in research. This is done by providing backstopping support in the preparation, submission, implementation and publication of research projects.

Conviction: Demonstrating tangible results by taking policy makers to the fields.

Internal and external reviews of the program**:** The Institute's activities and outputs undergo periodic critical reviews to ensure high standards and the achievement of the Institute's mission.

Since its founding in 1984, TSBF has conducted research on the role of biological and organic resources in tropical soil biology and fertility, in order to provide farmers with improved soil management practices to sustainably increase agricultural productivity. In recent years, TSBF-CIAT's research for development approach has been based on an Integrated Soil Fertility Management (ISFM) paradigm. ISFM is a holistic approach to soil fertility research that embraces the full range of driving factors and consequences of soil degradation — biological, physical, chemical, social, economic and political.

However, successful resource management and sustainable agricultural productivity need to go still further, into the realms of markets, health and policies (Figure 1). The central hypothesis is that natural resource management research will have more leverage if the apparent gaps between investment in the natural resource base and income generation can be bridged. Therefore, TSBF-CIAT's strategy proposes to take ISFM an additional step forward, by addressing the full chain of interactions from resources to production systems to markets and polices. Under the new framework, investment in soil fertility management represents a key entry point to agricultural productivity growth, and a necessary condition for obtaining positive net returns to other types of farm investments.

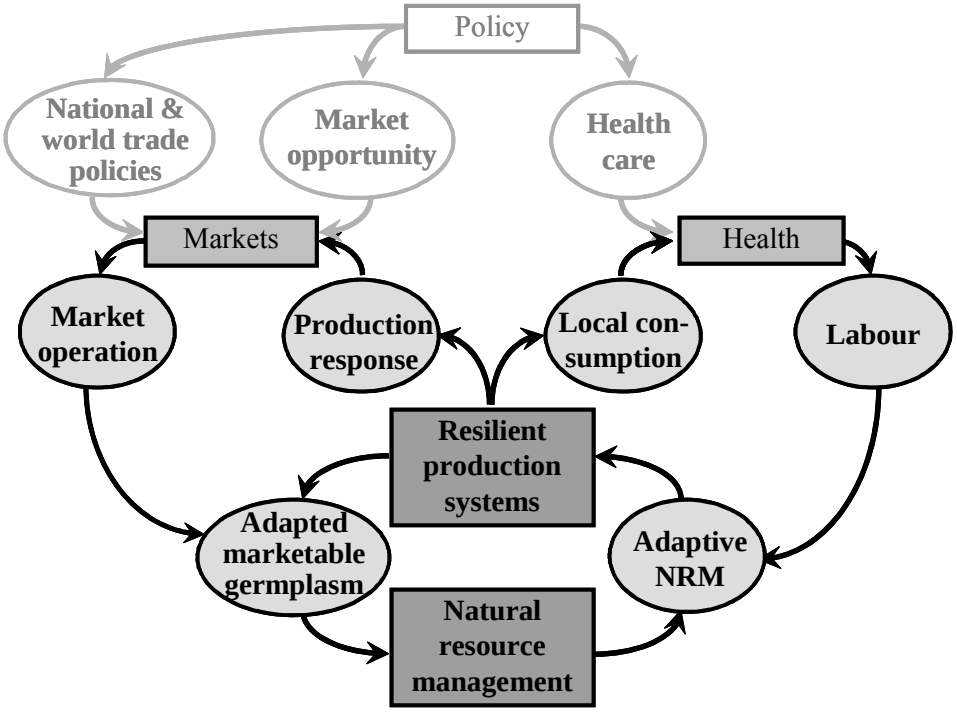

Figure 1. Conceptual framework of the TSBF-CIAT strategy. Topics in bold indicate the driving forces to be addressed by the proposed strategy; topics in shaded lighter gray are driving forces beyond the control of the Program.

TSBF-CIAT will pursue the following three major objectives under its strategy:

- to improve the livelihoods of people reliant on agriculture by developing profitable, socially-acceptable and resilient agricultural production systems based on ISFM;
- to develop sustainable land management (SLM) practices in tropical areas while reversing land degradation; and
- to build the human and social capital of all TSBF-CIAT stakeholders for research and management on the sustainable use of tropical soils.

To achieve these objectives, TSBF-CIAT's work is organized into five major outputs:

1. Biophysical and socioeconomic processes understood, principles, concepts and methods developed for protecting and improving the health and fertility of soils;
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;
3. Partnerships and tools developed and capacity enhanced of all stakeholders for improving the health and fertility of soils;
4. Improved rural livelihoods through sustainable, profitable, diverse and intensive agricultural production systems;
5. Options for sustainable land management (SLM) for social profitability developed, with special emphasis on reversing land degradation.

Each of these outputs has specific output targets for each year to contribute towards output level outcomes and output level impacts. The outcomes and impacts are accomplished through six major thrusts:

1. Intensification and diversification of cropping systems;
2. Managing the genetic resources of soil for enhanced productivity and plant health;
3. Moving from plot to landscape scale to address sustainable land management challenges;
4. Understanding farm level social dynamics;
5. Linking farmers to markets; and
6. Strengthening NARSs capacity.

TSBF-CIAT's strategy has a major focus on developing and extending technologies that support sustainable intensification of cropping systems, especially in the dry and moist savanna, hillside, and forest and forest margin agro-ecological zones (AEZs) in Africa and Latin America. In these AEZs, poverty, population growth and a rising demand for food is driving expansion of cropped area into increasingly marginal lands and/or remnant forest zones. Under these circumstances, sustainable intensification of agriculture on already cultivated land represents the most promising solution to achieving food security and protecting against natural resource degradation, the ultimate goals of TSBF-CIAT's work.

As a relatively small research institute, it is important that TSBF-CIAT position itself appropriately on the research-development continuum. TSBF-CIAT's primary role and comparative advantage is in conducting international public goods 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 two partner networks — the African Network for Soil Biology and Fertility (AfNet), and the Latin American Consortium on Integrated Soil Management (known by its Spanish acronym, MIS). TSBF-CIAT also collaborates with the South Asian Regional Network (SARNet) on soil fertility research in that region.

To carry out the work envisioned under the strategy, the following staff positions will be called for:

Agrobiophysical scientists: These include specialists in integrated soil fertility management, soil biota management, soil and water conservation, ecosystem services, microbiology, and plant nutrition and physiology.

Social scientists (including agricultural economics): This staff category will be strengthened to permit greater emphasis on the socio-economic aspects of the new research paradigm.

Coordination: This includes the Institute Director, coordinators of the AfNet and MIS networks, and the coordinator of the GEF-UNEP Below Ground Biodiversity Project.

Funding: The estimated funding required for TSBF-CIAT's work is approximately US$5 million per year, for a total budget of about $25 million over the next 5 years.

B. Project description

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

Goal: To strengthen national and international **capacity** to manage tropical ecosystems sustainably for human well-being, with a particular focus on soil, biodiversity and primary production; to reduce **hunger and poverty** in the tropical areas of Africa and Latin America through scientific research leading to new technology and knowledge; and to ensure **environmental sustainability** through research on the biology and fertility of tropical soils, targeted interventions, building scientific capability and contributions to policy.

Objective: To support the livelihoods of people reliant on agriculture by developing profitable, socially-just and resilient agricultural **production systems** based on Integrated Soil Fertility Management (ISFM); to develop **Sustainable Land Management** (SLM) in tropical areas of Africa and Latin America through reversing land degradation; and to build the **human and social capital** of all TSBF-CIAT stakeholders for research and management on the sustainable use of tropical soils.

External Conditions: Security and political stability does not restrict access to target sites and continuation of on-going activities.

Important Assumptions: Poverty reduction strategies remain central to human development support and funding. TSBF stakeholders remain engaged with TSBF-CIAT strategic priorities and/or TSBF management continues to adapt and innovate in response to changing priorities. Funding for research on globally-important issues continues.

Target Ecoregions: 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); Amazon rainforest (Brazil, Colombia, Peru).

Beneficiaries and End Users: Principally small-scale crop-livestock farmers and extension workers, NGO's and NARES in tropical agroecosystems of sub-Saharan Africa, Latin America and South-east Asia.

Collaborators: ***NARES:*** KARI (Kenya), DRSRS (Kenya), NMK (Kenya), KEFRI (Kenya), NARO (Uganda), NFA (Uganda), NEMA (Uganda), MOA (Uganda), ITRA (Togo), INRAB (Benin), SRI (Ghana), IER (Mali), IAR (Nigeria), INRAN (Niger), INERA (Burkina Faso); CORPOICA (Colombia), EMBRAPA (Brazil), Kerala Forest Research Institute (India), GBP Institute (India), SDREP (India), INTA (Nicaragua), DICTA (Honduras); IC-SEA BIOTROP (Indonesia), RIABGR (Indonesia), FNCRDC (Indonesia), FNCRDC (Indonesia), RRIEC (Indonesia), COSA (Indonesia), IOS (Cote d'Ivoire), ANADER (Cote d'Ivoire), NRMEE (Cote d'Ivoire), MOE (Cote d'Ivoire), INPDMDS (Cote d'Ivoire), ESDA (Cote d'Ivoire), UCA (Cote d'Ivoire), UAA (Cote d'Ivoire), BNETD/CCT (Cote d'Ivoire), CNRA (Cote d'Ivoire), (Instituto de Ecologia (Mexico), IEAC (Mexico), UNAM (Mexico), IFCP (Mexico), Centro Exp. Andres (Mexico), Reserve de la Biosfera de Los Tuxtlas (Mexico), ***ARIs:*** CIMMYT, ILRI, CIP, IFDC, ICRAF, IITA, ICRISAT, IRD (France), CIRAD (France), ETHZ (Switzerland), JIRCAS (Japan); ***Universities:*** Nacional (Colombia), Valle (Colombia), Pereira (Colombia), UNA (Nicaragua), UNA and EAP Zamorano (Honduras), Uberlandia (Brasil), University of Nairobi (Kenya), USIU (Kenya), Maseno University (Kenya), Methodist University (Kenya), Makerere University (Uganda), Kenyatta University (Kenya), University of Zimbabwe (Zimbabwe), Sokoine (Tanzania), Universidade Federal de Lavras (Brazil), Universidade Regionale de Lavras-FURB (Brasil), INPA (Brasil), UFAM

(Brasil), Universidade De Brasilia (Brasil), Jawaharlal Nehru University (India), University of Agricultural Sciences (India), Kumaon University (India), Sambalpur University (India), Universitas Lampung (Indonesia), Brawijaya University (Indonesia), Gadjah Mada University (Indonesia), Bogor Agricultural University (Indonesia), Université de Cocody (Cote d'Ivoire), Universite D'Adobo-Adame (Cote d'Ivoire), Universidade Veracruziana (Mexico), Instituto Polytecnico (Mexico), KULeuven (Belgium), University of Paris (France), University of Bayreuth and University of Hohenheim (Germany), SLU (Sweden), NAU (Norway), Cornell University (USA), University of Wisconsin-Madison (USA), Ohio State University (USA), Colorado State University (USA), East Anglia (UK), Queen Mary University (USA), Michigan State University (USA), ITC (The Netherlands), University of Exeter (UK), and Wageningen University and Research Centre (Netherlands). ***Regional Consortia:*** AFNET, MIS, CONDESAN; ***NGOs:*** CARE, World Vision; CIPASLA, CIPAV.

Project Changes: TSBF-CIAT has developed and published a document in 2005 on strategy and work plan for 2005-2010. CIAT activities of the Systemwide Program on SWNM are incorporated. Project logframe has been aligned to support goals of MDG, MEA and CGIAR Science Council priorities.

C. Project logframe

PE-2 Project Log Frame (CIAT-MTP 2005-2007)

Project: **Integrated Soil Fertility management in the tropics** ***Project Manager:*** **Nteranya Sanginga**

Narrative Summary	Measurable Indicators	Means Of Verification	Important Assumptions
Goal To strengthen national and international capacity to manage tropical ecosystems sustainably for human well-being, with a particular focus on soil, biodiversity and primary production; to reduce hunger and poverty in the tropics through scientific research leading to new technology and knowledge; and to ensure environmental sustainability through research on the biology and fertility of tropical soils, targeted interventions, building scientific capability and contributions to policy.	The principles of sustainable development integrated in country policies and programs. Reversal of the losses of environmental resources, especially loss of soil and below-ground biodiversity. Capacity built in tropical countries for sustainable management of natural resources. Developmental and environmental objectives taken inter-dependently.	National plans, human development and environment reports. Data from international organisations (UNEP, FAO, CG-institutes) that monitor the state of environmental resources. Impact studies, IARC and NARS reports, papers and publications.	Continued government and donor support. Sustained political and financial support for agricultural research and protecting the environment. Linkages maintained among research and development organizations.
Purpose To support the livelihoods of people reliant on agriculture by developing profitable, socially-acceptable and resilient agricultural production systems based on Integrated Soil Fertility Management (ISFM); to develop Sustainable Land Management (SLM) in tropical areas through reversing land degradation; and to build the human and social capital of all TSBF-CIAT stakeholders for research and management on the sustainable use of tropical soils.	By 2015, in at least two countries in each of the major tropical regions where TSBF-CIAT works, the number of rural people in extreme poverty reduced by 20%. By 2010, capacity built in at least three partner countries by at least three of the following: - a national level policy or legislative instrument developed by reference to a TSBF output. - all soil-related national institutions linked to TSBF networks with at least 50% of their scientists engaged in TSBF-inspired topics. - extension agencies and/or NGOs take up TSBF outputs to apply in their work programs. - farmers' organisations and/or civil society apply TSBF outputs in their plans and work. By 2008, TSBF-CIAT scientists are leading globally-funded research on at least three topics of key relevance to the international community (as identified in GEF, MDG, MEA, CGIAR mission and goal statements).	Reports of collaborating national and international institutions – in poverty reduction and sustainable development. National agencies surveys, development plans and reports. International agencies mission and goal statements related to TSBF-CIAT annual reports and accounts.	Poverty reduction strategies remain central to human development support and funding. TSBF stakeholders remain engaged with TSBF-CIAT strategic priorities and/or TSBF management continues to adapt and innovate in response to changing priorities. Funding for research on globally-important issues continues.
Output 1 Biophysical and socioeconomic processes understood, principles and concepts developed for protecting and improving the health and fertility of soils.	By 2006, indicators of soil health and fertility at plot, farm and landscape scales identified. By 2008, practical methods for rapid assessment and monitoring of soil resource base status developed. By 2010, decision tools for soil biota, nutrient and water management developed and disseminated to stakeholders.	Annual Reports/ publications. Reviews published. Documents of synthesized results. Detailed tables published in Annual Report. Decision guides for ISFM developed.	Sufficient operational funds for soil and plant analyses. Literature on constraints available. Farmers continue to participate. Projects SN-1, PE-3 and PE-4 actively participate. Active collaboration with participatory research project (SN-3), RII and NARS.

Narrative Summary	Measurable Indicators	Means Of Verification	Important Assumptions
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.	By 2006, decision support framework for ISFM developed, tested with and made available to stakeholders in at least 2 benchmark countries. By 2008, communities in at least 3 countries demonstrate and test direct or indirect management options that enhance locally important ecosystem services using BGBD. By 2010, local baselines and interviews show that farmers' understanding of soil processes is demonstrably enhanced within community-based experimentation in at least 5 benchmark sites.	Annual Reports/ publications. Scientific publications. Soil and crop management guidelines published. Decision support systems developed. Annual reports.	Sufficient operational funds for soil and plant analyses. Literature on constraints available. Farmers continue to participate. Projects SN-1, PE-3 and PE-4 actively participate. Active collaboration with participatory research project (SN-3), RII and NARS.
Output 3 Partnerships developed and capacity enhanced for improving the health and fertility of soils of all stakeholders.	By 2005, AfNet, MIS, SARNET and BGBD Networks restructured and strengthened. Publications (i.e., journal papers, books, extension materials, policy briefs, etc.), workshops, documentaries, field days implemented by each project. By 2010, tools for dissemination of research knowledge developed by each project. By 2010, appropriate policies and innovative institutional mechanisms developed and promoted.	Annual Reports/ publications. Scientific information (theses, publications, workshop reports, project documents) disseminated to network members and all stakeholders. Network trials planned and implemented with partners. Degree-oriented and on-the-job personnel trained (Farmers, NARS, NGO's).	Continued interest/participation of NARS and ARO partners, and national and international universities. Continued support for collaborative activities e.g. Challenge programs.
Output 4 Improved rural livelihoods through profitable, diverse and intensive agricultural production systems.	By 2006, cereal-legumes and livestock systems, with nutrient use efficiency as an entry point, tested and adapted to farmer circumstances. By 2006, Quesungual and other related agroforestry systems, with water conservation as entry point, including crop diversification strategies, tested and adapted to farmer circumstances. By 2006 increase farm income and production in at least 20 pilot sites in at least 6 countries. By 2007, banana and cassava based systems, with the relation between pest, diseases and ISFM as entry point, including novel cropping sequences, tested and adapted to farmer circumstances. By 2008 improved production systems have triple benefits of food security, income and environmental services. By 2008, farmers are testing and adapting improved production systems in at least 15 sites in 5 countries. By 2010, validated intensive and profitable systems are being demonstrated, promoted by partners and adopted by farmers in 10 countries.	Annual Reports/ publications. Farmer's surveys. Regional/national production statistics. Land use surveys (satellite imagery, rapid rural appraisal).	Land survey data available. Farmers adopt new technologies. Socioeconomic conditions are favorable for achieving impact. Adequate resources available for soils research.
Output 5 Sustainable land management for social profitability developed, with special emphasis on reversing land degradation.	By 2007, identification, characterization and monitoring of degraded lands available for at least 2 regions. By 2008 methods for socioeconomic evaluation/valuation of ecosystem services for trade-off and policy analysis used, at least in 2 humid and 2 sub-humid Agro-ecological zones. By 2010, 30% of partner farmers in pilot sites used SLM options that arrest resource degradation and for increased productivity in comparison with non-treated farms.	Annual Reports/ publications. Farmers surveys. Regional/national production statistics. Land use surveys (satellite imagery, rapid rural appraisal).	Land survey data available. Farmers adopt new technologies. Socioeconomic conditions are favorable for achieving impact. Adequate resources available for land management research.

2. CGIAR OUPUT TEMPLATE: CIAT MTP 2005-2007

Project PE-2: Integrated Soil Fertility management in the tropics

Output	Output Target 2005	Category	Achieved (yes or no)
OUTPUT 1: Biophysical and socioeconomic processes understood, principles and concepts developed for protecting and improving the health and fertility of soils	• Farmers'perceptions, preferences, economics and information flow pathways and use of local knowledge within research to extension linkages documented and analyzed • Role of social differentiation in the creation and maintenance of soil fertility analyzed	OTHER KINDS OF KNOWLEDGE OTHER KINDS OF KNOWLEDGE	YES YES
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	• Management options to enhance soil-based ecosystem services, with an initial focus on long-term impacts of organic and inorganic resource management, developed and tested	PRACTICES	YES
OUTPUT 3: Partnerships developed and capacity enhanced for improving the health and fertility of soils of all stakeholders	• AfNet, MIS, SARNET and BGBD Networks restructured and strengthened • Publications, workshops, documentaries, field days implemented by each project	CAPACITY CAPACITY	YES YES
OUTPUT 4: Improved rural livelihoods through profitable, diverse and intensive agricultural production systems	• Decision support tools made available to identify more productive, and profitable and resilient smallholder farm production strategies	MATERIALS	YES
OUTPUT 5: Sustainable land management for social profitability developed, with special emphasis on reversing land degradation	• Production systems that contribute to carbon sequestration and mitigation of greenhouse gas emission identified	PRACTICES	YES

Categories of output targets to be used are: Materials, Policy strategies, Practices, Capacity, and Other kinds of knowledge.

3. RESEARCH HIGHLIGHTS 2005

Output 1: Biophysical and socioeconomic processes understood, principles, concepts and methods developed for protecting and improving the health and fertility of soils

Water harvesting and interactions with dry mixtures of phosphate rock (PR) and water-soluble P in West African Drylands: Collaborative research of TSBF-CIAT with its West African partners (ICRISAT, INRAN, INERA) and with the Financial Support of UNEP-GEF for the DMP project, sorghum production in the dry sahelian zone increased by 300-800% following different technologies combining water harvesting and nutrient management. The water harvesting technologies include use of Zai, halfmoon or stone bounds and these could be accompanied by additions of small quantities of manure, mineral fertilizers or their combination. This research has also shown that nutrients are more important than water even in the dry areas. In 2005, use of Zai alone in Tougouri, Burkina Faso for example, performed better than the use of either nitrogen or phosphorus fertilizer. Combinations of water harvesting and nutrient application highly increased yields due to better utilization of inorganic fertilizers. Even when both Zai and halfmoon technologies were tested with combinations of water soluble P and phosphate rock in farmers' fields, similar yield increases were observed. From the studies, combining ¼ of water soluble P and ¾ of natural PR lead to the same yield as treatment where water soluble P was 100%. Water harvesting through Zai, half moon, use of tied ridges and stone bounds combined with nutrients such as manure, inorganic N and P and phosphate rock are some of the soil improvement technologies being scaled up in DMP West African countries by AfNet-TSBF, ICRISAT and other partners.

Overcoming phosphorus (P) deficiency in West African farming systems through Hill Placement and improving phosphate rock (PR) efficiency: Work done by TSBF-CIAT and its partners for several years with funding from Rockefeller Foundation focusing on phosphorus (P) availability has resulted in technologies that are now being taken up by farmers. The focus on P was because it is the most limiting nutrient to cop productivity in West Africa and about 80% of the African soils have inadequate supply. The technologies include hill placement of small quantities of P rather than broadcasting and combining PR with some water-soluble P. The work has shown that leguminous crops and cover crops in natural and managed fallows can take full advantage of biological nitrogen fixation in the presence of adequate P levels in the soils. It focused on utilizing PR deposits that are plenty in Africa by increasing their activity and suitability for direct application through use of PR together with water-soluble P. For several years, we have observed that the efficiency of Phosphate Rocks (PRK and PRT) can be increased above that of soluble P when a little amount of the soluble P is combined with the PR. Combining PR with 25% water-soluble P in has not shown any differences from its combination with 50%, 75% or 100% water soluble P. This clearly shows that placement of small quantities of water-soluble P fertilizers can improve the effectiveness of phosphate rock. To increase the impact of this outcome, Governments in West African Countries will require to invest more in bringing PR closer to the people or by facilitating this process to be carried out by entrepreneurs.

Strategic research in Latin America contributes to research for development in Africa: A participatory approach and a methodological guide were developed to identify and classify local indicators of soil quality and relate them to technical soil parameters and thus develop a common language between farmers, extension workers and scientists. This methodological guide was initially developed and used in Latin America and the Caribbean-LAC (Honduras, Nicaragua, Colombia, Peru, Venezuela, Dominican Republic), and was later improved during adaptation and use in eastern African (Uganda, Tanzania, Kenya, Ethiopia) through a South-South exchange of expertise and experiences. The aim of the methodological guide is to constitute an initial step in the empowerment of local communities

to develop a local soil quality monitoring and decision-making system for better management of soil resources. Impacts on higher education (Makerere University, Uganda), on a regional organization (African Highlands Initiaive, Tanzania) and on an international NGO (CARE International, Kenya) have been recently documented. Another example highlighted in several 2005 publications includes the use of the *In Vitro* Dry Matter Digestibility (IVDMD) lab assay as an excellent predictor of decomposition and N release in the soil, especially because it has important implications in resource savings when screening multi-purpose plants to be used as green manures.

Knowledge of spatial and temporal dynamics of soil macrofauna in the Quesungual Agroforestry System allows improved soil biota management: The activities of soil animals such as earthworms, ants and termites can improve soil structure, organic matter decomposition and nutrient cycling. In marginal environments, soil fauna can make an important contribution to soil quality and soil fertility. The rugged terrain of the isolated southern Lempira department in Honduras represents one such marginal environment, where the traditional slash-and-burn agriculture has been gradually, and successfully, replaced with slash-and-mulch agroforestry known as the "Quesungual System". The dramatic increase in organic matter input following slash-and-mulch, the introduction of a tree overstorey within fields, and the patchwork landscape of secondary forest, agroforestry and pasture that exists within the study area suggest likely increases in soil macrofauna abundance and diversity. During quantification and characterization of the soil macrofauna community one of the most important results was that absolute numbers of soil macrofauna in soils under Quesungual were much higher than expected, when compared with other agricultural systems of the semi-humid tropics. Numerically, termites, ants and earthworms were the most abundant animals, in that order. In terms of biomass, earthworms were dominant. Farmers' knowledge synthesized during participatory mapping of soil quality on-farm was instrumental to allow relevant stratification needed to guide spatially explicit sampling and spatial analysis of soil macrofauna. Spatial distribution of soil fauna distribution as reflected by earthworm casts and ant nests indicate that earthworm abundance is positively affected by the abundance of pruned trees, while ant abundance is negatively affected by tree abundance. This research has important implications for farm management, as it shows that farmers can manage litter cover and macrofauna activity by manipulating pruned tree density and distribution.

Determining the effects of tillage systems on soil physical properties, root distribution and maize yield on a Colombian acid-savanna Oxisol: Tillage system may affect many soil properties, which in turn may alter the soil environment and consequently may impact on root growth and distribution, and crop yield. In 1993, a long-term field experiment on sustainable crop rotation and ley farming systems was initiated on a Colombian acid-savanna Oxisol to test the effects of grain legumes, green manures, intercrops and leys as possible components that could increase the stability of systems involving annual crops. Five agropastoral treatments (maize monoculture, maize-soybean rotation, maize-soybean green manure rotation, native savanna, maize-agropastoral rotation) under two tillage systems (no tillage and minimum tillage) were investigated. Lower bulk density and higher total porosity for all treatments and soil layers was found in no-till as compared to the minimum tillage system. Between the two tillage systems, significantly higher maize grain yields were obtained under no-till agropastoral treatments as compared to the same treatments under minimum tillage. Maize yields on native savanna soils were markedly lower than in the rest of the treatments, indicating the need for improved soil conditions in subsoil layers for root growth of maize.

Determining the effects of tillage systems on soil organic matter pools and soil phosphorus fractions and maize yield on a Colombian acid-savanna Oxisol: Soil organic matter and phosphorus fractions play a key role in sustaining the productivity of acid-savanna Oxisols and are greatly influenced by tillage practices. In 1993, a long-term field experiment to test the sustainability of crop rotation and ley farming systems was initiated on the acid-savanna soils of Colombia. Five agropastoral treatments (MMO-maize monoculture, MSR-maize-soybean rotation, MGM-maize-soybean green manure rotation, NSC-native

savanna (control) and MAP-maize-agropastoral rotation) under two tillage systems (minus chisel-MC and plus chisel-PC) were investigated. The effects of chisel (vertical) tillage on soil organic matter (SOM) and phosphorus (P) fractions as well as maize grain yield under the five treatments were evaluated, seven years after establishment of the experiment. Results showed that the weights and nutrient contents of the SOM fractions decreased in the order LL (light Ludox fraction) > LM (intermediate Ludox fraction) > LH (heavy Ludox fraction). Treatment MGM had significantly higher values for the P fractions under both tillage systems. However, PC tillage resulted into slightly higher maize grain yields as compared to MC. Within MC tillage system, the trend of maize grain yield was MGM > MMO > MSR > MAP > NSC, while for the PC tillage system, it was MGM > MSR > MMO > MAP > NSC. Future research should focus on integrated approaches that combine biophysical and socio-economic parameters to evaluate the sustainable productivity of Colombian savanna Oxisols.

Identifying and overcoming the limitations for implementing conservation farming technology in the Fuquene watershed (Colombia) by integrating socioeconomic and biophysical research with financial mechanisms: Reduced tillage, rotations with green manures and direct drilling are agriculture conservation practices selected by CONDESAN, CIAT and GTZ (WFCP project) to be promoted in order to reduce the deposition of sediments, N and P in the Fuquene Lake, which is suffering an advanced process of eutrophication. Previous studies demonstrated that this alternative could reduce the negative environmental externalities by about 50% as the net income and employment opportunities are increased. These studies were: 1) Identification of point and non point sources of pollutants; 2) Prioritization of areas according with their responsibility in the lake eutrophication; 3) Application of experimental economics methodologies to explore willingness of water users and farmers to cooperate for modifying negative environmental externalities, 4) Determination of poverty profiles and how these are spatially distributed; and 5) Ex ante impact assessment of changing conventional tillage practices by farming conservation practices. Although, these studies showed that by incorporating conservation agriculture practices the net income is increased, the technological change is not reached readily since farmers' cash flows are unable to cover the required additional investment to incorporate green manures prior to the conventional crop is sown. For these reasons, the project designed a financial mechanism to investigate if the suspected restricted financial capacity of small farmers was constraining a massive technological change in the watershed. To reach this objective CONDESAN-GTZ made an agreement with the regional environmental authority (CAR) to assure the technical assistance needed for the implementation of the practices. Also, two farmers associations were introduced to the partnership acting as direct beneficiaries of the credits and also as intermediaries between CONDESAN and the smallest farmers who do not belong to the associations. These development actions are not only promoting technological changes but are creating in situ research scenarios for investigating the real constraints for using the soils in a sustainable manner. Therefore, this project expects to determine the biophysical ex post impact of these practices on the soils and lake conditions and the social and economic benefits caused by the technological change. If the results are positive, these practices will be incorporated as an alternative that can be compensated by a payment for environmental service (PES) scheme also promoted by the project.

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

Progress in defining the key principles behind the successful adoption of Quesungual slash and mulch agroforestry system (QSMAS): The QSMAS is an alternative to the slash and burn management system. It is based on planting annual crops (maize, sorghum, beans) and pastures under an indigenous slash and mulch management system. It combines the regrowth of native forest vegetation with no burning and zero tillage/direct planting operations on a permanent soil cover. More than 6,000 farmers covering an estimated area of 7,000 ha, who have adopted the QSMAS system during the last ten years in

Honduras, have increased crop yields by more than 100% (maize from 1200 to 2500 kg ha^{-1}, beans from 325 to 800 kg ha^{-1}) in comparison with the traditional slash and burn system. In 2004, TSBF-LA and MIS consortium in Central America obtained special project funding from the Water and Food CP to conduct a collaborative research program to determine the key principles behind the social acceptance and biophysical resilience of QSMAS. The specific objectives of the project are: 1) To assess socio-economic and biophysical context of QSMAS; 2) To define QSMAS management concepts and principles and to develop relevant tools to monitor soil and water quality; 3) To evaluate and document potential areas suitable to QSMAS and 4) To develop tools for dissemination, adaptation and promotion of the QSMAS management strategies. During this year, field research and validation activities have been implemented in Honduras and Nicaragua. Preliminary results indicate that soil losses due to erosion are negligible and water conservation is increased because of permanent mulch on the soil. Excess water leaving the system by runoff is almost clean and can be used by downstream users. However, there are methodological challenges to determine water dynamics in the soil because of the high proportion of stones in the soil. Preliminary results from the plot experiments on farmers' fields are showing strong interactions among key factors such as soil fertility, water availability and crop productivity.

Adoption of new soil conservation technologies in the Llanos of Colombia - Arable layer building technology: As a result of CIAT's collaborative research activities with regional partners (Corpoica, Pronatta and Unillanos) and with the financial support from the Ministry of Agriculture and Rural Development (MADR) and Colombian Science Foundation (COLCIENCIAS), a series of soil improvement and conservation practices have been developed. These practices focus on arable layer building technologies —part of the soil profile that can be modified through a combination of biological and physical management— in soils of the well-drained savannas of the Llanos of Colombia. These practices include use of proper crop and pasture rotations in agropastoral systems. Practices for arable layer building include a vertical corrective tillage using rigid chisels, correction of nutrient deficiencies in soil and sowing of acid soil adapted tropical forages with vigorous root systems and field crops with greater yield potential. Farmers in the Llanos region of Colombia are the main users of this outcome. Farmers in the past attempted to establish crops without adequate soils management and used non-adapted pasture and crop germplasm, and consequently experienced large economical failures. In contrast to their previous experiences, utilization of soil conservation methodologies together with the use of improved germplasm have shown significant advantages in productivity and in economic returns to the investments made. Recent impact studies conducted by CIAT and its partners indicated that the productivity gains constitute the principal benefit for those who apply soil conservation practices in the Llanos. Research publications, technical bulletins, extension brochures and progress reports in both English and Spanish documented the development of technologies. It is considered that for achieving wider impacts of arable layer soil management technologies, investment by the Colombian government in improving road infrastructure is critical.

Output 3: Partnerships and tools developed and capacity enhanced of all stakeholders for improving the health and fertility of soils

Strengthening research for development capacity of the AfNet: The year 2005 was marked by a continued growth of AfNet membership to over 350 members. During this period, AfNet continued the implementation of the Network trials located in over 80 sites in different agroecological zones distributed in East, South, Central and West Africa regions. These experiments have increased understanding on the sustainable management of the natural resource base and have generated and demonstrated new technologies that can help boost food production among the smallholder farmers in the continent. AfNet Steering Committees meeting was held during which the role of the Network in achievement of the TSBF Strategy was discussed. AfNet successfully organized two training courses: Participatory Approaches to Research and Scaling Up, attended by 37 participants, and the Decision Support Systems for

Agrotechnology Transfer (DSSAT) training workshop attended by 29 participants. AfNet ensured the review of over 100 papers presented during the Yaoundé Symposium in readiness for the publication of the AfNet Symposium Book and the Special Issue in Nutrient Cycling in Agroecosystems in 2006. Several proposals were also developed of which 10 received funding from various donors. AfNet published the TSBF newsletter, *The Comminutor*, which highlighted research issues in Latin America. The Network continues to be a pan African Network and will continue in its effort to coordinate and promote information sharing for the sustainable and integrated management of natural resources in the continent.

Advances in Conservation and Sustainable Management of Below-ground Biodiversity (CSM-BGBD) Project: The year 2005 was a major milestone for the CSM-BGBD project. It is the year when nearly all partners in the project met in a joint meeting in Brazil to present the results from the BGBD inventory they had carried out in their individual countries. Brazil, Cote d'Ivoire, India, Indonesia, Kenya, Mexico and Uganda were all represented by a minimum of five participants. The meeting also had all the technical advisors, the steering committee members and the project advisory committee members attending and reviewing the project progress. The mid-term reviewers of the project were also in the meeting held in April 2005 in Manaus Brazil. Technical papers were presented covering: Benchmark area descriptions and socio-economic characterization, Inventory of soil macro-fauna, Inventory of nematodes and Meso-Fauna, The inventory of legume nodulating bacteria, arbuscular mycorrhizal fungi and ectomycorrhiza, The inventory of pathogenic and antagonistic fungi and insect pests, Presentation of the standard methods, Ecosystem service and soil quality indicators, Analysis of BGBD at landscape level and in different land use intensities, Output of economic valuation of BGBD for different soil functions and environmental services, Information management and data sharing in the project. The overall conclusion from the technical reviewers during the meeting was that the project had succeeded in agreeing on appropriate standard methods for most of the functional groups mandated and has used them to assemble a unique and comprehensive dataset during the period since the last Annual Meeting in 2004. Apart form these technical observations; the project was subjected to a mid-term review as was required of the project and contained in the project document. The reviewers of the project, Professor Eric Smaling of ITC-The Netherlands and Professor Mateete Bekunda of Makerere University-Uganda, returned a final mid-term review rating of 'Good' for the project and recommended its continuation into the second phase that has now been approved by the Global Environmental Facility (GEF). There is ongoing progress of publishing all the technical papers presented in a Book to be released in late 2006. Partners during the BGBD annual meeting produced a total of 71 papers and four discussion papers in ecosystems services, land use intensity quantification, economic valuation of BGBD and data sharing and intellectual property rights. BGBD scientists participated in three global training workshops, two in Nairobi (ants and termites characterization) and one in India on mycorrhizal fungi. Individual countries organized workshops and training courses for their country partners and project executioners.

Nicaraguan farmers start validating the management principles of Quesungual slash mulch agroforestry systems (QSMAS) in their own farms: Twenty farmers from drought-prone areas of Nicaragua visited the farmers that are practicing the Quesungual on their farms in Honduras. The main objective of their visit was learning from farmers practicing the system the main management principles and benefits of the Quesungual. Six months later six farmers from Somotillo, Nicaragua showed their own Quesungual plots to a group of researchers from the MIS consortium. They were very excited about the good adaptation of the system and expressed their willingness to teach other farmers from similar regions the benefits of the Quesungual. This type of farmer-to-farmer exchange proved to be a dynamic mechanism of knowledge sharing and an effective way to disseminate ISFM principles.

Scaling out conservation farming experience in Fuquene (Colombia) to other Andean watersheds: Ambato (Ecuador) and Jequetepeque (Peru): Ex-ante evaluation of land use alternatives had demonstrated that conservation agriculture is an SLM alternative for improving environmental services

and rural livelihoods. Based on Fuquene (Colombia) experience, the special project "Payment for Environmental Services" (CONDESAN-GTZ-CIAT) of the WFCP is promoting a capacity building strategy for enhancing other pilot sites farmers' capacities in conservation agriculture. The strategy has started with training courses held in the conservation agriculture pilot site (Fuquene) and subsequent courses held directly at the extrapolation sites. The participants for courses were selected according with their previous commitment to apply the learned practices in their own farms. The project, through its extension partners (GTZ), will provide continuous technical assistance for a year in order to ensure that the technology is properly applied during green manures and commercial crops sowing. In Peru, strategic alliances between the project local partner (CEDEPAS) and the farmers were created in order to establish pilot farms. Complementary research activities are conducted in order to measure the impact of these practices on soil physical properties and incidence of crop diseases. For 2006, pilot implementation of these soil conservation practices was agreed between a community-based organization and the project in Ecuador. The monitoring of impacts will be measured by CONDESAN and CIAT.

Output 4: Improved rural livelihoods through sustainable, profitable, diverse and intensive agricultural production systems

Improving food security for western Kenyan farm households with integrated soil fertility management for local vegetable crops: We analyzed the food security in vegetable yields of subsistence households, which were producing kale for market and those, which were cultivating traditional African vegetables (TAVs) for home consumption. By comparing kale-producing households with TAV producing households in terms of the allocation of labour and capital and the coping mechanism enacted to cope with transitory food insecurity, we found that households producing kale have a higher level of food security. This increased food security stems from three key factors: the malleability of kale to be a vegetable and a high-value cash crop; the dedication of all households members to the daily maintenance of kale; and the location of farms adjacent to a water source. These three key factors allow for women to be able to access kale for home consumption, increase the purchasing power of households, and also, boost the total yield of vegetables cultivated on the farm. TAV producing households were found to be vulnerable to an insufficient vegetable supply largely because of geographic location and the overburdening labour demands on the women to singularly produce all household vegetables.

Improved decision making for achieving triple benefits of food security, income and environmental services through modeling cropping systems in Ethiopian Highlands: Food security in the Enset-based Ethiopian highlands is constrained mainly by land degradation, land fragmentation and limited access to technologies and skills. Enset (*Enset ventricosum*) is a perennial herb with edible corm, supporting about 13 million people in Ethiopia. A household survey, supported by field measurements, was conducted over three years (2000–2002) with 24 representative farmers to identify their production objectives and to quantify their available land resources, cropping system, crop yields and market price, for developing models to facilitate their decision making. Farmers identified three major production objectives depending on their household priorities, socio-economic status and resource base. In Scenario I, farmers were primarily interested in producing enough food from their farm. In Scenario II, they wanted food security and to fulfil their financial needs. In Scenario III, farmers were interested solely in generating cash income, regardless of its effect on food production. The change from current production systems to Scenario I offers high quality livestock feed, while Scenario III offers low quality livestock feed whereby about 84% of the feed is coming from coffee husk. Moreover, a shift from the current system to Scenario I would not have any effect on the level of soil erosion, while a shift to Scenario II and III will reduce soil erosion by about 39 and 52%, respectively, mainly as a result of expansion of the area of perennial crops.

Output 5: Sustainable land management for social profitability developed, with special emphasis on reversing land degradation

Evaluation of the Dalhem Desertification Protocol to evaluate land degradation problems drought-prone areas of sub-humid tropics: An international workshop meeting was hosted by the MIS (Manejo Integrado de Suelos) Consortium, in Honduras as part of collaborative activities with ARID*net*, a collaborative research network on desertification supported by the National Science Foundation. The objective of the workshop was to validate the Dalhem Desertification Paradigm (DDP) to prioritise policy and management interventions through an integrated analysis (at multiple spatial scales) of both *biophysical* (meteorological and ecological factors) and *socio-economic* (human factors) dimensions of land degradation. The Honduras workshop extended the application of the DDP to land degradation and recovery of steepland agricultural systems in Central America, including an assessment of the unique "Quesungual" slash and mulch agroforestry system. The Quesungual system has already been adopted by 6,000 farmer households in Honduras, resulting in a two-fold increase in crop yields and cattle stocking rates and significant reduction in costs associated with agrochemicals and labour. Working as a team of local and international experts, the workshop addressed a complete DDP-based analysis of the opportunities for -- and limitations to -- the recovery of an agroecological system in the Guarita municipality, and the potential application of the Quesungual slash and mulch agroforestry system. In addition to local dissemination of the results, we plan to synthesize and submit the results of the workshop to a peer-reviewed international journal, with authorship open to all participants.

Watershed analysis to identify niches for sustainable land management and use - two case studies: The special project "Payment for Ecosystem Services" financed by the WFCP is applying in their different pilot sites a methodology for integrated watershed analysis. The results of this analysis are providing guidelines to design economic mechanism for ecosystem services conservation. The watershed analysis consisted of: 1) Hydrological modeling using SWAT (Soil & Water Assessment Tool) 2) Socioeconomic and environmental ex ante evaluation of land use and management scenarios, and 3) Determination of opportunity cost for implementing the proposed land use scenarios and valuation of environmental services. During 2005, this approach was applied in the Colombian and Peruvian pilot sites. In Colombia, the results are oriented towards financial mechanism for promoting conservation agriculture. In Peru, the analysis was conducted for the Mayo River watershed located in the transitional zone between the Andes and the Peruvian Amazon. Here, several micro watersheds supply water to various downstream urban aqueducts. However, the replacement of native forest by farming uses seems to be causing the increment of suspended solids in water flows and therefore, of the water treatment cost. With the hydrological analysis 28 Hydrological Response Unites were identified and 8 were prioritized because of their contribution to the environmental externalities (water flows and sediments) and land use change feasibility. In these areas the following scenarios were evaluated: coffee under shade, reforestation and live barriers in traditional production systems, coffee under shade being identified as the most appropriate alternative. Thus, although all potential scenarios produce less quantity of sediments (reduction of about 50%) than the traditional land use system (slash and burn – corn cropping – pastures), the coffee under shade scenario permits to increase farmers' income by 89% and labor employment by 77%. Regarding the design of a PES (payment for environmental services) mechanism, the value of economic payments was determined for each scenario by calculating the cost of a ton of reduced sediments. Thus, one ton of reduced sediments cost 1.31 tons of sediments or \$53.6 ha^{-1} y^{-1} during the first two years since this alternative only requires the initial investment as an incentive to replace the traditional land use. Regarding that the 7136 Moyobamba city families are willing to pay \$1.5/month as a contribution for promoting watershed resources conservation. It was calculated that it was only required two month of payments to cover the cost required for promoting coffee under shade in the HRU prioritized in the Miskiyacu micro watershed.

Tools for ex-ante evaluation of land use and management alternatives, and for valuation of ecosystem services - ECOSAUT Model: CONDESAN, GTZ and CIAT during the first year of the WFCP project implementation were focused on developing tools for impact assessment of sustainable land uses and valuation of ecosystem services. Therefore, a multicriteria optimization model was designed for the ex-ante analysis, by means of which optimal values of the decision variables that maximize or minimize watershed management objectives can be identified without violating imposed constraints. Linear programming has been applied successfully to measure the tradeoffs between the economic performance of different activities and the environmental externalities. Thus the model permits to evaluate the economic and social potential of the alternatives in improving the quality of life, and the results can stimulate private and official investors to fund some of the alternatives. The project uses the model to support stakeholders in making decisions about multiple land-use options calculating the environmental and socioeconomic costs of changes in land use and technology under different spatial and temporal scenarios. In addition, shadow prices are calculated for determining the price of services and goods that do not have a market price (production of sediments, water flows, etc). This model and approach are being used in the analysis of the five pilot Andean watersheds (Colombia, Ecuador, Peru and Bolivia) in order to support the identification of land use alternatives and management practices that promote the internalization of externalities. The main externalities that are subject of analysis and interventions are retention of sediments, water quantity and quality, and carbon sequestration.

Other highlights

Output 1: Biophysical and socioeconomic processes understood, principles, concepts and methods developed for protecting and improving the health and fertility of soils

- In a set of medium to long-term trials in the West-African savannas, it was shown that the functioning of the often hypothesized 'safety-net' of trees in a tree-crop intercrop depended on (i) the tree species and on (ii) the presence of a subsoil of suitable quality, i.e., clay enriched and with high Ca saturation. Especially, *Senna siamea* trees were shown to enrich the topsoil with Ca on soils with a clay-enriched subsoil.
- In a long-term hedgerow intercropping trial in West-Africa, it was shown that application of prunings of *Senna siamea* in combination with limited amounts of fertilizer can sustain maize yields above 2.5 tons per hectare for over 15 years. These yields also showed the lowest between-season variation. Sole application of fertilizer resulted in highly variable crop yields between seasons.
- In the Sudan savanna in Burkina Faso, annual application of manure was shown to mitigate the negative effect of ploughing and hand hoeing on soil organic carbon related properties and can therefore contribute to the sustainability of agricultural systems in the Sudano-Sahelian zone.
- In Western Kenya, plant height measurements, taken at any moment after maize flowering, were shown to be good estimators for maize grain yield. This approach proved also a valuable tool to discuss yield variability with farmers.
- Short-term laboratory mineralization data supported the existence of 3 classes of organic resources instead of 4 originally proposed by the Decision Support System for organic N managment. It was also shown that direct prediction of decomposition and mineralization from NIR was faster, more accurate and more repeatable than prediction from residue quality attributes determined using wet chemistry.
- In evaluating the impact of inherent soil properties and site-specific soil management in Western Kenya, it was observed that both above factors explained the variability found in soil fertility status between farms. Texture explained the variation observed in soil C and related total N between sub-locations, whereas P availability varied mainly between farm types as affected by

input use. The internal heterogeneity in resource allocation varied also between farms of different social classes, according to their objectives and factor constraints.

- In Western Kenya, in-vitro techniques have shown a high variability within the soybean genepool for triggering suicidal Striga germination. This trait can be used to select specific soybean varieties to be integrated in soybean-cereal rotations in Striga-infested areas.
- Identified, validated, and applied local and technical indicators of soil fertility quality using replicable methodology under smallholder conditions in Kenya to support farmers' experimentation with soil fertility management options.
- Community-based learning and communication strategies to support ISFM research were evaluated collectively by farmers and researchers at a special workshop (June 2005), which contributed to greater farmer involvement in the planning and implementation of the renewed project's second phase.
- The "land degradation" concept was critically reviewed and re-interpreted through dialogue between local and scientific knowledge, updating and prioritizing ISFM interventions appropriate to diverse small-holder conditions.
- Synthesis volumes on the Conservation and Sustainable Use of BGBD published by country teams (Kenya, Indonesia, India) and abstracts from all the country teams' activities were compiled and presented at the annual meeting held in Manaus, Brazil.
- In medium-term trials in Colombian Andean hillsides it was shown that the *Tithonia diversifolia* slash/mulch fallow system could be the best option to regenerate soil fertility of degraded volcanic-ash soils after continuous cassava cultivation. Soil parameters most affected by slash/mulch fallow systems included soil total N, available N (ammonium and nitrate), exchangeable cations (K, Ca, Mg and Al), amount of P in the Ludox light fraction, soil bulk density and air permeability, and soil macrofauna diversity.
- Showed that the superior adaptation of *Calliandra calothyrsus* as planted fallow species to infertile soil conditions in Cauca, Colombia is related to its ability to develop fine roots in subsoil layers.
- Field studies on residual P response of maize and bean in volcanic ash soils in Cauca region of Colombia suggested that application of $\geq$ 40 kg P ha^{-1} $year^{-1}$ could gradually build-up soil available P and this practice is better than one time application of large amount of P.
- A methodological approach was developed to study the origin of soil aggregates separated according to visual criteria and determined by comparing their specific organic matter signatures assessed by NIRS to signatures of biogenic structures produced by soil ecosystem engineers.
- Studies in Colombia and Nicaraguan hillsides showed the high potential of NIRS for evaluating soil quality in large areas, rapidly, reliably and economically, thereby facilitating decision-making with respect to soil management and conservation.
- Found that the nitrification inhibition activity of sexual accessions of *B. humidicola* was similar to the commercial apomictic cultivar indicating the possibility for genetic regulation of the trait.
- Showed that the use of bio-char in acid soils of very low natural fertility could increase crop and plant yield and could serve as a valuable tool to increase soil quality of infertile acid soils.

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

- In trials in Western Kenya, aiming at determining limiting nutrients and site-specific responses to applied nutrients for different fields within a farm (soil fertility gradients), clear differences in above two attributes were found between different fields within a farm. This indicates that there is a clear scope for field-specific fertilizer recommendations, provided these are based on local soil knowledge and diagnosis.

- In Western Kenya, the 'push-pull system' was observed to substantially reduce both *Striga* germination and stemborer damage. While herbicide-resistant maize was observed to seriously reduce Striga emergence, resulting in significant response to fertilizer application, maize did not respond to application of fertilizer in the maize mono-crop systems with maize hybrid WH403. In the push-pull systems, application of fertilizer also led to higher Striga emergence but this did not affect the responsiveness of the maize to applied fertilizer.
- In Central Kenya, inoculation with AMF showed considerable potential to enhance the early growth of tissue-culture bananas. Initial observations have also shown significant enhancements in banana growth after application of specific combinations of nutrients as fertilizer.
- Showed that building an arable layer using subsoil tillage and lime + nutrient applications could improve yields of maize by 2 to 3-fold compared with convential systems of crop production on acid infertile soils of the Llanos of Colombia.
- Preliminary results from the Water and Food Challenge Program funded project on Quesungual system indicated that soil losses under Quesungual Slash Mulch Agroforestry System (QSMAS) of different ages (2, 5 and >10 years) were less than 2 Mg ha^{-1} in 14 weeks in comparison to the 30 Mg ha^{-1} soil losses observed in the slash and burn treatments.

Output 3: Partnerships and tools developed and capacity enhanced of all stakeholders for improving the health and fertility of soils

- Commercial farms implemented with conservation farming practices in Fuquene watershed have been at the threshold level to enhance farmer to farmer and technician to farmer knowledge sharing in the Andean region.
- Partners during the BGBD annual meeting produced a total of 71 papers and four discussion papers in ecosystems services, land use intensity quantification, economic valuation of BGBD and data sharing and intellectual property rights.
- AFNET researchers prepared a total of 6 journal articles, 3 book chapters and 11 other publications.
- Results from the use of the NuMaSS (nutrient management expert system) to improve N management in maize-based systems in Nicaragua and Honduras indicated that improved fertilizer N recommendations require knowledge of both the intended crop cultivar and field site characteristics.
- BGBD scientists participated in three global training workshops. Two in Nairobi (ants and termites characterization) and one in India on mycorrhizal fungi.
- Individual countries organized workshops and training courses for their country partners and project executioners.

Output 4: Improved rural livelihoods through sustainable, profitable, diverse and intensive agricultural production systems

- The use of a herbicide-resistant maize variety and fertilizer reduced significantly the emergence of Striga.
- Four Lablab accessions were identified as the most likely to be accepted by farmers based on their productivity, pest and disease resistance and palatability for human consumption.
- Farmers from Uganda provided with a wider spectrum of dual purpose cowpea lines from which they can choose depending on whether they need grain, fodder or soil improvement.
- Farmer evaluation of improved soybean varieties screened in five locations in Kenya indicated that the variety SB19 can be recommended across locations and that is clearly better than the existing farmers' own variety, Nyala.
- Soil fertility is a good entry point for participatory research on ISFM.

- Households of Western Kenya producing kale for markets had a higher level of food security compared to those growing traditional vegetable crops.
- The creation of awareness of the various attributes of soybeans is currently leading to widespread adoption of soybean among the communities in TSBF-CIAT action sites in Kenya.
- With the emergence of a broader agenda for agricultural research, building multi-institutional partnerships has become a core strategy for promoting innovation and achieving greater impact of agricultural research at the household level.
- The strategy of integrating research activities with extension oriented to farmers that are committed to use conservation farming practices has facilitated scaling out of minimum tillage technology and green manures cropping in the Ecuadorian and Peruvian pilot watersheds.
- Crop-pasture systems and legume-based pastures increased productivity and profitability of production systems in large and small-scale farms in sandy soils of the cerrados of Brazil.
- The combination of increased soil fertility, adapted crops and market-oriented options has the potential to improve significantly agricultural production and economic profitability of agriculture in hillsides of Central America.

Output 5: Sustainable land management for social profitability developed, with special emphasis on reversing land degradation

- Preliminary data from a study in Kenya, Ghana and Zimbawe to assess the interaction between organic resource quality, aggregate turnover, and agro-ecosystem nitrogen and carbon cycling, showed substantial effects of organic resource quality on crop performance. The quality of the applied organic resources also appeared to influence the presence of large macro-aggregates in the well-structured Embu soil.
- A study aimed at assessing the adoption of fertilizer use in the semi-arid areas of Kenya, recommended the following in order to increase the intensity of adoption of fertilizer: Promotion of off-farm employment activities; Improving the accessibility and effectiveness of agricultural extension services; Reducing the cost of fertilizer by improving the rural road infrastructure.
- In the Fuquene watershed (Andean highlinds of Central Colombia), conversion of native land cover (Mountain forest and Paramo vegetation) into cropland or pastures has resulted in an estimated loss of soil carbon in the range of 50 –80 TgC during the last century.
- Conversion of native land to crops or pastures in the Fuquene watershed resulted in a net decrease of the capacity of the soil to consume atmospheric methane thereby impacting negatively the function of the soil as a net sink for greenhouse gases. The use of nitrogen fertilizers in pastures and in crops increases net emissions of N_2O into the atmosphere as compared with the native land cover (Forest and Paramo vegetation). Total N_2O emissions accounted for 2-3% of applied N.
- Support to CENIPALMA in the systematization of soil data in a GIS-linked database was completed in 2005 and outscaling of the tool was initiated in 2006.
- A project to rehabilitate degraded lands through silvopastoral systems and reforestation with native timber species in the Caribbean savannas of Colombia, was successfully negotiated with the Biocarbon Fund. The project will generate significant employment and will enhance livelihoods of poor rural communities including native Indian groups. The Project will generate 0.7 Gg CO_2 equivalents over a 25-year period and will generate CERs (certificates of emission reduction) that could be traded in the emerging carbon markets as part of the Clean Development Mechanism (CDM) of the Kyoto Protocol.

4. INDICATORS

List of publications 2005

Type of publications	Published in 2005	Published in 2006	In press	In review	Total
TSBF-Africa:					
Refereed journal articles	15		12	7	34
Book chapters	1		7		8
Books edited	1				1
Conference proceedings	23				23
Oral and poster presentations	20				20
Sub-total	*60*		*19*	*7*	*86*
TSBF-Latin America:					
Refereed journal articles	8	4	6	9	27
Book chapters	2		7		9
Books edited	1				1
Conference proceedings	9				9
Oral and poster presentations	34				34
Sub-total	*54*	*4*	*13*	*9*	*80*
Total					**166**

Please see Annex-1 for the full list of publications.

5. LIST OF SPECIAL PROJECTS/DONOR CONTACTS 2005

5.1 New proposals approved in 2005
TSBFI-Africa: 31
TSBFI-Latin America: 13

5.2 On-going special projects in 2005
TSBFI-Africa: 19
TSBFI-Latin America: 8

Please see Annex-2 for the lists.

6. CAPACITY BUILDING 2005

6.1 List of courses & seminars, dates, place, subject, number of trainees
6.2 List of NARS visiting scientists, institutions, dates of stay, subject
6.3 List of MS & PhD students being supervised.

Please see Annex-3 for the lists.

7. LIST OF VARIETIES AND COUNTRIES FOR VARIETAL RELEASE

Not applicable.

8. STAFF LIST

TSBF Institute -Director
Sanginga, Nteranya (Soil Microbiologist)

TSBF Institute – Africa Staff

Senior Staff
Amede, Tilahun (Soil Scientist)
Bationo, André (African Network Coordinator -Soil Scientist)
Chianu, Jonas (Socio Economist)
Delve, Robert (Soil Fertility Management)
Huising, Jeroen (BGBD Coordinator/GIS Scientist)
Jefwa, Joyce (Microbiologist)
Lesueur, Didier (Microbiologist)
Murwira, Herbert (Soil Scientist)
Ohiokpehai, Omo (Food & Nutrition Scientist)
Okoth, Peter (Information Manager)
Ramisch, Joshua (Social Scientist)
Vanlauwe, Bernard (Soil Scientist)
Verma, Ritu (Anthropologist)
Andren, Olle (Soil Scientist, Modeler)
Roing, Kristina (Agronomist)

Consultants
Danso, Seth (Rhizobiology, BGBD project)
Osgood, Diane (Economist, BGBD Project)
Swift, Mike (BGBD Project)

Research Assistants
Ekise, Isaac (Asst Scientific Officer),
Kankwatsa, Peace (Research Asst, Kampala)
Kihara, Job (Asst Scientific Officer)
Mukalama, John (Snr Scientific Assistant)
Rusinamhodzi, Leonard (Research Asst, Harare)
Wangechi, Helen (Asst Scientific Officer)
Waswa, Boaz (Asst Scientific Officer)

Technical staff
Muthoni, Margaret (Laboratory Attendant)
Ngului, Wilson (Laboratory Technician)
Nyambega, Laban (Field Technician)
Njenga, Francis (Laboratory Attendant)
Muranganwa, Francis (Field worker Harare)

Administration staff
Agalo, Henry (Driver / Field Assistant)
Akech, Caren (Secretary)
Akuro, Elly (Driver / Field Assistant)
Chisvino, Stephen (Driver/OA, Harare)
Kareri, Alice (Administrator)
Meyo, Rosemary (Administrative Assistant)
Mulogoli, Caleb (Finance/IT Asst)
Ngutu, Charles (Finance/Admin. Officer)
Nyamhingura, Isabella (Admin. Asst, Harare)
Ogola, Juliet (Senior Administrative Secretary)

TSBF Institute – Latin America Staff

Senior Staff
Amézquita, Edgar (Soil Physics)
Ayarza, Miguel (Agronomy) MIS Coordinator, Honduras
Barrios, Edmundo (Soil Ecology and Biodiversity)
Estrada, Ruben (Resource Economist, CIP)
Rao, Idupulapati (Plant Nutrition and Physiology) (40% TSBF Institute, 30% IP1, 30% IP5)

Senior Research Fellows
Rondón, Marco (Ecosystem services)
Rubiano, Jorge (GIS/Agronomy)

Consultants
Mesa, Eloina (Biometrics)

Research Associates
Asakawa, Neuza
Cobo, Juan

Research Assistants
Borrero, Gonzalo
Chavez, Luis
Corrales, Irlanda
García, Edwin
Girón, Ernesto
Hurtado, María
Molina, Diego

Ocampo, Gloria
Pernett, Ximena
Quintero, Jenny
Quintero, Marcela
Rivera, Mariela
Rodríguez, Gloria
Trejo, Marco

Specialists:
Galvis Jesús Hernando
José Arnulfo Rodríguez
MeloEdilfonso

Secretaries:
Cervantes de Tchira Carmen
Escober Vilia
Núñez Cielo

Technicians:
Alvarez Arvey
Díaz Enna Bernarda
Herrera Pedro
Mina Hernán
Molina Jarden

Otero Martin
Rodríguez Carlos
Rodríguez Maryory
Rojas Gonzalo
Sánchez Amparo
Toro Flaminio
Trujillo Carlos Arturo

Workers:
Betancourt Nixon
Cayapú Joaquín
Messu Adolfo
Ortega Viviana
Romero Jaime
Salamanca Josefa
Soto Luis

9. SUMMARY OF 2005 BUDGET

SOURCE	AMOUNT (US$)	PROPORTION (%)
TSBF-Africa		
Unrestricted Core	602,118	15
Restricted Core		
Carry over from 2004		0
Sub-total	*602,118*	15
Special projects	3,332,543	85
Total-Africa	**3,934,661**	**100**
TSBF-Latin America (CIAT-HQ)		
Unrestricted Core	744,152	55
Restricted Core	120,000	9
Carry over from 2004		0
Sub-total	*864,152*	*64*
Special projects	172,663	13
Water and Food CP	311,888	23
Total-Latin America	**1,348,703**	**100**
TOTAL	**5,283,364**	

ANNEX-1: LIST OF PUBLICATIONS

TSBF Institute - Africa

Refereed journal articles

Journal articles published in 2005

Chianu, J., N. and Hiroshi, T. 2005. Integrated nutrient management in the farming systems of the savannas of northern Nigeria: what future? Outlook on Agriculture 34: 197-202.

Diouf D., Duponnois, R. Ba AT, Neyra, M. and Lesueur, D. 2005. Influence of rhizobial and mycorrhizal symbioses on growth and mineral nutrition of *Acacia auriculiformis* and *Acacia mangium* under salt stress conditions. Functional Plant Biology 32: 1143-1152.

Esilaba, A.O., Nyende, P., Nalukenge, G., Byalebeka, J., Delve, R.J. and Ssali, H. 2005. Resource flows and nutrient balances in smallholder farming systems in Mayuge District, Eastern Uganda. Agriculture, Ecosystems and Environment 109: 192-201.

Esilaba, A.O., Byalebeka, G., Delve, R.J., Okalebo, J.R., Ssenyange, D., Balule, M. and Ssali, H. 2005. On-farm testing of integrated nutrient management strategies in Eastern Uganda. Agricultural Systems 86: 144-165.

Lesueur, D. and Duponnois, R. 2005. Relations between rhizobial nodulation and root colonization of *Acacia crassicarpa* provenances by an arbuscular mycorrhizal fungus, *Glomus intraradices* Schenk and Smith or an ectomycorrhizal fungus, *Pisolithus tinctorius* Coker & Couch. Annals of Forest Sciences, 62: 467-474.

Mando, A., Ouattara, B., Sédogo, M., Stroosnijder, L., Ouattara, K., Brussaard, L., and Vanlauwe, B. 2005. long-term effect of tillage and manure application on soil organic fractions and crop performance under Sudano-Sahelian conditions. Soil & Tillage Reearch 80: 95-101.

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Sarr, A., Neyra, M., Oihabi, A., Houeibib, M.A., Ndoye, I. and Lesueur, D. 2005. Characterization of native rhizobial populations presents in soils from natural forests of *Acacia senegal* and *Acacia nilotica* in Trarza and Gorgol regions from Mauritania. Microbial Ecology 50: 152-162.

Tittonell, P., Vanlauwe, B. Leffelaar, P. A., Rowe, E. and Giller, K.E. 2005. Exploring diversity in soil fertility management of smallholder farms in western Kenya. I. Heterogeneity at region and farm scale. Agriculture, Ecosystems and Environment 110: 149-165.

Tittonell, P., Vanlauwe, B., Leffelaar, P.A., Shepherd, K.D. and Giller, K.E. 2005 Exploring diversity in soil fertility management of smallholder farms in Western Kenya. II. Within farm variability in resource allocation, nutrient flows and soil fertility status. Agriculture, Ecosystems and Environment, 110: 166-184.

Vanlauwe, B., Aihou, K., Tossah, B.K., Diels, J., Sanginga, N. and Merckx, R. 2005. *Senna siamea* trees recycle Ca from a Ca-rich subsoil and increase the topsoil pH in agroforestry systems in the West African derived savanna zone. Plant and Soil 269: 285-296.

Vanlauwe, B., Gachengo, C., Shepherd, K., Barrios, E., Cadisch, G. and Palm, C.A. 2005. Laboratory validation of a resource quality-based conceptual framework for organic matter management. Soil Science Society of America Journal 69: 1135-1145.

Vanlauwe, B., Diels, J., Sanginga, N. and Merckx, R. 2005. Long-term integrated soil fertility management in South-western Nigeria: crop performance and impact on the soil fertility status. Plant and Soil 273: 337-354.

Journal articles in press

Barrios, E., Delve, R.J., Bekunda, M., Mowo, J., Agunda, J., Ramisch J., Thomas, R.J. 2006. Indicators of Soil Quality: A South-South development of a methodological guide for linking local and technical knowledge. Geoderma (in press).

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Kimetu, J.M., Mugendi, D.N, Bationo, A., Palm, C.A., Mutuo, P.K., Kihara, J, Nandwa, S. and Giller K. 2006. Tracing the fate of nitrogen in a humic nitisol under different management practices in Kenya. Nutrient Cycling in Agroecosystems (in press).

Mafongoya, P.L. and Bationo, A. 2006. Appropriate available technologies to replenish soil fertility in southern Africa. Submitted to Nutrient cycling in agroecosystems. Nutrient Cycling in Agroecosystems (in press).

Odendo, M., Ojiem, J., Bationo, A. and Mudeheri, M. 2006. On-Farm Economic Evaluation and Scaling-up of Soil Fertility Management Technologies in Western Kenya. Nutrient Cycling in Agroecosystems (in press).

Okalebo, J.R., Othieno, C.O., Karanja, N.K., Semoka, J.R.M., Bekunda, M.A., Mugendi, D.N., Woomer P.L. and Bationo, A. 2006. Appropriate available technologies to replenish soil fertility in Eastern and Central Africa. Nutrient Cycling in Agroecosystems (in press).

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Shepherd, K.D., Vanlauwe, B., Gachengo, C.N. and Palm, C.A. 2006. Decomposition and mineralization of organic resources predicted using near infrared spectroscopy. Plant and Soil (in press).

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Vanlauwe, B., Tittonell, P. and Mukalama, J. 2006. Within-farm soil fertility gradients affect response of maize to fertilizer application in western Kenya. Nutrient Cycling in Agroecosystems (in press).

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Amede, T. and Bekele, A. 2006. Niches for Integration of Green Manures and Risk Management through Growing Maize Cultivar Mixtures in Southern Ethiopian Highlands. Journal of Agronomy and Crop Science (in review).

Amede, T. and Delve, R.J. 2006. Improved decision making for achieving the Triple Benefits of Food Security, Income and Environmental Services through Modeling Cropping Systems in Ethiopian Highlands. Agricultural Systems (in review).

Amede, T. and Delve, R.J. 2006. Improved decision making for achieving triple benefits of food security, income and environmental services through modeling cropping systems in Ethiopian Highlands Agricultural Systems (in review).

Amede, T. and Taboge, E. 2006. Optimizing Soil Fertility Gradients in the Enset (*Ensete ventricosum*) Systems of the Ethiopian Highlands: Trade-offs and Local Innovations. Nutrient Cycling and Agroecosystems (in review).

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Zingore, S., Murwira, H.K., Delve, R.J. and Giller, K.E. 2006. Influence of nutrient management strategies on variability of soil fertility, crop yields and nutrient balances on smallholder farms in Zimbabwe. Agricultural Systems (in review)

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Ramakrishnan, P.S., Saxena, K.G., Swift, M.J., Rao, K.S., Maikhuri, R.K. (eds.). 2005. Soil biodiversity, ecological processes and landscape management. Oxford & IBH Publishing, New Delhi, IN. 302 p.

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Adamou, A., Bationo, A., Tabo, R. and Koala, S. 2006. Improving soil fertility through the use of organic and inorganic plant nutrient and crop rotation in Niger. Springer (in press).

Amede, T., Mengistu, S. and Roothaert, R. 2006. Intensification of Livestock Feed Production in Ethiopian Highlands: Potentials and Experiences of the African Highlands Initiative. Proceeding of the Ethiopian Veterinary Society (in press).

Baaru, M.W., Mugendi, D.N., Batiano, A., Louis, V. and Waceke, W. 2006. Soil Microbial Biomass Carbon and Nitrogen as Influenced by Organic and Inorganic Fertilisation in Kenya. Springer (in press).

Bado, B., Bationo, A., Lompo, F.; Cescas M.P. and Sedoso M.P. 2006. Mineral fertilizers, organic amendments and crop rotation managements for soil fertility maintenance in the Guinean zone of Burkina Faso (West Africa). Springer (in press).

Bationo, A, Kihara, J., Waswa, B. and Vanlauwe, B. 2005. Technologies for Sustainable Management of Sandy Sahelian Soils. Keynote paper- Proceedings paper presented during workshop, 24th-3rd December 2005 in Khon Khaen Thailand.

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Delve, R.J. and Hauser, M. Strengthening competitiveness through research: Enabling rural innovation in smallholder organic in Uganda. Poster presented at the 15th IFOAM Organic World Congress 2005. Shaping Sustainable Systems. Adelaide, Australia, 20–23rd September 2005.

Delve, R.J., Hauser, M., Ssebunya, B., Mulindwa, J., Byandala, S. 2005. Strengthening the Competitiveness of Organic Agriculture in Africa through Linking Farmers to Service Providers and Exporters. In: Eric Tielkes, Christian Halsebusch, Inga Hauser, Andreas Deininger, Klaus Becker: Tropentag 2005 - The Global Food & Product Chain – Dynamics, Innovations, Conflicts, Strategies, October 11-13, 2005, University of Hohenheim, Stuttgart, 488; MDD Media Digitaldruck Copy Shop Baromaschinen GmbH Stuttgart, ISBN: 3-00-017063-4.

Desallegn, G. and Amede, T. 2005. Land degradation in Ethiopian Highlands: Major causes, development attempts and future deliberations. Presented in the 17th Symposium of the International Farming Systems Association, Rome, Nov. 17-20. www.ifsa.ufl.edu <http://www.ifsa.ufl.edu/>.

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Kimiti, J.M., Esilaba, A.O., Vanlauwe, B. and Bationo, A. 2006. Participatory Diagnosis in the Eastern Drylands of Kenya: Are Farmers aware of Their Soil Fertility Status? Springer (in press).

Mekonnen, K., Amede, T., Kidane, B., and Alebachew, M. 2005. Experiences of AHI in participatory technology development and dissemination at Galessa, Ethiopia. pp.57-67. In: Proceedings of a workshop on "Farmer Research Groups: Concepts and Practices". EARO-OARI, JICA Cooperation.

Miriti, J.M., Esilaba, A.O., Kihumba, J. and Bationo, A.:2006.Tied-ridging and integrated nutrient management options for sustainable crop production in semi-arid Eastern Kenya. Springer (in press).

Okoth, P.F. 2005. Project Data Sharing and Intellectual Property Rights: The Conservation and Sustainable Management of Below Ground Biodiversity Project' by in the Annual Meeting of the

CSM-BGBD Project in Manaus Brazil, April 2005. Paper to be published in the technical proceedings of the BGBd project annual meeting transactions.

Okoth, P.F., Oketch, P.A. and Kimani, P.K. The use of erosion proxies for the spatial assessment of erosion in a watershed and modelling the erosion risk in a GIS. Paper to be published in the proceedings of the Yaounde Workshop and published as a book.

Tabo, R., Tarawali, S.A., Singh, B.B., Bationo, A., Traore, B., Traore, M.D., Don-Gomma, Odion, A.E.C., Nokoe, S., Harris, F., Manyong, V. M., Fernandez-Rivera, S., de Haan, N. and Smith, J.W. 2005. Enhancing the productivity and sustainability of Integrated Crop-Livestock Systems in the dry savannahs of West Africa. (Omaya, G.O. and Pasternak, D. (eds.), Sustainable agriculture systems for the drylands. Proceedings of the international symposium for sustainable dryland agriculture systems, 2-5 December 2003, Niamey, Niger ICRISAT, pp.271-285.

Tabo, R., Bationo, A., Bruno, G., Ndjeunga, J., Marcha, D., Amadou, B., Annou, M.G., Sogodogo, D., Sibiry Taonda, J.B., Ousmane H, Maimouna K. Diallo and Koala, S. 2005. Improving the productivity of sorghum and millet and farmers income using a strategic application of fertilizers in West Africa. Springer (in press).

Tabu, I.M., Bationo, A., Obura, R.K. and Khaemba, J.M. 2006. Effect of rock phosphate, lime and green manure on growth and yield of maize in a non productive niche of a rhodic ferralsol in farmer's fields. Springer (in press).

Vanlauwe, B. 2005. Managing organic inputs for enhancing biological and physico-chemical soil health in the West African savannas. Proceedings of the International Symposium on 'The management of tropical sandy soils for sustainable agriculture- a holistic approach for sustainable development of problem soils in the tropics', November 2005, Khon Kaen, Thailand.

Vanlauwe, B., Sanginga, N., Diels, J. and Merckx, R. 2005. Case studies related to the management of soil acidity in the West African moist savanna. In: TECDOC on Acid Savanna Soils. International Atomic Energy Agency, Vienna, Austria.

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Amede, T. 2005. Development of Tools and Methods for Promoting Integrated Natural Resource Management in East African Highlands. In IPMS/ILRI meeting for Research and Development Officers. Oct 20, 2005, Addis Ababa, Ethiopia.

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Amede, T; Mengistu S; Roothaert R, 2005. Intensification of livestock feed production in Ethiopian Highlands: Potential and Experiences of the African Highlands Initiative 19th EVA Annual conference, 8 June 2005, ECA, Addis Ababa.

Bationo, A. 2005. Available Technologies for soil fertility replenishment in East, West and Southern Africa: presentation made during an IAEA workshop on Combating drought held in Nairobi, October 2005.

Bationo, A. 2005. Combining rainwater and nutrient management strategies to increase crop production and prevent soil degradation in the Desert Margins of Africa. Presentation given during DMP evaluation meeting in South Africa in May 2005.

Bationo, A., Sanginga, N., Kimetu, J., Kihara, J. 2005. From Knowledge to implementation: The challenge of the African Network for Soil Biology and Fertility (AfNet).

Bationo, A. 2005. Progress Report of TSBF Activities in West Africa.

Bationo, A. 2005. Promoting use of Indigenous Phosphate Rock for Soil Fertility "Recapitalization" in the Sahel. Presentation made during the launch of CORAF Funded projects in West Africa.

Bationo, A. 2005. The Collaboration between Jordforsk and the African Network for Soil Biology and Fertility (AfNet) of TSBF Institute of CIAT. Presentation made in Norway during a visit to enhance TSBF-JORDFORSK collaboration.

Bationo, A., Kihara J., Kimetu, J. and Waswa, B. 2005. The role of the African Network for Soil Biology and Fertility (AfNet) in training and capacity development of young researchers in Africa. Presentation given in Rwanda in February 2005 during training needs assessment for Rwanda workshop.

Chianu, J.N., Tsujii, H., Manyong, V.M. and Okoth, P.F. 2005. Crop-livestock interaction in the savannas of Nigeria: Nature and determinants of farmer decision to use manure for soil fertility maintenance' an invited paper presented at the 4th All Africa Conference on Animal Agriculture, September 20-24th, 2005, Arusha International Conference Centre.

Delve, R.J., Ssebunya, B., Mulindwa, J., Byandala, S., Hauser, M. 2005. Strengthening competitiveness through research: How rural innovations support market-led organic agriculture in Uganda. Paper presented at the conference on 'A critical look at the role of research in achieving the Millennium Development Goals'. The Commission for Development Studies, Vienna, November 29th 2005.

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Sanginga, N., Vanlauwe, B., and Bationo, A. 2005. Evaluation of long term agroforestry: Nitrogen and phosphorus use efficiency in the derived savanna in West Africa. Presentation given in Vienna, April 2005, during an Agro-forestry workshop.

Sanginga, N. and Bationo A. 2005. TSBFI-CIAT: The New Challenge: Strategy Direction (presented at AfNet FPR-SU training workshop held in Nairobi, Kenya, 19-30th September 2005. Made for a second time during an IAEA workshop on Combating drought held in Nairobi, October 2005.

Verma, R. 2005. Impact of Collective Action on Gender Relations , CAPRi Workshop, Gender and Collective Action, Chiang Mai, Thailand.

Verma, R. 2005. What is Participatory and What is Not?, Power Point Presentation and Participatory Exercise, AFNET Training Workshop on Participatory Research and Scaling Up, Nairobi, Kenya.

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TSBF Institute - Latin America

Refereed journal articles

Journal articles published in 2005

Barrios, E., Cobo, J.G., Rao, I.M., Thomas, R.J., Amézquita, E. and Jiménez, J.J. 2005. Fallow management for soil fertility recovery in tropical Andean agroecosystems in Colombia. Agriculture, Ecosystems and Environment 110: 29-42.

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Thierfelder, C., Amézquita E., Stahr, K. 2005. Effects of intensifying organic manuring and tillage practices on penetration resistance and infiltration rate. Soil and Tillage Research 82: 211-226.

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Begum, H. H., Osaki, M., Nanamori, M., Watanabe, T., Shinano, T. and Rao, I.M. 2006. Role of phosphoenolpyruvate carboxylase in the adaptation of a tropical forage grass, *Brachiaria* hybrid, to low phosphorus acid soils. Journal of Plant Nutrition 29: 35-57.

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Barrios, E., Delve, R., Bekunda, M., Mowo, J., Agunda, J., Ramisch, J., Trejo, M.T., Thomas, R.J. 2006. Indicators of Soil Quality: A South-South development of a methodological guide for linking local and technical knowledge. Geoderma (in press).

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ANNEX 2: LIST OF SPECIAL PROJECTS/DONOR CONTACTS 2005

TSBF-Africa - New proposals approved in 2005

Project	CIAT CC & PN *	Donor	Total Budget (US$)	Amount available to:	
				partners (US$)	CIAT (US$)
Development of sustainable integrated soil fertility management strategies for smallholder farmers in Sub-Saharan Africa	P-538	IFAD	648,500	162,125	486,375
Promiscuous SOYBEAN processing and utilization for improving the health and nutrition of rural households in HIV/AIDS affected areas of Kenya and Uganda	TSA53	Rockefeller	589,050	90,000	499,050
Enhancing the resilience of agro-ecosystems in Central Africa: a strategy to revitalize agriculture through the integration of natural resource management coupled to resilient germplasm and marketing approaches	TSA90	DGDC Belgium	2,326,070	1,022,020	1,304,050
Building impact pathways for improving livelihoods in *Musa*-based systems in Central Africa		DGDC Belgium	2,384,400	2,130,241	254,159
Integrated soil fertility management in the tropics	TSA84	Rockefeller	900,000	0	900,000
Training workshop on FPR&SU Participatory approaches to research and scaling-up: an African Soil Biology and Fertility Network (AfNet)	TSA86	CTA	44,532	0	44,532
Mainstreaming gender in Research and Development organisations		CTA	30,000	0	30,000
Book Publishing (Yaounde proceedings) Proposal for publishing the proceedings of the African Network for Soil Biology and Fertility Network (AfNet) International Symposium held in Yaounde, Cameroon, May 17-21, 2004	TSA57	Rockefeller	73,436	0	73,436
Water harvesting Combining water harvesting techniques and nutrient management to sustain food production in the dry lands of West Africa	P-818	WECARD	200,000	0	21,939

Project	CIAT CC & PN *	Donor	Total Budget (US$)	Amount available to:	
				partners (US$)	CIAT (US$)
Fertilizer Micro dosing Fertilizer micro-dosing and drought tolerant varieties technology transfer for small farmer prosperity in the Sahel	P-820	WECARD	200,000	0	21,939
Promoting Indigenous PR Promoting use of indigenous Phosphate Rock for soil fertility "recapitalization" in the Sahel	P-819	WECARD	200,000	0	21,939
Legume network for Uganda-prop devt		Rockefeller	5,000	0	5,000
Desert margins programme with GEF local areas on biological diversity with relevance to climate change and the reduction of land degradation in the desert margins areas	TSA30	UNEP-GEF	4,000,000	3,880,000	120,000
Agro-pastoral transitions (Mali)		SANREM	60,000	36,000	24,000
More Crop per drop, more cropping per dropping: Optimizing the interactions between organic resources, soil macrofauna biodiversity and soil structure for enhanced water and nitrogen use efficiency in West and East African Cropping Systems (in particular in Burkina Faso and Kenya)		Wageningen University	600,000	500,000	100,000
Integrated soil fertility management in the tropics: from knowledge to implementation	P-744	Rockefeller Found	896,049		
Accelerating prosperity of rural communities in the Umtara Province in Rwanda	TSA34	IFAD	300,311	144,930	155,381
Community-based interactive learning andits application to soil fertility management (Kenya), Phase II	TSA36	IDRC	323,185	0	323,185
Research to expand the production and commercialization of soybeans by smallholders farmers in East Africa	TSA88	Rockefeller	155,650	0	155,650
Developing an action research consortium addressing improved soil fertility and natural resource management trough development and support to scaling and scaling-out	TSA92	Kilimo Trust	50,250	0	50,250
Promotion and dissemination of Integrated Pest and Soil Fertility Management Strategies to combat striga and declining soil fertility in the Lake Victoria basin	TSA94	African Approp. Technology Found. (AATF)	140,000	16,000	124,000
Participatory Approaches Research & Scaling Up	TSA59	ICRISAT	14,976	0	14,976

* CIAT CC & PN = CIAT Cost Center and Proposal Number

TSBF Africa - List of ongoing special projects in 2005

Project	CIAT CC & PN *	Donor	Total Budget (US$)	Amount available to:	
				partners (US$)	CIAT (US$)
An exploration of integrated soil fertility management for BANANA production and marketing in Kenya and Uganda	TSA60	Rockefeller	277,000	0	277,000
Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin	TSA80	CPWF ICRISAT	1,500,000	1,180,000	320,000
Increasing legume efficiency		OPEC	80,000	0	80,000
Linking farmers to markets: Developing sustainable marketing systems to improve the competitiveness of small holder organic agriculture	TSA64 P-605	BMF-Austria	548,672	140,592	408,080
The interaction between resource quality and aggregate turnover controls ecosystem nitrogen and carbon cycling	TSA70	NSF	685,659	579,811	105,848
Striga control in Western Kenya: Raising awareness, containing and reducing the infestation and developing strategies for eradication	TSA38	AAFT	15,600	0	15,600
Using market-led approaches to drive investments in soil fertility management and improve production and incomes of rural communities in selected areas of the central watershed of Zimbabwe	TSA82	CIDA bilateral	68,077	0	68,077
Linking demand for, and supply of, agricultural production and post-harvest information in Uganda.		DFID	20,000		
Conservation and sustainable management of below ground biodiversity, Phase I	TSB42	GEF via UNEP	5,022,646	3,398,153	1,624,493
Integrated pest and soil management to combat *Striga*, stemborers and declining soil fertility in the Lake Victoria basin (via ICIPE)	TSB34	DFID	526,050	441,000	85,050
Valuing within-farm soil fertility gradients to enhance agricultural production and environmental service functions in smallholder farms in East Africa	TSB83	The Rockefeller Foundation	350,065	164,250	185,815
Integrated Soil Productivity Initiative through Research and Education (INSPIRE) Phase Two: Scaling-up and out	TSA45 P-608	The Rockefeller Foundation	250,700	64,000	186,700
Extension to LWR2/1999/03, Integrated nutrient management in	TSA40	ACIAR	41,697	8,438	33,259

Project	CIAT CC & PN *	Donor	Total Budget (US$)	Amount available to:	
				partners (US$)	CIAT (US$)
tropical cropping systems: improved capabilities in modelling and recommendations					
Congo livelihood improvement and food security	TSA78	USAID-DRC	750,000	609,000	141,000
Increasing crop water productivity in the Victoria Nile basin using stress tolerant maize and bean varieties in conservation agriculture systems		Water Challenge Program	1,998,000		
Building teamwork and research capacity for sustainable agricultural development in the dry lands of Africa: The challenge of combining water and nutrients		IDRC	497,200		
Combining rainwater and nutrient management strategies to increase crop production and prevent soil degradation in the Desert Margins of West Africa		IDRC	391,545		
Strengthening of the African Network for Soil Biology and Fertility (AfNet) to Combat Soil Nutrient Depletion in West Africa	P-536	The Rockefeller Foundation	181,000	61,000	120,000
Exploring the multiple potentials of soybeans in enhancing rural livelihoods and small industry in East Africa	TSA76	The Rockefeller Foundation	178,750	0	178,750
Integrated nutrient management in tropical cropping systems: improved capabilities in modeling and recommendations		ACIAR	40,000		
Strengthening Folk Ecology: Applying community-based learning and communication strategies to improve soil fertility and livelihoods in Western Kenya		IDRC – Nairobi	337,979		
Social dynamics of integrated production systems for food insecure households in marginal environments of sub-Saharan Africa		National Science Foundation	750,000		
Exploration of integrated soil fertility management for banana production and marketing in Uganda and Kenya: Arbuscular Mycorrhizal Fungi help establishment and production of tissue culture banana	P-625	The Rockefeller Foundation	174,000		

* CIAT CC & PN = CIAT Cost Center and Proposal Number

TSBF-Latin America - New proposals approved in 2005

Project	CIAT CC & PN *	Donor	Total Budget (US$)	Amount available to:	
				partners (US$)	CIAT (US$)
Overcoming land degradation to mitigate deforestation in the humid tropics	P-823	GEF-UNEP; PDF-B	700,000		To be defined
Fighting drought and aluminum toxicity: Integrating functional genomics, phenotypic screening and participatory evaluation with farmers to develop stress resistant common bean and *Brachiaria* for the tropics	P-761	BMZ	Euros 1,100,000	Euros 344,600	Euros 755,400
Payment for Environmental Services (PES) as a mechanism for promoting rural development in the upper watersheds of the tropics	NSB30	CGIAR Water & Food CP–GTZ, CONDESAN, DIIS	482,602	268,850	213.752
Achieving equitable and sustainable management of land and water in upper catchments: A proposal for linking regional soils consortia to Theme 2 of the CGIAR Challenge Program on Water and Food. SDC-Switzerland		SDC-Switzerland to CGIAR CP on Water and Food.	480,000		To be defined
Ubicación y Medidas de Control de Procesos Erosivos de la Cuenca del Río Cauca	NSR30	CRC	109,144	0	109,144
NuMaSS validation		USAID	71,665	0	71,665
Institutional Strengthening of CAIS - an alliance for local development		Kellogg	856,000		To be defined
Rehabilitation of degraded lands through silvopastoral systems and reforestation of marginal lands in the Caribbean savannas of Colombia - Carbon trading (not research) project		BioCarbon Fund: CVS	50,000	0	50,000
Environmental impact of reforestation	NSG50 P-782	CVS	62,010	0	62,010
Adoption of the nutrient management support system (NuMass) Software throughout Latin America	NSB40	North Carolina Univ.	161,000	0	161,000
Validación del sistema experto NuMass en Honduras	NST50	FAO	2,450	0	2,450
Evaluation and deployment of transgenic drought-tolerant varieties	P-839	GCP to IRRI	37,170	0	37,170

* CIAT CC & PN = CIAT Cost Center and Proposal Number

Latin America - List of ongoing special projects in 2005

Project	CIAT CC & PN *	Donor	Total Budget (US$)	Amount available to:	
				partners (US$)	CIAT (US$)
Bean genomics for improved drought tolerance in Central America	P-499	BMZ-GTZ, Bonn, Germany	740,300	264,000	476,300
Adaptation of *Brachiaria* grasses to low-P soils	P-636	SDC-ZIL, Switzerland	SF346,000	SF$ 246,900	SF$ 99,100
Quesungual Slash and Mulch Agroforestry Systems (QSMAS)	NSD30	Water & Food Challenge Program	754.800	257,124	497,676
Extension to LWR2/1999/03, Integrated nutrient management in tropical cropping systems: improved capabilities in modelling and recommendations	TSA40	ACIAR	41,697	8,438	33,259
Linkages Fund: Black carbon interactions with soil functions		USAID	37,328	0	37,328
Nitrification Inhibition		JIRCAS	37,000	0	37,000
Charcoal Interaction with soils		USAID linkages fund	15,000	0	15,000
FAO-CIAT project on seed production systems		European Union	15,000	0	15,000

- CIAT CC & PN = CIAT Cost Center and Proposal Number

ANNEX 3: CAPACITY BUILDING 2005

A. List of courses & seminars, dates, place, subject, number of trainees

TSBF Institute-Africa:

Date	Place	Subject	Number of trainees	Number of women participants	Number of CIAT instructors	Number of NARS instructors
Sept. 19-30	Nairobi Kenya	Participatory Approaches to Research and Scaling Up, an AfNet Training Workshop funded by CTA .	39	15	5	1
Oct. 21–29, 2005	Accra, Ghana	Advanced DSSAT4 Training Workshop: Assessing Crop Production, Nutrient Management, Climatic Risk and Environmental Sustainability with Simulation Models, M Plaza Hotel.	30	5	2	0
Oct. 10-12, 2005	Nairobi, Kenya	Combating soil degradation to enhance food security in Africa: The role of nuclear techniques in developing improved soil, water and nutrient management practices.	20	3	-	-

TSBF Institute-Latin America:

Date	Place	Subject	Number of trainees	Number of women participants	Number of CIAT instructors	Number of NARS instructors
December 6-8, 2005	CIAT, Colombia	Workshop: "Reflexiones de los aprendido en la gestión integral de cuencas andinas"	45	13	5	10
9-15 October 2005	Zipaquira, Colombia	Training in Conservation agriculture technology for Ecuatorian farmers and technicians.	13	4	----	2
14-18 November 2005	Patate, Ecuador	Training in Conservation agriculture technology for Ecuatorian indigenas farmers and technicians	40	11	-----	1
24-31 October, 2004	Zipaquira, Colombia	Training in Conservation agriculture technology for Peruvian farmers and technicians.	14	5	----	1
March 31 to April 5, 2004	Chilete, Peru	Training in Conservation agriculture technology for Peruvian farmers and technicians.	30	10	----	1
October 18-28, 2005	CIAT, Colombia	Training for using SWAT for watershed analysis. Oriented to Altomayo watersshed technician	4	3	2	---

B. List of NARS visiting scientists, institutions, dates of stay, subject

TSBF Institute-Latin America:

Name	Institution	Dates of stay (2005)	Subject
Soccorro Cajas G.	CORPOICA, Colombia	March 7-12	Preparation of Clean Development Mechanism (CDM) project
Martha Bolaños	CORPOICA, Colombia	January - December	Role of soil enzymes in vegetable banana production systems
Sergio Mejia	CORPOICA, Colombia	January - December	Identification of candidate genes responsible for adaptation of tropical forage grass, Brachiaria to low phosphorus soils

C. List of graduate and undergraduate students being supervised

A. TSBF Institute - Africa

Name	Nationality	Degree	Status	Institution	Research theme
Alejandro Ponce		PhD	Continuing	CINVESTAV-IPN	Abundance and diversity of macrofauna and soil aggregates in soil of Central Kenya added with organic material.
Aliou Faye	Senegalese	PhD		Centre International d'Enseignement a Distance, Rouen, France	Contribution of the assessment of the rhizobial diversity and its impact on the soil fertility within a natural settlement of *Acacia nilotica* subs *tomentosa*: example of the natural forest of Diarra located in the Senegal River Valley.
Amadou Sarr	Mauritanian	PhD	Completed	University Cadi Ayyad, Faculte des Sciences, Semlalia/ arrakech, Maroc.	Symbiotic improvement of growth of *Acacia senegal* and *Acacia nilotica* in Senegal and Mauritania.
Charles Walaga	Ugandan	PhD	Continuing	University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria	Organic agriculture development and livelihood improvement in Uganda: Future scenarios and policy measures.
Dilys Kpongor	Ghanaian	PhD	Continuing	ZEF, Univ. of Bonn, Germany	Evaluation of the best-bet soil fertility restoration technologies in Northern Nigeria.
Edward Yeboah	Ghanaian	PhD	Continuing	University of Ghana, Ghana	Sustaining crop productivity: the influence of organic resource quality and quantity.
Elisabeth Gotschi	Austrian	PhD	Continuing	University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria	Social capital in smallholder marketing groups in Sofala Province, Mozambique.
Jacintha Kimiti	Kenyan	PhD	Continuing	Kenyatta University, Kenya	Integrating legumes in the farming systems of Eastern Kenya to enhance soil fertility.
Jackson Tumwine	Ugandan	PhD	Continuing	University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria	Linking farmers to market: challenges and opportunities of improving rural livelihoods for communities affected by HIV/AIDS in Uganda.

Name	Nationality	Degree	Status	Institution	Research theme
Jane Kapkiyai	Kenyan	PhD	Continuing	Cornell University, USA	Effects of legume green manures on crop productivity and nutrient cycling in maize-based cropping systems of Western Kenya.
John Ojiem	Kenyan	PhD	Continuing	Wageningen University, Netherlands	Niche-based approach to soil fertility improvement by legumes in Western Kenya smallholder farming systems.
Joseph Kimetu	Kenyan	PhD	Continuing	Cornell University, USA	Restoration of soils in Western Kenya using manure and *Tithonia diversifolia.*
Juan Cobo	Colombian	PhD	Continuing	Hohenheim, Germany	Spatial and temporal management of nutrient and water resources in Zimbabwe and Mozambique.
Kibiby Mtenga	Tanzanian	PhD	Continuing	Cornell University, USA	Gender and soil fertility management in Malawi: a participatory analysis of farmers' incentives to reinvest in soil fertility management innovations by women and men farmers.
Michael Misiko	Kenyan	PhD	Continuing	Wageningen University, Netherlands	Knowledge and networks: Challenges and opportunities for scaling up integrated soil fertility management regimes.
Monicah Mucheru	Kenyan	PhD	Continuing	Kenyatta University, Kenya	N dynamics as affected by soil fertility status and nutrient replenishment inputs in the central highlands of Kenya.
Pablo Tittonell	Argentina	PhD	Continuing	Wageningen University, Netherlands	Exploring options, analysing tradeoffs and deriving indicators of efficiency for integrated nutrient management in smallholder farming systems of East Africa.
Pamela Pali	Ugandan	PhD	Continuing	University of Natural Resources and Applied Life Sciences (BOKU), Vienna, Austria	Impact of organic agriculture in Uganda: improving livelihoods through sustainable natural resource management.
Pauline Nhamo	Zimbabwean	PhD	Continuing	University of California, USA	Exploring how organic and mineral nutrient combinations interact to regulate nutrient cycling.

Name	Nationality	Degree	Status	Institution	Research theme
Peter Ebanyat	Ugandan	PhD	Continuing	Wageningen University, Netherlands	Dynamics of soil organic matter and nitrogen in farmer field schools generated integrated soil fertility management practices.
S. Some	Burkinabe	PhD		ZEF, Univ. of Bonn, Germany	Water use efficiency of sorghum based cropping systems in Dano, Burkina Faso.
Shamie Zingore	Zimbabwean	PhD	Continuing	Wageningen University, Netherlands	Farm-scale evaluation of nutrient use efficiencies of resource management options in smallholder farming systems of Zimbabwe.
Agnes Kavoo	Kenyan	MSc	Continuing	Kenyatta University, Kenya	Interactions between resource quality, aggregate turnover, and C and N cycling in the Central Highlands of Kenya.
Dick Lufafa	Ugandan	MSc	Continuing	Makerere University, Uganda	On-farm comparison of the economic profitability of selected dual-purpose live barriers. Second year.
Emily Ruto	Kenyan	MSc	Completed	Moi University	An attempt to promote the use of prep-pac in Western Kenya.
Esther Rutto	Kenyan	MSc	Completed	Egerton University, Kenya	Farmers' perceptions and evaluation of integrated approaches to combat striga, stemborer and soil fertility problems in Western Kenya.
Giannis Papanagiotou	Greek	MSc	Continuing	Wageningen University, Netherlands	The effect of endogeic earthworms on aggregate formation, stability and carbon distribution within different aggregate fragments in a vitro study.
Grace Agwaru	Ugandan	MSc	Continuing	Makerere University, Uganda	Assessing approaches and developing methods for presentation of research results to farmers within their livelihood situations: a case study in Soroti and Arua Districts.
Harrison Githinji	Kenyan	MSc	Continuing	Moi University	Effects of conservation tillage and organic residues on crop productivity.
Job Ogada	Kenyan		Completed	Egerton University, Kenya	Evaluation of interactions between farmers' resource endowment and within-farm resource flows in Western Kenya.

Name	Nationality	Degree	Status	Institution	Research theme
Judith Odhiambo	Kenyan		Continuing	Egerton University, Kenya	Effect of selected legume species on germination of *Striga hermonthica* seeds: a control strategy in maize.
Justin Muriuki	Kenyan	MSc	Continuing	Kenyatta University, Kenya	Economic evaluation of organic and inorganic technologies for soil nutrient enhancement in Mukuuni and Murugi, Central Kenya.
Kiwanka Achilles	Ugandan	MSc	Continuing	Makerere University, Uganda	Environmental and socio-economic impact of organic farming on the livelihood of small-scale farmers in Uganda.
Mary Baaru	Kenyan	MSc	Completed	Kenyatta University, Kenya	Effects of organic materials of differing quality and inorganic fertilizer on soil microbial biomass at Kabete, Kenya.
Matieu Henry	French	MSc	Continuing	CNEARC/ ENGREF	Carbon sequestration in the agrarian system of Western Kenya and eligibility to clean development mechanism.
Micheal Ochieng	Kenyan	MSc	Continuing	Jomo Kenyatta University, Kenya	On-farm interaction between soil fertility factors, farmer management, pests and diseases and the growth and yields of banana in Maragwa district, Kenya.
Moses Thuita	Kenyan	MSc	Completed	Moi University	On farm testing of phosphorus availability from phosphate rocks as affected by addition of local organic resources in western Kenya.
Mwashasha Rashidi	Kenyan	MSc	Continuing	Jomo Kenyatta, Kenya	Evaluation of the potential of various AMF strains to improve the initial growth of banana.
Nekesa Abigail	Kenyan	MSc	Completed	Moi University	A study on the liming effect of Minjingu phosphate rock in an acidic soil in western Kenya.
Nelson Ojango	Kenyan	MSc	Completed	Wye College, University of London, UK	Market and demand for soybean by livestock feed industries in Kenya.
Salome Muriuki	Kenyan	MSc	Completed	Kenyatta University, Kenya	Assement of long term impacts of organic and inorganic fertilizers on soil P franctions in Machanga, Mbeere District, Kenya.

Name	Nationality	Degree	Status	Institution	Research theme
Telesphoret Ndabamenya	Rwandese	MSc	Continuing	Wageningen University, Netherlands	Interactions of soil macrofauna, tillage and organic amendment affect soil aggregation, organic matter dynamics and crop performance in Kenyan cropping systems.
Wouter Ton	Dutch	MSc	Completed	University Twente, Netherlands	Comparison of participatory approaches in Uganda.
Samwel Njoroge	Kenyan	BSc	Completed	Kenyatta University, Kenya	Laboratory methods for soil analysis.
Amek Tom	Kenyan	MA	Continuing	Economics Department, University of Nairobi, Kenya	Ex-ante adoption potential of seven technological options for improving ecosystem services in Kenya.
Lucy Njaramba	Kenyan	MA	Continuing	Institute of Development Studies (IDS), University of Nairobi, Kenya	Market and demand for soybean by food processing industries and supermarkets in Kenya.

B. TSBF Institute - Latin America

Name	Nationality	Degree	Status	Institution	Research theme
Alvaro Rincón	Colombian	PhD	Completed	National University, Colombia	Integration of maize with forages to recuperate degraded pastures in the Llanos of Colombia.
Andrés Rangel	Colombian	PhD	Continuing	University of Hannover, Germany	Mechanisms of aluminum resistance in common bean.
Annabé Louw-Gaume	South African	PhD	Continuing	ETHZ, Zurich	Mechanisms of low phosphorus adaptation in *Brachiaria*.
Aracely Castro	Honduran	PhD	Continuing	Nacional University, Colombia	Nutrient dynamics in the Quesungual Agroforestry System.
Edier Humberto Pérez	Colombian	PhD	Continuing	U. del Valle, Colombia	Pollutants and soil water fluxes.
Jorge F. Navia	Colombian	PhD	Continuing	National University, Colombia	Impact of residue quality on beneficial soil biota in root-rot infested soils.
Julie Major	Canadian	PhD	Continuing	Cornell University, USA	Reducing nutrient leaching on acid soils trough charcoal amendments to soils.
Mariela Rivera P.	Colombian	PhD	Continuing	Nacional University, Colombia	Water dynamics in the Quesungual Agroforestry System.

Name	Nationality	Degree	Status	Institution	Research theme
Martha Bolaños	Colombian	PhD	Completed	National University, Colombia	Role of soil enzymes in vegetable banana production systems.
Natasha Pauli	Australian	PhD	Continuing	Univ. of Western Australia	The potential of the Quesungual Agroforestry System for soil biodiversity conservation and management in Western Honduras.
Nelson Castañeda	Colombian	PhD	Continuing	University of Goettingen, Germany	Genotypic variation in P acquisition & utilization in *A. pintoi.*
Sergio Mejía	Colombian	PhD	Continuing	National University, Colombia	Identification of candidate genes responsible for adaptation of tropical forage grass, *Brachiaria* to low phosphorus soils.
Steve Fonte	American	PhD	Continuing	U.C.Davis, USA	Influence of management practices, litter inputs and earthworm activity on soil fertility and soil organic matter dynamics in the Quesungual Agroforestry System.
Twaha Atenyi	Ugandan	PhD	Completed	Agricultural University of Norway	Soil phosphorus transformations and organic matter dynamics.
Belisario Volverás	Colombian	MSc	Continuing	U.de Nariño, Pasto-Colombia	No-tillage systems in hillsides planted with potato.
José Jaumer Ricaurte	Colombian	MSc	Continuing	National University, Colombia	Impact of aluminium tolerant *Brachiaria* genotypes on soil quality characteristics of an Oxisol of the Altillanura of the Meta Department of Colombia.
Jesús H. Galvis	Colombian	MSc	Completed	National University, Colombia	Sealing and crusting in the Llanos.
José Augusto Rodríguez T.	Colombian	MSc	Completed	National University, Colombia	Influence of some a amendments in some physical, chemical and biological characteristics of a magnesium soils.
Luis Carlos Pardo	• Colombian	MSc	Completed	Universidad del Valle, Cali	Biological erosion in rainforest.
Lyda Zárate	Colombian	MSc	Completed	National University, Colombia	Dynamics of water stable soil aggregation mediated by three different AMF species.

Name	Nationality	Degree	Status	Institution	Research theme
Marcela Quintero	Colombian	MSc	Continuing	University of Florida	Measurement and valuation of soil environmental services in the Andes.
Oscar Iván Ferreira	Honduran	MSc	Continuing	Nacional University, Colombia	Balances of greenhouse gases in the Quesungual system.
Oscar Molina	Colombian	MSc	Completed	National University, Colombia	Effect of residual P fertilizer and organic manure application on mycorrhizal association of maize-bean rotation in P-fixing Andisol in Cauca, Colombia.
Agustina Calero	Nicaragua	BSc	Completed	UNA	Physiography of the Rio la Danta microwatershed, Somotillo, Nicaragua.
Andrés Ceballos and Victor Bermúdez	Colombian	BSc	Continuing	Universidad del Valle, Cali-Colombia	Charcoal production by small scale producers in Colombia: improvements on the efficiency of production and and on safetty production.
Andrés Pereira Abella	Colombian	BSc	Continuing	Universidad del Valle, Cali-Colombia	Comparison of NIRS vs MIRS methodologies for analysis of total soil carbon and nitrogen.
Denis Valladares	Honduras	BSc	Completed	ESNACIFOR	
Gettsy Elizabeth Quiñónez Mora	Colombian	BSc	Continuing	Universidad del Valle, Cali-Colombia	Estimating total carbon stocks in soils from the Fuquene Lagoon watershed using a Bayesian statistical model.
Joisse Rincón	Colombian	BSc	Completed	National University, Colombia	Drought adaptation in *Brachiaria*.
José S. Muñoz	Colombian	BSc	Completed	National University, Colombia	Composting in Pescador, Cauca: an appropriate technology for residue management and environmental protection.
Leslie Fariña	Nicaragua	BSc	Completed	UNA	Physiography of the Rio la Danta microwatershed, Somotillo, Nicaragua.
Lester Talley	Nicaragua	BSc	Completed	UNA	Floristic characterization of the Rio la Danta microwatershed, Somotillo, Nicaragua.
Lina M. Gaviria	Colombian	BSc	Completed	U. Surcolombiana, Neiva-Colombia	Characterization of surface biogenic structures under different cassava treatments in Santander de Quilichao.

Name	Nationality	Degree	Status	Institution	Research theme
Luisa Jiménez	Colombian	BSc	Continuing	National University, Colombia	Physicochemical characterization of charcoal for agricultural use.
Milton Delcid	Honduras	BSc	Completed	UNA	Nitrogen response curves to validate the NuMaSS system.
Namán Sánchez	Honduras	BSc	Completed	ESNACIFOR	Biomass accumulation and nutrient composition of three forest species in the Quesungual system.
Osman Contreras	Honduras	BSc	Completed	UNA	Nitrogen response curves to validate the NuMaSS system.
Tomás Gutiérrez	Nicaragua	BSc	Completed	UNA	Floristic characterization of the Rio la Danta microwatershed, Somotillo, Nicaragua.
Yenni López	Colombian	BSc	Completed	National University, Colombia	Drought adaptation in common bean.