N2Africa Project Progress Report Month 30

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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The report is the product of the countless hours spent by Field Liaison Offices, Agronomists, Rhizobiologists, Research Assistants and students in African fields, farms and laboratories: and a testament to the support of our numerous in country partners and small holder farmers with which we are all privileged to work.

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1 Introduction

Although the N2Africa project was approved in September 2009, field activities began during 2010. This report summarizes progress to date. Detailed overviews of specific actions and activities can be found in the numerous milestone reports, protocols and MSc theses that are available on the N2Africa website. A supplementary grant was approved in December 2011 to extend research and monitoring and evaluation (M&E) activities in all eight current countries where N2Africa is active and to allow the exploration of possibilities to extend N2Africa to three new countries: Ethiopia, Tanzania and Uganda. In previous N2Africa reports, achievements within individual countries were nested into a review of milestones due within each reporting interval. As this current report relies more upon a summary inventory of all program milestones (Tables 1 to 5), it is fitting that a short description of country-level actions in DR Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda and Zimbabwe be given first.

2 Country Summaries

These summaries are based upon detailed Month 30 country reports covering November 2011 through April 2012 that are available upon request from the N2Africa Project Office or the Communications, Knowledge and Project management Officer. The eight country summaries follow in alphabetical order.

2.1 DR Congo

Program Developments and BNF Impacts: New satellite activities were established working with 1,500 additional farmers. Newly acquired soybeans resistant to rust show promise. A recent national policy on free importation of agricultural inputs is expected to improve access to fertilizers and inoculants. Estimates of 52 additional kg N as BNF per ha per yr for soybean were generated from combined use of P fertilizers and inoculants. Monitoring as directed by the M&E workstream continues, but data availability from partners in DRC is too slow to provide guidance season-by-season. Field days will be better managed so that they reinforce important technical messages rather than being overtaken by local politicians. The visit by external evaluator Dr John Lynam was rescheduled to end June 2012.

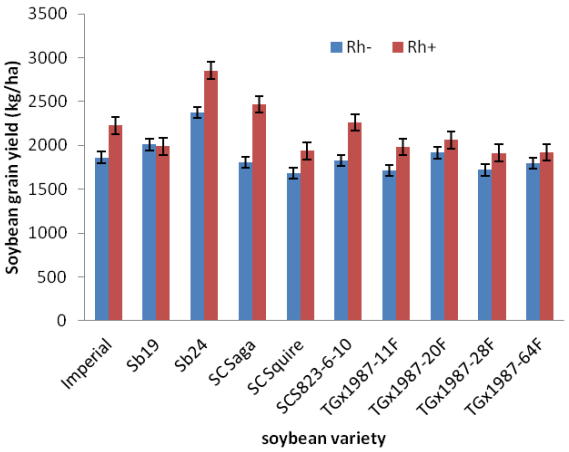

Figure 1. Response of ten soybean varieties to inoculation in an agronomy trial in DRC during 2011short rains.

Agronomy and Rhizobiology Research: Variety SB 24 is scheduled for release later this year while nine others are undergoing multi-location testing. Nine of ten test soybean varieties responded to inoculation in a trial (Figure 1). Two tree legumes (*Calliandra calothyrsus* and *Leucaena diversifolia*) and three forage legumes (*Stylosanthes guianensis*, *Clitoria ternatea* and *Lablab purpureus*) are under investigation on 25 farms. Establishment of the herbaceous legumes was poor due to excessive rainfall. Best-fit agronomic trials continue on intercropping and the effect of inoculants and phosphorus. In these trials, yield increased by 170 to 300 kg per ha depending on the system and season. Compilation of field book data to ascertain household benefits from BNF interventions has started. Bio-prospecting for rhizobia strains is ongoing with 80 isolates recovered to date but none yet identified as candidate elite strains. Characterization of two candidate peats as alternative carriers is underway. For further progress in inoculant formulation, it may be necessary that the rhizobiology team collaborate with counterparts in Rwanda. At least 3253 packets of imported inoculants were distributed over the past six months. No private investor appears interested in producing inoculants in eastern DR Congo but MEA Fertilizers (Kenya) is currently developing a strategy to export BIOFIX inoculants to DRC on a regular basis.

BNF Technology Dissemination: Seven satellite sites were commissioned with four new partners testing inoculants and multiplying seed of improved legumes. Additional master farmers (32) were trained to strengthen activities in the two new dissemination sites. Two soybean intercropping packages were promoted for maize and cassava. Collaboration with IFAD continues with collection centers identified and quality assessment tools distributed. Lack of buyers for large quantities of soybean continues to pose a problem. Training in processing of soybean into soymilk, soy beverage and tofu continues with 48 women trainers commissioned to train 2,400 households by end of July 2012. Over the past two seasons, 29 demonstrations served as the foci for 5023 households to establish 10.1 tons of bean seed, 22.3 tons of soybean seed and over 182,000 intercropped cassava cuttings. Six field days involving 760 farmers (61% women) were held and twelve exchange visits involving 364 farmers (73% woment) were conducted. Three of these field days featured information on processing legumes. Women involvement included 70% of participating farmers, 72% of field day attendees and 74% of exchange visitors. Twenty-four weekly radio shows on FM Radio Maendeleo resulted in 1,032 SMSs requesting additional information on BNF technologies.

Capacity Building: Training workshops on N2Africa field protocols and data collection were attended by 10 agronomists and 16 field technicians. No agro-dealers were trained but 18 candidates were identified for training in July 2012. Ms Bintu Ndusha Nabintu completed her coursework and is currently characterizing rhizobium isolates. Fidel Barhebwa Bnagaliza finalized coursework and is preparing his research proposal, he will start field work in September 2012. Isaac Balume has started laboratory work on quality assessment of inoculants used in N2Africa. Eric Sika Torroma is finalizing his course work. N2Africa training manuals are being used in field and laboratory work by two universities in Bukavu. More details on DR Congo are available in the recent country report prepared by Frederick Baijukya, Jeanmarie Sanginga, Dieudonne Mongane and Prof. Jean Masamba Walangululu.

2.2 **Ghana**

Program Developments and BNF Impacts: Three research technicians were recruited with field responsibilities in Upper East, Upper West and Northern regions. Many staff were engaged in M&E activities to compensate for overdue reporting. Agricultural inputs in the form of legume seeds, fertilizers, inoculant and insecticide were distributed to 30 villages in six districts covering 344 Lead Farmers and 10,800 satellite farmers (41% women). Estimates of 77 kg N as BNF per ha were generated from on-farm soybean trials.

Agronomy and Rhizobiology Research: Seven soybean varieties were examined in on-station varietal trials with inoculated yields between 1561 and 3329 kg per ha. Application of manure and micronutrients to cv. Jenguma increased best yield to 3809 kg per ha. Similar studies were conducted for cowpea and groundnut with best yield of 1476 and 790 kg per ha, respectively. Groundnuts were also assessed for resistance to *Cercospora* leaf spot. Soil samples were collected from 22 sites for enumeration of indigenous rhizobia and MPN counts conducted using soybean as a host. Results ranged from 2 to 142 cells per g soil. Bio-prospecting has started with 80 rhizobium isolates now stored on agar slants.

BNF Technology Dissemination: Dissemination is now conducted with six partners in Ghana; Urban Agriculture Network, Savanna Agricultural Research Institute, Association of Church Development Projects, Kwame Nkrumah University of Science and Technology, Agricultural Development and Value Chain Enhancement and Evangelical Presbyterian Development and Relief Agency. One new dissemination tool developed for the 2012 season is a smaller (100 g) size soybean inoculant package, which is more suitable for N2Africa farming groups. A total of 344 field demonstrations were established across the six districts consisting of 191, 68, and 85 sites for soybean, cowpea and groundnut, respectively. The effect of P fertilizer application and inoculation led to a 22% increase in soybean grain yield (data not presented). Inoculants are now available in 100 g sachets allowing for easier handling. Community seed production was initiated on 9 ha to supplement quantities that are purchased from seed companies. While the past six months fall outside of the growing season, a special field day was held at Bontanga irrigation dam to demonstrate the effect of inoculants and Yara legume fertilizer (P2O5: 18, K2O: 12%Mg: Zn: Mo: Bo) on soybean to 34 project staff and cooperators. Participants observed that the "off-season" irrigated plot that received both inoculants and Yara legume fertilizer had greater yield (Figure 2). Women in Agricultural Development trained 254 participants (92% women) on legume recipes and value-added processing technologies.

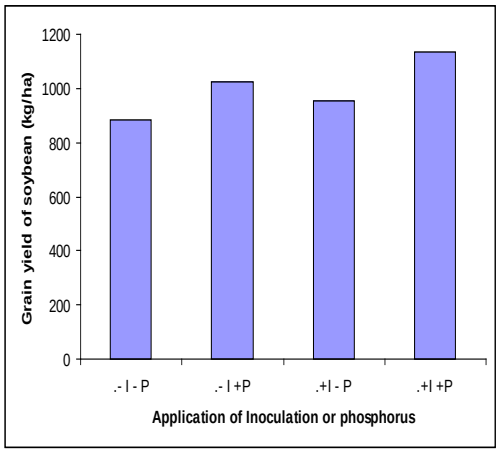

Figure 2. Effect of Yara P/K/Mg legume fertilizer application and rhizobial inoculation on grain yield of soybean.

Capacity Building: A total of 27 farmer training events were conducted focused upon inoculation techniques, legume and demonstration protocols. In addition, a three day pre-season workshop was conducted at SARI. Two MSc students at Kwame Nkrumah University of Science and Technology commenced their research. In addition, three PhD students are currently conducting field research on legume agronomy or rhizobiology. More

details on Ghana are available in the recent country report prepared by Robert Abaidoo.

2.3 **Kenya**

Program Developments and BNF Impacts: Three new opportunities were identified: soybean varieties from Seed Co with improved tolerance to rust, potential for improving the Sympal fertilizer blend through the addition of zinc and field testing of the first candidate elite rhizobium isolates for soybean and common bean. An analysis of BIOFIX production and marketing in Kenya was conducted. BIOFIX offers a full range of inoculant products in packets of 10, 20, 50 and 100 grams. Total production and marketing costs are estimated to be $0.72. At a sales price of $1.34 per 100 g, this allows a manufacturer's profit of $0.62 per unit. Knowledge of input requirements, costs, resultant yields and prices allows estimation of benefits to farmers. Total production costs of soybean are $266 per ha. Fertilizer is the largest single cost ($119) and inoculant one of the least (<5% of total). A household earns $947 per year from one ha, enjoying a benefit-to-cost ratio of 3.5 to 1. The planned External Evaluation was not conducted but several materials were forwarded to Dr Lynam in preparation for this evaluation in June 2012.

Agronomy and Rhizobiology Research: Four varieties were submitted to the Kenya Plant Health Services for inclusion in National Performance Trials in preparation for official release. Four bush bean varieties and one climbing bean appear less infested by root rot and root knot nematodes. This limited success has prompted testing of new climbing bean varieties from Rwanda as well as bush bean lines from the national bean program. Six BNF technologies (rhizobium inoculation, phosphate fertilization, fertilizer blend, rock phosphate addition, intercropping or rotation and soil liming) are being examined during the 2012 long rains season. The Maseno nursery provided 1,600 seedlings of the forage legume tree *Calliandra calothyrsus* that were distributed to 42 farmers for evaluation. Bio-prospecting for rhizobia in Kenya continues. As of month 30, 208 strains were collected from 20 legume genera. MIRCEN developed an effectiveness screening procedure that separates isolates into effectiveness classes and forwards the best ones for field testing. The best performing isolates on soybean were NAK 96, 115, 128, 176 and 179. BIOFIX standards are at least 10^9 rhizobia per gram of inoculant and no more than 10^7 contaminants. Inoculants are submitted to MIRCEN for quality control of a 0.2% sub-sampling. A recent series of batches of BIOFIX averaged $6.5x10^9$ cells (CV 25%) when sampled off the factory curing shelf. Experimental inoculants prepared by MIRCEN averaged $3.5x10^9$ cells (CV 26%). Contamination often exceeds the 10^7 threshold because sterilization of the filter mud carrier is incomplete. The reporting time is currently too late to intercept inferior samples from the manufacturer's inventory. A candidate logo and accompanying grading system was proposed. Grade criteria run from B (>10^8 rhizobia, contaminants < 10^7) through AAA (>10^{10} rhizobia, no contaminants). MEA reported that its overall production in 2011 was 400,000 packets of BIOFIX. N2Africa and its partners account for approximately 8% of these sales. N2Africa and MEA are exploring the feasibility of using vermiculite carriers.

BNF Technology Dissemination: N2Africa operates through four node leaders, 25 cooperators and 10 pilot agro-dealers, leaving few areas uncovered. The largest Satellite cooperator is the commercial alliance of Smart Logistics and Promasidor, and it is through their opportunities opening to Progressing Farmers that the greatest impacts are being achieved. A detailed dissemination tool was developed for the 2012 long-rains in west Kenya introducing eight BNF technologies to farmers that included two new soybean varieties, effects of inoculation with BIOFIX and inclusion of Zn in the Sympal fertilizer blend. Fifty field demonstration and local Information Centers were installed in seven counties and 16 administrative Districts of Nyanza and Western Provinces that supplied 8000 satellite farmer with "take-away" technology. Over the past year, 94 on-farm demonstrations leading to 48 farmer field days were installed. During the past short rains, 23 field days attracted 2443 participants, 91% of whom were farmers (51% women). On average, these events cost $245. Overall, BNF technologies reached 12,100 new farm households. These activities suggest that SB19 outperform a SeedCo line by 5%, inoculants increase yield for both specific (+67%) and promiscuously nodulating varieties (+14%), and Zn fortification of Sympal results in higher yields (+31%). All current cooperators are expected to become self-sufficient in terms of seed production. Following the 2011 long rains, Smart Logistics purchased over 45 tons of soybean from 691 farmers belonging to 16 partner organizations (67% market linkage). In early 2012, Smart Logistics purchased 217 tons of soybean worth about $111,000 from 19 partner organizations (79% market linkage). The main focus of legume

processing remains soy milk production at the grassroots level following a simple five-step procedure using apparatus costing only $55 (see Figure 3). Five media events, mostly local FM broadcasts, were conducted during the past six months. This format appears to reach the right audience for little or no money. During the short rains, 60% of New Farmers conducting BNF Technology Tests were women. Sixteen special events relating to women's empowerment were conducted during the past six months, all in conjunction with farmer field days. These events included skits and poems, legume variety appreciation, local cooking contests and exhibition of value-adding processes.

Step	Process	Cost/Value
Step 1: Soak	Wash and soak 1 kg of soybean in 2 l clean water for 4 to 6 hours	- $0.50
Step 2: Mince	Pass 3 kg soaked soybean through mincer, add 5 liters clean water, mix	- $0.24
Step 3: Press	Transfer mince to clean cloth and press between two heavy pots, drain	- $0.08
Step 4: Boil	Filter soymilk, boil for 5 minutes, recover 2 kg press cake for grit or animal feed	+ $0.37
Step 5: Package	Cool and place 6 liters of soymilk in clean container or add tea and sugar and market (consume) as "African sweet tea".	+ $3.40

Figure 3. A simple five-step procedure for local production of soymilk.

Capacity Building: No Master Farmers or grassroots training was conducted during the past six months owing to delays in the release of funds. Nonetheless, training materials for farmers were included into the BNF Technology test kits distributed to cooperators and informal training was offered at farmer collection points. A two-day training workshop was attended by 40 agro-dealers from west Kenya. A mechanism was established that connects these agro-dealers to MEA Fertilizers through the Western Chapter of the Kenya National Agro-Dealer Association. Five MSc students are affiliated with the project in Kenya. One of these, Ms Maureen Waswa has completed her coursework and is actively screening NAK isolates for effectiveness on soybean in the MIRCEN greenhouse. Samuel Mutuma is a seconded student at the University of Nairobi under an AGRA scholarship. Calvince Ouko Othoo is a self-funded student interested in inoculation technology of bean and will commence his laboratory and field research in June 2012. George Mwenda was recently accepted as a PhD candidate by Murdoch University, Perth, Australia. The Regional Universities Forum for Capacity Building in Agriculture is organizing a conference and N2Africa plans to participate. More details on Kenya are available in the recent country report prepared by Paul L. Woomer, Prof. Nancy K. Karanja and Fredrick Baijukya.

2.4 **Malawi**

Program Developments and BNF Impacts: Since the rainy season began a month later than normal in Malawi this year, harvesting was not completed until June, and consequently field results will appear in the next report. Furthermore, a late start of the rainy season and a mid-season drought had an adverse impact on crop performance. Having field trials implemented by N2Africa staff rather than contracted partners corrects problems encountered last year with data reporting. Sympal fertilizer from Kenya improved root nodulation compared with crops grown in unfertilized plots. Another positive development was that legume seed was “repaid” to the community by 66% of the farmers for distribution to new beneficiaries.

Agronomy and Rhizobiology Research: Due to the failure of last year's legume agronomy trials to produce results, they were repeated this season with seven variety and 12 input trials installed. Most trials were harvested at the end of April and results are being collected. Technology performance in dissemination trials and farmers’ perceptions of these technologies are recorded in Field Books. No tree or forage legumes are being evaluated in Malawi. A PhD student from the US is determining BNF of soybean using 100 rhizobium isolates from Malawi. SPRL (Zimbabwe) tested inoculants from Argentina that were already distributed for use in Malawi and found them unacceptable (average 2.2 x 10^5 cells per g). The rhizobiology laboratory at the Chitedze Research Station started producing inoculants for sale in Malawi, but it appears to be of inferior quality and they do not appear guided by Objective 3 tasks of bio-prospecting, isolate characterization and inoculant quality assessment.

BNF Technology Dissemination: Dissemination is conducted by five outreach partners in 19 communities. This alliance reached 9661 farmers (48% women) with a "full" BNF technology package. An additional 1258 farmers (58% women) received seed and produced crops using N2Africa improved production technologies through community mechanisms. About 45% of these farmers are linked to markets through the Agriculture Commodity Exchange, RAB Processors and NASFAM. Prices for soybean in Malawi rose strongly last season creating a strong demand for soybean seed. During the concluding season, 129 local field days were held that attracted 11669 participants (51% women). Five radio programs covering BNF technologies were supported by Farm Voice Radio and aired over Malawi Broadcasting Corporation Radio. An article 'Making Nitrogen Fertilizer the Natural Way' was posted on the Agfax website and published by two local newspapers. Legume processing and nutrition training was offered to 227 persons (68% women).

Capacity Building: Over the past six months, 629 Lead Farmers and 124 Extension Officers were trained in crop management, post-harvest handling and collective marketing. Thirteen Malawian agro-dealers underwent training in inoculant handling and marketing, and later established their own product demonstrations. Two Malawians sponsored for MSc degrees continue their work at Bunda College of Agriculture. Both have approved research proposals, one in soybean agronomy and the other in screening rhizobia. A PhD student, Admire Katunga has spent six months at Wageningen University and returns next season to conduct studies on "Economic and social analysis of soybean and groundnut production in central Malawi". More information on Malawi is available in the recent country report submitted by Anne Turner, Joseph Mhango and Gloria Kasongo.

2.5 **Mozambique**

Program Developments and BNF Impacts: Several trials were established using new soybean and groundnut varieties to determine the appropriate planting dates, row spacing and P application rate and to evaluate their responses to inoculation, liming and starter N. Two groundnut varieties demonstrate rosette resistance, have large seeds and are high-yielding, three traits preferred by farmers. Several standardized M&E forms including farm characterization, dissemination packages, on-farm technology evaluation, lead farmer assessment, field days, capacity building events, distribution of publications and media events have been completed for project evaluation and planning (see M&E Workstream Summary).

Agronomy and Rhizobiology Research: Five soybean varieties from the TL II project and one variety from Seed Co in Zimbabwe were evaluated using inoculants and P application. The varieties differ in maturity duration; hence individual farmer preferences depend on the location and time of planting. All varieties are susceptible to soybean rust disease, future efforts must identify rust tolerant genotypes. Trials were established on both on-station and on-farm at 20 sites in 4 provinces using either soybean or groundnuts. Six soybean and 5 groundnut varieties were evaluated. No tree or forage legumes are being evaluated. Studies of household benefits from specific BNF interventions are not yet underway. Lack of laboratory facilities in Mozambique remains a major constraint to the implementation of rhizobiology activities. One hundred and sixty (160) kg of peat-based inoculants packaged in four hundred 400 g packets were imported from Laboratorios Biagro, Argentina. Technoserve also imported more than 3,000 packets of peat-based inoculants in 200 g package from Total Biotecnologia, Brazil to establish demonstration plots and sell to farmers at affordable prices. An Uruguayan company has recently started to export rhizobial inoculants to Mozambique. No quality assessment on inoculants was conducted by N2Africa in Mozambique.

BNF Technology Dissemination: More than 20 satellite sites were identified to test at least one BNF technology. A new dissemination tool included a groundnut production package consisting of improved groundnut varieties, lime, P-fertilizer and starter N. The legume seed market is dominated by IKURU, Technoserve and CLUSA that purchase seeds for resale. More than 90% of the farmers in the N2Africa project communities are now linked to soybean processors. Farmers were introduced to home processing and utilization of soybean with 979 persons (79% women) trained in grain legume processing. The project procured inputs for demonstration and dissemination activities and trained farmers on setting up demonstration plots. In total, 1.6 tons of soybeans were obtained from the project's multiplication activities and 1.5 tons of groundnut seed purchased by the project along with 7 tons of SSP, 160 kg of inoculants and 1 ton of lime. Most farmers harvested by May and are currently processing their grain. The project reached 7,455 soybean farmers (28% females) and 1350

groundnut farmers (63% women) during the concluding season through its dissemination activities. Six field days and two exchange visits were organized. One radio program on soybean management was broadcast. The project trained 471 lead farmers on improved crop production practices (44% women). In addition, of 134 field demonstrations, 29% were managed by women.

Capacity Building: Trainer workshops were organized in collaboration with Technoserve and IKURU in March 2012. Fifty-seven people (28% women) participated in training-of-trainers. This led to training an additional 709 Lead Farmers. Admission of the two MSc. candidates into Bunda College is delayed. The PhD. applicant will begin studies in Brazil later this year. Six BSc. students (33% women) from three local universities joined the project for six-month attachment. No agro-dealer training was initiated, but inoculants are imported by partner NGOs for sale to farmers. More details on Mozambique are available in the recent country report prepared by Steve Boahen, Henrique Colial and Artur Fernando.

2.6 **Nigeria**

Program Developments and BNF Impacts: Key BNF technologies for soybean, cowpea and groundnut were identified for three different agro-ecological zones. The trials involved eight soybean, seven cowpea and five groundnut varieties. Resulting technology packages for soybean, consisting of improved varieties, inoculant and P fertilizer, greatly improved farmers' soybean yields. No on-farm estimates of BNF are yet available but samples are being processed by an MSc. student in Wageningen. The project external review initially planned in took place from 24-26 June 2012.

Agronomy and Rhizobiology Research: Five soybean varieties from different maturity groups were evaluated with and without inoculation but no results were included within the country report. Five groundnut and three cowpea were tested with and without P fertilizer. Preliminary results suggest significant increase of cowpea and groundnut yield following P application. Eighteen on-farm adaptive trials were conducted in 2011 to assess response to single superphosphate, 'Crystaliser' rock P and 'Agrolyser' micronutrient blend with Ca, Mg and S. Evaluation of forage legumes started with *Mucuna* and *Stylosanthes*. Field sites were identified and forage crops were planted shortly before issuing this report.

Quality assurance was assessed for 1250 units of 200 g packets of Legume-Fix imported from UK using the drop plate method and results will be available soon. A need-to-inoculate bioassay was conducted for 31 soils. This assessment is based upon the relative effectiveness of indigenous rhizobia (RE) compared to inoculation (IR) (Figure 4). Large differences were observed between soils as the Northern Guinea savanna supports larger populations of indigenous rhizobia while drier soils respond more readily to inoculation. This approach, once validated, may serve as an alternative to conducting MPN assays. Bio-prospecting started with isolations from 80 nodules and characterization is ongoing. A potential inoculant producer expressed interest in establishing inoculant production prior to the 2013 planting season. The project has yet to start work with regulatory agencies in Nigeria to review policy on rhizobial inoculants.

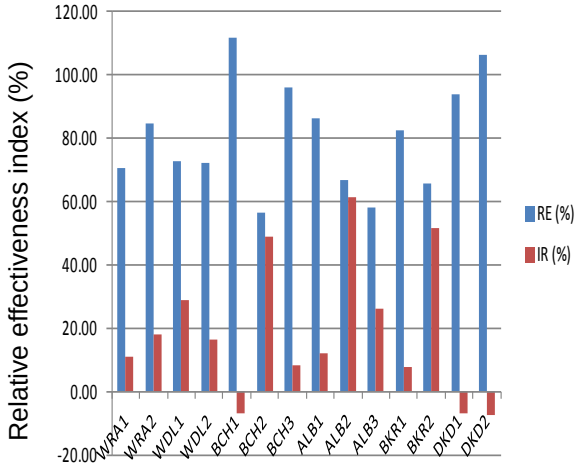

Figure 4. Effectiveness of native rhizobia (RE) and responses to applied inoculants (IR) of selected Nigerian soils as assessed under greenhouse conditions.

BNF Technology Dissemination: Strong partnerships along the entire value chain were forged by engaging with development programs, legume seed producers, farm input suppliers and commodity marketing and processing initiatives. During the 2011 season, the project engaged 11,868 households though establishment of 624 demonstration plots of soybean (55%), cowpea (35%) and groundnut (15%). During the upcoming 2012 demonstration campaign, the project will engage approximately

30,600 households. Lead Farmers manage demonstration plots of 600 m^2, while 24 nearby satellite farmers install 200 m^2 plots. An innovation platform has emerged consisting of governmental and non-governmental organisations to improve coverage of these demonstrations. Inputs for the satellite plots are distributed for 800 Naira (US $5). Because of cultural prescription in Northern Nigeria, women are less engaged in program field activities, however, they are heavily involved in legume processing and household nutrition. In this regard, 160 women from 10 communities were recently trained.

Capacity Building: Pre-season training was conducted for extension agents and Lead Farmers prior to the 2012 season. Thirty agro-dealers were also trained in handling and marketing of inoculants. Aliyu Abdullahi Anchau will soon begin PhD training at Murdoch University under the supervision Prof. John Howieson and Dr Graham O'Hara. One MSc student at Zaria University is characterizing rhizobial isolates recovered in northern Nigeria. More details are available in the recent country report prepared by Martin Jemo and Abdullahi Bala.

2.7 **Rwanda**

Program Developments and BNF Impacts: Soybean is now a priority crop in Rwanda and an oil extraction plant is under construction at Kayonza. Newly introduced SeedCo varieties Saga and Squire have resistance to soybean rust disease and are undergoing characterization for formal release. The government constructed warehouses for bean packaging and marketing. Estimates of additional 42 kg/ha for soybean, 49 kg/ha for bush bean and 72 kg/ha for climbing bean were generated from best practice from use of P fertilizers, inoculants and their combinations. Progress is being made on better complying with M&E requirements with 13 communities surveyed between December 2011 and March 2012. The external evaluation by Dr John Lynam was rescheduled to end June 2012.

Agronomy and Rhizobiology Research: Four new soybean varieties that respond to inoculation and P fertilizers (Figure 5) are undergoing national variety performance testing in preparation for release next year. Sufficient seeds were available for two tree legumes and seven herbaceous legumes with 40 farmers testing one tree legume and 2 herbaceous legumes. Data collection quantifying household benefits from BNF continues as does bio-prospecting across diverse ecosystems. RAB-Rubona is characterizing 252 isolates and screening them for effectiveness against commercial strains but no candidate elite strains yet identified. Cost effective inoculant production methods are under examination. RAB-Rubona conducts quality control assessment on its own inoculants but they do not yet meet the N2Africa standard of 10^9 cells per g. This partner produced 2800 eighty-gram packets of inoculants to meet local demand. COCOF (a partner NGO) expressed interest to producing inoculants pending an ongoing feasibility study.

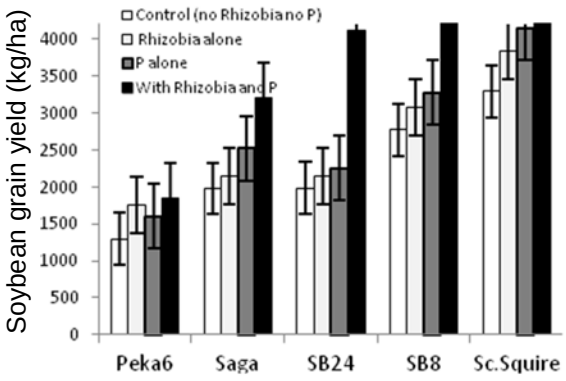

Figure 5. Response of selected soybean varieties to rhizobia, P and their combination in relation to the local check (Peka6) as observed at Rukara site in Kayonza action site during 2011B growing season.

BNF Technology Dissemination: Three additional satellite sites serving more than 3,800 households are testing several N2Africa technologies including use of inoculants, improved varieties and soybean processing. Four new dissemination tools were developed that include Sympal fertilizer, new Seed Co soybean varieties, use of sisal strings in staking climbing beans and distribution of three new "fortified" climbing bean varieties identified by Harvest Plus. All project cooperators are now linked to processors and buyers of soybean, including government institutions. A group of 26 women trained on soybean processing and nutrition in November 2011 has in turn trained 580 farmers in post-harvest processing and soybean. Some farmers involved in bean production were trained in post harvest handling by Rwanda Agri-Business Industry, a local company involved in processing and marketing of beans. Large-scale dissemination campaigns reaching 5,000 households were conducted in 13 communities during the past short rains.

Fifteen demonstrations reached 11,050 households. In November 2011, five farmers participated in a study tour in Kenya. Thirteen field days were conducted by partner organizations in late 2011. Nine media events were held including broadcasts over two FM radio stations and one TV show. Women remain very active within the project comprising 60% of participating farmers. Twenty-six women trainers undertaking a two-day course on legume processing and household nutrition during November 2011 have since trained 580 additional women and continue to do so.

Capacity Building: Training was offered to 104 extension agents and 46 new Master Farmers. In November 2011, 34 agro-dealers were trained on fertilizer and seed handling, but not in the marketing of inoculants. Site-specific farmer training continues with 165 recent trainees in seed production and grain storage and processing. Alfred Rumongi and Domitilla Mukamkubana are in advanced stages of completing their thesis MSc. proposals, the former on rhizobiology and the latter on extension approaches. A PhD. candidate, Edouard Rurangwa, spent six months at Wageningen University developing his PhD proposal. More details are available in the recent country report prepared by Frederick Baijukya, Speciose Kantengwa and Mathilde Uwizerwa.

2.8 **Zimbabwe**

Program Developments and BNF Impacts: Over the past six months, little opportunity was available to identify new opportunities as data compilation from the just concluded growing season is ongoing. SPRL continues to produce only larger sachets of inoculant (100 g). The use of hermetic bags for cowpea and common beans is emerging as an option for reducing pests of stored grain. Estimates of BNF are 40 additional kg N as BNF per ha. M&E tools were accepted by the D&D partners in Zimbabwe but these data are somewhat time consuming to analyze, and is not yet available for detailed planning. An IFAD-funded marketing project complements N2Africa in marketing in some of the districts where N2Africa is implemented. Documents from Zimbabwe were forwarded to the external evaluator but no schedule is finalized. Plans are underway to conduct cost-benefit analyses of BNF technologies as a component of the upcoming 2012-13 season.

Agronomy and Rhizobiology Research: Elite soybean varieties continue to be evaluated across the different agro-ecological zones with Saga and Squire displaying high grain yields while promiscuous varieties from IITA performing well on clayey soils. Trials to evaluate adaptability of multipurpose trees were established during the past season, results are not yet available. During the past season, several field cropping practices were explored including rhizobium inoculation, fertilizer blends with and without dolomitic liming, addition of organic inputs and timely disease control. Bio-prospecting for rhizobia strains is delayed, with only 38 isolates recovered to date but none yet identified as candidate elite strains. Most Probable Number estimates from 23 soils were conducted for bean and soybean. Bean counts ranged between 0 to 13 cells per gram with 20 soils testing negative. These results suggest a large potential response to inoculation at all but 3 sites. SPRL plans to improve rhizobium inoculant quality by exploring alternative sterilization of carrier material through gamma irradiation and reducing the particle size of the carrier material through milling, but these approaches have not yet been implemented within the factory. SPRL conducts quality assessment on 0.4% of its inoculants, the recent average counts were 1.16×10^9 cells per gram, acceptable within N2Africa standards. Inoculant production for the 2011-12 growing season was at 60,435 sachets (94% for soybean). Each 100 g sachet sold for US $5. SPRL, as a parastatal, is keen to raise awareness of inoculants among many stakeholders.

Dissemination: Dissemination continues in seven districts with increased numbers of farmers reached in the concluding season by offering BNF technologies to new areas. Several technology options are under consideration for next season including fertilizer distribution at reduced interest rates, legume production within prison farms, better linkage to agro-dealer networks and streamlined distribution of inoculant in communal farming areas to stabilize prices. Farmer guidelines are now translated into Shona. Training in collective marketing and establishment of collection points continues. Prices remain high as shelled groundnuts sell for US $750 and common bean for US $1200 per ton. In total, 320 demonstrations were established in the past season through 320 Lead Farmers (47% women) reaching 6210 households (62% women farmers). Seventeen field days were attended by 3546 participants (58% women). Exchange visits for 22 farmers (45% women) were arranged between districts to share experiences in legume production and marketing. In contrast, no mass media events

were conducted over the past six months, in part because of the political situation. Overall, 62% of the farmers involved in the project are women.

Capacity Building: Training-of-Trainers sessions were conducted among nine NGO staff and 36 extension officers (38% women). Last season, 320 Lead Farmers were trained in BNF technologies passing knowledge to another 5890 farmers. Agro-dealer training is delayed but now rescheduled for later this year. The two M.Phil. students on N2Africa scholarships are progressing well. Ms Dunjana has finalized her fieldwork and will finish later this year. Ms Kainga collected results from the past season but is required to collect data over two seasons. The PhD candidate, Mazvita Chiduwa, is enrolling in Murdoch University and will pursue studies in inoculant optimization. In addition, Zimbabwe hosted one MSc. student from Wageningen. More details are available in the recent country report prepared by Judith de Wolf, Isaac Chabata, Talkmore Mombeyarara and Byron Zamasiya.

3 Milestone Achievements

Because relatively few program milestones (10) were due between months 25 through 30, this report assumes a broader perspective of examining all milestone achievements to date. N2Africa is comprised of five Objectives, twenty-seven Activities and 119 time-bound Milestones. Of these Milestones, 75 were due by Month 30 (64% of total). Of these due Milestones, 49 are covered by Milestone Reports (see *www.n2africa.org*). Another 14 Milestones, mostly recurrent ones (due every year), are described within the series of six-months reports (this being the most recent), bringing the coverage of due Milestones as of Month 30 to 84% with 13 Milestones presently overdue. This Milestone appraisal is next extended toward each Objective and its component Activities (Tables 1-5) as a means to identify program strengths and shortcomings in greater detail.

Objective 1: Baseline, targeting legumes, M&E and impact assessment. This Objective incorporates six Activities and 29 Milestones, 24 of which (83%) were due by Month 30 (Table 1). Ten Milestone reports covering 17 Milestones are posted over the N2Africa website. An additional two Milestones (1.1.4 & 1.3.4) were covered in detail by past program narratives, bringing this Objective to 83% complete (20 of 24 due milestones). One Milestone relates to approval of detailed planning (1.2.9) by the Foundation, which was granted and acknowledged in the Month 18 Report. The three overdue Milestones involve market analysis of inoculants (1.3.3) and recurrent use of M&E framework in seasonal planning (1.5.2). Market analysis of inoculants is completed in Kenya and overdue for Ghana and Zimbabwe. While baseline reports (1.4.1 and 1.4.2) and key indicators (1.5.1) are useful in seasonal planning, feedback from submitted M&E reports is difficult to provide quickly enough, especially in countries with two growing seasons per year (see M&E Workstream Summary).

Table 1. Activities and Milestones within Objective 1 Baseline, M&E and Impact Assessment.

Milestone	Activity and Milestone	Milestone status			
		total	due	reported	described
Activity 1	***Establish project management structures***				
1.1.1	Establish project steering committee	1	1	1	0
1.1.2	Hold a general project inception meeting	1	1	1	0
1.1.3	Engage project staff and complete capital investments	1	1	1	0
1.1.4	Hold a project interim assessment workshop	2	1	0	1
1.1.5	Hold a cross regional synthesis meeting	1	0	0	0
Activity 2	***Develop detailed planning documents***				
1.2.1	TL-II collaboration formalized	1	1	1	0
1.2.2	At least 10 action sites identified in the different impact zones	1	1	1	0
1.2.3	Detailed country-by-country extension plan developed	1	1	1	0
1.2.4	Detailed country-by-country P access plan developed	1	1	1	0
1.2.5	Detailed country-by-country seed increase plan developed	1	1	1	0
1.2.6	Detailed country-by-country marketing support	1	1	1	0
1.2.7	Final TL2 interaction plan developed	1	1	1	0
1.2.8	Final AGRA interaction plan developed	1	1	1	0
1.2.9	Approval of detailed plans by donor	1	1	0	1
Activity 3	***ID opportunities for BNF technologies***				
1.3.1	Priority legume and inoculant technologies identified	1	1	1	0
1.3.2	New opportunities identified each season	3	2	2	0
1.3.3	Market analysis of inoculants completed.	1	1	0	0
1.3.4	Market demand for legumes documented	1	1	0	1
Activity 4	***Quantify on-farm BNF and its impacts on livelihood***				
1.4.1	Background document completed.	1	1	1	0
1.4.2	Baseline report quantifying BNF completed	1	1	1	0
Activity 5	***Monitor impact of legume and inoculant technologies***				
1.5.1	Indicators for M&E developed	1	1	1	0
1.5.2	M&E framework used for future planning	3	2	0	0
1.5.3	External project review conducted	1	1	0	0
Activity 6	***Impact of legume and inoculant technologies assessed***				
1.6.1	Impact report on N2-fixation technologies produced	1	0	0	0
Objective 1	*Subtotal*	*29*	*24*	*17*	*3*
	Percentage	*24%*	*83%*	*71%*	*83%*

Objective 2: Identify best legumes and integrate them into farming systems. This Objective incorporates six Activities and 16 Milestones, only 7 of which (43%) were due by Month 30 (Table 2). Five Milestone reports covering 5 Milestones are posted over the N2Africa website. An additional two Milestones (2.1.2 & 2.4.2) were covered in detail by past program narratives, bringing this Objective to 100% complete (7 of 7 due milestones). This record is not balanced across all countries, as the southern African countries (Malawi, Mozambique and Zimbabwe) have completed only a single season. Nine milestones remain over the remaining 18 months that involve delivering improved grain legume varieties to other parties for full release (2.1.3, 2.1.4, 2.2.2 & 2.3.2), implementing tree and fodder legume adaptive research (2.4.2) and quantifying the benefits and trade-offs of smallholders' adopting N2Africa BNF technologies (2.6.1 & 2.6.2). These pose challenging outcomes to an Objective that is presently on course.

Table 2. Activities and Milestones within Objective 2 Legume Agronomy.

Milestone	Activity and Milestone	Milestone status			
		total	due	reported	described
Activity 1	***Field test soybean varieties***				
2.1.1	Soybean varieties identified	1	1	1	0
2.1.2	Soybean BNF potential identified	1	1	0	1
2.1.3	Soybean breeding materials forwarded to TLII	1	0	0	0
2.1.4	Farmer-accepted lines of soybean submitted for national release	1	0	0	0
Activity 2	***Field test bean varieties***				
2.2.1	Bush and climbing bean varieties identified	1	1	1	0
2.2.2	Bean breeding materials forwarded to TLII	1	0	0	0
2.2.3	Farmer-accepted beans with high BNF identified	1	0	0	0
Activity 3	***Field test cowpea and groundnut varieties***				
2.3.1	Superior groundnut and cowpea varieties identified	1	1	1	0
2.3.2	Groundnut and cowpea materials forwarded to TLII	1	0	0	0
2.3.3	Farmer-accepted groundnut and cowpea with high BNF identified	1	0	0	0
Activity 4	***Explore BNF of multi-purpose tree and forage legumes***				
2.4.1	Tree and forage legume species identified	1	1	1	0
2.4.2	Sufficient planting material obtained	1	1	0	1
Activity 5	***Identify best-fit agronomic practices***				
2.5.1	Implement grain legume adaptive research campaigns	1	1	1	0
2.5.2	Implement tree and fodder legume adaptive research campaigns	1	0	0	0
Activity 6	***Evaluate system productivity, livelihoods and trade-offs***				
2.6.1	Household benefits from grain legume interventions quantified	1	0	0	0
2.6.2	Household benefits from tree and forage legumes quantified	1	0	0	0
Objective 2	*Subtotal*	*16*	*7*	*5*	*2*
	Percentage	*13%*	*43%*	*71%*	*100%*

Objective 3: Select rhizobia and develop inoculant production. This Objective incorporates five Activities and 21 Milestones, 14 of which (67%) were due by Month 30 (Table 3). Eight Milestone reports covering 5 Milestones are posted over the N2Africa website. An additional six Milestones (3.2.2 & 3.4.1 to 3.4.4) were covered in detail by past program narratives, bringing this Objective to 79% complete (11 of 14 due milestones). Several important milestones are not achieved fully, in four of five Activities (1 to 4). While laboratory protocols were established quickly (3.1.1) and technicians trained in them (see 5.1.1), the laboratories were slow to be upgraded (3.4.2) and afterwards supervision and performance was inconsistent. This led to delays in collecting and screening rhizobium isolates (3.1.3 and 3.1.4, only 838 isolates to date of expected 2000) and implementation of routine quality assessment of inoculants (3.3.2). In Kenya, Rwanda, DR Congo Mozambique and Malawi, inferior inoculants have been released to farmers, which the implementation of quality control has been unable to intercept in time. Performance is imbalanced among countries with Kenya, Rwanda, Nigeria and Zimbabwe performing well, DR Congo and Ghana catching up and Malawi, Mozambique face greater constraints of human capacity. A planning meeting was recently held on how best to accelerate rhizobiology activities in Ghana, Malawi, Mozambique and Nigeria and its follow-up will be covered in the next report (Year 3).

Table 3. Activities and Milestones within Objective 3 Rhizobiology and Inoculant Production.

Milestone	Activity and Milestone	Milestone status			
		total	due	reported	described
Activity 1	***Assess the need-to-inoculate and identify elite strains***				
3.1.1	Rhizobiology protocols established	1	1	1	0
3.1.2	MPN counts and need-to-inoculate trials conducted	1	1	0	0
3.1.3	2,000 strains screened for effectiveness and top 5% identified	1	1	0	0
3.1.4	Top 5% field tested and top 2% elite strains identified	1	0	0	0
3.1.5	Best elite strains distributed to inoculant manufacturers	1	0	0	0
Activity 2	***Establish and characterize a rhizobium germplasm bank***				
3.2.1	Commercial strains obtained leading rhizobiology laboratories	1	1	1	0
3.2.2	Nodules collected and rhizobium isolated and characterized	1	1	0	1
Activity 3	***Improved production and quality assurance methodes evaluated***				
3.3.1	Quality assurance protocols developed	1	1	1	0
3.3.2	Cost effective inoculant production methods developed	1	1	0	0
3.3.3	Universal QA logo adopted	1	1	0	0
Activity 4	***Expand and upgrade inoculant production capacity***				
3.4.1	Information on existing inoculant products compiled	1	1	1	1
3.4.2	Three existing rhizobiology laboratories upgraded	1	1	1	1
3.4.3	150,000 inoculant packets produced or imported per year	3	1	0	1
3.4.4	Contacts with potential inoculant investors established	3	3	0	2
3.4.5	Alliances formalized between private sector and research	1	0	0	0
Activity 5	***Conduct policy review on inoculants and cross border movement***				
3.5.1	Policy briefs on regulations and trade produced	1	0	0	0
3.5.2	Procedures for exchange of rhizobium approved	1	0	0	0
Objective 3	*Subtotal*	*21*	*14*	*5*	*6*
	Percentage	*18%*	*67%*	*36%*	*79%*

Objective 4: Deliver legume and inoculant technologies to farmers. This Objective incorporates five Activities and 31 Milestones, 20 of which (65%) were due by Month 30 (Table 4). Ten Milestone reports covering 16 Milestones are posted over the N2Africa website. An additional Milestones (4.5.3) was covered in detail by past program narratives, bringing this Objective to more than 90% complete (18 of 20 due milestones). Milestones 4.4.2 and 4.4.3 both relate to technology dissemination and extension campaigns which continue in the current growing seasons in East, Central and West Africa continue through Month 30. These are both recurrent milestones, meaning that they are repeated every year in all countries, and milestone deadlines are inaccurately matched to

Table 4. Activities and Milestones within Objective 4 Legume and Inoculant Technology Delivery.

Milestone	Activity and Milestone	Milestone status			
		total	due	reported	described
Activity 1	***Create strategic alliances for disseminating technologies***				
4.1.1	MoUs among partners formalized	1	1	1	0
4.1.2	Co-funding/financing options identified	1	1	1	0
4.1.3	Satellite sites established	1	0	0	0
Activity 2	***Dissemination tools produced and tested***				
4.2.1	Legume and inoculant tools deployed and refined	3	2	2	0
Activity 3	***Engage with seed systems, markets and nutrition initiatives***				
4.3.1	Sufficient legume seed acquired	1	1	1	0
4.3.2	Farming communities produce legume seed for local distribution	1	1	1	0
4.3.3	Farming communities linked to legume markets	1	1	1	0
4.3.4	Farming communities linked to legume processing initiatives	1	0	0	0
Activity 4	***Disseminate technologies and create awareness***				
4.4.1	Document extension process and proof of principle	1	1	1	0
4.4.2	Conduct large-scale dissemination campaigns	4	3	2	0
4.4.3	Conduct and document extension events	4	3	2	0
4.4.4	Conduct and document mass media events	4	2	2	0
Activity 5	***Develop strategies for empowering women farmers***				
4.5.1	Baseline gender analysis conducted	1	1	1	0
4.5.2	Involvement of women in farmer-related activities documented	3	1	1	0
4.5.3	Special events on nutrition and value-addition conducted	4	2	0	2
Objective 4	*Subtotal*	*31*	*20*	*15*	*3*
	Percentage	*26%*	*65%*	*75%*	*90%*

the actual growing seasons. The effectiveness of these campaigns will be covered in the next report (Year 3). Another set of milestones that warrant future attention is community engagement in legume processing initiatives (4.3.4 due month 12 year 3) and the annual task of incorporating nutrition and value-added processing into special events empowering women (4.5.3) because costs and returns must now be attached to different processing options, including cottage industries.

Objective 5 Develop and strengthen capacity for BNF. This Objective incorporates five Activities and 22 Milestones, 11 of which (67%) were due by Month 30 (Table 3). Six Milestone reports covering 7 Milestones are posted over the N2Africa website, bringing this Objective to only 64% complete (7 of 11 due milestones). While we continue to deliver more than promised in terms of MSc and PhD training, the capacity building of other key players has fallen behind targets. The four overdue milestones involve annual technical training (5.1.2), developing training packages for AGRA and sister projects (5.5.2), support to African universities (5.5.3) and training of private sector partners in program advances (5.5.4). These incomplete milestones are not country-based, but rather orchestrated by CIAT-TSBF and require several months advance planning. This situation and plans to rectify these important overdue milestones will be covered in the next six-month report (Year 3).

Table 5. Activities and Milestones within Objective 5 Capacity Building in BNF Technologies.

Milestone	Activity and Milestone	Milestone status			
		total	due	reported	described
Activity 1	***Provide training in microbiological skills and BNF technologies.***				
5.1.1	Staff trained in laboratory, greenhouse, and field techniques	1	1	1	0
5.1.2	Annual master classes conducted to upgrade skills	3	1	0	0
Activity 2	***Training of African scientists at MSc and PhD levels***				
5.2.1	MSc and PhD candidates selected	1	1	1	0
5.2.2	First MSc candidates graduate	1	0	0	0
5.2.3	Remaining MSc and PhD candidates graduate	1	0	0	0
Activity 3	***Training-of-trainers workshops conducted***				
5.3.1	Workshop conducted for 'master' trainers on BNF technology	1	1	1	0
5.3.2	Country-level training-of-trainers workshops conducted	2	1	1	0
Activity 4	***Training workshops on BNF technologies at community-level***				
5.4.1	Training events conducted at grassroots-level	1	1	1	0
5.4.2	Grassroots trainers promote BNF within their rural communities	2	0	0	0
5.4.3	Agro-dealers trained in distributing BNF technologies	3	1	1	0
Activity 5	***Provide training materials to support activities 5.1 – 5.4***				
5.5.1	A revised manual for rhizobium methods posted	1	1	1	0
5.5.2	Develop technology packages and train AGRA and TLII	1	1	0	0
5.5.3	Support for undergraduate and postgraduate education	1	1	0	0
5.5.4	Train private sector partners in program achievements	1	1	0	0
5.5.5	Provide web-based support on BNF techniques	2	0	0	0
Objective 5	*Subtotal*	*22*	*11*	*7*	*0*
	Percentage	*18%*	*50%*	*64%*	*64%*

Activities under the supplementary grant December 2011 to July 2012 to extend the activities of N2Africa to Ethiopia, Tanzania and Uganda

This section summarizes in brief activities taken to extend N2Africa to new priority countries for the foundation. A key aspect of our approach in these new countries is to seek strong collaboration and leadership from national partners, and to seek alignment and cofounding opportunities. This has been highly successful and in Ethiopia our proposed activities are aligned with the Dutch funded initiative to coordinate and support the development of the soybean value chain, and in all countries we are aligning with activities led by IFDC to improve access to inputs and markets. Our current activities are limited to seed multiplication as preparation for anticipated funding to be able to start a full capacity project in 2013. Progress against milestones is highlighted in Table 6.

Ethiopia

- A background report on Ethiopia was prepared, including an inventory of ongoing projects around grain legumes.
- In January an exploratory visit was made to Ethiopia, to identify potential partners and initiate discussions.
- In May a follow-up workshop was organized with these potential partners, to identify the crops, sites, and activities to be carried out as input for a project proposal (see also report already submitted to the foundation 041: Opportunities for N2Africa in Ethiopia).
- 'Seed activities' for 2012 were agreed on: seed multiplication will be done by five institutes (Hawassa University, Pawe Agricultural Research Institute, Amhara Regional Agricultural Research Institute, Oromia Agricultural Research Institute and ILRI). All institutes received budget for this in July and have started planting.
- A WUR MSc student will travel to Ethiopia on 23 July, for on-farm research on the need for inoculation in chickpea.

Uganda

- A background report was prepared, including an inventory of ongoing projects around grain legumes (to be finalized after stakeholder workshop).
- A one day workshop was held with a small group of potential partners in March, to get initial ideas on legumes and areas with high potential for N2Africa.
- A follow-up stakeholder workshop will be organized in August/September 2012.
- Start-up activities (seed multiplication, on-farm trials) will be carried out in the short rainy season (September-December)

Tanzania

- A background report was prepared, including an inventory of ongoing projects around grain legumes (to be finalized after stakeholder workshop).
- Potential partners have been identified through the network of IITA Tanzania. The project will Initial ideas on which legumes and areas to work in are:
- A stakeholder workshop with these potential partners will be organized in November 2012.
- Start-up activities (seed multiplication, on-farm trials) will be carried out in the short rainy season (September-December)

Table 6. Progress on milestones under the supplementary grant

ID No	Activity/Milestone	Target Date	Progress
	Objective S1 *To establish partnerships to extend the activities of N_2Africa to three new countries: Ethiopia, Tanzania and Uganda.*		
S1.1.1, 1.1.2, 1.1.3	Exploratory visits to Ethiopia, Tanzania, Uganda to meet key stakeholders and conduct initial rapid field appraisals in major potential production areas.	Month 6	Exploratory visits made to Ethiopia and Uganda. Contacts made in Tanzania.
S1.2.1, 1.2.2, 1.2.3	Prepare review and background of previous relevant agronomic, farming systems and market research in each country.	Month 9	Background reports have been made for all three countries
S1.3.1, 1.3.2, 1.3.3	Hold a stakeholder workshop in each country to build collaboration, choose partners and develop action plans.	Month 12	Stakeholder workshops + action plan only in Ethiopia and Uganda.
S1.4.1	Report and recommend to the foundation, together with a roadmap and project proposal for the three new countries.	Month 18	

4 Workstream accomplishments and challenges

D&D Workstream. The workstream on Delivery and Dissemination attends to all tasks that relate to encouraging smallholder farmers to take up the project technologies. Encouraging progress towards D&D milestones was achieved but shortcomings persist (Table 4) and differ between countries. Mozambique stands out in Southern Africa for its achievements in seed production and market linkages, however, it lags behind Zimbabwe and Malawi in empowerment of women. DR Congo is outstanding in this regard, but may not achieve the targeted number of households and linkages to output markets. Kenya and Rwanda exceeded targets with respect to all D&D tasks.

Shortcomings are recognized and corrections underway with respect to specific objectives. Falling short of targeted households is perhaps understandable in DRC and northern Nigeria given the difficult working conditions. With respect to the number of dissemination tools developed, all countries have either met or exceeded the targeted numbers. Linkages to markets and processing initiatives exceeded targets for Kenya and Mozambique and are catching up in other countries. In some cases, these markets are in fact dominated by the need for seed rather than grain, so market conditions and prices are distorted. Extension events missed the target of three per season per country, keeping in mind that over the past six months there were no growing seasons in some countries. Involvement of at least 50% women in all farming activities was exceeded in most countries except for Mozambique, Ghana and Nigeria, in large part due to cultural norms beyond the scope of our program. Increased precision regarding roles and responsibilities will lead to better lines of communication between Farm Liaison Officers, Country Coordinators, Workstream and Program Specialists so that we may better benefit from the solutions of others. That said, it appears that we are well positioned to achieve most, if not all our workstream tasks over the next 16 months. More information on this workstream is available from a report recently issued by Anne Turner.

M&E Workstream. The implementation of the N2Africa program in eight countries is complex which in turn is reflected in the challenges faced by its Monitoring and Evaluation (M&E). M&E aims to enhance learning from project activities, reflect and improve on implementation and findings, and to facilitate the feedback loops between other activities. N2Africa developed meaningful indicators that are sufficiently measurable and robust to encompass the diversity of different sites and stakeholders, yet data collection must be simple enough to be understood and used by all, ranging from researchers to extension staff and farmers. Reaching this balance was the greatest challenge toward agreement on what is measured. We settled on nine standardized reporting tools: 1) Seasonal Checklist; 2) Input Distribution; 3) Training Events; 4) Field Days; 5) Production and Distribution of Publications; 6) Media Events; 7) Lead Farmer Assessment; 8) Use Survey; and 9) Seasonal Field Book. These tools allow for both quantitative and qualitative assessment (Milestone 1.5.1).

There is progress but on-going gaps in reporting exist and it is becoming obvious that co-operators must work more on data entry throughout the season rather than wait until its end. Data forms are often not filled correctly, making data cleaning laborious. Responsibility for reporting within countries sometimes changes, so quality reporting between seasons is unreliable. Sometimes most data is reported but one or two forms ignored. Too often, in-country co-operators/partners must be reminded to submit data in a timely manner. Nonetheless, M&E has become routine in all countries, but at a pace that too often does not allow for sufficient learning from one season to the next (Milestone 1.5.2). The program now has better understanding of the time and costs of M&E. The most recent Use Survey certainly represents more advanced approaches to M&E in terms of information captured. Some areas of M&E are not working as well as hoped, particularly the feedback loop between the Research and Dissemination Workstreams, but closer collaboration between Workstream leaders is beginning to show positive results. While present M&E is not perfect, it operates well enough to identify constraints and opportunities as we prepare for impact assessment over the next 16 months (Milestone 1.6.1). More information on this workstream is available from a report recently issued by Judith de Wolf.

Research and Data Workstream. The workstream on Research and Data deals with data collection activities, data storage and analysis with the aim to maximize learning from different research activities and provide timely feedback to those operating in the field. In the last 6 months, considerable progress has been made in terms of data collection, storage and analyses. Data collection in agronomy trials has continued. While the project started with comparable trial set-ups in the eight countries (variety

and input trials), a proliferation of trials has occurred in countries tackling a wide range of emerging issues. These include trials on rust tolerance by soybean, staking methods in climbing beans, diagnosis of non-responsive soils and intercropping cassava with grain legumes. Data collection from disseminated technology packages started last year. Data from these surveys are available from West and East Africa and data from the southern African countries is expected to be available for analyses soon.

Emphasis has shifted from testing the G_l x G_r x E x M model to understanding the mechanisms behind its interactions under different conditions. Along with this reorientation, the importance of data collection in dissemination trials has increased. In the rhizobiology research, the isolation and screening of strains from legume nodules have made some progress but remains behind schedule in six countries. Some promising elite indigenous rhizobia strains were identified and are currently being compared to commercialized strains under farmer conditions. Delays in sample processing and analyses constitute a major cause for delays in data analysis and timely feedback of results from data analyses to country teams. These include delays in soil sample processing and soil chemical and physical analyses, MPN counts in soil samples to estimate effective rhizobium numbers and plant sample processing for BNF assessments. Also precipitation data are often missing and in some places insufficient GPS data is collected These variables are important for explaining variability of legumes' responses to inputs under the heterogeneous biophysical and socio-economic conditions under which farmers work and incomplete data hinders full interpretation.

Some key findings of our analyses to date: 1) widespread responses of legumes to phosphorus and soybean to inoculation; 2) non-responsive soils, where current recommendations do not lead to responses, require addition of additional limiting nutrients, organic inputs and/or other measures; and 3) small farm size is often a binding constraint to the expansion of legumes but may be overcome where legumes can be integrated in the cultivation of another staple crop through mixed, relay or strip cropping. More information on this workstream is available from a report recently issued by Linus Franke.

Communication, Knowledge and Project Management Workstream. The interest of the communication, knowledge and project management workstream is to safeguard and improve the leadership, information and administration processes of the project. This will, through better transparency and accountability, achieve a sustainable congruity between the project's internal and external operational narratives, their supporting finance, donor reporting and wide learning.

Joint project office teams in Nairobi and Wageningen have worked to assist the project and partner staff at all levels and locations: to seek to maximize learning though their structures and routines: and to customize, author and maintain the linked N2Africa internet and intranet websites. A 20 minute video was made with the team in Malawi evidencing N2Africa as a research to development project.

In this reporting period, particular attention has been paid to improving the operation and transparency of country and sub-partner, project finances. M&E should now assume greater significance as it is evident in the narrative above that the coordination and day-to-day management of our M&E, and that of our partners needs support. The final 16 months of the project will also see an increased focus on R&D information flow. We must enable processes to deliver and report on all the data, whilst paying close attention to M&E objectives and facilitating the inception of the endline survey work.

During the next period, the N2Africa project office teams must undertake to receive and process, not just regular periodic reports but information to bring both the technical and financial story of the project to a successful conclusion. Preparation for these tasks began in May at a successful joint Steering Committee and Leadership team meeting, facilitated by the workstream leader, Alastair Simmons from whom further information and documentation relating to this workstream is available.

4.1 Management Updates

During the period, for expediency, Alastair Simmons combined his workstream role with that of acting Project Leader, following the resignation of Dr Kenton Dashiell in March 2012.

At this stage in the project lifecycle, the Steering Committee determined that more than one project leadership role is needed to:

1. Deliver and support the work outstanding in M&E and enable robust fulfilment of training and capacity building objectives.
2. Ensure the veracity, delivery and consistency of the field data from research, D&D and M&E that can feed into 'higher level' R&D. This will be more reflexive to initiate new activities in different countries to test approaches to D&D and M&E.
3. Make certain that all the regular and final narratives of the project are drawn together, reported, concluded and promulgated.

Therefore, these tasks are to be split across two persons and new Terms of Reference are agreed for the new post of N2Africa Project Coordinator, based in Africa with CIAT to which Dr Jeroen Huising has been appointed from 1st September, 2012, and for the Communication, Knowledge and Project management officer (work stream leader, Alastair Simmons) currently working out of WU.

WU commissioned and funded a financial audit of N2Africa finances through CIAT and IITA which made some useful recommendations to streamlining accounting procedures and confirmed that all proper checks and procedures are in place to ensure efficient use of the funds.

4.2 Lessons Learned

1. Some rhizobia native to African soils compare favorably to standard inoculant strains. This was demonstrated with promiscuously nodulating soybean and industry standards USDA 110 and SEMIA 5019. Greenhouse testing found that 4% of Kenyan isolates outperformed industry standards by over 20%. Farmers are intrigued that rhizobia recovered from their fields could become widely available as inoculants.
2. Legumes are often attractive as cash crops, generating higher net benefits than non-legume staple crops and compare favorably to other cash crops such as tobacco, cotton, coffee or sugar cane because of their multiple uses as domestic food and cash crop for local, national and international markets. Grain legumes are also flexible in terms of different growing periods and local adaptation, thereby offering great opportunities for their integration into a wider range of African cropping systems.
3. The Lead Farmer approach has proved effective for reaching large numbers of rural households quickly with BNF technology packages. The project has managed to train more Lead Farmers than originally planned for and on average there are about 20 other farmers to every Lead Farmer, though the precise number varies between countries. Although in some countries it is challenging to engage sufficiently educated Lead Farmers, this is addressed by involving extension officers to ensure thorough capacity building on BNF of other farmers.
4. The general principle that N2Africa follows in technology dissemination is that no households should be provided with inputs or technical packages free-of-charge because this may be a disincentive for purchase of inputs in the long-term. As farmers are often testing completely new technologies (e.g. inoculation) and when installing test packages or larger demonstrations do so with their own land and labor, this is viewed as an investment in BNF technology of value to the project. In general N2Africa operates through seed loans. The key is to disseminate BNF technologies in a manner that discourages dependencies but does not bypass the poorest households most in need of them. Different solutions to this dilemma are being explored within N2Africa (see related Risk and Mitigation).
5. Small-scale farmers are able to meet the grain industry standards of top-end buyers but quality standards must be matched with a suite of post-harvest handling tools and practices, in addition to a price incentive for them to invest the extra effort required to meet higher standards.

4.3 Changes

Two changes impacted the program over the past six months, loss of key staff and deteriorating economic and political conditions in some countries. The Project Leader resigned to take another position and the Rhizobiology Specialist also left resulting in some lost momentum within late-starting Objective 3 activities. A Research Officer was lost to private enterprise in Malawi at a time when the

team urgently requires quantitative impacts from candidate BNF technologies. This sort of attrition is not unique to N2Africa but requires that experienced staff assume additional roles to fill gaps in expertise and effort.

Another change is deterioration of political and economic conditions in some countries. The continuing instability in Nord Kivu, DRC threatens to spill over into project areas. Life in Northern Nigeria has become more dangerous following a series of sectarian bombings. Working conditions in Malawi are worsened due to spiralling inflation, making it difficult to arrange for input promotion in rural areas. Certain forms of mass communication and collective actions that would otherwise advance the program are actively discouraged by politicians in Zimbabwe. A general election in Kenya was recently rescheduled to coincide with the start of the 2013 long rains, which we hope will pass peacefully.

4.4 **Risks and mitigation**

1. *Risk:* Improved varieties of grain legumes are recognized late into the project or remain unlicensed by private seed companies. In many cases, the most disease resistant varieties were not identified until midway through Year 3. *Mitigation:* Fast-track community-based seed bulking so that these improved varieties become widely available during the project's end phase. In some cases, multiply these seeds using irrigation during the dry season. Work with TL2 to have these best varieties registered and licensed.
2. *Risk:* Rhizobiology laboratories too late to start rhizobium bio-prospecting and isolate characterization now have insufficient time to identify field-tested candidate elite strains from their collections. This is certainly the case in Malawi and Mozambique, and likely in DR Congo and Nigeria. *Mitigation:* Candidate elite strains from more advanced collections in Kenya, Rwanda and Zimbabwe may be field tested in other countries during Year 4.
3. *Risk:* The anticipated level of private sector interest and participation in inoculant production may not materialize. The program had planned to produce at least 50,000 packets of inoculants through each of four cooperating laboratories by the end of Year 2. This only occurs in Zimbabwe (although the Malawi partner makes this quantity of inoculants there is no quality control as yet and doubts remain as to the efficacy of the product). In Kenya, MEA Fertilizers (Kenya) had launched full commercial production before the start of the project. In many countries N2Africa has relied on importing inoculants, which may prove to be a more sustainable way of ensuring supply in the long-term although this is still a point of discussion within the project. N2Africa had proposed to establish strategic alliances between private sector and research centers by the end of the project, and we will work towards this, but given the size of the current market it is unclear what further interest in production in partner countries by the private sector will arise. *Mitigation:* Develop supply chains based upon both African and imported inoculants and encourage smaller-scale pilot production by rhizobium laboratories. These actions strengthen demand for inoculants that could attract private investors in the future.
4. *Risk:* Farmers discredit BNF technologies extended free-of-charge or grow dependent upon them and legume production packages are not fully adopted. Distributing free farm inputs inhibits their attraction by agro-dealers and prevents farmer associations from developing fully rounded operations. At the same time, poor farmers may be extremely risk adverse and require incentives to test new grain legume enterprise. *Mitigation.* "New" farmers are provided a one-time input package consisting of seed, inoculant and fertilizer, suitable for a small area but still sufficiently large to produce seed for an entire field in the following season. At the same time, a fair and available market for legume grain is fostered. The following season these "progressing" farmers are encouraged to up-scale legume production and offered incentives to purchase needed inoculant and fertilizer.
5. *Risk:* Stepwise yield improvement of grain legumes is not being precisely reported and the process of tracking best managements to disseminated BNF technology packages is not obvious. For example, only half of the recent country reports contained legume yield information from legume agronomy trials yet all have assembled technology packages. Other countries report where and how many legume agronomy trials are installed but fail to report on their findings. In some cases, results are relayed to the R&D workstream by country teams with no effort to interpret the findings themselves. *Mitigation:* The Legume Agronomy Specialist and R&D

Workstream Leader will take additional effort to assure that country teams make better, and better documented use of their field results and these findings appear in country, milestone and program reports. Reports that Country Coordinators submit that do not include quantitative interpretation, tables and figures should be returned as unsatisfactory.

List of project reports

1. N2Africa Steering Committee Terms of Reference
2. Policy on advanced training grants
3. Rhizobia Strain Isolation and Characterisation Protocol
4. Detailed country-by-country access plan for P and other agro-minerals
5. Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya-24-28 May 2010)
6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis
7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan
8. General approaches and country specific dissemination plans
9. Selected soybeans, common beans, cowpeas and groundnuts varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launch and workshop report
11. Advancing technical skills in rhizobiology: training report
12. Characterisation of the impact zones and mandate areas in the N2Africa project
13. Production and use of Rhizobial inoculants in Africa
18. Adaptive research in N2Africa impact zones: Principles, guidelines and implemented research campaigns
19. Quality assurance (QA) protocols based on African capacities and international existing standards developed
20. Collection and maintenance of elite rhizobial strains
21. MSc and PhD status report
22. Production of seed for local distribution by farming communities engaged in the project
23. A report documenting the involvement of women in at least 50% of all farmer-related activities
24. Participatory development of indicators for monitoring and evaluating progress with project activities and their impact
25. Suitable multi-purpose forage and tree legumes for intensive smallholder meat and dairy industries in East and Central Africa N2Africa mandate areas
26. A revised manual for rhizobium methods and standard protocols available on the project website
27. Update on Inoculant production by cooperating laboratories
28. Legume Seed Acquired for Dissemination in the Project Impact Zones
29. Advanced technical skills in rhizobiology: East and Central African, West African and South African Hub
30. Memoranda of Understanding are formalized with key partners along the legume value chains in the impact zones
31. Existing rhizobiology laboratories upgraded
32. N2Africa Baseline report

33. N2Africa Annual country reports 2011

34. Facilitating large-scale dissemination of Biological Nitrogen Fixation

35. Dissemination tools produced

36. Linking legume farmers to markets

37. The role of AGRA and other partners in the project defined and co-funding/financing options for scale-up of inoculum (banks, AGRA, industry) identified

38. Progress Towards Achieving the Vision of Success of N2Africa

39. Quantifying the impact of the N2Africa project on Biological Nitrogen Fixation

40. Training agro-dealers in accessing, managing and distributing information on inoculant use

41. Opportunities for N2Africa in Ethiopia

42. N2Africa Project Progress Report Month 30

Partners involved in the N2Africa project

Bayero University Kano (BUK)

Caritas Rwanda

Diobass

Eglise Presbyterienne Rwanda

Resource Projects-Kenya

Sasakawa Global; 2000

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