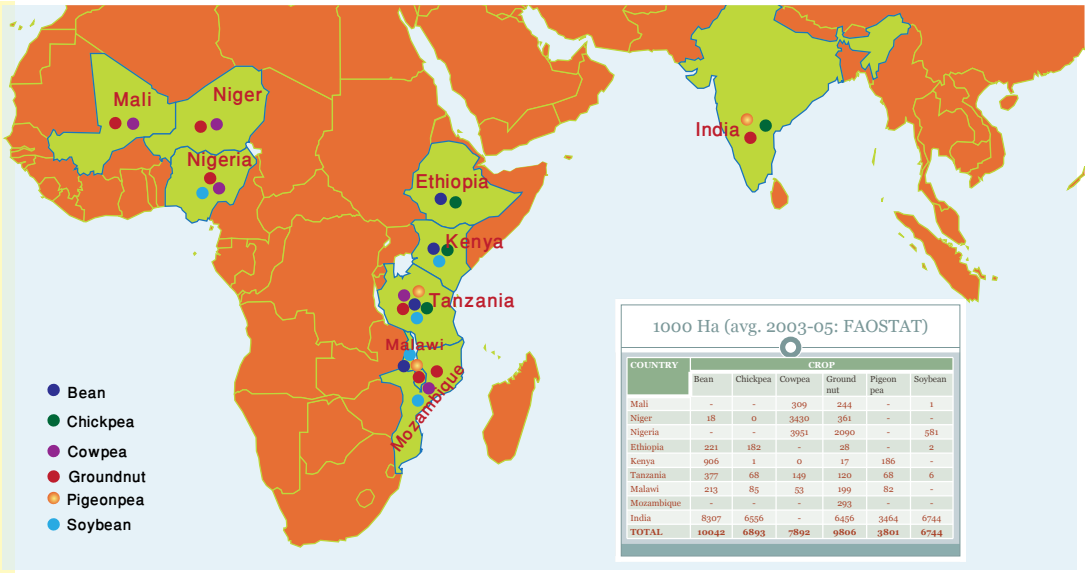
Highlights of Year One

Introduction

The Tropical Legumes II (otherwise known as TL II) Project aims to bring about significant increases in the productivity and production of tropical legumes to improve farmers' income, nutrition quality, and livelihoods in Sub-Saharan Africa (SSA) and South Asia (SA). The project consists of eight sub-objectives: Targeting Impact; Enhancing Productivity and Production of each of six crops, namely common bean (*Phaseolus vulgaris*), chickpea (*Cicer arietinum*), cowpea (*Vigna unguiculata*), groundnut (*Arachis hypogaea*), pigeonpea (*Cajanus cajan*), and soybean (*Glycine max*); and Enhancing Seed Production and Delivery Systems. This is a joint project among ICRISAT, IITA and CIAT and funded by the Bill and Melinda Gates Foundation. All activities are implemented in full partnership with NARS of nine target countries in Western and Central Africa (WCA): Mali, Niger and Nigeria; Eastern and Southern Africa (ESA): Ethiopia, Kenya, Malawi, Mozambique and Tanzania; and South Asia (SA): India. The project also works in close partnership with other stakeholders – NGOs, CBOs, FBOs, and private sector.

TL II was launched with a stakeholders meeting on 24-29 September 2007 at Arusha, Tanzania, which was attended by nearly 100 participants representing different professionals and policy makers from 15 countries. This meeting served as a vehicle to introduce the project to all stakeholders and define the roles and responsibilities of all partners. Subsequent meetings have also been held at sub-regional and country levels.



1000 Ha (avg. 2003-05: FAOSTAT)

COUNTRY	CROP					
	Bean	Chickpea	Cowpea	Ground nut	Pigeon pea	Soybean
Mali	-	-	309	244	-	1
Niger	18	0	3430	361	-	-
Nigeria	-	-	3951	2090	-	581
Ethiopia	221	182	-	28	-	2
Kenya	906	1	0	17	186	-
Tanzania	377	68	149	120	68	6
Malawi	213	85	53	199	82	-
Mozambique	-	-	-	293	-	-
India	8307	6556	-	6456	3464	6744
TOTAL	**10042**	**6893**	**7892**	**9806**	**3801**	**6744**

Overview of Progress

A Programme Management Team consisting of Objective Coordinators, Principal Investigators, and the Project Manager was put in place. An Advisory Board comprising the Deputy Directors General for Research of the three partner centres (ICRISAT, IITA & CIAT); an internationally renowned legumes expert; one reputed legumes expert each from SSA and SA; and Project Managers of TL I and TL II has also been constituted.

All objectives have met or exceeded their milestones in the first year of the project life: September 2007 – August 2008. The socio-economics group (Objective 1) has generated baseline data and analyses; write up of their results are under way. Situation analyses have been carried out for some crops in some of the regions. The crops groups (Objectives 2 to 7) have assembled large numbers of existing national, regional and international germplasm and screened in nurseries for drought tolerance and other desirable traits; established farmer participatory variety selection (PVS) trials and demonstrations; and generated new breeding lines. The Seed Systems objective (Objective 8) was instrumental in catalyzing the scaling up of Foundation and Certified seed; testing models and raising awareness.

Objective 1 (Targeting Impact):

Studies by this objective have revealed the existence of "ruling varieties", such as 'TMV2' (groundnut), 'Annegeri' (chickpea), and 'Maruti' and 'Asha' (pigeonpea) in India. In spite of a large number of varieties that have been released in recent times, "ruling varieties" are still in use in many parts of India and crop productivity has not shown significant increases over the last more than three decades. In India drought accounts for 10-25% yield loss in crops; pigeonpea is less vulnerable to drought stress than chickpea and groundnut. Detailed analyses are being carried out to establish the cause for the persistence of such varieties, some of which are more than 40 years old. Results of these and related studies in other target countries show that women and men use different criteria for choosing crop varieties. Groundnut women farmers in Malawi based their preference for varieties on ease of uprooting, shelling, high grain yield and taste whereas men's preferences were based on high grain and fodder yields, larger seed, and market demand. Adoption rates for groundnut and pigeonpea were 24% and 5%, respectively. About 63% of groundnut and 70% of pigeonpea farmers in this country use their own recycled seed. Ownership for TV, mobile phone and radio here was about 2.5%, 5%, and 53%, respectively.

Objective 2 (Groundnut):

This objective operates in India, Malawi, Mozambique, Tanzania, Mali, Niger and Nigeria. A total of 146 mother and 340 baby trials were conducted at 52 villages in three districts each of Karnataka and Tamil Nadu in India. In a similar fashion, 23 mother and 180 baby trials were carried out on 875 farmers' fields across Mali, Niger, and Nigeria. Three Spanish type varieties/ advanced lines (with pod yield advantages of 31-39% over the local check) have been identified in Malawi. In Tanzania three Spanish type (14-16% pod yield advantage) and four Virginia type (71-100% pod yield advantage) varieties/advanced lines have been identified. More than2000 new advanced breeding lines have been made available to NARS in Malawi (1500), Mozambique (240), Tanzania (340), Mali (77), Niger (45) and Nigeria (178) to help enrich their breeding material resources. About 3.8 tons of Nucleus seed and 37 tons of Breeder seed have been produced. A total of 13 scientists from India (2), Malawi (2), Tanzania (2), Mali (2), Nigeria (4) and Niger (1) were given short-term training at ICRISAT-Patancheru. Four technicians from Malawi and two from Tanzania also received short-term training courses. Some 5200 farmers and other stakeholders from India (2197); Tanzania (2000); and WCA (>1000) were given exposure to improved groundnut varieties; more than 32% of the farmers in India were women. Five production guides/ manuals have been produced in Tamil (2), Kannada (2) and English (1).

Objective 3 (Cowpea):

Target countries for cowpea are Mali, Niger, Nigeria, Mozambique and Tanzania. A total of 89 elite lines made of 46 lines from different breeding nurseries at IITA were evaluated for their drought tolerance in these countries. Of these, a total of eight were selected for their drought tolerance in the five countries; one of the lines, 'IT00K-1263', was selected

by farmers in Mozambique and Tanzania. Seeds of this and another line ('IT97K-1069-6') have been planted for seed multiplication under irrigation in Zambesia province, Mozambique. In Mali two lines: 'CZ1-94-23-1' and 'IT93K- 876-30' were selected by farmers at Niono. The two preferred lines by farmers at Kadawa, Nigeria, were 'IT93K-452-1' and 'IT97K-499-35' out of 68 lines tested. Out of 36 elite lines tested at Maradi, Niger, two that gave the highest yield under drought condition - 'IT98K-628' and 'IT97K-499-38' - have been selected by farmers. Out of 50 elite lines tested at the IITA station at Minjibir, Kano State, for tolerance to drought the following were selected IT97K-499-5, IT98K-506-1 and IT98K-205-8. The 50 elite lines were also evaluated for resistance to three virus diseases - *Cowpea Aphid-Borne Mosaic Virus* (CABMV), *Cowpea Mild Mottle Virus* (CPMMV) and *Cowpea Mottle Virus* (CPMoV) - the genotypes, 'IT98K-133-1-1', 'IT04K-405-5' and 'IT99K-573-1-1', were highly resistant to all the three viruses. These would serve as sources of genes for resistance to these virus diseases. Genotypic differences in P utilization under both low and high P conditions were non-significant ($P \leq 0.05$) but the line 'IT00K-1263' has performed better than most other genotypes under low P conditions. Out of 1230 germplasm lines tested for drought at IITA-Ibadan, 140 were selected and are being further tested. Two students from each of the five countries have been identified for MSc training. Many of those have now been registered in their respective universities and started their studies.

Objective 4 (Common Bean):

Target countries for this objective include Ethiopia, Kenya, Malawi and Tanzania. Two important drought traits (pod partitioning index & pod harvest index) that were identified in research in Colombia were correlated with yield in trials in Kenya at levels of 0.87 and 0.58, respectively. As many as 500 drought selections were established in five countries in ESA. In Colombia 240 promising F2 families were identified out of more than 1200, for subsequent shipment to Africa and local selection. Two independent groups of crosses are being pursued to develop 10 parental lines from inter-specific crosses and other races. One set of crosses is derived from hybridizing common bean with runner bean (*P. coccineus*), and the second group consists of crosses among inter-specific progeny derived from tepary bean (*P. acutifolius*) and common bean. Inter-specific lines between drought tolerant common bean and runner bean with superior root penetration reached the F5 generation in late 2007 and were increased as RILs for field studies. Several displayed excellent yield potential (up to 4 tons/ ha) in the single row seed increase plots. RILs were evaluated in drought in 2008. Simple observation suggests that at least four lines have superior root systems and perform well under both drought and non-drought conditions. F2 inter-specific populations with tepary bean were selected in the drought season in 2007; 140 F3 bulk families were planted in the December-February season, and about 100 were chosen for evaluation in drought in June 2008. The intermittent drought permitted the susceptible check to recover late in the season, and

thus the trial did not reveal large differences at harvest, but at mid-season many families presented superior pod setting compared to the check. Individual plants have been selected within those families for further selection in 2009. F8 Andean lines were tested in the drought season in 2007. Intermittent rainfall did not permit severe drought, but even in these conditions, yield advantage of selections reached 51% in large reds; 33% in whites; 45% in sugars; and 24% in calima types, with shorter growth cycle. The trials were replanted, but again, agronomic problems associated with excess rains in the prior months complicated the management of the trial. The trials have been harvested and analysis of drought data is pending. About 3600 F1.2 families (representing at least 25 crosses) were planted in the drought nursery in Colombia. Approximately 1500 of these were created with Andean parents. Among these latter populations, parental types that typically produce more biomass combined well with drought-selected lines that typically display good remobilization. 'CAL 143' is a line that has been widely released in southern Africa and that expresses tolerance to poor soil, and has good biomass accumulation. It combined especially well with drought selected lines. Future analysis will need to determine if these preliminary observations hold true, and if the formula of greater biomass plus better remobilization can be effectively exploited. Eight scientists and 13 technicians were trained in techniques of field experimentation, including sampling for studies in physiological partitioning. One PhD candidate from Ethiopia and one MSc candidate from Kenya are registered at the University of Pretoria and the University of Nairobi, and two more PhD candidates are pending matriculation at the Free State University in South Africa.

Objective 5 (Chickpea):

Chickpea work is done in partnership with the NARS of India, Ethiopia, Kenya and Tanzania. In India 20 mother and 217 baby trials were carried out in the districts of Kurnool and Prakasam (Andhra Pradesh) and Dharwad and Gulbarga (Karnataka). Preferred varieties in Kurnool were 'JG 11', 'JAKI 9218' and 'JG 130'; whereas 'JG 11', 'BGD 103' and 'JAKI 9218' were selected in Dharwad and Gulbarga districts. Evaluation could not be carried out in Prakasam district as the crop was destroyed by heavy rains at the reproductive stage. Over 100 kg basic seed of each of the varieties involved in the PVS trials was produced. Six released varieties were selected for PVS trials in Ethiopia. Over 900 kg breeder seed of these varieties was produced during 2007/08 main and off-seasons at Debre Zeit Research Centre of EIAR. A total of 38 PVS trials (sown in August 2008) are being conducted in four districts - Minjar (10), Shenkora (8), Lume/Ejere (10) and Gimbichu (10). In addition, 190 demonstrations of improved varieties (0.25 ha each) are also being conducted. Seeds of all varieties in the PVS trials are being multiplied during the 2008/09 main season. Evaluation will be made at podding stage. In Kenya six varieties/advanced lines (4 kabuli & 2 desi) are being tested at 24 PVS trials in Bomet and Nakuru districts of the Rift valley. Breeder/foundation seed of these varieties is being multiplied at ICRISAT-Nairobi and NARS partners. In Tanzania five improved lines (3 kabuli & 2 desi) were tested in 19 mother trials in four villages of Mwanza and Shinyanga regions. During three field days organized in August farmers gave the highest rank to the desi lines 'ICCV 00108' and 'ICCV 97105' and the kabuli 'ICCV 00305', on the basis of yield, *Fusarium* wilt resistance, seed size, and domestic market demand. These lines will be included in the NPT (National Performance Trials) for their release. ICRISAT-Nairobi supplied 1.5 tons seed of 'ICCV 96329', 'ICCV 95423' and 'ICCV 97105' to the Tanzanian NARS for seed production at farmers' fields in eight villages. There is a plan to buy 15 tons of seed from the farmers for redistribution during the 2009 crop season. Work to develop improved chickpea germplasm with desirable traits is in progress. Progenies of different generations of crosses are being screened in the partner countries. In India training was provided to 155 extension personnel and 465 farmers (412 men + 53 women) in improved chickpea production

technology at different project locations. Six scientists (two each from Ethiopia, Kenya and Tanzania) were provided 20 days to 3 months training on chickpea breeding and seed production at ICRISAT-Patancheru. Three students (one PhD student from India and one MSc student each from Kenya and Ethiopia) have registered for their thesis research on chickpea and two of these students are linked to TL I activities. In Ethiopia training was provided to 38 farmers on improved chickpea production technologies during the first week of August 2008. In Tanzania one-week training was organized on principles of chickpea production to 127 farmers and 18 extension staff in Shinyanga, Kwimba and Misungwi districts.

Objective 6 (Pigeonpea):

Partner NARS for pigeonpea are India, Malawi and Tanzania. A total of six mother and 16 baby trials in Maharashtra and four mother and 16 baby trials in Andhra Pradesh are under way; the baby trials in the latter are tested under intercropping conditions. PVS trials were conducted in 29 on-farm sites in Babati and Karatu districts of northern Tanzania using long duration varieties. Out of six improved varieties/advanced lines tested, farmers preferred 'ICEAP 00053', 'ICEAP 00040', 'ICEAP 00936', and 'ICEAP 00932' on the basis of seed yield, early maturity, seed size, seed colour and *Fusarium* wilt resistance. From PVS trials carried out with five improved medium duration varieties in central Malawi, farmers preferred 'ICEAP 01514/15', 'ICEAP 01162/21', and 'ICEAP 001167/11'. Seed production of farmer preferred varieties was carried out by on-farm revolving seed system (Tanzania) and on-station (Tanzania & Malawi) seed multiplication systems to ensure availability of required seed in the next cropping season. In Tanzania, 3.58 tons of 'ICEAP 00053' and 5 tons of 'ICEAP 00040' seed were distributed to farmers in eight districts for seed multiplication and supply back double the quantity of seed for re-distribution. Work on developing new improved lines is in progress. ICRISAT launched the world's first CMS based commercial pigeonpea hybrid 'Pushkal' (ICPH 2671) on 15 July 2008. This is a medium maturing (170-180 days), high yielding (30-40% yield advantage over Maruti); disease (wilt and sterility mosaic) resistant hybrid suited for the project locations of Maharashtra and Andhra Pradesh. This hybrid is also suitable for cultivation in parts of Karnataka and Madhya Pradesh states. In 2008, test marketing of this hybrid was started by seven seed companies. A short-duration hybrid ICPH 2438 ('Sholay 38) was also marketed on limited scale for cultivation in Maharashtra state. Multilocation yield trials for identification of other medium duration hybrids are in progress. Short- and medium- maturity A_4 CMS lines are being characterized at ICRISAT Patancheru during 2008. ICRISAT-Nairobi evaluated 325 new genotypes developed in the three maturity groups at three locations. A total of 34 short-duration and 27 medium-duration high yielding genotypes have been identified under rained situations. Pest tolerance screening of medium duration genotypes was done at two sites. ICEAP 01528, ICEAP 01547, and ICEAP 01530 were found promising genotypes with pest tolerance coupled with high yield. A total of 12 and 21 short- and medium-duration genotypes, respectively, with preferred traits have been identified from trials carried out at SARI and ARI-Ilonga, Tanzania. These will be advanced for seed multiplication in the coming season. Four superior genotypes ('ICEAP 01143/8', 'ICEAP 01487/16', 'ICEAP 01162/21' and 'ICEAP 01485/9') have been identified out of 22 medium duration genotypes evaluated at Chitedze Research Station, Malawi. ICRISAT and partner NARS of India have conducted a total of 21 training programs in the target districts where a total of 530 beneficiaries (including 120 women) participated. A total of 4500 farmers (40% women) were trained in Tanzania and Malawi on crop management, seed multiplication, processing and utilization. Two PhD students have registered at two Indian universities to conduct their research at ICRISAT.

Objective 7 (Soybean):

Partners for soybean are Kenya, Malawi, Mozambique, Tanzania, and Nigeria. Improved

varieties were evaluated at two locations —Chitedze and Mbawa, Malawi. At Mbawa, grain yield ranged from 1602 kg/ha ('TGx 1844-4E') to 3633 kg/ha ('Ocepara-4'). At Chitedze the highest yield (1568 kg/ha) was obtained with 'TGx 1835-10E', followed by 'Soprano', 'Ocepara-4', '747/6/8', and 'Solitaire', compared to 820 kg/ha for the local variety 'Magoye'. Early maturing varieties gave the highest yield as the rain ceased during the grain filling stage in March that seriously affected the long maturity groups. P application did not influence soybean yields significantly. Farmers gave the highest overall average score of 7.91 for 'TGx 1835-10E' during their evaluation at physiological maturity at Chitedze. It is a rust resistant and relatively early maturing variety released in Uganda in 2004. This and four other better performing genotypes will be advanced to PVS and NPT trials in the 2008/09 season. In Mozambique, 20 soybean varieties were tested at Nampula and Ruace. At Ruace, 'TGx 1740-2F' had the highest yields of 2.89 and 2.80 tons/ha with and without P application, respectively. However, in Nampula 'TGx 1440-1E' performed well. In general, the relatively early maturing varieties performed better than the medium to late maturing varieties at both locations. Based on the results, six' varieties ('TGx 1740-2F', 'TGx-1440-1E', 'TGx 1485-1D', 'TGx 1937-1F', 'TGx 1805-31F' and 'TGx 1961-1F') which performed well under P and no P applications at both locations were selected for seed bulking and further observations. Several farmer-preferred varieties have also been identified in Tanzania and Kenya. In an on-farm trial of three varieties in Malawi, farmers showed preference for '427/5/7' and '747/6/8'. In Nigeria, on-farm trials of two varieties one standard and one local check are growing at 19 locations. Regarding breeder seed production, 0.9 ton of seed was produced from three soybean varieties in Malawi. In Nigeria, 0.8 ton of breeder seed has been multiplied from different varieties during the off-season. Multiplication of selected varieties in all countries will continue in the off-season. Two farmer preferred soybean varieties ('931/5/34' and '917/5/16') in Kenya are in the pre-release stage. Moreover, on-farm verification is going on in Nigeria to release 'TGx 1835-10E' and 'TGx 1740-2F'. Ten selected local *Bradyrhizobium* strains together with a control (USDA 110) were tested on three promiscuous soybean varieties in Kenya. The local *Bradyrhizobium* sp. and *B. elkanii* produced the highest amount of dry shoot biomass and nodulation on these varieties. Significant ($P<0.05$) interaction between varieties and strains on dry shoot biomass and nodulation was observed. Progress is made in developing new segregating populations in Malawi and Nigeria. A total of 10 parental lines have been identified, at least 23 crosses have been made and the F_1 generations were grown. Five postgraduate students have been identified from all project countries. The students from Malawi, Mozambique and Nigeria are registered in plant breeding whereas those from Kenya and Tanzania are doing their studies in marketing and processing, respectively. In addition, 817 farmers (95% women) were trained on soybean processing in the five project countries, 35 people were trained in baseline survey and 418 farmers were trained in PVS in four of the five countries (the one from Nigeria is soon to be organized). Picture 8 here

Objective 8 (Seed Systems):

This crosscutting objective is carried out in all nine target countries. The objective encompasses six separately managed components (Objective 8.1 to Objective 8.6). Their work focused on scaling up foundation and certified seed, testing production models, testing distribution and marketing models, and awareness-raising activities. The aggregated foundation, certified and truthfully labelled seed produced in Year 1 amounted to 861.9 tons. Fifteen different seed production models are being tested across crops within Objective 8, including eight

which provide foundation or certified seed and another seven which produce seed of 'other' qualities (e.g. quality declared seed, farmer-acceptable). The establishment of diverse and widespread partnerships has allowed for this massive testing, as well as the scaling up of seed production (and training and demonstrations), even during this experimental phase. Across components, at least 138 organizational partnerships have been established for seed production, with many of them formalized through contract or Memoranda of Understanding. Partners include *inter alia*, seed parastatals, private sector companies, government research and extension systems, non-governmental organizations, schools, universities, farmer cooperatives and associations. Marketing experiments of small packets (ranging from 100 gm to 5 kg) of seed were initiated in four of the Objective 8 components: with groundnut in Niger, common bean in Kenya, and cowpea and soybean in Nigeria (with the aim of moving varieties quickly, making new varieties affordable for all, and stimulating demand for high quality seed). Initial tests in Kenya showed women as likely to purchase; and in Niger, showed higher demand for smaller packets (1 kg) of treated seed in particular. The approach also demonstrated how small initial amounts can quickly turn into impressive production surfaces. Over 65 tons were sold in the first TL II marketing tests, partially due to substantial links with private sector companies (e.g. Premier Seeds in Nigeria, Leldet in Kenya). Several constraints were also in identified for sharpening the small approach: limited locations of sale, low marketing skills of local vendors, and insufficient awareness raining information on benefits of new varieties and improved seed. Training was carried out in seed production, marketing, processing and storage concerns. Across crops in Objective 8, a total of 9234 people were trained including, technicians, farmer research group leaders, extension officers, and farmer seed producers. Where gender-differentiated information was collected, female participation ranged from 22 to 43%. Four MSc students were sent for training in Year 1 (with another 2 MSc and 1 PhD to be placed within the next half year). Training sessions greatly benefited from previous investments made in manual development by IARC, NARS and NGO partners (with the latter especially helping with manual translation). Across crops in Objective 8, manuals are available on themes such as general crop production, seed production, agro-enterprise and seed business, disease identification and financial planning for small businesses. Overall, seed-related training materials have been translated into some 19 languages (English, French, Portuguese, Spanish, Marathi, Telugu, Tamil, Kannada, Amharic, Luganda, Kinyarwanda, Kiswahili, Kinyaankole, Luwo, Chichewa, Tumbuka, Bemba, Swazi, and Kirundi). Across seed components, 1702 demonstration plots were laid in Year 1 by way of awareness raising activities. Farmer field days, radio programs, newspaper articles, as well as direct meetings with traders have also been used to quickly raise awareness of TL II variety and seed products. In several sites (Kenya, Nigeria, Niger, Mali) seed samples are also being distributed in 'test sizes' to raise awareness and stimulate demand.

Infrastructure Capacity Building

Support has been provided to various NARS to enhance their capacity for undertaking research in drought resistance. Equipment has been purchased; new irrigation facilities have been installed or existing ones upgraded; storage facilities have also been upgraded in some countries.

Lessons Learnt

The project has learnt a good number of lessons during its first year. First, many of our partner NARS have a severe shortage of personnel, both in terms of quantity and experience. This would mean that project scientists need to invest more time and efforts in mentoring the existing staff and facilitating the identification and placement of degree program students in such countries. Second, there is a strong need to increase emphasis on crop management and post-harvest aspects. Third, the project could gain significant synergy by forging working relations with other projects (e.g. DTMA project).

Project Review

TL II held its first Annual Review and Planning meeting on 29 September – 03 October in Addis Ababa, Ethiopia. Nearly 50 people attended the meeting. These included representations of the three CG Centres; Advisory Board (AB); Objective Coordinators and Principal Investigators of TL II; members of TL I partners; and members of host institution. The project has been favourably reviewed by the AB, which also forwarded positive recommendations to further strengthen it.

For more information, please contact:
Tsedeke Abate (PhD)
Project Manager Tropical Legumes -II
ICRISAT-Nairobi
Email: t.d.abate@cgiar.org
PO Box 39063-00623, Nairobi, Kenya
Tel: +254 20 7224566
Website: http://www.tropicallegumes.org