# 4. PROJECT OUTCOME

**Promotion and dissemination of Integrated Pest and Soil Fertility Management Strategies to combat *Striga* and declining soil fertility in the Lake Victoria basin**

*Striga hermonthica* and declining soil fertility are major constraints to maize production in the Lake Victoria basin. The aim of this project, implemented by the Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture (TSBF-CIAT) and supported by the African Agricultural Technology Foundation (AATF), was to evaluate and disseminate best-bet options to alleviate *Striga* and declining soil fertility constraints in order to boost maize production in the Lake Victoria Basin in the western Kenya. Specific attention was given to soybean-maize rotations, imazapyr-resistant (IR)-maize, and *Desmodium*-maize push-pull intercrops. The expected deliverables were: (i) *a set of best-bet options to alleviate Striga-related production constraints*, (ii) *a set of best-bet legume species/varieties for triggering suicidal Striga germination*, (iii) *recommendations for the best use of herbicide-coated maize,* (iv) *a strategy for farmers to test and disseminate best-bet options to alleviate Striga-related production constraints*, (v) *improved access to inputs (seeds, fertilizer) through linkages with organizations facilitating input availability,* (vi) *various extension materials*, and (vii) *two MSc theses*.

In a set of multilocational demonstration trials, involving 11 farmer associations in 4 districts, it was observed that, although IR-maize reduced *Striga* emergence, its productivity was lower than that of the WH hybrid varieties in presence of fertilizer. The push-pull system substantially reduced *Striga* emergence but only after 2 seasons. In absence of fertilizer, maize yields in the push-pull system are less than those in the mono-cropped system, likely caused by competition for water between the *Desmodium* and maize during seasons with erratic rainfall. *Mucuna*-maize rotations led to a substantial reduction in *Striga* emergence and increase in maize grain yield while this was not true for the soybean-maize rotation. In the latter case, however, the production of grains for food or sale is certainly going to result in better economic returns in the latter treatment. *Striga* emergence reduced substantially between season 1 and season 4 in all treatments, indicating that consistent uprooting *Striga* seedlings before flowering can gradually decrease its seed-bank. Both male and female farmers appreciated the *Striga* tolerant properties of the IR-maize but less its productivity. Fertilizer application was also appreciated, even in terms of *Striga* tolerance, probably due to better maize growth after fertilizer application, even in presence of *Striga*.

During the long rainy seasons of 2006 and 2007, large-scale farmer-lead evaluations of IR-maize relative to locally used maize varieties were conducted. Farmer-managed evaluation during the LR 2006 season with involvement of about 1,000 farmers revealed that in IR maize resulted in less *Striga* germination in the four districts considered (Bondo, Busia, Siaya, Vihiga).This resulted in improved maize yields of IR maize only in Bondo and Siaya districts. More detailed farmer-managed evaluation of IR maize relative to local maize during the LR 2007 season with involvement of about 3,200 farmers revealed that in IR maize scored better than local maize across a number of 9 agronomic traits but was negatively ranked for tasty Ugali, high labor requirement, high input requirement, careful farm management, high management cost, and ease of sell based on color.

In relation to the demonstration trials, field school activities, cross-site visits, and field days were organized to enhance farmer capacity. A total of 732 people attended the various field days, belonging to various farmer associations, local NGOs, and local and international research organizations. In the context of the IR-maize evaluation activities, 1,000 farmers were involved during the long rainy season of 2006 and 3,200 during the long rainy season of 2007. The distribution of IR maize seeds was accompanied by a number of technical extension materials. Two MSc projects have been completed in the context of the project. In order to facilitate access to inputs, links with Western Seed and Leldet Seed companies have been established through our own project for the dual purpose soybean varieties and through partner institutes for the *Desmodium* and IR maize seeds. Links with Farm Input Promotions (FIPS) Africa, a NGO promoting external inputs in affordable quantities at affordable rates, have also been established.

**Economic Evaluation of the Contribution of Below Ground Biodiversity: Case Study of Biological Nitrogen Fixation by Rhizobia**

Although it is common knowledge that soil microorganisms form an important constituent of below ground biodiversity and provide ecosystem services, such knowledge does not often lead to formulation of policies to conserve and manage these soil microorganisms, or to strategies that lead to explicit use of these resources. Applying the knowledge gained from several experimental stations and from on-farm research [supplemented with necessary assumptions on FAO-sourced secondary data on soybean (*Glycine Max*) from 19 countries in Africa], this study attempts to increase the awareness on the importance of these microorganisms by quantifying the economic value of nitrogen fixation of legume nodulating bacteria (LNB) associated with promiscuous soybean. Computation of economic value (of nitrogen fixation) was based on the method of cost replacement or cost savings in terms of mineral nitrogen fertilizer that would have been required to attain the same level of nitrogen fixed biologically. Result shows that the economic value of the nitrogen-fixing attribute of soybean in Africa, especially the promiscuous varieties, annually amounts to about US$200 million across the 19 countries. The study concludes with recommendations on various ways of increasing the chances of smallholder farmers benefiting from the nitrogen-fixing attribute of LNB, especially since many of them cannot afford adequate quantities of inorganic fertilizers required for increased crop productivity.

**Investment options for adoption of Integrated Soil Fertility Management (ISFM)**

CIAT-TSBF was involved as a learning partner and played an important role in developing the Soil Health strategy of the Alliance for a Green revolution (AGRA) funded by the Bill and Melinda Gates Foundation.., and in suggesting different investment scenarios and especially those based on ISFM principles and practices. This report provides a strategy to better manage soil fertility and sustain crop productivity through Integrated Soil Fertility Management (ISFM) in Africa. These goals will be achieved through the increase in fertilizer agronomic efficiency (AE) as its use grows from an average of 8 to 50 kg nutrients $ha^{-1}$, as recommended by the technical committee of the African Fertilizer Summit (AFS), recently held in Abuja, Nigeria. We define ISFM as *'The application of soil fertility management practices, and the knowledge to adapt these to local conditions, which optimize fertilizer and organic resource use efficiency and crop productivity.*

*These practices necessarily include appropriate fertilizer and organic input management in combination with the utilization of improved germplasm.'* Maximum benefits from ISFM practices and technologies can only be obtained within an enabling context, where such factors as viable farm input supply and produce markets, functional institutions, and good policy are in place. Dissemination of successful ISFM case studies such as micro-dosing of fertilizers or crop rotation and intercropping of legumes with cereals, will lead to more sustainable and profitable agriculture in sub-Saharan Africa. ISFM strategies must be targeted to different agro-ecological zones (AEZs) where their use will affect the maximum number of Africa's farming households.

Two investment options are suggested that can result in large-scale impact in a relatively short time: (1) Disseminate ISFM in dry-lands in Sahelian West-Africa and (2) Enhance fertilizer use through cereal-legume intercropping and rotations in moist-savannas of West, East and Southern Africa. Three investments options are suggested in which ISFM can create substantial impact through initial pilot projects: (3) Establish ISFM guidelines for cassava in humid lowland areas of West and Central Africa, (4) Develop ISFM practices for 'New Rice for Africa' (NERICA) upland rice in West and Central Africa, and (5) Integrate ISFM principles into conservation agriculture (CA) in cereal croplands of West, East, and Southern Africa. Two final investment options are required for backstopping the above: (6) Operationalize country-level projects designed to advance ISFM, and (7) Establish a Centre of Excellence for ISFM in Africa. Total funding required for the 7 investment options for 11 countries is estimated at $152 million for an initial period of 5 years. Investment in options 1 through 5 would directly empower 545,000 households (or approximately 3.8 million persons) to produce an additional 321,000 tons of additional food worth about $52 million per year. By year 2 the average benefit: cost ratio is 9.8. Similar improvement could be expected through year 5 as the number of cumulative participating households' increases to 10.4 million.