DEVELOPING SHORT-AND MEDIUM-DURATION GROUNDNUT VARIETIES WITH IMPROVED YIELD PERFORMANCE, ACCEPTABLE MARKET TRAITS AND RESISTANCE TO FOLIAR DISEASES

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End of Project Progress Report
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2. National Smallholder Farmers' Association of Malawi (NASFAM) − Malawi.
3. Department of Research and Development (DRD) of the Ministry of Agriculture and Food Security –Tanzania.

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Executive Summary

This report marks the end of phase I of the McKnight Foundation supported project '*Developing short and medium duration groundnut varieties with improved yield performance, market traits and resistance to foliar diseases'*. Funded through the framework of the Collaborative Crop Research Program, the overall goal of the four-year (2006/07 to 2009/10) project is 'poverty reduction and improvement in food and nutrition security among smallholder farm families in mid-altitude and lowland areas of Malawi and Tanzania through the development of short- and medium-duration groundnut varieties with improved yield performance, acceptable market traits, and resistance to foliar diseases. The project rationale is to provide resource-poor farmers with practical low-cost options for disease control and drought management based on plant host resistances. Strategies adopted were farmer focused and participatory in nature to ensure sustainable access to the technologies, including improving formal and informal seed systems, strengthening capacity of smallholder farmers and agricultural advisors, and improving awareness of the technologies. The project was led by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and is being implemented in partnership with the Department of Research and Development through Naliendele Agricultural Research Institute (NARI) in Tanzania and the National Smallholder Farmers' Association of Malawi (NASFAM).

Phase I of the project targeted delivery of three main outputs: a) high yielding farmer and market-acceptable short- and medium-duration groundnut varieties with resistance to foliar diseases; b) Increased adoption of improved farmer and market-acceptable varieties and production technologies; and, c) Increased groundnut productivity. Highlights of achievements by the project during the past four years (2006–2010) are provided below:

- Five improved groundnut varieties (ICGV-SM 01711 (Nachingwea), ICGV-SM 01721 (Masasi), ICGV-SM 99555 (Naliendele), ICGV-SM 99557 (Mangaka), and ICGV-SM 83708 (Mnanje) were released in Tanzania during the project period.
- The adoption rate of improved varieties in the project target districts stands at 92% from a baseline of 17% in Malawi and 60% from a baseline of ≤10 % in Tanzania
- The project in Tanzania has contributed to increased income. At the baseline, the average farmer in Masasi district was earning approximately Tshs 700,000 from groundnuts but the income increased to Tshs 1.5 million by 2010 as a result of promotion of improved variety Pendo and associated crop management production packages.
- Four new sources of resistance to aflatoxin contamination identified – J11, ICGV 95494, Ah 7223, ICGV-SM 02538 and ICGV 93280
- Four new sources of resistance to Groundnut Rosette Disease (GRD) identified – ICG 13099, ICG 14705, ICG 15405 and ICG 9449
- Four new sources of resistance to Rust identified – ICG 11426, ICGV 02194, ICGV 01276, ICGV 02286
- 178 successful crosses for introgression of rosette, Early Leaf Spot (ELS) and Rust resistance into farmer-preferred varieties were completed between 2006 and 2009.
- Three training workshops for NARS technicians and scientists conducted with the assistance of the Statistical Service Centre –University of Reading to equip NARS on the use of Genstat for data analysis and principals of experimental design.

- At least 6–10 nurseries comprising breeding materials from segregating populations (F2 – F7) to elite trials evaluated at NARS research station and on-farm locations through Farmer Participatory Variety Selection (FPVS) annually.
- Approx 80,693 kg breeder seed of eight farmer market-preferred varieties produced in the two countries during the last 4 years with support from the project.
- Nuclear seed of about 160 lines in advanced testing in the National Programs of Malawi and Tanzania were produced each season in amounts ranging from 2 to 80 kg per line to support on-station and on-farm testing.
- A total of 1,506 lines and varieties (trials, breeding populations and breeder seed) were distributed from Chitedze Agricultural Research Station to seven country NARS programs, including Malawi, Tanzania, Mozambique and NGOs with additional support from the BMGF-funded TL2 Project.
- As a result of the project and through FPVS, Tanzania has released five varieties: Mnanje 09, Mangaka 09, Nachingwea 09, Naliendele 09 and Masasi 09. In Malawi, additional to ICGV-SM 90704 and ICGV-SM 99568 which are already released varieties, ICGV-SMs 01711, 01513 have shown promise.
- At least 60 demonstrations for improved practices on options for management of GRD and aflatoxin were implemented on farmers' fields in Malawi each season for the past 4 years.
- At least 40 FPVS were implemented in Malawi and Tanzania each season.
- A total of forty-nine (49) Farmer Field Days (FFDs) and four seed fairs were conducted during the project period, attracting a total of 8184 farmers at the venues.
- Seven hundred and forty four government extension officers, association field officers and lead farmers were trained on various aspects of groundnut technologies and principles of extension.
- Fifty one seed banks with 1,940 members are functional in Malawi and 50 Farmer Field Schools (FFS) are operational in the project target areas in Tanzania.
- Up to 15,000 groundnut leaflets, 11 radio documentaries and 8 TV documentaries 151 posters, 2000 booklets and 1 video film highlighting project activities and impact were produced in the two countries.
- NASFAM, one of our project collaborators, continues to buy and export groundnuts. Additionally, NASFAM has facilitated the registration of its Mzimba District association as fair trade certified. This opens door for higher quality groundnut exports and higher incomes to groundnut farmers in Malawi.

1 Web Page Update

Project information

The problem

Infrequent and/or very unpredictable rainfalls characterize the climate of the Eastern and Southern Africa region (ESA). This coupled with poor soil fertility and devastating biotic stresses (GRD, ELS, Rust and aflatoxin) has rendered farmers in the region prone to continuous food shortages, low income and poor nutrition. Most households do not produce enough food to feed themselves for more than nine months of the year. More than 49% (Malawi) and 40% (Tanzania) of children under five in the rural areas are malnourished to such a degree that their development is retarded. Food shortfalls play a major role in malnutrition but a lack of protein, oil and vitamins in a largely cereal-based diet is also of major importance. More than half of the population in the two countries live below the poverty line and investing in crops that have the capacity to withstand both biotic and abiotic stresses prevalent in ESA has the potential to mitigate problems faced by majority of the population.

Groundnut (also known as peanut) is an important legume crop in the region and provides a valuable source of proteins (12−36%), oil (36−54%), and minerals and generates cash income to many poor farmers. The crop grows from latitude 40ºN to 40ºS. In most countries in ESA, smallholder farmers with no irrigation and almost no inputs other than land and labor grow the crop in semi-subsistence conditions. It is grown under a wide range of agro-ecological conditions (altitude: from sea level to over 1500 m, rainfall 300−1000 mm) but production is concentrated in areas of low and highly variable rainfall. Groundnut production has been on the decline since the late 1980s in Malawi, from 142,573 ha producing 51,136 tons in 1984 to 48,272 ha producing only 18,640 in 1990. This decline was attributable to low yielding varieties, reduced area under cultivation, foliar diseases and a collapse of the export markets. Thanks to concerted research efforts by ICRISAT and NARS partners in Malawi, which began in 1982/83 and culminated in the release of several high-yielding varieties that have been successfully adopted by farmers, increasing the national hectarage to 266, 508 ha and production to 267,078 tons by 2007 (Malawi Ministry of Agriculture and Food Security – 2007).

Due to the crops' ability to fix atmospheric nitrogen as well as yield under low and or erratic rainfall, groundnut remains one of the most important crops with the potential to improve food security, incomes and reduce levels of malnutrition among smallholder farmers. Foliar diseases remain a major constraint to increased groundnut production. Groundnut Rosette Disease, caused by a viral complex, is endemic to the African continent and epidemics occur often with losses approaching 100% in many fields. Early leaf spot caused by *Cercospora arachidicola*, late leaf spot caused by *Phaeoisariopsis personata*, and Rust caused by *Puccinia arachidis*, are other key fungal diseases that cause considerable damage to groundnut production. Leaf diseases can be controlled by timely applications of fungicidal sprays. However, the cost of fungicidal application is prohibitive for smallholder farmers. Therefore, the use of resistant crop cultivars provides the most appropriate means of disease control that can be easily incorporated into farmers' operations at little extra cost.

Through the McKnight-funded project, ICRISAT and partners (NASFAM and NARI in Tanzania) instituted a number of interventions aimed at mitigating food insecurity, low income and poor nutrition. These included on-farm groundnut trials and demonstrations in all the benchmark districts in the two countries community seed production systems, and participatory variety selection. These are beginning to bear fruits including the recent release of five new high yielding foliar and rosette disease resistant varieties in Tanzania.

2 Research Report

The McKnight CCRP (Groundnut Breeding) Project Phase I was a four-year project premised on three main outputs expected to be delivered in Malawi and Tanzania:

a) High yielding farmer and market-acceptable short- and medium-duration groundnut varieties with resistance to foliar diseases developed through conventional and farmer-participatory breeding approaches;
b) Adoption rates of improved farmer and market-acceptable varieties and production technologies enhanced; and,
c) Groundnut productivity increased.

In this section, activities undertaken during the reporting period between September 2006 and August 2010 have been compiled by objective. For each, a brief introduction is followed by a summary of activities undertaken preceding short comments on implications of the research findings for the next stage of research, for suggested development activities, and for policy where applicable.

Objective 1 Develop high-yielding farmer and market-acceptable short- and medium-duration groundnut varieties with resistance to foliar diseases

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Introduction

Smallholder farmers in the Semi-Arid Tropics (SAT) of sub-Saharan Africa (SSA) continue facing challenges to harness limited available resources in harsh environments (prone to biotic and abiotic stresses) to improve their incomes and reduce malnutrition and poverty through agriculture. These farmers also have a limited capacity to deal with new and emerging challenges. The project, implemented in four benchmark districts − Mchinji and Nkhotakota in Malawi and Dodoma and Masasi in Tanzania, developed and implemented a number of interventions aimed at mitigating the challenges these resource-poor farmers are facing. In these drought-prone target areas as in the rest of SAT, groundnut production is severely constrained by diseases, including the Groundnut rosette disease (GRD), Leaf spot diseases (Early and Late leaf spot- ELS and LLS, caused by *Cercospora arachidicola* and *Phaesariopsis personata*, respectively, and Rust (*Puccinia arachidis*), aflatoxin (produced by *Aspergillus flavus*) contamination.

The project sought to investigate the adequacy of available germplasm base in the region as a source of high-yielding varieties with farmer- and market-preferred traits and the ability to overcome existing biotic and abiotic constraints. To complement this, actions were taken to improve available germplasm through introductions and breeding work. Breeding efforts were aimed at developing groundnut-breeding lines with combined resistances to GRD and foliar diseases and acceptable farmer- and market-quality traits using a farmer participatory approach. Based on prior testing and experience, ICRISAT and the NARS from Tanzania identified germplasm from ICRISAT's extensive groundnut collection with resistances to diseases and drought as initial parents for the development of improved populations. Through introgression of desired traits into farmer-preferred varieties, the project has so far produced F4 progenies and BC2F1 materials for GRD, ELS and Rust in adapted backgrounds that are ready for exploitation by the two countries. Confirmatory tests for resistance to GRD and the aphid vector in the released varieties in Tanzania as well as other promising materials were conducted in the green house at Chitedze Research Station.

Narrative summary

The following activities were undertaken in the two countries between 2006 and 2010

- 1.1.1 Identify through Participatory Plant Breeding (PPB) and introgress germplasm for yield components farmer/market preferences and adaptation
- 1.1.2 Develop diverse groundnut breeding lines and populations and capacity to screen for GRD and foliar disease resistance in Tanzania
- 1.1.3 Develop and evaluate advanced breeding lines and varieties
- 1.1.4 Germplasm exchange between Malawi, Tanzania, Mozambique and others

1.1.1 Identify through PPB and introgress germplasm for yield components farmer/market preferences and adaptation

a) Additional sources of resistance to foliar diseases identified from core collections, local and wild germplasm

Disease screening efforts using the infector row technique have resulted into the identification of four new sources of resistance for GRD, five for ELS and four for Rust. The project also conducted pot experiments to identify potential materials for Aflatoxin resistance. Two introduced sets of germplasm from ICRISAT – the Minicore comprising 192 lines and the Reference Set comprising 289 lines were each evaluated for two seasons (2006/07 and 2007/08 for the minicore and 2008/09 and 2009/10 for the reference set). The minicore was a subset of the reference set. From both the following sources of biotic resistances have been identified: for GRD, ICG 13099, ICG 14705, and ICG 15405 and ICG 9449; for rust, ICG 11426, ICGV 02194, ICGV 01276, and ICGV 02286; and for ELS, ICG 6022, ICG 405 ICG 14466, ICG 6057, ICG 9449, and ICG 12509. Screening in pots revealed J11, ICGV 95494, Ah 7223, ICGV-SM 02538 and ICGV 93280 as potential sources of resistance to aflatoxin production. It was also observed that lines: ICGV-SM 07531, ICGV-SM 06661 and ICGV-SM 01711 showed combined resistance for both GRD (0% Rosette incidence) and ELS (ELS scores < 4). As a result of screening activities at

Naliendele, Nachingwea and Makutopora in Tanzania, ICGV-SM 02501, ICGV-SM99568, ICGV-SM 03701 and ICGV-SM 90704 were identified as tolerant to foliar diseases (ELS, Rosette and Rust). ICGV-SM 03590 combined resistance to Rosette and ELS (<4) whereas ICGV-SM 02501 combined resistance to Rust (score of 3) and Rosette. The project characterized the reaction to Rosette disease status of improved varieties released in Tanzania (*Pendo, Johari* and *Nyota*). Grafting experiments with a susceptible variety carrying Groundnut Rosette Virus (GRV) after infestation confirmed that all these varieties were susceptible to GRV. GRD was observed on *Pendo, Johari* and *Nyota* whether used as scion or rootstock. This presented the project with the challenge of quickly identifying from the elite lines some rosette-resistant varieties for Tanzania.

b) Farmer-preferred varieties with local adaptation identified and hybridization initiated for introgression of GRD and foliar fungal disease resistance

The project has developed a wide genetic pool for purposes of introgression of GRD, Aflatoxin, ELS and Rust disease resistance for utilization by breeding programs for both Malawi and Tanzania. A total of 178 crosses for the introgression of the afore-mentioned traits were made involving farmer-preferred varieties [*Johari* (Robut 33-1), *Pendo* (ICGMS-33), *Nyota* (Spancros) and *Red Mwitunde* from Tanzania and *Chalimbana*, CG 7, JL 24 (Kakoma) and *Nyanda* from Malawi] at Chitedze Research Station in Malawi. Groundnut accessions ICGV-SM 90704, ICG 12991, ICGV-SM 95714, and ICGV-SM 94114 were used as sources of resistance to Rosette, Aphid, ELS and Rust respectively. This effort has resulted in the production of breeding populations and back cross materials ready for exploitation. Since the onset, the activity has generated more than 1,500 F4 segregating progenies each for the three major biotic constraints in short-duration background and more than 100 BC2F1 materials for exploitation by Malawi and Tanzania and other ESA countries. In building the capacity of the NARS to screen germplasm for resistance and use the infector row technique as is currently done in Malawi, the project helped in the construction of Aphid rearing facilities at Naliendele Research Station in Tanzania. In further support to screening activities in Tanzania, ICRISAT initiated the dispatch of screening nurseries to Naliendele Research Station from 2008/09 starting with 12 nurseries ranging from 3 to 25 entries as well as 38 rosette disease segregating F2/F3 populations for on station screening. Currently screening activities using the infector row technique are fully implemented in Tanzania.

1.1.2 Develop diverse groundnut breeding lines and populations and capacity to screen for GRD and foliar disease resistance

a) Disease screening capacity strengthened in the NARS on the use of the infector row technique

The project identified training NARS partners in the use of the infector row technique and data analysis as central pillars to ensuring effective project operations. At least one training activity per year was conducted. Two NARS technicians from Tanzania were trained in 2007; seven technicians from Malawi and Tanzania in were trained in 2008 in addition to three scientists from Malawi, Mozambique, and Tanzania who participated in the data analysis training conducted from 19th October to 2nd November 2008. Another one-week training workshop was organized at Chitedze Research Station in Malawi from 31st May to 5th June in 2010. The workshop focused on data cleaning, organization and analyses of multi-location, mother-baby trials, and ranking data. The workshop attracted a total of five project scientists from Tanzania and Malawi. The Southern Africa CoP also organized a one-week workshop from 7–12 June 2010 with an objective to provide participants of CoP projects with the skills required to produce quality research data and proper management of research data. Two scientists from the groundnut breeding team Dr. Omari Mponda (Tanzania) and Mr Wills Munthali (Malawi) participated.

b) Diversified groundnut populations/ breeding lines with genetic resistance to Rosette, ELS, rust and LLS and combined resistances

Screening Breeding Populations for Rosette resistance

Between 2006 and 2010, at least 71 nurseries for Rosette breeding populations were established under Rosette high disease pressure. Populations evaluated consisted of progeny rows ranging from 56–1074 each combining more than one trait (Rosette and ELS resistance, grain yield, high Oleic acid and confectionery), and ranged from F5 to F7. These efforts resulted in the development of 938 single plant progenies in different filial generations. During the same period, at 21 nurseries for ELS segregating populations were established with up to 1277 progeny rows from which 495 progenies in different filial generations were selected for generation advance (Table 1).

Table 1. Summary of nurseries for rosette and ELS segregating populations (2006−2010)

	ROSETTE		
Year	No. nurseries	No. progeny rows	No. of selections
2006/07	16	394	240
2007/08	31	1074	213
2008/09	14	227	123
2009/10	10	56	36
Total	**71**	**1751**	**938**
	ELS		
Year	No. nurseries	No. progeny rows	No. of selections
2006/07	6	591	186
2007/08	6	331	164
2008/09	5	278	118
2009/10	4	77	27
Total	**21**	**1277**	**495**

1.1.4 Germplasm exchange between Malawi, Tanzania, Mozambique and others

a). Nucleus seed of elite lines produced annually for NARS testing and for breeder seed production

For the past four years and with additional resources from the Bill and Melinda Gates Foundation, the following achievements were attained in nuclear and breeder seed production. A total of 69,656 kg of breeder seed from eight varieties (Nsinjiro, CG7, Kakoma, Chitala, Nyanda, Mnanje, Baka and Chalimbana 2005) was produced in Malawi

(Table 2). In Tanzania the project produced a total of 11,037 kg of breeder seed of five varieties (Pendo, Nyota, Mnanje, Mangaka and Masasi).

Table 2. Breeder seed production throughout the project period

Malawi	2006/07	2007/08	2007/08	2009/10	Total
ICGV-SM 99568	995	3,060	11,448	20,536	36039
ICGV-M 90704	1,000	2,370	12,096	3,791	19,257
JL 24		380	2,772	1,700	4852
Baka		1,020	720	697	2437
Nyanda				1,190	1190
CG 7		1,400	594	2,992	4986
Chalimbana		335			335
Chalimbana 2005		560			560
Total	**1995**	**9,125**	**27,630**	**30,906**	**69656**
Tanzania					
Pendo	200	1,500	2000	6591	10291
Nyota				7	7
Mnanje				400	400
Mangaka				104	104
Masasi				242	242
Total	**200**	**1,500**	**2,000**	**7344**	**11,037**

Various quantities of nuclear seed of 646 lines ranging from 2–80 kg were produced during the project period. These were in support of national variety testing and breeder seed production efforts.

b) Advanced breeding lines and breeder seed of improved groundnut varieties available to NARS and NGOs in ESA on an annual basis

Table 3 below presents the groundnut seed by category distributed to national programs and other partners in the sub-region. A total of 1506 lines and varieties were distributed from ICRISAT-Malawi Chitedze Agricultural Research Station to different NARS programs in DR Congo, Kenya, Malawi, Mali, Mozambique, and Tanzania. Through the project a total of 8.1 tons of good quality seed of the variety ICGV-SM 90704 (Nsinjiro) was issued to CARE, a collaborating partner in support of farmer learning through Farmer Field Schools (FFS). This NGO is now capable of producing 25t good quality groundnut seed annually through their community FFS.

Table 3. Seed distribution to different national programs and NGOs with support from the project

Nursery	Malawi	DR Congo	Tanzania	Mali	Mozambique	Zimbabwe	Kenya	CARE	Total
International trial sets	42	1	39	2	38	3	0	134	**259**
Advanced breeding trials	122	10	96	0	67	0	4	0	**299**
Early generation breeding materials	0	0	214	711	0	0	0	0	**925**
Others (varieties/breeder seed)	0	0	8	0	13	1	0	1	**23**
Total	**164**	**11**	**357**	**713**	**118**	**4**	**4**	**135**	**1506**

d) Early high yielding, farmer preferred lines identified for evaluation under high GRD and ELS disease pressure using the infector row technique

Promising lines and new farmer preferred varieties were evaluated throughout the project period under the Regional Elite Groundnut Variety Trials using the infector row technique under Rosette and ELS high disease pressures at Chitedze Research Station. Rosette high disease pressure was maintained through addition of sick plants (spreaders), and weekly aphid inoculations whereas for ELS, additional inoculation using haulms from the previous ELS nursery was also done. At least 20 Spanish, 20 Virginia and 16 Valencia varieties were evaluated each year in both Rosette and ELS nurseries. Similar trials were evaluated on-station in Tanzania. Table 4 highlights the three best (yield and resistance to diseases) varieties for each growing season and for specific country. Yields greater than at least 1,114 kg/ha were observed for the selected genotypes against checks that were as low as 540.5 kg/ha and rosette incidence and ELS score of up to 63% and 8% respectively. Results show ICGV-SMs 90704 and 99568 performed well across countries. Malawi had ICGV-SMs 90704, 01711 and 99568 as consistent genotypes whereas Tanzania had ICGV-SMs 01513, 90704 and 99568 as best performers. Most importantly, all varieties reflected in Table 4 are short to medium duration maturing between 90 and 120 days.

The use of the infector row technique has significantly increased the likelihood of our ability to identify lines that are possible candidates as sources of resistance to GRD and ELS. At least 20 Spanish and 20 Virginia type varieties are evaluated at the ICRISAT Chitedze Research Station annually in Regional Elite Variety Trials under high GRD and ELS disease pressure. Significant differences, $p \leq 0.05$ were observed in all varieties for pod yield, reaction to GRD and ELS. High yielding Spanish varieties included ICGV-SM 03590, ICGV-SM 99566 and ICGV-SM 99551 giving a pod yield ranging from 3094 kg ha^{-1} to 3228 kg ha^{-}. These varieties also presented good resistance to both GRD (< 5.6%) and ELS (<4) for the Spanish. For Virginia, ICGV-SM 02712 and ICGV-SM 01711 were the highest yielding varieties with a pod yield of 4344 kg ha^{-1} and 3039 kg ha^{-1} respectively. These varieties yielded more than CG7 (2217 kg ha^{-1}), which was used as a check. ICGV-SM 01711 is resistant to both ELS (score ≤3) and Rosette (incidence 0%). ICGV-SM 02712 has good levels of resistance to ELS but is moderately resistant to GRD (late onset of incidence 31%), compared to CG7 (incidence 47) and early onset of symptoms. (Table Appendix 1b)

Implications of the research findings

a. For the next stage of research

Intensification of screening activities in Tanzania and Malawi has revealed a number of promising materials as candidate lines for addressing both biotic and abiotic stresses. There will be need to introgress new sources of resistance into favorable farmer/market-preferred varieties. Additionally, biotic stress resistant lines identified through on-station trials will have to be promoted to on-farm testing to quickly identify varieties for release in the next 3 years. There is need for the project to focus on identifying materials that will combine both drought and disease resistance in short to medium duration timeframes.

b. For future development activities

Past efforts were directed towards the introgression of GRD and ELS resistance into farmer/market-preferred varieties. Similar focus is required for the introgression of aflatoxin and rust resistance into both farmer/market preferred varieties and some of the newly released varieties.
There will also be need to reinforce community seed production structures as informal seed production systems have proved very effective. This will ensure that smallholder farmers have access to good quality seed.

Objective 2 Promote adoption of improved high-yielding farmer- and market-acceptable short- and medium-duration groundnut varieties

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Introduction

Groundnut production if appropriately exploited can mitigate the numerous challenges small-scale farmers face to great extent. The crop is well traded within and across the region and has high potential to minimize poverty and malnutrition. Making farmer friendly groundnut technologies available is key to unlocking the potential in investing in groundnuts. To effectively achieve significant strides in exploiting benefits from groundnuts, high adoption levels as well as efficient and effective market linkages should accompany such technologies. In spite of a wide range of groundnut technologies (including varieties) being available, it has become apparent that small-scale farmers are not adequately utilizing most. Thus, rates of adoption remain low, partly because farmers are either not aware of the availability of the technology, or unable to access quality seed of the improved germplasm. The latter is related to the under-development of seed supply systems for groundnuts and lack of NARS and farmer capacity to multiply quality seed. Groundnut being a self-pollinated crop has attracted less interest from seed companies and seed is not available on the market. Furthermore, even in areas where improved varieties have been adopted, poor crop husbandry practices still predominate among poor farmers; yields remain low, and varietal potentials, even when improved germplasm is available, remain largely untapped. For the benchmark districts, the project has observed a significant change in the rate of adoption of improved technologies such as improved varieties, management of GRD and aflatoxin. Due to the elevated standards for aflatoxin levels permissible in the international and regional markets, the issue of aflatoxin contamination has gained global significance and the need for further research on aflatoxin management and scaling up of such technologies is gaining importance due to the deleterious effects of aflatoxin on human health.

The main strategy for this objective was promotion of wide-scale adoption of 'best bet agronomic practices' such as optimum plant populations, planting dates, plot water management and host plant resistance in a bid to sustainably increase groundnut production in Malawi and Tanzania. Demonstrations of improved technologies were conducted on farmers' fields to enable farmers to experientially learn through comparison with farmer practices and these were hoped to enhance village adoption.

Narrative Summary

2.1.1 Conduct participatory adaptive trials and demonstrations including promotion of systems for control and management of aflatoxin
2.1.2 Conduct field days, agricultural shows and rural seed fairs with farmers, researchers and market players
2.1.3 Enhance institutional innovations to improve access of the poor to good quality seeds of improved high-yielding adapted varieties
2.1.4 Conduct training-of-trainers program on seed and crop production techniques for extension and NGO partners

Progress of Outputs:

2.1.1 Conducting participatory adaptive trials and demonstrations including promotion of systems for control and management of aflatoxin

Varieties for widescale on-farm adaptive testing with farmer participation

In Malawi, the project managed 110 participatory variety trials and demonstrations for the management of GRD and aflatoxin by 51 research groups in the two benchmark districts annually. Trials and demonstrations were all researcher-designed but farmer managed. Female collaborators hosted an average of 50 of these trials and demonstrations. Trials were managed exceptionally well and strategically positioned for public view. Both Nkhotakota and Mchinji suffered from dry spells in the month of January in the 2008/09 growing season. In Tanzania, 40 participatory variety trials were implemented each year leading to the release of two Spanish varieties; ICGV-SM 99557 and ICGV-SM 99555 and three Virginia varieties; ICGV-SM 01711, ICGV-SM 01721 and CG 7 in 2009. The devastating droughts and high incidence of rosette during 2008/09 growing season in Tanzania was testimony to the ability of the new improved varieties to respond to the constraints of drought and Rosette.

a. Participatory varietal evaluation

At least 40 participatory variety trials were conducted in the two benchmark districts of Mchinji and Nkhotakota each year. Each mother trial consisted of a minimum of six elite lines and two checks planted on four plots each measuring 9m^2. A farmer was treated as a replicate and each test site had eight farmers arranged in a Randomized Complete Block Design (RCBD). Data collected included: pod weight, Rosette incidence, ELS scores, plant count, rainfall distribution and farmer trait preferences. To elicit farmers' preferences, the following criteria were used: pod yield, grain size, taste, and level of disease resistances and drought. Similar arrangements were implemented in Tanzania in Masasi and Dodoma districts. Table 5 highlights farmers' preferences as revealed by the FPVS for the two countries. In Tanzania, four of the most preferred varieties have been released. Varieties were selected mainly for their yield and disease resistance with the exception of Chalimbana in Malawi which is preferred for its large grain size. ICGV-SMs 90704 and 99568 already released in Malawi have been promoted to on-farm trials in Tanzania and targeted for release within two more seasons.

Table 5. Farmer preferred varieties for the four-year period in Malawi and Tanzania

Country	**Farmer preferences season-wise**			
	2006/07	**2007/08**	**2008/09**	**2009/10**
Malawi	Chalimbana	ICGV-SM 90704	ICGV-SM 99568	ICGV-SM 01708
	ICGV-SM 01513	ICGV-SM 99568	ICGV-SM 90704	ICGV-SM 03576
Tanzania		ICGV-SM 01711	ICGV-SM 99557	ICGV-SM 01721
		ICGV-SM 01721	ICGV-SM 99555	ICGV-SM 99568

For 2009/10 growing season in Malawi, the PVS were grouped into Virginia and Spanish trials and new materials were introduced. The Spanish varieties included: ICGV-SM01514, ICGV-SM03572, ICGV-SM03576, ICGV-SM99566, ICGV-SM99551, ICGV-SM99567 and Virginia varieties included: ICGV-SM 01708, ICGV-SM 01731, ICGV-SM 01724, ICGV-SM 99772, ICGV-SM 01728 and 92R/70-4. Similarly, new varieties included for on-farm are ICGV-SM 02501, ICGV-SM 03701, ICGV-SM 90704 and ICGV-SM 99568.

Significant differences for kernel yield were observed for Nkhotakota, p = 0.05, but no significant differences for yield were observed in Mchinji (p =0.05). The site means were also higher in Nkhotakota than Mchinji, 1040.5 and 688.87 kg/ha respectively. Low yields in Mchinji were attributed to a prolonged dry spell experienced in the month of January. Overall performance showed ICGV-SMs 01731 and 01708 yielding better (1348.9 and 1089.3kg/ha respectively) than both checks (ICGV-SM 90704 and Chalimbana 2005), which yielded 1024.4 and 621.7 kg/ha respectively (App 2). ICGV-SM 90704 however performed better than the rest in Nkhotakota giving a yield of 1460 kg/ha. Under natural infestation, significant differences were also observed for Rosette incidence, p = 0.05. The two lines (ICGV-SMs 01731 and 01708) were more resistant to Rosette compared to Chalimbana 2005. Preference ranking for Virginia varieties showed ICGV-SM 01708 ranked first whereas ICGV-SM 01731 and ICGV-SM 90704 were second for yield and resistance to diseases (Rosette and ELS). Combined analysis for Spanish varieties gave no significant differences for kernel yield, p = 0.05. ICGV-SMs 03576, 03572 and 99551 performed better (1288.8, 1103 and 1172kg/ha respectively) than the rest. Varieties used as checks (ICGV-SM 99568 and JL 24) sprouted heavily making yield comparisons difficult. Higher yields for Spanish varieties were observed in Nkhotakota compared to Mchinji giving site means of 956.75 and 661.34 kg/ha respectively. Preferred Spanish varieties included ICGV-SMs 03572, 03576 and 01514. These varieties were also chosen on the basis of yield and resistance to diseases.

Results from grain yield analysis tally with outcome of preference rankings in which ICGV-SMs 01708 and 90704 for Virginia and ICGV-SMs 03572 and 03576 for Spanish varieties were the most preferred. Results also showed that the most preferred trait for farmers was yield followed by grain size probably due to the fact that most farmers growing groundnuts are targeting the confectionary market. Of the 459 farmers interviewed, 49% indicated yield as the main trait of interest followed by 29.5% grain size. There was no difference in terms of rankings between males and females. These results also showed that farmers look at varieties combining more traits than just yield. Pursuing the above criteria, the best variety in Tanzania was ICGV-SM 90704 followed by Pendo, ICGV SM 03701, and ICGV SM 99568 with pod yields of 1955, 1572, 1342 respectively (App. 3). The mean pod yield for local variety was 498 kg/ha. The differences between varieties were statistically significant (p=0.05). Farmers' preference of the varieties suggested that at Muungano in Dodoma; Mnanje-09, Masasi-09 and ICGV SM 90704 in that order were the most preferred. Farmers at Msanga Dodoma selected Pendo and ICGV-SM 99568. In southern Tanzania: Masasi-09, ICGV SM 99568 and ICGV SM 90704 were the most preferred. These results are in favor of more rigorous evaluation of ICGV SM 99568 and ICGV SM 90704 for potential release in Tanzania. These varieties demonstrated tolerance to major diseases including Rosette. ICGV SM 99568 is an early maturing Spanish variety already released in Malawi. The ICGV SM 90704 is a good for the confectionary market Virginia type popular for its Rosette resistance and already released in four other countries in ESA.

b. Demonstrate technologies for the management of Rosette

At least 30 demonstrations for the management of Rosette were conducted in the two districts in Malawi each year. These demonstrations were premised on popularizing some of the common disease management technologies amongst small-scale farmers, validating recommended cultural practices with specific released varieties and enhancing the capacity of smallholder farmers to improve their food security through increased groundnut production. Three management options were demonstrated on farmers' fields. The mother-baby approach was used and treatments were arranged in a RCBD with each farmer acting as a replicate. Treatments demonstrated included: time of planting (early vs. late (3 wks later), variety (resistant vs. susceptible) and plant population (high (10 x 60cm) vs. low (30cm x 75cm) plant population), botanical class (Spanish vs. Virginia) resulting in 16 treatment combinations. Two Virginia (*Chalimbana* and *Nsinjiro* (ICGV-SM 90704)) and two Spanish (*Malimba* and *Baka*) varieties were tested. Baka is resistant to aphids (vector responsible for transmission of GRD) and Nsinjiro, resistant to GRV. Chalimbana and Malimba (farmers' varieties) are susceptible to GRD.

Since Rosette epidemics do not occur each season, results showed significant differences for 2006/07 and 2009/10 growing seasons in Rosette incidence for varieties (p=0.002) and planting density, p = 0.05. No significant differences were observed in time of planting though early planting reduced levels of Rosette as compared to late planting (Fig. 1). Significant differences (p = 0.05) were also observed in Rosette incidence for planting density, p = 0.05. Resistant varieties (ICGV-SM 90704 and Baka) recorded lower Rosette incidences than susceptible varieties (Malimba and Chalimbana). Additionally, these demonstrations helped confirm that incorporation of resistance was of greater value than trying to manage disease through cultural practices because other constraints including labor shortage did not always render this option possible.

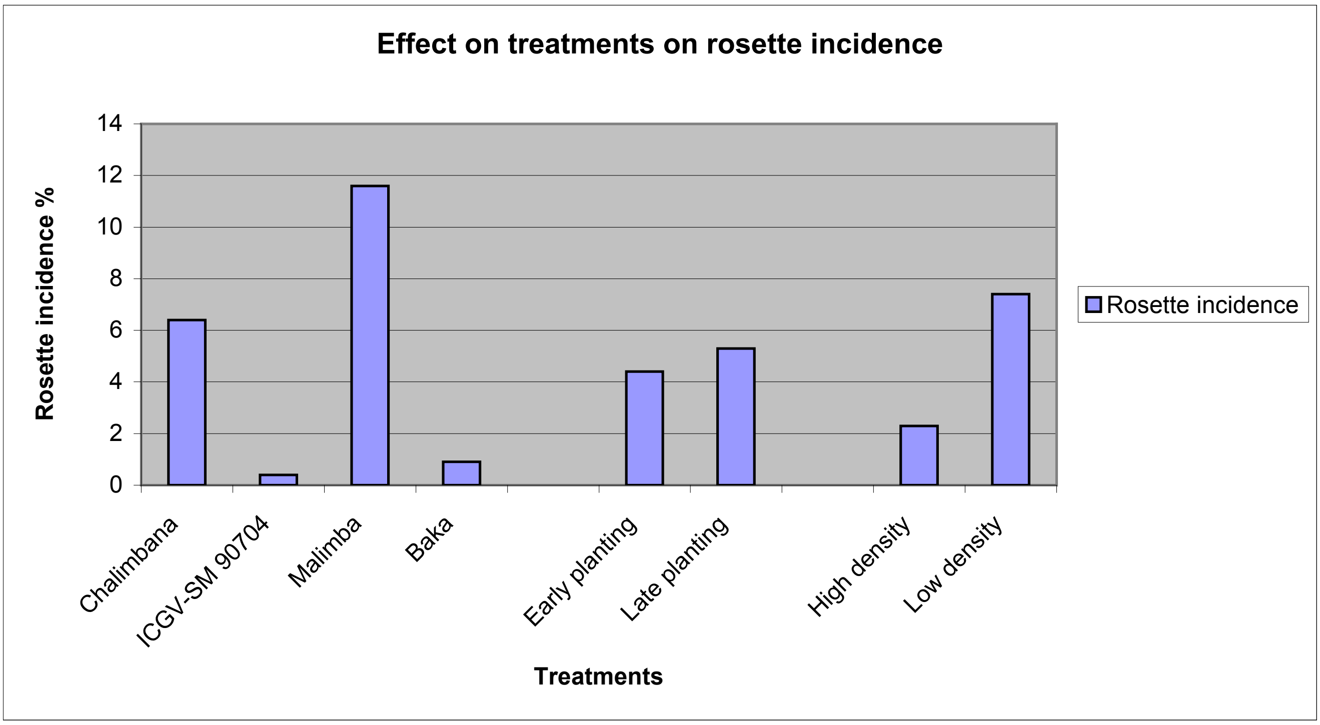

Fig. 1. Effect of variety and cultural treatments on Rosette

For interactions, significant differences in both Rosette incidence and yield were observed (p = 0.05), implying that the treatments had an effect on these traits. This trend was particularly clear in the 2007/08 and 2008/09 growing seasons. All varieties (Chalimbana, ICGV-SM 90704, Malimba and Baka) registered high yields when planted early in high plant populations compared to late planting in low plant density: 1113 kg/ha vs. 408 kg/ha, 1575 kg/ha vs. 563 kg/ha, 854 kg/ha vs. 321 kg/ha and 804 kg/ha vs. 556 kg/ha, respectively (App. 4). Results also show that even resistant varieties planted late and at low density had relatively higher Rosette incidences and lower yields. This shows the importance for farmers to integrate all the three management options for better gains (App. 4).

Use of susceptible varieties, late planting and wide spacing (all being farmers' practice) were shown to aggravate the impact of Rosette. Resistant varieties, early planting and high plant densities have individually shown to reduce Rosette incidences by up to 60% and for four successive seasons. We demonstrated that use of integrated approach (combining resistant varieties, early planting and high plant density) presents an even greater opportunity for farmers to reduce Rosette incidences. The project made significant strides to validate these options as such measures must be put in place to ensure wide-scale dissemination and adoption.

c. Demonstrate technologies for reduction of aflatoxin under smallholder conditions

The main objective of the study was to validate and promote options for management of aflatoxin contamination of groundnut. Treatments validated were use of varieties (resistant, J11 vs. susceptible, ICGV-SM 99568), time of planting (early vs. late) and water management (box vs. open ridges). The three-factor experiment with eight treatment combinations was arranged in a mother-baby trial design. Each season mother trials were planted at four farmers' fields per district (8 in total) with each farmer having all three treatment combinations but flanked with babies each implementing a sub-set of the mother trial – comparing one improved treatment with the normal practice. Ridges were constructed in rows spaced at 75cm apart and 10cm between planting stations. Plots contained 4 rows each 20m long. Ridges for the water management treatment were boxed every 2m to conserve rain water. Important data collected included stand count, technology assessment (based on plant growth) and pod weight. Groundnut samples harvested from each plot were taken to Chitedze Research Station and after drying, a 300g random sample was subjected to aflatoxin analysis using the Enzyme Linked Immuno-Sorbent Assay (ELISA).

Even though treatments were not significantly different ($p = 0.05$), useful results were observed between genotype, time and water management interaction for the three-year period. Results show use of resistant genotype, early planting and tied ridges interaction reduced aflatoxin contamination 3.04-fold as compared to use of the same (resistant) genotype at late planting and open ridges, 75.5 ppb vs. 204.9 ppb respectively. For genotype and water management there was no significant difference observed in aflatoxin contamination though big differences were observed on susceptible and resistant genotypes when planted on open ridges compared to when planted on tied ridges (App. 5). Results showed a contamination of 205.5 ppb vs. 140.6ppb for open and tied ridges, respectively. Genotype and time of planting interaction were not significantly different, $p = 0.05$. However, genotypes planted late had a higher aflatoxin contamination compared to early planting (App. 6). J-11 planted early had aflatoxin level reduced 2.8-fold compared to late planting, 59.2 ppb vs. 168.5 ppb respectively. Results from demonstrations from 2006/07 to 2008/09 seasons were compiled and shared with farmers during field days.

2.1.2 Conduct field days, agricultural shows & rural seed fairs with farmers, researchers & market players

Throughout the project period (2006–2010), FFDs and seed fairs have played a central role in showcasing groundnut production technologies to farmers, traders and other partners. The useful information collected has formed the basis for phase II of the project as well as providing strong case for release of varieties in Tanzania. Over the period, a total of 49 FFDs were conducted in Malawi attracting a total of 2858 farmers of which 1141 were women. FFDs were arranged to provide a chance for farmers and scientists to critically review research activities and isolate the project's islands of success and establish future focal points in addition to giving chance to these farmers and other stakeholders to observe and select from a range of elite materials available and potential new materials in the pipeline through PVS. In Malawi, FFDs were often conducted at two crop stages: physiological maturity and harvesting. Efforts were put in place to train farmers and extension workers on groundnut production practices, seed production and post harvest crop handling with focus on the management of aflatoxin. Modern drying techniques including the use of ventilated stacks (Mandela corks) were demonstrated on yearly basis. In Tanzania, 10 farmer field days were conducted annually and attracted approximately 825 farmers of which 40% were women. Video films on agricultural technologies including groundnut seed production and improved agronomic practices were highlighted. A total of four (4) seed fairs were conducted with the objective of creating awareness and accessibility of improved seed to farmers. Each of these seed fairs attracted approximately 1500 farmers. The Tanzania seed fairs are expected to have impacted more than 4500 farm families in the target districts.

2.1.3 Enhance institutional innovations to improve access of the poor to good quality seeds of improved high-yielding adapted varieties

a) Agreements established with at least two non-governmental organizations to establish community seed production for at least two different varieties in each country

The project in Malawi established two partnerships aimed at involving communities in seed multiplication and providing them with the chance to access seed of improved varieties. CARE (Cooperative for American Relief Everywhere)-Malawi and NASFAM were envisaged as strategic partners for the roles they play working with rural communities. For NASFAM, 47 research groups were established in the project sites in 2006/07 growing season. 93 farmers in Mchinji received 10 kg each of ICGV-SM 90704 (GRD resistant variety) and 140 farmers in Nkhotakota received 5 kg each of JL 24 a high-yielding short-duration variety. Though CARE Malawi is not operating in the project's target districts, farmers targeted by this NGO in Kasungu District benefitted through seed (8.1 tons) produced in Mchinji which provided a seed market for our farmers.

b) Monitoring system established to assess seed demand from demonstration trials and linked to basic seed production

In 2007/08, improved variety, seed and marketing platforms were established in the two countries. The project also defined market channels in the target areas. NASFAM already had established functional market collection points. Similar efforts were implemented through cooperative societies in Masasi and Dodoma in Tanzania. In February 2010, the project's monitoring team visited all the nine chapters in Mchinji and Nkhotakota to ascertain status of these market channels as well as trials, demonstrations and community seed production activities. The two varieties supplied by the project currently enjoy demand from traders who actually compete with NASFAM. Some of the areas in Mchinji faced severe drought especially in Mlonyeni and Mkanda in 2007/08. The same year Tanzania also experienced severe droughts. Project activities were demonstrated along the main roads, providing members of the general public and other stakeholders an opportunity to appreciate available technologies.

c) Community seed banks established and fully functioning

In Malawi, there are 1940 farmers organized in 51 research groups in the seed pass-on program who participate in community seed banks as a result of project activities. The program has created a lot of interest in community seed banks and farmers have registered full appreciation on the impact brought by the seed pass-on program. For example, most farmers in Nkhotakota are currently growing an acre or more of the improved variety JL 24 from initial 5 kg seed supplied to them at the beginning of the project in 2006. The same applies to Mchinji where some farmers have up to about 2 acres of ICGV-SM 90704 (Nsinjiro) from an initial supply of 10 kg at the beginning of the project. Seed inspectors from the Ministry of Agriculture played an important role in ascertaining seed quality through their inspection services. The exercise has also brought excitement and more impetus to farmers as most were issued with certificates for the production of certified seed. Groundnut production trends have been on the increase as a result. Farmers from the community seed production groups in Mchinji were able to sell certified seed of ICGV-SM 90704 amounting to 6.52 metric tons during 2009/10 to the ICRISAT seed revolving fund from an estimated total production of 23 tons. Seed production trends by the established groups as a result of the project intervention have therefore moved from 17.48 tons in 2007/08 and 18.9 tons in 2008/09 to 23 tons in 2009/10 season. This production is the basis of the 8.1 tons the project was able to avail to CARE-Malawi during 2008/09 season. Figure 2 shows one of the fields for seed production in Mchinji.

In Tanzania, a total of at least 50 Farmer Research Groups (FRG)/ FFS (30 groups in Mtwara and 20 groups in Dodoma) were involved in PVS and seed multiplication in the 2007/08 season. A total of 140 tons of seed was produced in the 2007/08 and by 2008/09 the project for the first time facilitated FRGs into official seed production groups with the national seed agency The Agricultural Seed Agency (ASA). By 2009/10 the groups in Southern Tanzania (Masasi and Mtwara) were already capable of supplying a total of 40 tons of groundnut seeds to the ASA. These efforts are in collaboration with the BMGF-funded Tropical Legumes II project.

Fig. 2. Community seed production Mrs Ida Chizungu's field in Mchinji

2.1.4. Conduct training-of-trainers program on seed and crop production techniques for extension and NGO partners

a) Training and information needs of partners identified

One of the set backs derailing proper implementation of activities for our partners is the inability of the target communities to own project activities. In view of this, the project identified '*community appraisal*' as an area on which both staff and farmers in the target communities needed training. A total of 497 farmers (including lead farmers) were trained on postharvest crop handling with a focus on the management of aflatoxin. Community seed groups formed the basis for training. Modern drying techniques including the use of ventilated stacks (Mandela corks) were demonstrated. Additionally, at least 7 Association Field Officers from NASFAM, 5 Agricultural Extension Development Officers from MoA and Food Security, and 18 lead farmers were trained on a yearly basis in the seed production and general production practices. Training on crop evaluation for data collection was also done. It is anticipated that through farmer learning activities promoted in the project target areas, more farmers will benefit by learning from one another.

b) Informal short- and formal/long-term training initiated during year 1 and continuing

Ministry of Agriculture and Food Security and project partners were continuously engaged in a number of training activities in order to consolidate understanding on groundnut production practices and facilitate sound extension services on the same. Lead farmers were equipped with information on groundnut production technologies through training for them to effectively operate as village facilitators. More than 25 Government extension officers, at least 10 NASFAM and district council association field officers and lead farmers were trained on an annual basis from both Malawi and Tanzania (Table 6). Training topics covered principles of quality seed production, marketing, common pest and diseases of groundnuts and their management, and postharvest crop handling.

Table 6. Number of staff trained during the project period in Malawi and Tanzania

	Seasons				
Trainees	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**Total**
Govt. extension workers	24	20	39	25	108
Association field officers	13	13	3	7	36
Lead farmers	50	11	42	497	600
Total	87	44	84	529	744

Implications of the research findings

a. For the next stage of research

In the next phase of the project there will be need for introduction of FFS so that communities learn through an organized curriculum. This will also allow for all activities (variety trials, demonstrations for management of Rosette and aflatoxin and demonstrations for postharvest crop handling) for a particular research group to be in one place. These have successfully been implemented for communities under a sister project also being implemented by ICRISAT and CARE-Malawi. Successful pro-poor seed production models learned in phase I will be scaled up to increase farmer access to improved varieties.

b. For future development activities

There is a window of opportunity for the project to reach out and build on the lessons learned from the benchmark districts to Mzimba District in Malawi. The district is fair trade certified which gives it the opportunity to sell to the lucrative European market at preferential prices. This also implies maintaining the highest aflatoxin quality standards. Phase II will therefore impart farmers with the required knowledge for on-farm management of the aflatoxin problem in order to produce good quality healthy groundnuts. For Tanzania, the project will scale out the successful technologies by involving more farmer groups in the participating districts. Significant efforts will be spent to map the occurrence and distribution of aflatoxin contamination in Tanzania and development of strategies for integrated management of aflatoxin that can be applied by resource-poor farmers.

Objective 3 Increase groundnut productivity by development and implementation of a sound and practical technology dissemination program

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Introduction

The level of impact the project brings to the target groups and the ease with which technologies advocated are adopted often measures the success of the project. Utilization of appropriate and effective technology dissemination tools is key to ensuring speedy uptake of technologies. To achieve this, all players in the groundnut value chain need to be involved. Use of media is of paramount importance as it helps get information at national level rather than solely at the level of the communities where the project operates. In this project, the multi-disciplinary partnership for technology uptake included farmers, community leaders, researchers, extension agents, and private sector, traders and processors. The objective aimed to put in place farmer platforms and mechanisms to improve sustainability of the project outputs and in the process expose the project's main features and successes.

Narrative Summary

3.1.1. Organize planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation.

3.1.2. Promote/encourage development of farmer associations/clubs and producer marketing groups and community collection points from village to district levels

3.1.3. Disseminate (scale up and scale out) both methodologies for technology promotion and the proven technologies from benchmark testing sites (target communities) to communities in the district and at the national level

3.1.4. Establish strategy and time frame for impact monitoring and reporting

3.1.1 Organize planning workshop of project stakeholders to agree on project components for promotion, pilot areas and mode of operation

Strategic planning meetings were conducted with personnel involved in project implementation. In 2007, two stakeholder workshops were organized in Lilongwe-Malawi and Mtwara-Tanzania to discuss issues related to groundnut production and develop strategies that could be used to improve project work plans and ensure more sustainable outcomes. The workshop drew participants from NASFAM, Department of Agriculture Research Services, ICRISAT and DRD through Naliendele Research Institute. The project also organized an annual review meeting in Lilongwe held at Cresta Hotel on 24 September 2007 in which delegates shared project experiences and reviewed baseline survey reports for Malawi and Tanzania. Thereafter, the project organized annual planning and review meetings in conjunction with the regional CoP meetings. In January 2010, a special stakeholder's workshop was convened in Lilongwe-Malawi to discuss the problem of aflatoxin and its implication on human health, nutrition and markets. The meeting attracted the attention of players in the groundnut industry (Malawi and Tanzania) with the Principal Secretary of the Ministry of Agriculture and Food Security (Malawi) as the guest of honor. The main aim was to create awareness of aflatoxin in Malawi and solicit input from stakeholders for the needs of aflatoxin-related research. At local level in Malawi strategic planning meetings were also organized. Since NASFAM runs its activities through associations vis-à-vis Mchinji and Nkhotakota associations, it was necessary to have planning sessions with Association Business Managers and Association Field Officers annually to map an appropriate way forward for implementation and monitoring of activities. Some of the challenges identified included shortage of personnel that was so severe that some important production areas did not have Field Officers. Additionally, the delay in provision of fuel to Field Officers was another area of concern. Both forums agreed to take necessary actions in order to facilitate smooth operations.

3.1.2 Dissemination (scale up and scale out) methodologies for promotion of proven technologies from benchmark testing sites (target communities) to communities in the district and at the national level

The project in Tanzania in collaboration with media experts from the National Television Channels, TVT, Star TV has produced 14 documentaries of which seven 7 have been broadcast to the general public to sensitize stakeholders on project activities in groundnut production and marketing in particular. The project has also published booklets and flyers of groundnut improved production practices in Chichewa for Malawi and Kiswahili for Tanzania intended for farmers (collaborating and non-collaborating) and extension officers. Although a lot of proven technologies have been developed, most of them are still not known by farmers, which have led to low adoption. Media was employed to complement conventional interventions to scale up and out newly developed technologies.. By using the media it is anticipated that technologies will be spread to cover a wider area than could be reached by researchers alone. One of the most important project expectations was farmer adoption of the technologies demonstrated in farmers' fields (improved varieties and options for the management of GRD, drought and aflatoxin). By 2009/10 growing season, the fourth year of the project, a total of 116 trials and demonstration for improved production technologies had been conducted in farmer's fields in the two countries.

a) Traders/ Stakeholder Engagement:
The business community was engaged and sensitized on the existence of improved groundnut technologies through seed fairs. A total of six seed fairs were held during the project period in Dodoma Central Tanzania and Nanyumbu Districts Southern Tanzania to create awareness and accessibility of seeds of improved varieties. These seed fairs attracted more than 4500 farmers. During the events, live radio coverage and TV broadcasts were made by both local and national radios. Channel 10 and Tanzania Broadcasting Corporation were also engaged. In Malawi a number of strategies were put in place to reach out to many members including traders with the objective of providing awareness about available groundnut technologies (varieties, pre- and postharvest crop handling techniques, seed production and management of Rosette and aflatoxin). Field days, videos and radio programs provided an excellent forum for engaging these stakeholders, which included members of the business community and policy makers. These also helped to link traders with farmers looking for groundnut markets.

b) Leaflets, flyers, videos and radio programs:
In order to enhance groundnut productivity, production and incomes of poor farmers in Malawi, the project has produced and distributed 15,000 flyers of three different types in Chichewa to communities and extension workers in Mchinji and Nkhotakota Districts. These flyers depict improved groundnut varieties released in Malawi, production technologies for the management of Rosette and aflatoxin. The project also produced posters that were presented during Annual General Meetings of NASFAM aimed at highlighting project activities and islands of success. The NASFAM Annual General Meetings normally attract farmers throughout the country, officials from the Ministry of Agriculture and Food Security including occasionally the the Permanent Secretary and Deputy Minister which makes it an excellent venue for policy messages. The project team from ICRISAT also recorded radio programs through NASFAM's Communications Unit sensitizing the communities on the dangers of aflatoxins and approaches to managing it. In Tanzania, 1000 leaflets, 2000 groundnut booklets on improved groundnut crop husbandry in Kiswahili (*Kanuni Bora za kilimo cha karanga*) have been distributed to farmer groups and students from the Ministry of Agriculture Training Institute (MATI-Mtwara) and other interested stakeholders during seed fairs. The project also invited media from the national television and newspapers to visit the project areas to document the impact of activities. Star TV for example has produced six documentaries of which three have been broadcast while Tanzania Broadcasting Corporation (TBC) through TVT has produced eight documentaries of which four have been broadcast to the general public. Table 7 below summarizes methodologies used over the project cycle for the two countries.

Table 7. Leaflets, flyers, videos and radio programs produced in Malawi and Tanzania over the project period

Technology promotion method	2006/07	2007/08	2008/09	2009/10
Radio documentaries	6	2	14	11
Flyers/leaflets	1000	1500	15000	6000
TV documentaries	1		6	8
Booklets		1	2000	
Posters			151	
Video films		1		

3.1.3 Establish strategy and time frame for impact monitoring and reporting

Monitoring and evaluation was built into the project design to monitor progress in all activities. This has provided an opportunity for the Project Management Team to analyze assumptions laid out at the onset of the project. On 6 April 2008, the project team (NASFAM and ICRISAT) from Malawi visited research activities in Masasi and Dodoma in Tanzania to backstop activities. Dr Mponda, the principal collaborator based at Naliendele Research Station, showcased activities in Tanzania. A similar trip was undertaken in July 2009. In view of the project ending in August 2010, the project members from ICRISAT organized a meeting with their Tanzanian counterparts to share experiences from the project on the two sides and provide direction on evaluation of project activities. The meeting took place on the 8 April 2010 in which logistics for the end of project survey and impact assessment was discussed by team members who included Dr O Mponda, Dr E. Monyo, Dr E. Kafiriti, Mr W. Munthali, Mrs. Joana Kasuga, Mr Phillipo Mashamba and Mrs. E Chilumpha. Following the approval of Phase II the Malawi project team (ICRISAT and NASFAM) comprising Dr. E. Monyo, Mrs. Candida Nakhumwa, Mr W. Munthali, Mr Harry Msere, Mrs. E. Chilumpha and Mr Samu Phiri met at ICRISAT to develop a monitoring and evaluation plan for the project. This took place on 20 July 2010 where a framework for impact monitoring of phase II of the project was developed.

3 Highlights of the Project Impact Assessment

After four years of implementation, an impact assessment study was conducted to assess the short-term impact of the project. The study was conducted in both project areas of Mchinji and Nkhotakota in Malawi and Masasi and Dodoma in Tanzania. In Malawi the project interviewed participants who are NASFAM members and non-members from the same area as control group. Similarly, in Tanzania, group members who participated in the project and non-group members from the same villages were interviewed. A total of 429 farmers were interviewed.

The findings in Malawi indicated that about 92% of the interviewed farmers were cultivating improved groundnut varieties whereas in Tanzania on average 60% were cultivating improved varieties. A high adoption rate of 96% was obtained in Masasi Southern Tanzania where the improved groundnut variety Pendo is grown by virtually all farmers. The project assisted in increasing farmers' access to improved seed through establishment of community seed banks. This strategy enhanced adoption of improved varieties, which resulted in improvement of yield, quantities of groundnut consumed and income of smallholder farmers. The project also created aflatoxin awareness, a major barrier to export market. This knowledge will improve crop management that will assist in increasing export base of Malawi and improve foreign exchange revenues. The project in Tanzania has contributed tremendously to increase income from an average of TShs 700,000 in 2007 in Masasi to 1.5 million in 2010 as a result of increased productivity through use of improved variety Pendo. Consequently, there has been increased ownership of physical assets such as mobile phones, corrugated iron houses and increased number of sprayers and other items.

a) Assets and other items purchased in the last three years

Results show that through groundnut sales or with contribution from groundnut income, farmers acquired a number of life changing assets. The most popular use of the increased income from groundnuts was purchase of furniture, kitchen utensils, bicycles and radios (4 – 71% of the respondents at the end of the project vs. 16–23% at the baseline (Tables 8a and

8b). The majority (70%) of female farmers in Malawi indicated to have purchased kitchen utensils. The purchasing of these assets is likely to improve quality of life, improve access to information and ease transport problems.

Table 8a. Household assets acquired in 2005/06 season at the beginning of the project

Asset acquired	% of members	% of non-members
Kitchen utensils	23	29
Bicycle	22	23
Radio	22	22
Furniture	16	17
Television/video set	3	2
Iron sheet/ tile roofed house	4	2

Table 8b. Assets purchased within the project implementation time

	Assets owned by membership and country			
	Malawi		**Tanzania**	
Assets bought	**Members**	**Non-members**	**Members**	**Non-members**
Bicycle	48.2	61.0	58	57.5
Radio	52.6	45.5	58	54
Television	6.0	6.5	3.5	12.5
Furniture	38.6	37.7	66.5	61.5
Kitchen utensils	70.1	71.4	65.5	50
Oxcart	6.8	1.3	10.5	5.5
Iron sheet	18.3	15.6	56	54.5
Cell phone	28.7	16.9	51.5	30.5

b) Frequency of groundnut inclusion in main meals/week

The results revealed that frequency of including groundnuts in meals per week was very variable among the respondents. The findings indicated that about 77% and 26% of the respondents in Malawi and Tanzania included groundnuts in their main meals at least three times in a week. Furthermore, about 23% of members included groundnuts in their diets up to twice per week compared to 21% of the non-members in Malawi. Approximately 21% of members in Malawi and almost 50% in Tanzania included groundnuts in their diets more than 4 times a week compared to 13% and 40% of non-members respectively (Table 9). Regular inclusion of groundnuts in the main meal is likely to contribute to nutrition security as groundnut is a cheap source of proteins and oil.

Table 9. Number of times groundnut is included in meals per week

	Number of times groundnut is included in meals per week by respondent type			
	Malawi		**Tanzania**	
	Member	**Non-member**	**Member**	**Non-member**
Once	8.7	7.8	17.5	19.5
Twice	13.7	13.0	13.5	7
Three times	35.0	41.6	11	14.5
Four times	20.9	24.7	8.5	16
More than four	21.3	13.0	49.5	40.5

times				

c) Groundnut production trend

In terms of groundnut production pattern, the results showed that there was an increase in groundnuts produced at the end of each season. The yields are slightly lower because most farmers sell and consume their groundnuts while they are fresh. The results further indicated that the yields per farmer are higher in Malawi than in Tanzania. There was a decline in yield per farmer during the 2008/09 due to dry spells. The results also indicated an increase in yield among non-members due to spillover effects of the project as almost all the non members reported to have planted the same varieties planted by the members (Table 10).

Table 10. Change in groundnut production and consumption pattern

Cropping season	**Average yield (kg) of improved groundnut variety by season, respondent type and country**			
	Malawi		**Tanzania**	
	Members	**Non-members**	**Members**	**Non-members**
2009/10	680	536	No results yet	No results yet
2008/09	320	302	239	164
2007/08	640	453	270	252
2006/07	370	312	654	303

Implications of the research

a. For future development activities

Technologies implemented by farmers in the benchmark districts have demonstrated their potential to reduce chronic food shortages experienced in the two countries. Increased groundnut consumption is indicative of the progress the project has achieved. This has in turn put pressure on the need for increased production and delivery of quality seed. The project will have to fully utilize and enhance the capacities of existing and new community seed groups and collaborating NGOs for intensive dissemination of the available and new technologies using media and other appropriate strategies. These will go a long way towards achieving the overall project goal of poverty reduction and improvement of food and nutritional security.

b. For policy

Deliberate policies need to be put in place to extend lessons learned in the benchmark areas to other districts to enable a good proportion of farmers in Malawi and Tanzania to access the improved technologies.

4 Team Report Section

Team activities: The team had two formal exchange visit programs. The first one was during the stakeholder launching workshops which also provided a venue for joint planning of year 1 activities. The Malawi-based team (ICRISAT and NASFAM) participated in the launch workshop in Tanzania, and the Tanzania-based team also participated in the launching workshop in Malawi. The teams contributed to the deliberations related to the workplan for each country and included people with varying experiences. For example, the Tanzania team brought a private groundnut trader to the workshop in Malawi.

The Tanzania team organized a seed fair at Mpeta and Mangaka villages in Masasi which was attended by close to 2000 farmers. One representative of the team from Malawi was in attendance. Groundnut technologies including new seed varieties, displays of farmer variety selection results, and village value addition methods were displayed. Farmers took the opportunity to purchase seed from one another. It is estimated that more that half of the farmers were able to exchange germplasm and learn various value addition techniques like oil expression.

Meeting with DRT, Tanzania

A visit was paid to the Ministry of Agriculture, and discussions held with Dr. Musabaha, the Assistant Director for Crops at the Department for Research and Training (DRT, Tanzania), on behalf of the Director. Dr. Musabaha welcomed the Groundnut ESA Project to Tanzania, noting that their activities were in line with the goals of the Government of Tanzania. He urged the project to continue to focus on linking farmers to markets to improve income generation. He also urged the teams to be prepared for the McKnight CoP meeting in Tanzania, and assured them of his Directorate's support.

Visit to field activities of the Cowpea Alectra Project

As part of the learning activities of the McKnight ESA legumes CoP, four members of the Groundnut Breeding (ESA Africa) project, Emmanuel Monyo (PI and Groundnut Breeder, ICRISAT, Malawi), Omari Mponda (Collaborator and Groundnut Breeder, Naliendele Agricultural Research Institute, DRT, Tanzania), Moses Osiru (Collaborator and Groundnut Pathologist, ICRISAT, Malawi) and Frank Masankha (Collaborator and Crop Production Specialist, NASFAM) visited the Cowpea Alectra (ESA) project sites in Dodoma, Tanzania, to improve cross learning and lesson sharing among the two projects. Two field sites of the Cowpea Alectra Project were visited − Bihawana Farmer Training Center (BFTC) and the "Voice of the Farmer" Group in Dodoma, that helped to underscore the objectives and activities of the cowpea project achievements.

Community of Practice (CoP)

The first meeting of Legumes Community of Practice was successfully held on 25−28, September 2007 in Lilongwe, Malawi. Project team members attended the meeting, delivered a presentation on the ESA Breeding Project and also hosted one of two field days. During the CoP, a number of important challenges were raised for the project team such as:

1. How can farmers benefit nutritionally from increased production of groundnuts? Increased production may not mean increased consumption and increasing incomes often does not improve nutrition.
2. How can farmers obtain access to small shelling machines?
3. How can farmers (particularly men) improve knowledge on nutritional components that could impact child feeding?
4. Is there need to look into P efficient groundnuts? Are there correlations with root hairs and P uptake, P screening etc.

The second annual meeting of the Southern Africa CCRP community of practice (CoP2-SAf) was held between 6 and 9 October 2008 in Maputo, Mozambique. Representatives of the six CCRP projects in Malawi, Mozambique and Tanzania shared strategies and plan for their projects; gave presentations about their project's progress, and mounted project displays, which included posters, leaflets, and products. Dr. Manual Amane of IIAM, the national agricultural research program of Mozambique, hosted the meeting and organized a field day at Umbeluzi Research Station. The featured topic of the CoP2-SAf was climate variability and change, for which Dr. Roger Stern served as resource person. The meeting was coordinated by Regional Representative, Joseph Mpagalile and facilitated by Jurgen Hagmann.

The third annual meeting of the Southern Africa CCRP community of practice (CoP3-SAf) was held from 21 to 25 September 2009 at the Millennium Sea Breeze Hotel in Bagamoyo, Tanzania, under the theme 'farmer participation'. The meeting focused on how best farmers could be engaged effectively in project activities. Prior to the meeting, Nick and Baruani trained extension staff in the preparation of participatory video. Eight videos were prepared covering a range of topics, and these drew a lot of interest from grantees. Grantees were also engaged in discussions with resource persons on what kind of support Reading's Statistical Services Centre would provide to the McKnight-funded projects and issues of research methods and data management came out prominent. The meeting also drew participation from farmers and NGOs. The fourth Community of Practice Meeting (CoP4-Saf) will be held from 26 September–2 October, 2010 at the Club Makokola, Mangochi District, along the shores of Lake Malawi.

Other insights and lessons learned:

1. Sprouting has been a big challenge in Malawi for all the short-duration varieties being promoted. Urgent attention is needed to incorporate field dormancy into adapted varieties.
2. Most varieties under participatory variety selection are susceptible to aflatoxin, which calls for hybridization activities for introgressing of aflatoxin-resistant traits into farmer-preferred varieties. A few resistant lines have been identified from ICRISAT germplasm that could be used as sources of resistance.

Actions required and outlook

1. Identify materials through screening or introductions that will be sources of resistance to seed dormancy
2. Initiate hybridization program for introgressing aflatoxin resistance into farmer/market preferred varieties
3. Organize farmers into groups and promote formation of FFS
4. Informal seed systems have proved effective in increasing availability of seed and also in promoting improved varieties with small-scale farmers particularly for self-pollinated crops such as groundnuts. Reinforcement of community seed production structures will be key to sustainability of the program.

5 Work plan for Year 1 Phase II: (September, 2010 – August 2011)

Groundnut varieties improvement for yield and adaptation, human health and nutrition

Project Outputs and Activities

1. Output 1: High-yielding farmer- and market-acceptable groundnut varieties with resistance to foliar/viral diseases and aflatoxin contamination

Activities:

1.1. Identify and introgress germplasm for yield components farmer/market preferences and adaptation to biotic and abiotic (drought) traits
1.2. Develop diverse groundnuts breeding lines and populations while developing capacity to screen for GRD and foliar disease resistance in Tanzania
1.3. Develop advanced breeding lines and varieties of groundnut with special emphasis on resistance to aflatoxin contamination

2. Output 2: Nutritional status, dietary diversity, human health and mycotoxin contamination problem spatially characterized

Activities:

2.1. Define the scale of the mycotoxin contamination problem and identify the hotspots depicting pockets of the populations where mycotoxin occurrence is higher
2.2. Assess the relative exposure of humans to mycotoxin contamination of food in drought-prone regions and other vulnerable areas and nutritional benefits from aflatoxin-free foods
2.3. Assess aflatoxin load in exposed populations and relationships to health-related ailments
2.4. Assess aflatoxin load in exposed populations and relationships to nutrition as determined by body mass index (BMI)

3. Output 3: Adoption rates of improved farmer- and market-acceptable varieties and production technologies enhanced

Activities:

3.1. Conduct participatory adaptive trials to assess mycotoxin management practices relating to crop production in pre- postharvest operations, and demonstrations for postharvest handling, food processing methods, consumption patterns and diets
3.2. Conduct field days, agricultural shows and rural seed fairs with farmers, researchers and market players to promote improved mycotoxin management including testing of resistant cultivars
3.3. Enhance institutional innovations to improve access of the poor to good quality seeds of improved high-yielding adapted varieties

4. Output 4: Capacity of partners for management of mycotoxins in food, variety development and enabling policy environment enhanced

Activities:

4.1. Stakeholders project startup/planning workshop to agree on project components for promotion, pilot areas and mode of operation

4.2. Conduct training workshops for NARES staff

4.3. Degree training program to MSc to develop regional capacity for pathology work including screening of commodities for aflatoxin contamination

4.4. Conduct sensitization workshop for policy makers, NARES/ NGO/private sector

4.4.1. Through a national level workshop, recommended policy options will be advocated to decision-makers at national level by end of project. Preliminary findings will be shared with stakeholders.

4.4.2. Linkages with the health and other sectors will be developed and maintained for future collaboration

4.4.3. Develop and share project reports, policy briefs and journal articles

4.5. Establish strategy and timeframe for impact monitoring and reporting

Yea r	Quarter	Activity number	Type of milestone	Description of milestone	Time due*	Means of verification
1 1 1	1 3 4	1.1.1	Activity	• Breeding objectives incorporates knowledge and skills of smallholder farmers through PVS thereby improving breeding efficiency from year 1 of phase II (2010) • Additional sources of resistance to foliar diseases and/or aflatoxin contamination identified from the groundnuts reference set, core collections, local and wild germplasm (2010–2014) • Farmer-preferred varieties with local adaptation identified and hybridization initiated for introgression of resistance to aflatoxin, GRD and foliar fungal disease resistances (2011)	Nov 2010 June 2011 Sept 2011	• List of farmer researcher groups in the two countries • List of sources of resistance for hybridization • List of varieties with farmer /market preferred traits
1	1	1.1.2	Activity	• Disease screening capacity developed in Tanzania and NARS scientists routinely use the infector row technique (2010–2014)	Nov 2010	• Training reports • Infector row technique established in Tanzania
1 1	3 4	1.1.3	Activity Activity	• Advanced breeding lines and breeder seed of improved groundnut varieties available to NARS and NGOs in ESA on an annual basis (2010–2014)	June 2011	• Seed requests/signed MTAs • List and quantities of germplasm distribution by

Yea r	Quarter	Activity number	Type of milestone	Description of milestone	Time due*	Means of verification
				• Sick plots for resistance to aflatoxin contaminated developed and screening and testing activities initiated	Aug 2011	country • List of entries screened and report of performance
1	4	2.2.1	Activity	• Aflatoxin disease survey implemented in Tanzania – (Oct – Dec 10; May – Jun 11)	Aug 2011	• Survey report
	4	2.2.1	Activity	• Aflatoxin testing of survey samples from Tanzania – (Oct –2010; Jun 2011)	Aug 2011	• Report of aflatoxin levels
	4		Activity	• *A.flavus* testing of soil and grain samples from Tanzania – (Oct –2010; Jun 2011)	Aug 2011	• Report of *A. flavus* abundance
	4	2.2.3	Activity	• Aflatoxin testing of human samples from Malawi – (Oct –2010; Jun 2011)	Aug 2011	• Report of aflatoxin load in tested samples
1	1	2.3.1	Activity	• Training implemented on aflatoxin testing and handling of human samples (India)	Aug 2010	• Training report
1	4	2.3.4	Activity	• Nutrition survey implemented in Tanzania (Jul 2010 – June 2011) link with postharvest project	Aug 2011	• Survey report
1	4	3.1.1	Activity	• Varieties for widescale on-farm adaptive testing with farmer participation (2010 – 2014)	Aug 2011	• List of varieties for on-farm testing in PVS in each country
1	4	3.2.1	Activity	• Field days, demonstrations, agricultural shows and seed fairs conducted at select farmer field school sites annually (2010 – 2014)	Aug 2011	• No. of field days, number and type and stakeholders participating • No. of demonstrations

Yea r	Quarter	Activity number	Type of milestone	Description of milestone	Time due*	Means of verification
						mounted • List of traders and others involved in groundnut trading • No. of farmers demonstrating at seed fairs and list of varieties preferred by farmers and market
1	1	3.3.1	Activity	• Engagement with at least two non-governmental organizations for community seed supply of improved groundnut varieties (2010−14)	Dec 2010	• No. of seed delivery innovations operational • Quantity of seed produced and sold • Publications
1	1	4.2.1	Activity	• Phase II launching workshop for linkages, partnerships establishment and familiarization with new stakeholders (August 2010)	Dec 2010	• Workshop report
1 1	1 4 4	4.2.2	Activity	• Training in partners in disease screening • Training partners in aflatoxin detection • Training new technicians on hybridization techniques (Feb and Sept in alternative years)	Mar 2011 Aug 2011 Sept 2011	• Training report • Training report • Training report

Yea r	Quarter	Activity number	Type of milestone	Description of milestone	Time due*	Means of verification
1	4	4.5.1	Activity	• Project annual review for internal monitoring established and functioning (Oct/Nov 2010−2014)	Oct – Nov 2010	• M&E plan • Progress reviews and annual workplans

6 Publications Summary

1. Osiru, M., Monyo, E., Waliyar, F., and Harvey, C., 2007. Strategies for management of the groundnut rosette disease in sub-Saharan Africa. Fourth Annual General Meeting of the Forum for Agricultural Research in Africa. 10 – 17 June, 2007. Sandton, South Africa.
2. ICRISAT (International Crops Research Institute for the Semi Arid Tropics) 2008. Proceedings of a Stakeholder Workshop on Groundnut Production in Malawi and Tanzania, 1-2 March, 2007, Lilongwe, Malawi. Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics.
3. Monyo ES, Osiru MO, Kadyampakeni D, Mponda O and Chinyamunyamu B. (eds.). 2009. Improving Food Security and Nutrition in Malawi and Tanzania through Research on Edible Legumes. Proceedings of Stakeholder Workshops on Groundnut Production in Malawi and Tanzania held 1-2 March and 13 April 2007, Lilongwe (Malawi) and Mtwara (Tanzania). Patancheru 502 324, Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 96 pp. ISBN: 978-92-9066-515-1.
4. Monyo ES, Osiru M, Mponda O, Harvey C and Munthali W., 2008. Rosette and Early Leaf spots resistant groundnut varieties for Eastern and Southern Africa. Third International Conference of the Peanut Research Community on Advances in Arachis through Genomics and Biotechnology (AAGB-2008). ICRISAT, Hyderabad (AP), India 4-8 November, 2008. Abstracts – pg 20.
5. Vadez V, Varshney RK, Bertioli D, Leal-Bertioli S, Patterson A, Monyo E, Mponda O, Kapewa T, Ntare B, Hamidou F, Moutari A and Ndoye O. 2008. The long journey towards molecular breeding to improve groundnut productivity for marginal environments in sub-Saharan Africa. Presented at the 2008 Annual Research Meeting of the Generation Challenge Program, 16-20 September 2008, Bangkok, Thailand.
6. Monyo ES., Osiru MO., Siambi M., Munthali W., Chinyamunyamu B., Mponda O., Nakhumwa C., Kafiriti E., Phiri SD and Sijaona M. 2008. Developing Short- and Medium-Duration Groundnut Varieties with Improved Yield Performance, Acceptable Market Traits and Resistance to Foliar Diseases. Annual General Meeting of the National Smallholder Farmers Associations of Malawi (NASFAM) – 25th November, 2008. ICRISAT. Lilongwe, Malawi.
7. Monyo, E.S., Osiru M.O., Mponda, O., Chinyamunyamu, B., Kafiriti, Warren D., and Nakhumwa, C. 2008. Developing short and medium duration groundnut varieties with improved yield performance, acceptable market traits and resistant to foliar diseases. Paper presented at the second meeting of the McKnight Legumes Community of Practice Meeting, 6 – 10 Oct 2008 Maputo, Mozambique.
8. Osiru, M.O. and Monyo, E.S. 2008. Life-saving nuts. SATrends Issue 86.
9. 7. **UHURU:** Wakulima nchini hupoteza shs. Bilioni 14 kutokana na kutotumia mbegu bora. (Farmers in Tanzania lose US$14 million annually from lack of good quality groundnut seed). Emmanuel S Monyo (ICRISAT) http://www.uhuruinfo.co.tz. ISSN 0876-3896 Na. 20126 Jumatatu Desemba 22, 2008 pg5.

7 Training and Outreach Summary

Ministry of Agriculture and Food Security engaged in training activities in order to consolidate understanding on groundnut production practices and facilitate sound extension services on the same. The project with additional resources from Bill and Melinda Gates continues to conduct training-of-trainers programs. A total of 25 extension staff (4 crop officers, 4 agricultural extension development co-ordinators (AEDCs) and 17 research technicians) from the Ministry of Agriculture (MoA) and Food Security were trained in seed and crop production techniques. This was conducted in Salima District from 8–12 February 2010.

One of the set backs derailing proper implementation of activities for our partners is inability of the target communities to own project activities. In view of this, the project identified *'community appraisal'* as an area in which both staff and farmers in the target communities needed training. A training workshop on FFS was organised for SAFE, a project to which ICRISAT is a partner. The training conducted in three Traditional Authorities (TAs) (Njombwa, Mwase and Kaomba) was aimed at helping farmers define, identify, analyse and solve their problems; also for them to develop own work plans. The training attracted a total of 533 participants (197 males and 245 females) from 109 FFS.

APPENDICES

App. 1a: Rainfall data over the project period in Malawi and Tanzania

	Malawi		Tanzania		
Year	**Mchinji**	**Nkhotakota**	**Naliendele**	**Hombolo**	**Nachingwea**
2006/07	499.5	368.4			
2007/08	1675.5	1613.9	760.3	604.7	491.9
2008/09	587	1003.3	932.8	713.5	667.1
2009/10	1261	691	1277.8	574.3	772.7
Cumulative total	3523.5	3308.2	2970.9	1892.5	1931.7
Average rainfall	880.875	827.05	742.725	473.125	482.925

Appendix 1b: Summary Performance of the Regional Elite Groundnut Variety Trials Spanish and Virginia

Genotype (SB)	Pod yield	ELS score	Rosette Incidence (%)	Genotype (VB)	Pod yield	ELS score	Rosette Incidence (%)
ICGV-SM 03590	3228	3	0	ICGV-SM 02712	4344	2	32
ICGV-SM 99566	3139	6	1	ICGV-SM 01711	3039	3	0
ICGV-SM 99551	3106	4	1	ICGV-SM 01721	2833	2	18
ICGV-SM 01514	3094	4	0	ICGV-SM 05693	2733	2	31
ICGV 94139	3028	4	0	ICGV-SM 90704	2689	4	1
ICGV-SM 00537	3028	4	6	ICGV-SM 03708	2628	5	0
ICGV-SM 99537	2856	5	1	ICGV-SM 03710	2611	3	0
ICGV-SM 99568	2778	7	3	ICGV-SM 01709	2600	4	1
ICGV-SM 99530	2728	5	1	ICGV-SM 02710	2400	2	26
ICGV-SM 01504	2333	8	1	ICGV-SM 02725	2317	2	24
ICGV-SM 99555	2217	6	1	ICGV-SM 03709	2278	4	0
ICGV-SM 99557	1922	7	2	ICGV-SM 02701	2222	2	28
ICGV-SM	1606	7	0	CG 7	2217	2	47

Genotype (SB)	Pod yield	ELS score	Rosette Incidence (%)	Genotype (VB)	Pod yield	ELS score	Rosette Incidence (%)
01501							
ICGV-SM 98543	1289	3	23	ICGV-SM 02715	2039	2	40
ICGV-SM 99554	1211	5	2	ICGV-SM 05696	1922	1	30
F. Pr	<0.008	<0.001	<0.001	F. Pr	<0.001	<0.006	<0.001
Grand Mean (20)	1776	4.97	2.61	Grand Mean (20)	2534	2.65	16.2
S.E	42.6	0.461	2.456	S.E	206.4	0.57	5.35
L.S.D	715.6	1.36	7.245	L.S.D	608.8	1.682	15.79
C.V	19.3	13.1	133.3	C.V	11.5	30.4	46.8

App. 2a: Participatory variety trial (Virginia) for 2009/10 growing season for Malawi (kernel yield kg/ha)

Variety	Combined yield (kg/ha) Analysis	Yield (kg/ha) for Mchinji	Yield (kg/ha) for Nkhotakota	Rosette incidence (%) -combined
92R/70-4	572	495	688	7
CHALIMBANA 2005	622	304	1099	10.4
ICGV-SM 01708	1089	1141	1011	3.6
ICGV-SM 01724	824	608	1147	6
ICGV-SM 01728	697	490	1008	8.2
ICGV-SM 01731	1349	1329	1379	4.6
ICGV-SM 90704	1024	734	1460	3.2
ICGV-SM 99772	459	411	531	5.8
Mean	829.53	688.87	1040.51	6.1
Fpr	0.006	0.066	0.043	0.032
sed	223.731	323.484	221.901	2.101
lsd	458.293	693.804	524.711	4.303
CV	43	57	21	54.5

App. 2b: Participatory variety trial (Spanish) for 2009/10 growing season for Malawi (kernel yield kg/ha)

Variety	Combined	Mchinji	Nkhotakota	Rosette incidence-combined
CHITALA	288	491	153	2.5

Variety	Combined	Mchinji	Nkhotakota	Rosette incidence-combined
ICGV-SM01514	1029	714	1239	1.167
ICGV-SM03572	1103	503	1503	5.167
ICGV-SM03576	1289	801	1614	9.167
ICGV-SM99551	1172	932	1332	2.167
ICGV-SM99566	637	556	691	1.5
ICGV-SM99567	778	774	780	2.667
KAKOMA	414	521	342	8
Mean	838.00	661.34	957	4.04
Fpr	0.08	0.143	0.174	<.001
sed	361.59	154.08	580.73	1.782
lsd	739.58	364.35	1245.5	3.651
CV	68	23	74	69.7

App. 3: Groundnut On-farm trials (VB)-Pod yield (kg/ha) across sites 2009/10 growing season in Tanzania

Variety	**MUUNGANO**	**MKWAJUNI**	**MSANGA**	**MEAN KG/HA**
ICGV-SM 99568	920	1725	1380	1342
ICGV-SM 90704	2300	1955	1610	1955
ICGV-SM 02501	345	1840	1265	1150
ICGV-SM 03701	1495	1150	1380	1342
ICGV-SM 01711	690	1265	1380	1112
Pendo	1380	1725	1610	1581
CG 7	460	690	1150	767
Local	230	575	690	498
Mean				1217
CV %				29
LSD				621
p=0.05				**

App. 4: Trends for Rosette incidence for individual treatment combinations

Treatment combination	V = Variety	T = Time of planting	P =Density	Kernel yield/ha	Rosette inc %
V1T1P1	Chalimbana	Early (T1)	High (P1)	1113	2.2
V1T1P2	Chalimbana	Early (T1)	Low (P2)	843	3.5
V1T2P1	Chalimbana	Late (T2)	High (P1)	681	8.6
V1T2P2	Chalimbana	Late (T2)	Low (P2)	408	11.3
V2T1P1	ICGV-SM 90704	Early (T1)	High (P1)	1575	0.2
V2T1P2	ICGV-SM 90704	Early (T1)	Low (P2)	1312	0.1
V2T2P1	ICGV-SM 90704	Late (T2)	High (P1)	663	0.6
V2T2P2	ICGV-SM 90704	Late (T2)	Low (P2)	563	0.9
V3T1P1	Malimba	Early (T1)	High (P1)	854	4.7
V3T1P2	Malimba	Early (T1)	Low (P2)	754	6.9
V3T2P1	Malimba	Late (T2)	High (P1)	609	17.7
V3T2P2	Malimba	Late (T2)	Low (P2)	321	16.9
V4T1P1	Baka	Early (T1)	High (P1)	804	0.2
V4T1P2	Baka	Early (T1)	Low (P2)	694	0.5
V4T2P1	Baka	Late (T2)	High (P1)	616	0.7
V4T2P2	Baka	Late (T2)	Low (P2)	456	2.3
Mean				767	4.8
Fpr				<0. 001	0.03
sed				247.9	5.91
cv %				51.1	193.8

App. 5: Aflatoxin levels for genotype and water management

App. 6: Aflatoxin levels for genotype and time of planting interaction