N2Africa Project Progress Report

Month 42

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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1 Summary of progress

1.1 Highlights

Reaching the 225000 farmers in disseminating legume technologies.

In this report, we report on progress achieved by the project up to and including month 42 of the project. Month 42 refers to the month of April 2013, by which time the last full season had already been concluded in Ghana and Nigeria, while in the other countries (Eastern DRC, Rwanda, Western Kenya, Zimbabwe, Malawi and Mozambique) the last season in the project is underway or coming to a close. Based on the country reports submitted we conclude that the 225000 farmers, set as a target for reaching farmers for the delivery and dissemination of legume technologies, has been achieved and even surpassed during this last season in the project. These are farmers reached directly by the project. Through diffusion of technology the project will reach a substantial number of farmer in an indirect way. Case studies of these diffusion processes will give us some insight in the probable number it concerns. Furthermore, farmers are exposed to legume technology through satellite activities. Preliminary and incomplete reports indicate that an additional 20000 farmers are reached in these satellite sites.

Start with the construction of the business incubation unit for inoculum production at IITA, Ibadan

By the time of reporting a start has been made with the construction of the Business Incubation Unit (BIU) at IITA at Ibadan for the production of rhizobium inoculants, following a meeting convened early May 2013. This meeting brought engineers from IITA and scientist together to finalize the design of the production facility as well as of production process including required equipment and instrumentation. Currently there is no commercial inoculum production in Western Africa and we expect this BIU to boost local production and improve availability of inoculants for smallholder farmers. N2Afrcia has demonstrated the benefits to be derived from inoculation of soyabean and other legume crops and the large potential market for inoculants in the region and elsewhere. Production will start immediately when the facility is completed, planned for November 2013. Production will start at a modest scale using imported sterile sachets with carrier material that will be injected manually with locally produced rhizobia. In a next phase, the production will move to semi-automated processes for carrier preparation and injection of broth, to increase scale of production and reducing risks of contamination. An applied research program to optimize the production process and guarantee quality control will be established alongside. The plant will demonstrate state of the art technology, production processes and serve as a business model for private investors in Nigeria and other African countries.

N2Africa kicks-off in Ethiopia, Tanzania and Uganda

The N2Africa project has kicked-off in Ethiopia, Tanzania and Uganda. Even though this progress report concerns the eight countries of the original project proposal we would like to mention the start of project activities in the three target countries of the supplementary grant as an integrated component of the project. In Ethiopia the activities kicked-off with training workshops and establishment of the demonstration/dissemination and knowledge generation plots early July 2013. Activities are implemented in the 4 regions: Benishangul Gumuz, Amhara, Oromia and Southern regions.

In Uganda, a follow-up workshop was held in February 4th, 2013 to agree with partners on the start-up of activities to disseminate best available legume technologies in the areas where the key identified partners operate. The available legume technologies refer to high yielding and disease tolerant varieties of climbing and bush beans, rosette tolerant groundnut varieties, rust tolerant soyabean varieties kept by the various research Institutes. The project will focus on fertilizer packages and linkages to markets through its partner IFDC, and on rhizobium inoculants production at Makerere University. Dissemination of the technologies will be done through Africa 2000 Network Uganda, who uses a group approach through on-farm demonstrations at village level led by community-based facilitators. Activities during the first season of 2013 will be in implemented in the southwestern region (highlands of Kabale and Kisoro) for climbing bean, the northern region (Apac, Oyam, Kole and Lira) for soyabean and the eastern region (Serere, Pallisa, Bukedea and Tororo districts) for groundnut.

In Tanzania a two days' sensitization and planning workshop was conducted from 11-12 February 2013 at the Nelson Mandela African Institute of Science and Technology in Arusha, Tanzania. Demonstrations in farmer's fields have started in March 2013 in northern highlands of Tanzania, using released climbing common bean varieties. These varieties can yield four times more than the conventional bush types. This will be accompanied by staking, small addition of Triple Super Phosphate (TSP), Farm Yard Manure (FYM) and rhizobial inoculants. Opportunities for involving private companies to produce rhizobial inoculants in northern Tanzania are being discussed.

Launch of three soyabean-processing factories in Western Kenya

The United Nations Industrial Development Organization (UNIDO) and the Government of Japan announced launched three soyabean-processing factories in western Kenya (Migori, Kisumu and Malakasi) using state-of-the-art Japanese equipment for which the Kenyan Ministry of Industrial Development provided the facilities. The facilities will produce soymilk for school nutrition programs and fortified blends (flour) for emergency famine relief. The three facilities together have the capacity to process about 220 tons of soyabeans per year, and are currently fully supplied by N2Africa farmers. The N2Africa project has played and instrumental and catalytic role in the establishment of these facilities. Without the presence of the project in the area and the guarantee to supply the required amount of soyabean these facilities would not even have been conceptualized. Moreover, one of the N2Africa node leaders in west Kenya was recruited by UNIDO to serve as national coordinator to oversee the installation of the equipment and to launch factory operations. Soyabean processing within the program has grown to represent a considerable market for west Kenya's farmers and a great opportunity to better respond to humanitarian crises in Africa.

1.2 Summary of progress on delivery and dissemination

For Ghana and Nigeria the D&D activities reported on refer to the cropping season of 2012. In these countries there is only one season per year. For the countries in the southern Africa region (Malawi, Zimbabwe and Mozambique) the season is about to end and for the countries in central and eastern Africa (eastern DRC, Rwanda and Kenya) the season has progressed that far that they can present indicative figures on the number of farmers reached. That means, that at this point of time the figures we are able to present reflect the final score of the project. However, the data presented is somewhat preliminary, and still subject to further scrutiny. The final results will be compiled through the monitoring and evaluation process in the project.

In Table 1.1 below the number of farmers reached during the last season of the project are listed as reported by the country programmes. For Ghana and Nigeria this relates to the season ending in October – November 2012; in the case of Kenya the numbers for the 2012-2013 short rains and the 2013 long rains are added up. The project has reached a total of 118248 farmers during the last season(s).

Table 1.1: The number of farmers reached in each of the countries during the last cropping season in the project.

	2010-2011 season	2011-2012 season	2012-2013 season and/or 2013 long LR	Total households reached
Kenya		7187[1]	16310[2]	34012[3]
Rwanda			7900	
DRC			6110	19021
Malawi	3410	10407	17000	30817
Zimbabwe			16000	
Mozambique			9111	

Nigeria	30000 (22627)[4]
Ghana	23190
Total	**118248**

[1]. The number of farmers reached during the long rains in 2012 only
[2]. The number includes farmers reached from both the shorts rains 2012-2013 and the long rains 2013.
[3]. The number reported as total number of household reached since 2010
[4]. In narrative mentions almost 30000 farmers reached in Nigeria, but the number of input packages distributed/disseminated in the number between brackets). This number relates to the 2012 season (the 2013 season starts around May-June 2013)
[5]. Numbers reported for the 2012 season

In March 2013 we reported a total 165336 farmers reached by months 36 of the project. This was based on the numbers reported in the country programme updates for months 36 (also presented at the leadership and steering committee meeting in October 2012). To derive the total number of farmers reached in the project, we will have to discount for the number of farmers reached that are likely to have been included in the month 36 report already; that is the numbers reported for Ghana and Nigeria, as well as the number of farmers reached in Kenya during the short rains of 2012-2013. Therefore, we add 64441 farmers reached since month 36 to get an estimated total of 229777 farmer reached during the course of the project. Again, we will present conclusive figures based on M&E data in the final report. Note that in countries like Kenya D&D activities will be carried out still during the upcoming short rains of the 2013-2014 season. The final tally will largely surpass the targeted 225000 farmers.

All countries have reported on their satellite sites and satellite activities (see also Chapter 3, update on milestone 4.1.3) and, though quantitative data on the number of farmers involved is lacking for some countries, we estimate that at least an additional 20000 farmers are reached indirectly through satellite activities (and that is a conservative by conservative estimate). This would bring the total to above 250000 farmers reached directly and indirectly by the project. The definition of satellite sites is somewhat fluid though. In most countries this refers to existing partners expanding and extending their activities beyond the project mandate areas (or action sites), in other countries this refers to third parties taking the dissemination of legume technologies on. These satellite activities are not facilitated by the project and therefor at no extra cost to the project. However, inoculants are not available in most countries and may have been provided for by the project. In Mozambique, partners have imported and distributed inoculants themselves. In Ghana, for example, the satellite partner became a partner and their activities became more or less and integral part of the project (though still with their own funding and their own programme). From Kenya we have examples of the private sector engaging with the project. Promasidor (a food processor) is using the N2Africa farmers as out-growers for the their soyabean. They are in the same areas as the N2Africa project and this does not constitute a satellite site as such. The programme has gained momentum and they are dealing directly with the farmer groups and associations and are including new areas in their programme, all without further direct involvement of the project. We have further examples from Kenya where satellite sites have been established very far from the project's action sites and where the project only provides technical backstopping. In general we can conclude the project has played a catalytic role in bringing new initiatives off the ground in most of its target countries.

An excel-based utility was developed earlier this year to calculate cost and returns to legume crop and intercrop management, in response to the request from some quantitative information on the impact the project is generating. This tool was used to project N2Africa outreach achievements through to year 3, The data is presented in table 1.2. Program activities involved 165,336 households, planting 6961 ha with improved grain legumes. Net benefit from farmer outreach is estimated to be $5.6 million offering a 4.5-fold return on investment.

Note, this is based on the rather tentative figures presented in the country month 36-progress reports, and on assumptions of area planted, yield obtained and amount of N fixed. That is, it is not based on actual observation and measurement on farmers' fields. The figures presented in Table 1.2 are therefore tentative, but nevertheless give the order of magnitude in tons of grain produced and income generated. Through the 'early impact assessment' currently underway, we will be able to produce more accurate information.

Table 1.2: Estimated direct impacts of BNF technology dissemination activities in eight countries through Year 3 of the N2Africa Project (PL Woomer 6 March 2013 update)

165336	Households engaged[1]	*Farmer organizations and NGOs empowered*
418 MT	Legume seed deployed[2]	*Legume varieties licensed, bulked and marketed*
4.18 MT	Inoculant deployed[3]	*Inoculant producers contracted and facilities expanded*
696 MT	Fertilizer deployed[4]	*Fertilizer blends developed, agrominerals mobilized*
6961 ha	Legumes established[5]	*Production packages deployed, input suppliers engaged*
11418 MT	Legumes produced[6]	*Forward contracts issued, community nutrition improved*
274 MT	N fixed by legumes[7]	*Environmental quality protected*
$6,953,710	Income generated[8]	*Household incomes improved*
-$1,963,946	Other income lost[9]	*Farm enterprises diversified through grain legume enterprise*
$611,576	N fertilizer savings[10]	*Mineral nitrogen imports reduced*
$5,601,340	Total project value	*Foreign exchange retained*
$1,233,822	Total input & extension costs[11]	*Demand for farm inputs stimulated*
4.54	Overall benefit to cost ratio	*BNF technologies legitimized*

[1] Based upon Country Reports through Month 36. [2] Assumes 60 kg seed per ha. [3] Assumes soyabean and bean inoculated at 10 g per kg seed (not adjusted for non-inoculated cowpea and groundnut). [4] Assumes 100 kg fertilizer applied per ha. [5] Assumes each household plants a weighted average 0.0421 ha with 2.1 kg seed. [6] Assumes fertilizer Agronomic Efficiency of 6.4, increased BNF of 39.4 kg N per ha and BNF-N Agronomic Efficiency of 6 resulting in average yield increase of 0.88 t per ha (see Table 1). [7] Assumes 39.4 kg increased BNF per ha. [8] Assumes grain legume value of $609 per ton. [9] Assumes substitution of 802 kg per ha maize at $360 per ton, and a 22 kg/ha residual benefits to maize yield the following crop. [10] Assumes full substitution of N fixed for fertilizer N at $2.23 per kg N. [11] Assumes $0.75 per kg seed, $0.71 per kg of fertilizer, $19 per kg of inoculant and outreach costs of $1.50 per household.

1.3 Summary of progress with legume agronomy

The agronomy work reported relates to the trials conducted in the last concluded season for which the results are now available. In many cases, variety and inputs trials similar to the previous season have been conducted. In other cases treatments to test different types of inputs (e.g. manure) and applications rates were included, in response to the maybe poor local soil conditions and where the earlier trials (treatments) had been less successful (e.g. on the sandy soils in Zimbabwe). The results continue to show a generally strong response to inoculation. The response to P fertilizer is generally strong but often not markedly better than the response to inoculation only. If P is added to inoculants we often see a limited marginal response. The country summaries (chapter 2) show a wealth of data that is being generated from the agronomic trials (response to various varieties to different inputs regimes under varying agro-ecological conditions). We are currently synthesizing and summarizing results from all these trials, which will give insight in the G x E x M interactions.

The project is gathering economic data and doing some economic analyses. In quite a number of cases adding P to an inoculated crop does seem to make economic sense, in that the cost for fertilizer are higher than the benefits from increased yield. In other cases we see that adding P gives a net return but the benefit cost ration drops compared to the using inoculant only (see for details Chapter 2). This means that adding P makes economic sense if the capital can be raised at no or little extra cost and if there are no opportunity costs involved. Adding P will increase the yield and volume of production and total net benefit, but with reduced margins. If, however, farmer is cash strapped and there are costs associated with securing the capital for the investment, the farmer is best off with applying inoculants only. It will give him/her the highest return per dollar invested. Farmers, in many cases, do seem to adopt the ‘inoculant only’ technology more readily than the ‘inoculant plus P-fertilizer’ option. But, this is at the expense of the volumes produced. It might be worthwhile for industry and government to develop a policy to stimulate the use of P fertilizer if the volume of production is an important consideration. Conclusive results will be presented towards the end of the project.

An issue remains the strong variability in yield, with or without the required inputs. That is, we may see an unvaried strong response (in absolute terms or as ratio) to either inoculant and/or fertilizer application, but with strongly varying yields levels. The data from Ghana illustrates this, with soyabean yield (inoculated and P fertilizer added) ranging from less than 500 kg/ha to over 3000 kg/ha. The result from research into the variability in yield and response to inoculants and fertilizer application is pending the results from the lab on the soil and plant tissue analyses, which we hope we will be able to present before the end of the project. But, the results so far seem to suggest that there is a lot to be gained from reducing variability in crop performance, especially by improving yields on the poorly performing soils. But in order to determine how to do this, we still need to get some further insight in the constraining factors that determine this variability.

1.4 Summary of progress with rhizobiology work

The project has made considerable progress with the testing of the efficacy of rhizobium isolates and will continue with these activities until the end of the project, after delays that have occurred during earlier phases of the project. In Kenya the testing of isolates for soyabean has been concluded, but testing of isolates for common bean in the field is still in progress. For the other countries testing in either the lab or in the field is continuing. We will be able to present results still before the end of the project. However, the testing of 2000 isolates, from the various impact zones, will not be reached. Apart from Kenya, the countries have not been able to obtain the target number of isolates and the testing is behind schedule. At this phase of the project collection and isolation of rhizobium strain is no longer relevant and has also not been conducted over the period of reporting. The current contribution of rhizobium isolates the germplasm bank stands at 1151 (see Table 2.22). Students conduct much of this work and as far as the MSc students are concerned all students are expected to finish before the project ends.

The project will continue to support the labs to the end of the project, through technical training, technical backstopping and facilitation. Activities are still on-going in Mozambique where a small lab is being established at IIAM in Nampula, in Rwanda and DRC through supervision of student activities and direct operational support for the lab, in Ghana and Nigeria through training and supervision of students activities as well.

In the meantime considerable progress has been made towards enhancing production and improving quality of the inoculants. The case of MEA in Kenya is testimony to this fact, in that production has increased, quality has steadily increased and they are now even exporting to other countries in the east and southern Africa region. Research was conducted into possible alternative carrier material and into the shelf life of the inoculants in order to provide recommendations for improving the quality of the inoculants further.

Exciting is the progress achieved towards establishing a business incubation unit for the production of inoculants, at IITA in Ibadan, Nigeria. N2Africa is making a major contribution to this effort. The business incubation unit aims to demonstrate the state of the art technology for making rhizobium inoculants and provide support to (prospective) investors in doing research for technology development. This will relate among others to research into the alternative carrier materials and improved formulation. In the meantime the construction has taken a start.

1.5 Project process and administration

Early Impact Assessment

During the leadership and steering committee meeting in October 2012 it was decided to conduct an early impact assessment (EIA) such that quantitative information on the realization of the project's vision of success can be presented at the close of the project. The EIA aims to capture information on change of behaviour of target audiences of the project. One aspect concerns the adoption of legume technology by farmers directly targeted by the project, the area planted and yield obtained and the effect on household income, food security and nutrition. We also want to get insight in the adoption by non-facilitated farmers and processes of technology diffusion. Another aspect of the impact assessment is the availability of inputs, especially inoculants and fertilizers, through the local agrodealers network. Finally, we want to get some insight in how effective our D&D approach has been. Because the delivery and dissemination is done through our D&D and outreach partners we will solicit their feedback and draw lessons learned on how our D&D approach could be improved.

The project has developed various instruments and identified various case studies that should provide information on adoption and impact of the technologies, and give insight in the processes of adoption. Provisions have been made in the budget for all countries to carry out these activities, as these where unforeseen at the beginning of the project. Also, the activities for 2013 for each country were scheduled such that all results would be available by end of July latest, to allow enough time for analyses and reporting towards the end of the project.

The surveys take place after harvesting of the crop in the last season. This means that, by time of reporting, the surveys were already conducted in Ghana and Nigeria whose last season finished in 2012. In Kenya the surveys have been conducted as well, even though the last seasons was still in progress. However, because in Kenya we have two seasons a year there were enough farmers to sample from.

Transition planning

The project put plans in place to secure a smooth transitioning to the next phase (assuming there would be a second phase, and if not this would resort to putting an exit strategy in place). The project had not planned to undertake any kind of D&D activities during the (last) season, if it would not be able to present any results before the end of the project. For Ghana and Nigeria this means that no specific D&D activities were planned for the 2013 seasons (that starts around June-July), for example. The risk of ‘losing’ one season and herewith also farmers that have adopted or that are willing to adopt the technology is especially big for those countries that have only one season a year. The main risk being that inputs would not be available and that farmers would decide not to grow legumes crops anymore (or certainly not to expand the area under legume production) and thereby losing much of the gains the project has made over the past few years.

In anticipation of the role of the project in the second phase for the Tier 1 countries (so-called in the proposal for the original countries that will not belong to the core countries in the second phase) changing from direct implementation to facilitating and technical backstopping, we concentrate our attention during the transition phase towards assuring that input, especially inoculants, will be available to farmers in our mandate areas. We are working towards a more sustainable input supply system. This is especially relevant for those countries where there is no distribution network available (viz. Ghana, Nigeria, Malawi, DRC and Mozambique to some extent). In these countries the project has identified partners (agro-dealers, distributors) who will be responsible for the distribution of the inoculants and for advertising the project, while the project will still be responsible for importing of the inoculants in sufficient quantities and for the technical backstopping and training, assuming that if successful the companies will take on that responsibility for the next season themselves. The country summaries (chapter 2) give more information on the transition plans for the individual countries.

Financial management

For the last year of the project we have tightened the financial management of the project. The aim was to secure funds for new initiatives planned for this year while maintaining the financial basis for the implementation and finalizing of regular D&D and research activities. The new initiatives for which we had to provide financial coverage refer to:

- Early impact assessment and the various surveys and cases studies associated with it,
- Writeshop we planned to make sure we would have a number of publishable papers towards the end of the project,
- Implementation of the transition plan,
- Establishment of the RhizaTech Business Incubation Unit (with partial financial support of the project) as important element of our strategy to stimulate and improve regional inoculants production and to foster a sustainable input supply system for inoculants in the regions.
- Closing event of the project.

Financial reports for June 2012 (end of year 3 in the project) showed considerable balance on the accounts. It was however not clear whether this was the result of actual savings made or underspending of the original budget or whether the reported balance was the results of outstanding payments and commitments. In the former case it would mean that funds would be available for additional or new activities. The project was restructured according to workstreams after the second year of the project and the budget redone accordingly (absorbing possible balances at the end of the year two and changing the dates for the financial year). Because of this it was difficult to analyse where the balances at the end of year three originated from. We did financial reporting for December 2012, to confirm the balances reported earlier and at the same time we made a cost projection based on workplans for each of the eight countries individually. This informed the funds available for 'new' activities' based on which the financial planning for 2013 was done. We also introduced monthly monitoring of the budget execution per country. For CIAT this requires some additional work, because the system does not allow for disaggregation of the figures per country – there are no specific accounts for the individual N2Africa countries). So far the countries have been spending according the cost projections and there is no need for further financial adjustments. The following financial report will include the period up to and including June 2013.

2 Country summaries

2.1 Kenya summary

Program update and BNF impact

At the time of writing this progress report the last season of this first phase of the project is in full swing. There were a few new co-operators present at the planning meeting and the number of farmers that will have been reached at the end of the season will have further increased. Input requirements have been determined and distributed at the meeting, plans for transitioning to the next phase of the project have been discussed and agreed.

There have been several developments over the past 6 to 12 months. The soyabean variety Squire proved to be high yielding and resistant to soyabean rust and is a much preferred variety. Climbing bean variety RWV 51348 appears to outperform Kenya Tamu, the current recommended variety, but it is smaller seeded. The Sympal legume fertilizer blend includes now 0.1% Zn (without additional cost) and is used as the fertilizer in all our trials and demonstrations.

The involvement of the processing industry has further increased with Promasidor having purchased 659 tons of SB19 through our network of 16 marketing collection points. Three small-scale soyabean-processing factories (as part of A UNIDO project) have been officially inaugurated from 7 to 9 May 2013 for which N2Africa collaborators supplied the first 30 tons of soyabeans.

The search for elite rhizobia continues through field-testing of candidate elite strains and results seem to indicate that indeed a number of elite strains have been identified. A publication is forthcoming. Examination of BIOFIX also continues, with recent results suggesting that the expiration period should be 90 days, not the current 180 days, implying that inoculant produced for one bimodal season should not be used the next.

Partial economic analyses, based on data from the 2012-2103 short rainy season, indicates a net return of over $819 per ha can be achieved with SC Squire (inoculated) and MBILI maize intercrop, compared to $192 per ha for a non-inoculated Squire pure stand (Table 2.1). The corresponding B/C ratio is 2.8 and 1.6 respectively. SB19, though giving lower yields than SC Squire, gives similar net returns and B/C ratios, because of its higher price. Maize-soyabean intercropping using the MBILI system is more complex and expensive, but offers considerably greater returns (in large part due to the rising price of maize compared to soyabean).

Table 2.1: Economic return to different soyabean managements during the 2012-2013 short rains in western Kenya (based on 20 farms) [1]

management	total cost	gross return[2]	net return	benefit: cost ratio	labour days per ha
	------------ US $ ha^{-1} ------------				
SC Squire no BIOFIX	329	521	192	1.58	39
SC Squire + BIOFIX	343	664	321	1.94	39
SC Squire + BIOFIX + Zn	343	730	386	2.13	39
SC Squire w/ MBILI maize	445	1264	819	2.84	52
SB 19 no BIOFIX	302	546	244	1.81	39
SB 19 + BIOFIX	315	697	382	2.21	39
SB 19 + BIOFIX + Zn	315	716	401	2.27	39
SB 19 w/ MBILI maize	428	1200	772	2.80	52

[1] Assumes KSh 82 = US $1. [2] Commodity prices are $549 per ton for SC Squire (commodity-type, non-GMO), $630 per ton for SB 19 (food-type, non-GMO) and $463 per ton for maize.

The M&E data needs to be compiled and evaluated still, but of the farmers participating in the BNF technology test (farmer reached) during the 2102 long rains, 58% were women, households averaged 6 person per households and these managing on average 0.96 ha of land. Of these farms 70% proved to be *Striga* infested!

Several surveys (household survey, agrodealer survey and outreach partner survey) for the early impact assessment were conducted and completed in April. The results are forthcoming, but preliminary results indicate an increase in number of agrodealers that market BIOFIX (69%, up from 17% from the baseline survey) and that refrigerate the inoculant as well (71% from 23 in the baseline). The outreach partners indicate to have benefitted from the collaboration with N2Africa especially through improved facilities at their headquarter and services rendered (70%) and through training of master farmers and grassroot groups (67%). A considerable percentage (38%) indicates to have established input distribution services as result of their involvement with the project.

Agronomy and Rhizobiology

SeedCo varieties Saga and Squire, were not released before the 2013 long rains as was hoped. The SeedCo varieties are larger seeded, higher yielding and more resistant to soyabean rust, but lower protein to oil ratio, which make them unsuitable or processing for foodstuffs like Promasidor's Sossi. SB19, on the other hand, gives lower yield but gives better price because of its more favourable protein to oil ratio (2.1:1). Squire does respond very well to inoculation and fertilizer applications (see Figure 2.1).

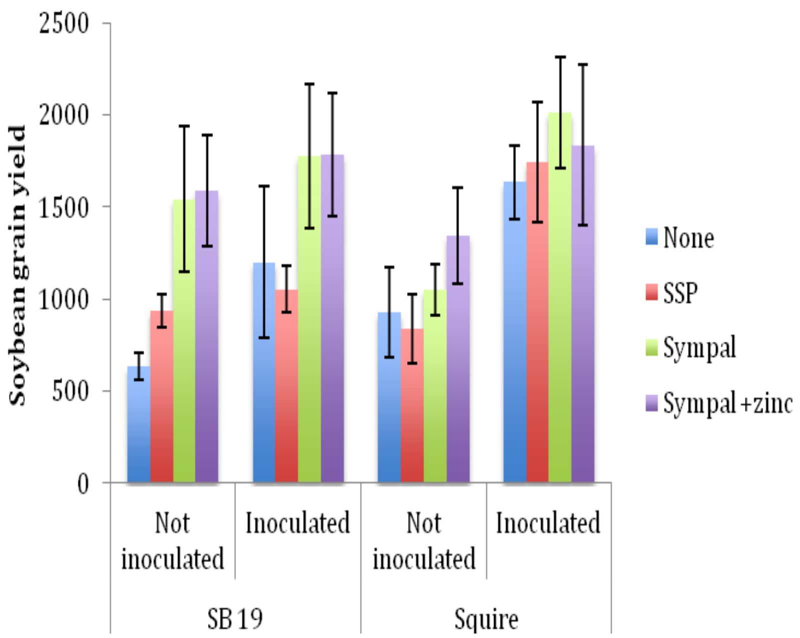

Figure 2.1: Performance of climbing beans under different fertilizer and inoculation managements in Migori, South Nyanza, Kenya

Conclusions from adaptive research trials 2012 trials include:

1) Soyabean responded inoculation in four of six sites,
2) Sympal fertiliser gives significantly higher grain and stover yields than SSP but addition of Zinc led to higher yields at only one site,
3) SSP and Sympal increases yield of bush and climbing bean yield at all sites, relative to the control treatment,
4) Two out of three climbing bean trials showed a significant positive response to inoculation.

The MIRCEN laboratory collection currently stands at 387 NAK isolates. Of the 186 authenticated isolates 100 were selected for testing in sterile media for symbiotic effectiveness, from which the best 24 have been retested in potted soil for competitive ability and the top six tested have been tested under field conditions. From these, NAK 115 and NAK 128 showed a 16 and 20% better response compared to the USDA 110 reference strain. The results under field conditions may vary from the potted soil experiments and growth on sterile media, in part because soyabeans are harvested at a later stage of development. A paper is forthcoming. A similar evaluation process for bean rhizobia is nearing completion. The elite strains are currently undergoing molecular characterization.

Research into the quality aspects of the inoculants is continuing. One study indicates that BIOFIX does not maintain its minimum standard (1 x 10^9 rhizobia per gram) for the current 180-day expiration interval, regardless of storage at room temperature or under refrigerated conditions. Results for soyabean inoculant (USDA 110, Figure 2.2) and bean inoculant (CIAT 899) were very similar. Research into alternative and improved carrier materials and formulations continues with biochar and coconut coir proving not to be suitable carriers.

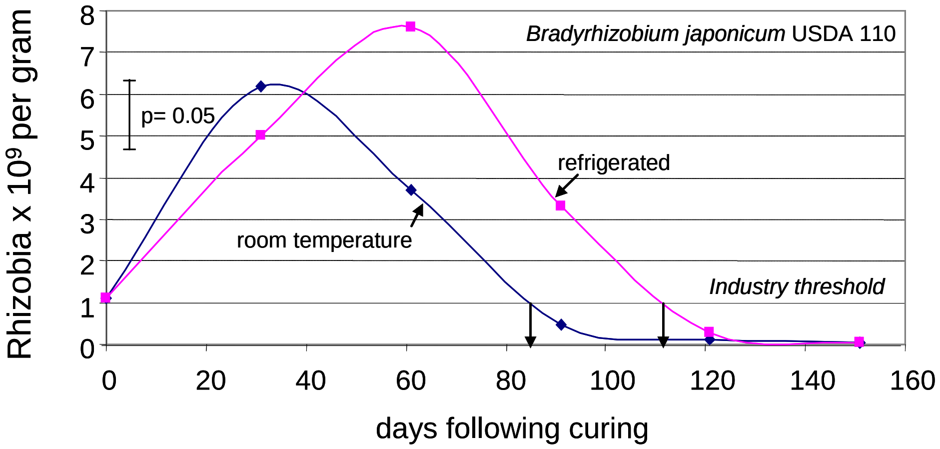

Figure 2.2: Rhizobial survival in BIOFIX inoculant over time (data from Isaac Balume, MIRCEN)

Technology dissemination

A number of new initiatives are undertaken in Kenya that are associated with the N2Africa project and that build on its work, but do not require further financial inputs from the project. These are being referred to as satellite initiatives or sites. In Kenya there are six such initiatives:

1) MEA Ltd. Farm Input Manufacturer that is directly involved in the input distribution to the N2Africa farmers and beyond, at that works in close cooperation with the project to improve and assure the quality of their inoculants
2) Promasidor Outgrower Network that was initiated from within the project but operates independently and is expanding its network. Promasidor Outgrowers receive credit that is deducted from deposited payment and includes farmers that grow soyabean but have never worked directly with N2Africa but rely on its market collection points.
3) Mumias Sugar, who have started a program of intercropping sugarcane with soyabean at the early stages of crop development.
4) The Agricultural Development Corporation Kiswani Complex (ADC), who have embarked upon a soyabean program with technical input and advice from the N2Africa project
5) UNIDO that have established three soyabean processing factories that rely on N2Africa for their input and have relied on N2Africa staff and partners for coordination of their activities
6) One Acre Fund-Kenya, who are incorporating soyabean in their program relying on technical backstopping and input from the project

Four of these Satellite Partners will work directly with 461 farmers on 506 ha, with expansion foreseeable in the future through creation of outgrower networks by Mumias Sugar and ADC, as well as greater attention to grain legume enterprise by One Acre Fund in response to the spread of Maize Lethal Necrosis Virus in Kenya.

Further we like to report that Reckoning International (see www.thereckoning.org), a faith-based outreach partner joined in the final season in west Kenya outreach, only received farm inputs but no operating funds (contact: herman.melisa@gmail.com). Two of our outreach cooperators, (KESOFA and MFAGRO) have extended their numbers of participating farmers well beyond the targets set and supported by the program, opening new opportunities through revolving funds and marketing collection points for all members. In some cases, a single Outreach Cooperator will contain several categories of farmers including first-time BNF technology testers and progressing farmers receiving inputs on credit that pay back in soyabeans.

To date, the 27 member Kenyan Outreach Network has installed 329 BNF technology field demonstration, conducted activities on 50127 farms reaching at least 34012 new households, deployed 4.5 tons of BIOFIX inoculant in 54805 packets, distributed 205 tons of improved seed and 304 tons of recommended fertilizers, trained 226 Master Farmers and distributed 44438 total copies of five different extension manuals (Table 2.2: Summary of N2Africa outreach activities in West Kenya from 2010 through month 42 (April 2013)Table 2.2). Farmers produced much of this seed at 140 seed multiplication sites under the 2-for-1-payback agreement, with payback used to recruit new farmers the next season. About 56% of fertilizer and inoculant inputs were extended on credit to Progressing Farmers, with the remainder used to introduce new farmers to BNF technologies.

Reportedly 2296 persons (50.3% women) attended 22 field days during the 2012-2013 short rains (four cooperators have not reported). The average age of participant was 43, ranging from school children to 93. Currently, we have 26 Farmer Field Days scheduled for the 2013 long rains during May or June.

Table 2.2: Summary of N2Africa outreach activities in West Kenya from 2010 through month 42 (April 2013)

Outreach action	2012 long rains	2012-2013 short rains	2013 long rains	Total since 2010
Number of on-farm demonstrations	50	52	53	329
Number of satellite technology tests	12500	10130	10775	50127
Number of new households reached	7187	7990	8320	34012
Inoculant deployed (kg)	650	959	2166	4458
Inoculants packets distributed (BIOFIX)	15500	10877	12644	54805
Soyabean seed distributed (tons)	73000	37875	38495	204 tons
Climbing bean seed distributed (kg)	58	89	286	894
Fertilizer distributed (tons)	126	46.4	46352	304 tons
Seed multiplication sites	24	26	27	140
Master farmers trained	94	52	0	226
Master farmer manuals distributed	0	53	10	188
Extension manuals distributed	8300	18000	10288	44438

During the *past 2012-2013 Short Rains season we* continued to test new soyabean varieties, input combinations and cropping arrangements that promote BNF. Two farmer-accepted soyabean varieties (SC Squire and SB 19) were evaluated with and without addition of zinc in addition to inoculants and fertilizer and in stand-alone and combination with maize in the MBILI 2x2 staggered intercrop. Cereals received 33 kg N ha^{-1} as urea topdressing in split application. Further details on the treatments and recording protocols can be found in the Kenya progress report. Root nodulation responded strongly to inoculation with 2.4-fold more nodules and 4.1-fold greater frequency of crown nodulation, and 2.6-fold increased red interior pigmentation. Inoculated soyabean yields were 1.2 and 1.1 t per ha, for SC Squire and SB19, respectively, which is an improvement of 12% over the past short rains, probably due to a timelier onset of the rains. SC Squire responded to the addition of Zn in the Sympal fertilizer blend (+10%). Maize yields in the MBILI intercrop averaged 1.8 tons per ha and were considerably improved over last season (+47%), likely because of our substitution of an OPV (WS303) for a new hybrid (WH507).

For the on-going *2013 Long Rains season* fifty-three field demonstrations and 8320 satellite field tests of BNF technologies were installed. Each demonstration consists of eight grain legume technologies with two contrasting grain legumes, SC Squire soyabean (specifically nodulating) and cv Tamu climbing bean grown as both monocrops and intercrops with maize. Cooperators are recommended to spray fungicide to control soyabean rust as standard practice and Diazinon to control aphids and other insects on climbing bean as needed. Each demonstration then serves as the nucleus of 160 on-farm field tests with the participants receiving fertilizer, seed, inoculant and field instructions for immediate planting 200 m^2 BNF technology tests on their nearby farms. Some co-operators have opted may elect to test a second soyabean variety rather than climbing bean.

Marketing and Value Addition

In collaboration with Promasidor Ltd., we have established 16 soyabean marketing collection points. Promasidor reports 604 tons of soyabean purchased from N2Africa cooperators during the past two rounds of announced buying. UNIDO purchased 30 tons. KESOFA recently sold another 55 tons. These soyabeans are worth about $420,000 (or KSh 35.7 million). We also printed and distributed another 4000 fifty-kg "branded" woven polythene sacks for grain processing, 2000 ten-kg woven sacks for seed collection and 8000 two-kg two-ply paper bags for seed distribution.

Kleen Homes and Gardens, leading our legume processing effort in west Kenya, indicate that nine of 26 cooperators (35%) maintain continuous processing operations. Products include fresh soymilk, often further processed into yoghurt, roasted, powdered soy beverage, fried soyabean snacks and composite soy flour. These cottage operations utilize about 2284 kg of soyabeans per month worth $1,391 as non-processed grain. Products are valued at $3,371 per month resulting in a 2.4-fold value addition. These findings are derived from groups operating small shops and do not include value-added processing at the household level.

The United Nations Industrial Development Organization (UNIDO) and the Government of Japan have established three soyabean-processing factories in west Kenya using state-of-the-art Japanese equipment. Factories able to process about 45 kg of soyabean per hour are now in operation in Migori, Kisumu and Malakisi. Each factory specializes in a different range of soy products. This local industrial processing complements the cottage industry processing designed to improve household nutrition at the grassroots level.

Capacity building

We have one Ph.D. candidate (George Mwenda) and investigating inoculation of beans and who currently is characterizing 179 isolates from beans at Murdock University (Australia). One M.Sc. student (Samuel Mutuma) has completed his thesis "Farmer Perceptions, Use and Profitability of Biofix on Soyabean *(Glycine max)* Production" in which is shown that household size, distance to market, contact with organizations and membership of local farmer group determine the adoption or use of BIOFIX. Maureen Waswa (M.Sc. student) has drafted her thesis titled "Evaluation of Indigenous Rhizobia Isolates Obtained from Kenyan Soils for Effectiveness on Growth of *Glycine max*" and Isaac Balome (M.Sc. student) has researched inoculant quality and alternative inoculant formulation. All MSc students are expected to graduate before the end of the year. Newly recruited students include Teresah Wafullah, formerly the production supervisor of BIOFIX at Nakuru, and Martin Koinange (research assistant) is testing candidate elite strains of bean rhizobia in collaboration with the Maseno Legume Agronomy Team.

The fourth and final *Master Farmer Training* was conducted from 14 to 16 November 2012 and assembled 50 candidate Master Farmers using the 188 pages 'master farmer training manual'. The training consists of lectures, fieldwork and practical and included demonstration on field-testing of rhizobium strains and preparation of value-added legume products. More time was spent on examining plants and nodules in the field than on previous occasions. Copies of the Master Farmer Guidelines were handed out to assist master farmers in their own localized training and master farmers were provided with an inoculant and fertilizer pack for demonstration and product promotion package. The main objective was to empower co-operator's farmer-to-farmer capacities to disseminate BNF technologies in west Kenya. The training also sought to strengthen the program's Master Farmer network with additional members and linking them to past efforts.

An agrodealer training workshop was conducted on 23 January 2013, attended by 33 agrodealers. Considerable time was reserved to discuss strengthening agrodealer support for BNF technologies.

Soyabeans (and other legumes) must be available for sale alongside BIOFIX inoculant and Sympal so they may be purchased as a technology package. Legumes should be included in the agro-dealer roadside demonstrations of products (usually dedicated to maize) and availability of product information and extension information should improve. In parallel, we should develop capacity for farmer groups to market BNF products as a service to their members. Need exists to reduce the risks of expiry when stocking BIOFIX in return for agrodealers consolidating their orders for BIOFIX inoculants in advance. Finally, concrete steps were taken to consolidate links between N2Africa farmer groups and local agro-dealers for continuity of input supply and program gains.

2.2 DR Congo summary

Program update and BNF impact

A new DFID funded project, led by WUR (social science group) to assess the impact of different ways of technology dissemination is implemented in the Ruzizi plains covering the N2Africa action sites (100 villages) with technical support of N2Africa team. It covers the N2Africa actions sites and includes additional locations. This project is considered to be one of the satellite activities in DRC. Five (5) village based- agro-dealer shops (small kiosks selling other consumer products e.g. Coca-Cola) were identified to stock and sell inoculants. They were supplied with 400 packets of LegumeFix (100g) at USD 3 per pack. However, importing inoculants form either the UK or Kenya remains expensive and sourcing the inoculants from RAB-Rubona (Rwanda) could be a more sustainable solution if quality can be guaranteed.

During the reporting period a total of 6110 new households were recruited bringing the total of household directly reached by N2Africa to 19021. Lessons learned from past experience to improve planning, supervision of field days and improving community based seed production were implemented. After the season ended, the household survey as part of the early impact assessment was concluded and data has been forwarded for further analysis. Topics for case studies have been identified and these and the partner survey will be done in the next few months.

Agronomy and Rhizobiology

Four new promiscuous soyabean materials from IITA Malawi were evaluated for adaptation to different soils and agro-ecological conditions in east DR Congo. Results indicate that the materials respond to inoculation and yield slightly higher than common varieties including SB 24 (Figure 1). The varieties add to the SeedCo materials (SC Saga and SC Squire), the Ugandan SB 24 (Namsoy) and the local varieties Imperial and PK06 that had been confirmed to be suitable for eastern DRC already.

Adaptive research campaigns focusing on the response of soyabean to inoculation, compost manure and use of different P fertilizers on so-called non-responsive soils were concluded during 2012B growing season. Analysis of data from 3 sites combined from the north axis (Karehe, Mumosho and Bughore) indicates improved response to the application of different P fertilizers, with Sympal giving the highest yield. The trend was the same for sites in south axis. Erik Sika (an MSc student) is conducting a double-pot experiment to identify the actual limiting nutrients in these depleted soils that would explain the poor response.

Further research is conducted on two tree legumes *Callindara callothyrsus* and *Lucaena diversifolia* and two herbaceous legumes *Clitoria ternatea and Lablab purpureus* as fodder crops. Trials were established on 25 farmers' fields in Kamisimbi and Ikoma where there is relatively large number and diversity of livestock (cattle, small ruminants and cavies), following poor establishment in previous sites (Tubimbi and Kamanyola). The activity is implemented jointly with the forage program of CIAT and it is part of the long term trials to assess the impact of fodder legumes on soil erosion control, livestock nutrition and soil fertility improvement.

Isolation of the rhizobium strains from the 2120 nodules collected I finalized. Of the batch of 107 earlier isolated strains for soyabean, 80 strains have been tested for effectiveness and 4 promising elite stains identified. These strains are now being tested on potted soils. The activities have been seriously delayed, because of security concerns around November to December 2012, which led to total destruction of the established greenhouse experiments. Field-testing of elite strains will no longer be feasible within the timeframe of the project.

Quality of inoculants used in our experiments, demonstration plots and in adaptation plots is routinely assessed. The results are presented in Table 2.3. The average concentration does not really give the most probable number but gives an indication of the quality. The lab has also tried to produce its own inoculants, but the quality is very poor (see Table 2.3). Further technical support is required to improve the quality of the processes for production of inoculants as well as quality assurance.

Table 2.3: Quality control results of inoculants obtained from outside DRC and one produced at Kalambo research station

Name of inoculants	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	The average concentration
Legufix from the Soyabean	528	300	85	5	2	1	2.3×10^8
Rizobiumuya soya from RAB RubonaRwanda	352	240	58	21	1	0	0.6×10^8
Inoculum ya soja/kalambo Manufactured at Kalambo DRC	189	132	22	2	0	0	0.095×10^8

Technology dissemination

Five (5) satellite sites were established (with partner and number of households in brackets): Kasila (CODEBU, 124 households), Mukwija (SOLF, 471 households), Bushushu (ACDERU, 600 households). Luzira (CLD-Luzira- 240 households) and Idwji (PLANET VERTE, 240 households). This makes the total of established satellite sites to be 8.

In the 21012B season 37 demonstration plots were established, demonstrating use of Sympal and inoculants on soyabean and Sympal and TSP on beans.

For the 2013A seasons 20 demonstration plots were established in 13 project and 5 satellite sites, with 6110 households receiving the dissemination packages to use in their adaptation trials. The focus continues on soyabean inoculation and use of P fertilizers in north axis (Kalehe, Murhesa, Mumosho) and use of input on beans in south axis (Ikoma, Burhinyi, Mulamba).

A total of 12 field days were conducted by partner organization in their respective mandate areas between December 2012 and January 2013. Also a total of 12 exchange field visits were conducted involving a total of 172 male farmers and 848 women farmers. Women participation in project activities continues to be high: 65% of recruited households (6110) are women while 82% of farmers that participated in exchange visits were women. Likewise, as indicated in table1.2, the majority of farmers participating in different training are women.

Marketing and Value Addition

Training and organizing farmers in collective marketing continues. Farmer cooperatives established collection centres Ikomo, Miti, Mumosho, Bwirembe, Birava, Walungu, Mulamba, Bughorhe and Murhesa (9 in total) collecting in total 26.5 tons of soyabean and 28.5 tons of beans. The collected grains were sold three months after harvest at a price of USD 1.2 and USD 1.5 per kg of soyabean and beans respectively (compared to USD 0.5 for soyabean and USD 1 for beans at harvest time). The respective farmer cooperatives get initial capital from microfinance institutions MECREBU, COOPEC FOMILAC, COOCEK KIVU, and COOPEC Nyawera to facilitate the buying. The local market easily absorbs all the soyabeans and beans produced; some (soyabeans) finds its way to Rwanda.

A total of 595 women were trained as trainers on household and cottage processing of soyabean into products such as soymilk, soy beverage and tofu. It is anticipated that these farmers will reach out to another 2500 farmers before the end of season 2013B.

Capacity building

N2Africa in collaboration with CIALCA team produced a leaflet on soyabean inoculants for the purpose of creating awareness on the use of inoculants among farmers. The leaflet is distributed as part of the inoculants package sold at the village-based agro- input shops. In addition 18 radio shows were conducted (12 by Radio Maendeleo based in Bukavu and 6 by Radio Communautaire de Nyangezi). The shows covered the use and benefits of fodder legumes on livestock, benefits of use of inoculants on soyabeans, post-harvest processing of soyabean, use of fertilizers on beans and soyabeans.

Five (5) village based input sellers were identified and trained on inoculant handling and selling, and given some soyabean inoculants to sell in their kiosks. A total of 228 master farmers, 241 facilitators and 1040 farmers were trained on various aspects of legume technology.

Table 2.4: Distribution of farmers by (gender) participating in various trainings of N2Africa DRC

	MASTER FARMERS		FACILITATERS		HOUSEHOLDS	
	Male	Female	Male	Female	Male	Female
DIOBASS	30	21	22	40	256	245
PAD	32	30	40	35	138	92
SARCAF	9	40	17	45	37	272
Sites satellites	25	41	30	32	0	0
Total	**96**	**132**	**109**	**152**	**431**	**609**

Progress on the MSc is as follows:

Bintu Ndusha (registered at University of Nairobi) continues her research on “Evaluating effectiveness of Rhizobia strains isolating from South Kivu soils (Eastern DRC) on Soyabean (Glycine max), after returning from maternity leave and having to abandon her initial experiment because of security reasons. She is expected to graduate before the end of the year though.

Erick (registered at Kenyatta University) has started his research on “Profiling limiting nutrients for Soyabean (Glycine max (L.) Merril) production in highly degraded soils of South-Kivu / Democratic Republic of Congo”.

Fidele Barhebwa admitted at Kenyatta University is continuing with his research with the title “Evaluation of small scale legume production towards poverty reduction in East of the Democratic Republic of Congo” This research was also affected by security unrest situation in DR Congo.

Isaac Balume registered at University of Nairobi is continuing with his research with title “Quality control of rhizobia inoculants”. This research is progressing well and a paper is forthcoming. He is expected to graduate before the end of the year.

2.3 **Rwanda summary**

Program update and BNF impact

Several new opportunities emerged during the reporting period. Seed Co has opened a business unit in Rwanda in January 2013 and is set to play a key role in developing soyabean sub-sector in the country. Seed Co is committed to facilitation release and commercialisation of the newly introduced soyabean varieties Saga, Sequel and Squire. The microbiology lab of RAB at Rubona received additional equipment for inoculant production (a big fermenter, autoclave, a reciprocating shaker and grinder) through an AGRA grant. The oil extraction facility of Mount Meru Soyco Ltd is nearing completion and the Government of Rwanda is stimulating the production of soyabean in the country such that the factory can be adequately supplied. They aim for 18000 ha to be planted with soyabean during 2013 B growing season (March-June, 2013). In support of this policy the government has joined N2Africa in promoting the use of rhizobia inoculants and RAB Rubona is charged to produce the needed inoculants. This has seen the laboratory at Rubona raise its inoculants production 40-fold (from producing 222 packets of 80g mid-2010 to more than 8780 packets at the end of 2012).

However, the quality of inoculants produced is still far below N2Africa standards (10^6-10^8 cell/g compared to the 10^9 cells /g required). Improving the quality of inoculants produced at Rubona is still one of the focal points of N2Africa in the remaining period of the project. One aspect to be addressed is the costing of the inoculants and economic analyses of rates of returns from the use of inoculants at smallholder level.

During the reporting period a total of 8500 farmers were recruited and continue to test N2Africa technologies. Preliminary results from the use survey indicate that average land sizes are below 1 ha in all districts (confirming the baseline). Out of the 298 farmers, 289 farmers indicated they grow one or more legume crops. Climbing beans and bush beans are the most widely grown legumes. Soyabean is mainly grown in Kamonyi. In this district some farmers also grow groundnut and cowpea. All farmers applying inoculants did so with soyabean. The use of organic fertilizer is also relatively high for this crop, together with bush and climbing bean. The main mineral fertilizer used for climbing bean, bush bean and soyabean is DAP (Table 2.5).

Table 2.5: Use of inputs in percentage of fields cultivated with legumes in Rwanda

	N	Inoculants	Organic fertilizer	Synthetic fertilizer	Other N2Africa technologies
Bush beans	220	0%	63%	6%	25%
Climbing beans	288	0%	97%	68%	61%
Cowpeas	2	0%	0%	0%	50%
Groundnuts	19	0%	11%	0%	0%
Soyabeans	41	10%	76%	27%	29%
Total/ average		**0.7%**	**79%**	**39%**	**43%**

For 60% of the climbing bean fields, farmers indicate to plant in rows, apply row spacing and/or practice crop rotation (practices promoted by N2Africa). There does not seem to be any difference in the choice of crop between farmers with a low and a high socio-economic score, since the majority of farmers grow climbing bean and bush bean irrespective of class. Climbing beans tend to be grown more by the intermediate socio-economic class, while farmers from the wealthier class tend to favor groundnuts and soyabean. Farmers with larger land holdings tend to grow climbing beans at the cost of bush beans, as compared to farmers with small or average land holdings.

Organic fertilizer is commonly used while mineral fertilizer is used on more than one third of the fields (Table 2.6). Striking is the tendency of ‘average income’ and ‘average size land holding’ farmers more often to use organic and mineral fertilizer compare to the other two classes. Very few farmers use inoculants.

Table 2.6: Use of inputs by socio-economic class and land size (Rwanda)

	N	Inoculants	Organic fertilizer	Mineral fertilizer	Other N2Africa technologies
Socio-economic status					
poor	73	0%	81%	38%	47%
average	231	0%	82%	45%	45%
wealthier	266	2%	74%	31%	36%
*Land size**					
Small	159	0%	22%	10%	10%
Average	244	0.5%	33%	15%	19%
Large	167	0.2%	24%	14%	13%

The household survey for the early impact assessment has been conducted in April and the partner survey and the case studies will be conducted in June-July.

Agronomy and Rhizobiology

Four soyabean varieties, namely SB 24 (Namsoy), SB 8, SC Saga, and SC Squire, passed the NPT test and now are ready to be released. Results from one of the NPT sites are presented in Figure 3 (source: Musambila). Seed Co, Makerere University and IITA have been slow in giving their consent and this has delayed the release of the varieties. The varieties have been selected for biomass accumulation (BNF potential) and yield. These varieties do respond well to rhizobia inoculation and P fertilizers giving a yield ranging between 1800 and 3500 kg/ha (Figure 2.3) on good soil and under good climatic conditions.

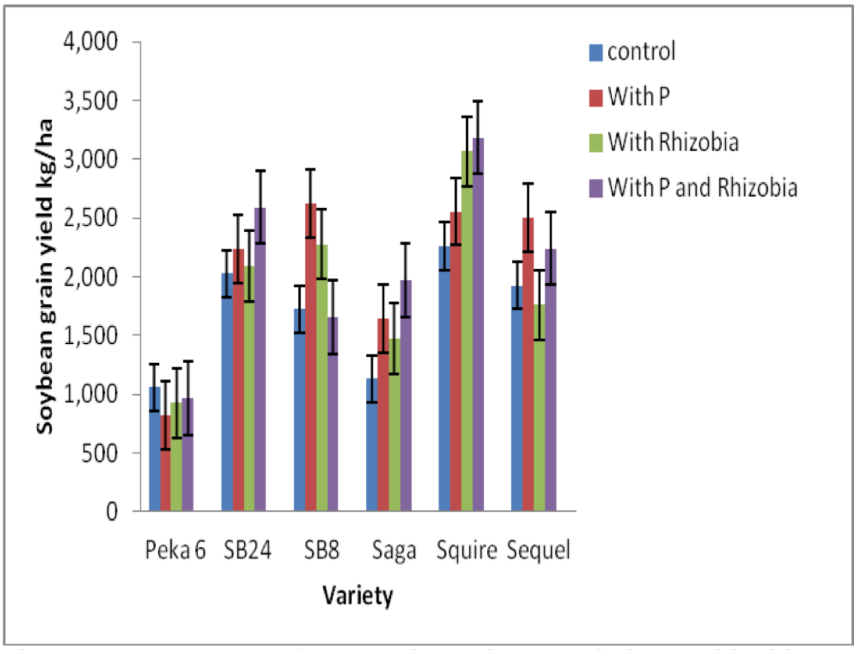

Figure 2.3: Response of selected soyabean varieties to rhizobia, P and their combination in relation to the local check (PK06); Musambila Kamonyi site, 2013B growing season, Rwanda

Results from adaptive research campaigns conducted during 2012 B growing season indicate that inoculating soyabean with rhizobia results in yield increase up to of 60%. Use of P fertilizers increase biomass and grain yields of soyabean, with Sympal outperforming other P fertilizers (TSP, DAP and TSP+ KCl) in 70% of test sites. The trend seems to be the same for climbing and bush beans.

A student from Wageningen University is investigating the cause of the lack of response to application of P fertilizer on some soils in Rwanda, and results will help to improve fertilizer recommendations.

From the tested tree legumes, farmers prefer *Lucaena pallida* and *Lucaena diversifolia*, while *Stylothanses guianensi, Desmodium intortum and Macroptilium atropurpureum* emerged as the best herbaceous legumes. The preference was based on fast the growing characteristics, ability to adapt to poor soil and ability to grow in mixtures with Elephant grass, the common fodder grass. The forage specialist at RAB is processing the data on the performance of different fodder legume species. The selected tree legumes are now being promoted in northern Rwanda where dairy cattle is commonly kept and to complement as source for staking material for climbing beans. Monitoring of performance in established trials continues.

RAB-Rubona has isolated and characterized a total of 259 rhizobia isolates (94 from soyabean and 165 from a bean). All the isolate have been entered into the central database. Greenhouse screening found 15 soyabean isolates outperforming the commercial strain USD 110 and 13 bean isolates outperformed commercial strains CIAT 889 and UMR1957. These candidate strains have been advanced for further testing in potted soils and concurrently in the field at Musanze and Rubona. Field-testing will not be completed until after the end of the first phase of the project.

The rhizobiology laboratory at RAB has embarked upon full production of rhizobia inoculants, following the campaign by the Ministry of Agriculture and Livelihood (MINAGRI) to promote soyabean cultivation in the country. Between August 2012 and January 2013 the laboratory produced about 8780 80g packets of inoculants, which were distributed to farmers with the support from the Clinton Foundation. To ensure local availability, the inoculants are distributed through selected agrodealer shops. RAB and Rwanda Bureau of Standard are currently developing the quality control protocol to ensure that the inoculants produced in country and or imported are of acceptable standard. In this aspect RAB will need the advice of N2Africa.

Technology dissemination

The following satellite sites were operated since October 2012:

- EPR (Presbyterian church of Rwanda), Clinton foundation, COCOF, and Medicus Mundi established activities in 5 satellite sites serving more than 4200 households by October 2012.
- DRD established 5 additional satellite sites in Gakenke and Burera districts (sectors Cyuve and Rwaza), in Musanze district (Muko) and in Burera district (Cyanika and Rugarama sectors) in January 2013, with N2AFrtica dissemination packages distributed to 4000 households
- CARITAS extended dissemination of N2Africa technologies in 4 more sectors (Nyarugenge, Rweru, Juru and Ririma) in Bugesera, with 1200 households being served.
- EPR opened a new satellite site in Kayonza (Kabarondo) serving 200 households.
- COCOF scaled out N2Africa activities in 3 more sectors in Kamonyi district (Gacurabwenge, Karama and Mugina) with 1050 households.

This brings the total to 10650 households being reached in satellite sites

Four new dissemination tools were composed for use in 2012B growing season. These include:

1. Use of Sympal fertilizer (included in 8 demonstration plots in Kamonyi, 8 demo plots in Bugesera and 3 demo plots in Kayonza)
2. Testing of 2 new Seed Co soyabean varieties SC Saga and SC Squire planted in 6 demo sites (3 in Kamonyi and 3 in Kayonza);
3. Use of sisal strings as an alternative method of staking climbing beans in northern Rwanda
4. Testing of 3 new fortified climbing bean varieties currently promoted by RAB and Harvest Plus project.

Demonstration plots were established, at least one per action site, in all the 13 sites, to test inoculants for beans with the use of Sympal fertilizer.

Eighteen demonstration and dissemination campaigns were established during 2013A in 13 action sites with the participation of 7900 households who received the dissemination packages. The focus continues on climbing bean-maize rotation (in Burera and Gakenke), maize-soyabean rotation, cassava-beans intercropping and soyabean rhizobia inoculation (in Kamonyi, Kayonza and Bugesera) and tree legumes for fodder and staking in Burera and Gakenke district. In collaboration with 7 agro dealers, 3 from Kamonyi, 2 Kayonza, and 2 from Bugesera, soyabean inoculant is being sold to farmers.

Thirteen (13) field days were conducted by partner organization in their respective mandate areas in December 2012. Partners from the 5 impact zones in Burea, Gakenke, Kamonyi, Bugesera and Kayonza participated in open days organized by district authorities, where they mostly exhibited soyabean products locally processed by women groups.

A radio program was conducted by DRD in collaboration with a local FM radio Musanze by visiting demonstration plots of beans where participating farmers were able to explain and disseminate their work. The show on the event was aired for 5 days consecutively. Two radio shows were organized at the national radio where N2Africa FLO was invited to explain how to use the hermetic bags to store Maize and Bean grain.

Women participation in project activities continues to be emphasized. The number of women participating in the DRD program remains high (61% of 7418 farmers), in the dissemination activities of EPR the percentage has increased from 37% to 58.6% (of 4500 farmers) and for COCOF it remains almost 80% (out of 6789 farmers).

Marketing and Value Addition

The new SOYCO oil processing plant (under construction in Kayonza district) has started to buy farmers' soyabean harvests. All farmers producing soyabean in Rwanda are under one registry and have opportunity to sell their produce at this processing plant. Existing markets include COCOF, SOSOMA industries and CARITAS-Rwanda through its food security program. There is a shortage of soyabean on the market and soyabean is selling at approximately USD 700/Mt, well above the word market price ranging between USD 450-600/t (postharvest handling and storage). The department has established the grain collection centers in Bugesera district. The centers are run by the farmer cooperatives and grains sold to customers from within and outside the district.

Capacity building

N2Africa has produced a leaflet and a poster on soyabean inoculants in collaboration with RAB for the purpose of creating awareness on the use of inoculants among farmers. The leaflets are distributed through selected agro-dealer shops that are selling inoculants.

To follow up upon the training of 26 women as trainers (ToT) in November 2011, women have been given a stand on all 'open' days organized at district level to exhibit locally made soyabean products (milk and tofu, especially). These women have trained about 880 other women to date and continue to do so. In February 2013 a further 28 women were trained as trainers (ToT) by CARITAS, on soyabean processing, bringing to the total of women trainers to 54. These farmers are in turn expected to train at least 20 farmers in each season.

2.4 **Malawi summary**

Program update and BNF impact

Efforts were undertaken to secure the supply of inoculants through commercial channels to N2Africa farmers for the November 2013 season. Agro Input Supply Association of Malawi (AISAM) is the likely partner to import and distribute inoculants among its network of agrodealers. To devise a strategic inoculants and legume seed distribution system, the demand for legume seed is projected and production estimates are made. A stakeholder meeting is planned for June to discuss inoculants and legume technologies research results.

The household survey for the early impact assessment has been concluded and the data has been forwarded to the coordinator R&D for further analysis. N2Africa intends to carry out three case studies also as part of the early impact assessment. These are:

1. Capture adoption, adaptation and/or innovation of N2Africa technologies in two contrasting districts with the same D&D partner are being compared. Data will be collected through semi-structured interviews and field observation. As a point in case, agronomic data has been collected from a field where the farmer defoliated the soyabean plants at podding as a means to control caterpillar infestation. However, this resulted in yield decrease from 1651 to 863 kg/ha. Caterpillars are being eaten, an alternatively strategy, therefore, could be to accept yield loss while harvesting the caterpillars. Further data is required.
2. Assess the role of Lead farmers in influencing adoption and innovation of N2Africa technologies. We will profile the Tipindule Club in Salima district, established by a lead farmer who on his own accord ventured into providing extension services.
3. Study the case of the Chikuluti club in Lilongwe as an example of soymilk processing and marketing; this will be presented in the form of a poster.

Agronomy and Rhizobiology

A total of 60 agronomy trials were established in four districts of Lilongwe, Dedza, Salima and Kasungu. Most of the trials were planted in December 2012 and a few (particularly in Kasungu) were established early January 2013. The soil samples collected before establishment are yet to be analyzed. Rain gauges were used to collect rainfall data. The performance of trials has been good generally; some trials were lost in Salima due to dry spells. All trials are harvested and data is being compiled.

Variety trials:

- Soyabean Variety Trials (SVT) were established to determine the performance of improved soyabean varieties under varying agro-ecological conditions and response to rhizobium inoculation. Further these trials are used for participatory variety selection. Trials were established in Dedza, Salima, Lilongwe and Kasungu. Varieties being evaluated are: PAN 1867, Nasoko, Makwacha, Solitera, Soprano and Tikolore (TGX). Two trial were discarded due to poor germination owing to the dry spell at planting. Harvesting was completed mid May 2013.
- Four (4) cowpea variety trials (CVT) were established in Salima to test the varieties IT 16, Sudani 1 and Mkanakaufiti and one cowpea line IT 97 with and without fertilizer application. Mkanakaufiti was released in Malawi in 2011 and specifically bred for resistance to *Alectra vogelii.* Harvesting of cowpea trials was completed by mid-April 2013.
- Ten (10) groundnut trials were established in Lilongwe, Salima and Kasungu where two varieties, Nsinjiro and Chitala, were being evaluated for their response to different sources of P fertilizer. Chitala is tolerant to rosette disease, which wiped out CG7 in 2011-12 season. Harvesting was completed by end of May 2013.

Input trials:

- Fourteen (14) soyabean input trials were established in Dedza, Salima, Lilongwe and Kasungu. The trials were laid out in a split plot with inoculation and P-sources as main and sub-treatments respectively. Response of soyabeans to P application and to inoculation (and their interaction) under various agro-ecological conditions is measured.
- Eight (8) input trials with common bean were established in Dedza, Lilongwe and Kasungu, using a split plot design with inoculation and various P-sources as treatments. These trials are also use for the participatory evaluation of the technologies.
- For groundnuts the input and variety trials are combined to test response of the various varieties under different agro-ecological conditions. Trials were established in Salima, Lilongwe and Kasungu.

Separate trials were conducted to determine the response of promiscuous and specific soyabean varieties to different types of inoculants. Trials (with three replications) were established in Dedza, Salima, Lilongwe and Kasungu. A CRBD was used. The rhizobial strains tested were NAK115, NAK96, NAK128 and NAK9 and two controls with and without N-application (Urea).

Similar inoculation trials were also conducted for common bean using the same design. Trials were established in Dedza, Lilongwe and Kasungu Germination was generally poor in bean inoculants trials and this expected to affect yield.

Need to inoculate trials were conducted as potted experiment under greenhouse conditions. However, only 32 out of the 50 trials/pots were successful. Data on plant height, nodule number, nodule score, shoot fresh weight, shoot dry weight and root dry weight were collected and has been forwarded for further analysis. The 18 trials failed due to poor germination of the fertilized pots and suspected rust attack, but they were replanted in the last week of March 2013.

Rhizobium bacterial cells were isolated from the nodules harvested from the plants from the need-to-inoculate trials as well as from plant from the field. A total of 47 isolates were characterized by end February 2013 (31 isolates from the need to inoculate trials and 16 isolates from the field samples collected from Zomba, Machinga and Chiradzulu districts in the southern part of Malawi. This is work in progress.

Technology dissemination

D&D activities were carried out in seven districts in central region of Malawi and included: training of Lead Farmers in legume and inoculants technologies, procurement and distribution of legume seed, fertilizer and inoculants for demonstration plots, implementation of field days and demonstrations and strengthening partnerships. The activities targeted 17000 direct beneficiaries during the season, which brings the total to close to 31000 direct beneficiaries (Table 2.7).

Table 2.7: Number of direct beneficiaries of N2Africa D&D activities in Malawi

Season	Target No	Actual No
2010/11	2000	3410
2011/12	7000	10407
2012/13	16000	17000 (projected)
Total	**25000**	**30817 (projected)**

During this season 8779 demonstration plots were established on farmer's fields (lead and satellite farmers). The technologies demonstrated consist of the selected varieties with and without fertilizer for common bean and cowpea and of selected varieties without inoculants and fertilizer, with inoculants only and with fertilizer and inoculants for soyabean. For groundnut no inoculant or fertilizer was used. The following varieties of the four legume crops were promoted:

- Groundnut: Nsinjiro and CG 7
- Cowpea: Sudan 1 and IT82E-16
- Bean (Common) Kholophete and Kalima
- Soyabean: Makwacha and Nasoko

Farmers seem to prefer Makwacha as soyabean variety, because of the number of pods per plant, the response to fertilizer, the high yielding characteristics and large seed size. For cowpea they preferred IT82E-16, because it is early maturing (allows for two crops per season) and because the leaves are tasty, besides the high yielding characteristics (and response to fertilizer application). Farmers appreciate both the groundnut varieties but because of varying reasons. CG7 was valued because of it high yielding capacity and ability to re-germinate after a dry spell, whereas Nsinjiro was appreciated because of the lower oil content (good to be used for seasoning flour) and because it is less affected by disease.

No less than 120 field days were conducted during this season. In total 12739 participants attended these field days of which 5577 were male and 7162 (56%) were female. The details per district are provided in the country report.

Review (feedback) meetings were organized by WorldVision in the various districts; attended by extension officers, cluster managers and development facilitators including lead farmers. Total number of participants was 24 of which 5 women.

Two (2) radio programs were aired one on state radio station and one on private radio station after field days conducted in Dedza (DAES) and Lilongwe (World Vision). The messages covered what N2Africa and partners show cased during the field days.

NASFAM, DAES and WorldVision have each added sites to the sites where they were originally operating for the project. In total 9 satellite sites were added during the 2012/2013 season (Table 2.8).

Table 2.8: Number of satellite sites identified during the last season in Malawi

District	Partner	ADP, Zone Office, EPA(*)	Old Sites	New Sites	Total Number of Sites
Lilongwe	DAES	Mngwangwa EPA	2	1	3
	World Vision	Nkhoma/Chilenje ADP	8	0	8
	NASFAM	Lilongwe North AMC	1	1	2
Mchinji	NASFAM	Mchinji AMC	2	0	2
	World Vision	Mlonyeni/Bua ADP	1	1	2
Dedza	DAES	Linthipe EPA	12	3	15
	World Vision	Tchesa/Chitundu ADP	5	3	8
Ntcheu	DAES	T.A. Makwangwala	13	0	13
Salima	DAES	Makande EPA	3	0	3
	DAES	Chinguluwe EPA	3	0	3
Dowa	World Vision	Lipiri, Kafulu & Kasangadzi ADP	3	0	3
Kasungu	CRS	Nkhamenya Zone Office	4	0	4
Total			**57**	**9**	**66**

* Partners use different units for the administrative divisions: ADP – Agricultural Development Program, EPA – Extension Planning Area and may use different organisational structures for their dissemination campaigns, e.g. Group Village Headman (GVH), Village Development Committees (VDC) or Agricultural Sections.

Marketing and Value Addition

N2Africa Malawi is using the commodity exchange to link farmers to markets. The Agriculture Commodity Exchange (ACE) and the Auction Holdings Commodities Exchange (AHCX) both operate an electronic system to link buyers to suppliers (producers) and use Warehouse Receipt System. They provide a platform for negotiation, which has been lacking on the farmers' side. The advantages of using this system are:

a) Farmers are able to negotiate the price of their commodity.
b) Farmers are able to get a competitive price on offer at the exchange market
c) Farmers can sell their produce at their own convenient time depending on the prices being offered.
d) Farmers can access loans with banks on the basis of the receipts
e) Farmers can also access farm inputs through the Warehouse Receipt System.

AHCX conducted awareness meetings with the farmers' marketing groups as shown in Table 2.9.

Table 2.9: Number of lead farmers who attended marketing awareness meetings in N2Africa Malawi

Date	District	Partner	Site	Lead Farmers		
				Total	Male	Female
15th April '13	Dedza	DAES	Linthipe EPA	20	18	2
16th April '13	Dedza	WV	Tchesa ADP	18	13	5
17th April '13	Ntcheu	DAES	Bilira EPA	11	7	4
18th April '13	Salima	DAES	Chinguluwe EPA	10	5	5
19th April '13	Salima	DAES	Makande EPA	6	2	4
8th May '13	Kasungu	CRS	Nkhamenya	56	21	35
			Total	**121**	**66**	**55**

Farmers especially those who are member of the Marketing Committee were taken to visit ACE. The participation at ACE was as shown in Table 2.10.

Table 2.10: Number of Marketing Committee Members who visited the Agricultural Commodity Exchange (ACE) in Malawi

Date	District	Partner	Site	Total	Male	Female
6/5/2013	Dedza	DAES	Linthipe EPA	20	16	4
6/5/2013	Dedza	WV	Tchesa ADP	10	8	2
7/5/2013	Ntcheu	DAES	Bilira EPA	9	7	2
7/5/2013	Salima	DAES	Chinguluwe EPA	10	6	4
7/5/2013	Salima	DAES	Makande EPA	6	3	3
			Total	**55**	**40**	**15**

Farmers are thus bulking their Soyabean, Bean and Groundnut produce to sell through ACE and/or AHCX. Farmers get market information (e.g. quantity and quality of commodity required, prices offered and other) via their mobile phones, through a price board at each warehouse and through Radio and TV announcements to inform decision on when to sell.

N2Africa through its partners, is also facilitating the following marketing activities:

- Training of the marketing committees
- Market research and negotiations
- Meeting quality requirements for the intended market
- Bulking of produce
- Selling of produce

Capacity building

The renovation of the glasshouse at Chitedze (DARS) was completed and the last consignment of the equipment needed to conduct basic rhizobiology work was delivered in April 2013.

Potential private sector inoculant producers invited to a planning meeting and interim assessment workshop planned for June 2013.

N2Africa supports three students:

1. Donald Siyeni started his studies at Bunda College, University of Malawi, on 1 November 2011 and is expected to finish by 31st of October 2013. He is working on the effect of rhizobia Inoculation and phosphorus fertilizer application on nodulation and yield of soyabean in Dedza, Salima and Kasungu districts of Malawi. He is currently conducting field research, which is at an advanced stage.
2. Esnart Nyirenda started her studies, at Bunda College, University of Malawi, in November 2011 and is likewise expected to finish by October 2013. She is assessing the diversity of cowpea rhizobia in soils from different cropping systems in Chiwosya Extension Planning Area in Mchinji district Various strains have been isolated and she will now test the strains on different cowpea varieties.
3. Joseph Mhango started his studies, at Egerton University in September 2012 and is expected to finish in May 2014. He is evaluating of the efficacy and competitiveness of native rhizobium species in nodulation, nitrogen fixation and growth properties of soyabean (*Glycine max* (l.) Merr.) Course work is completed and research work is planned to start in June 2013 at Chitedze Research Station.

Seventeen agro-dealers, under AISAM, were trained on inoculants technologies. Lead Farmers and Extension workers were also trained as shown in table 2.11 below:

Table 2.11: Number of Lead farmers and Extension staff trained on inoculants and legume technologies in the N2Africa Malawi programme

Group	Total	Male	Female
Lead Farmers	592	377	215
Extension Staff	81	67	14
Total	**673**	**444**	**229**

2.5 Zimbabwe summary

Program update and BNF impact

The results from the agronomy trials in the 2011-12 season showed clear influence of inoculating soyabean with rhizobium with yield increases of over 200% especially in the sandy soils of Zimbabwe (see Figure 2.1 below).

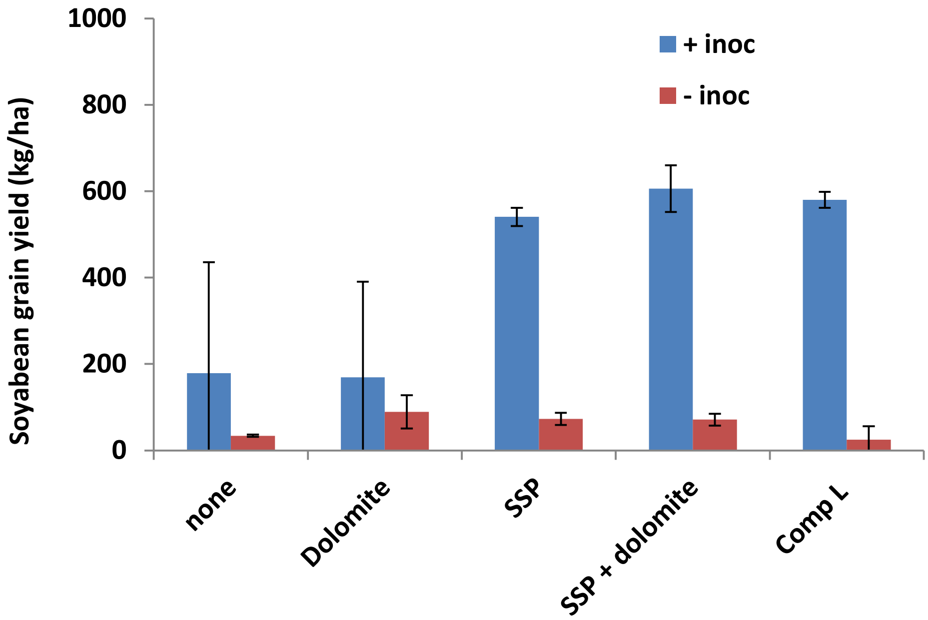

Figure 2.4: Response of soyabean grain yield to inoculation under various inputs regimes Zimbabwe

Given this clear positive influence we decided to use inoculation in all trial plots as opposed to a split-plot design where inoculation and non-inoculation where the main treatments. It was also clear that Compound L and SSP where the superior fertilizers, and SSP, being the cheaper option, was then used in the D&D trials for the 2012-13 season.

For the agronomic trials we included cattle manure as a treatment (with and without P), besides the nutrient treatments (P, P-K, P-K-S and P-K-S-Mg and Soyblend) to investigate the often poor response on the sandy soils of Zimbabwe. The results are to inform the management recommendation for the next season.

Hermetic bags were piloted in Mudzi and Guruve districts for storage of maize, groundnuts, common beans and soyabeans. Where these PICS bags were first earmarked for storage of cowpea, the farmers themselves started experimenting, using them for storage of other crops. The results of the grain storage trials on cowpeas show that the crop stored in hermetic bags was of better quality compared to that stored in ordinary synthetic bags. Insect damage, discolouring and loss of moisture content was high in ordinary bags compared to the hermetic bags. However, because the bags are not readily available in Zimbabwe it was decided to discontinue the use and promotion at this point in time.

Cost-Benefit analyses have been carried out for soyabean production in Zimbabwe and results show that smallholder farmers can realize a high benefit if they use inoculants with or without P fertilizer. Inoculant with SSP gives the highest return, but benefit cost ratio is slightly lower than when improved seed and inoculant only is being used (USD 2.26 for every dollar spent, compared to USD 2.31 for every dollar spent respectively). The benefits of using SSP only do not weigh up against the cost for the fertilizer (see Table 14). It is not completely clear why the response to fertilizer application is poor (see also Figure 4), but obviously the nitrogen fixing capacity of soyabean in these soils is very low. Also the common practice to place the fertilizer with the seed might contribute to this phenomenon. In order to realize the returns as indicated in Table 2.12, yields need to be increased considerably from what is currently realized on average. Nevertheless the case for using inoculants if firmly made.

Table 2.12: Cost benefit analyses for soyabean production, Zimbabwe

Management practice	Seed only	Seed+SSP	Seed +Inoculant	Seed+SSP+ Inoculant
Seed	160	160	160	160
Fertiliser	0	80	0	80
Inoculant	0	0	5	5
Labour	265	265	255	245
Bagging	26	27	29	32
Total cost	451	532	449	522
Yield	1.57	1.663	1.853	2.106
Gross Revenue	879.2	931.28	1,037.68	1,179.36
Net Revenue	428.2	399.28	588.68	657.36
Benefit: Cost Ratio	1.95	1.75	2.31	2.26

The Chemistry and Soils Research Institute, Department of Research and Specialist Services produces rhizobial inoculants in Zimbabwe and the enjoys a monopoly. The department of Agricultural Technical and Extension services distributes the inoculants countrywide. Inoculants are retailed at $5 per pack, which is good for one ha. Only recently, policies have been announced to promote the use and enhance availability of inoculants for smallholder farmers, It is good to note that SPRL is not operating as a commercial unit, but where rather given production targets based on the projected area of soyabean cultivation for that year (by large scale farmers). So far there have not been particular efforts to promote the use of inoculants for smallholder farmers, though that production is not done at a commercial services. We have conducted analyses of the production cost, and considering the current production volumes (80000 packs/yr) and price of USD 5 per pack, they generate a net profit of USD 144,187, which presents a very good business perspective.

For the 2012-13 season the project reached approximately 16000 farmers. The M&E has yet to be analysed, but will give the exact figure. The household survey for the early impact assessment in currently being implemented and the agrodealer survey, the case study on lead farmers (incl. training) and the case study on farmer's adaptation and innovations is on-going.

The 'use survey' is an M&E tool that investigates the use of technologies by farmers that have been part of the project the previous season. It gives insight in early adoption. In total 314 farmers (both lead and satellite farmers) participated in the use survey for the 2011-2012 season. The results indicate that almost all farmers cultivated legumes in the year succeeding N2Africa input distribution. However, these were not always the same legumes that were received with the N2Africa input package. Only 47% of the farmers who had received an input package for soyabean continued with soyabean the following season. This is 61% for common bean and cowpea to 96% for groundnut (Table 2.13). This is probably reflects the market preference for groundnuts. On average, legumes were usually cultivated on about 10% of the total cropped area. Of all legumes, groundnut was grown by the largest number of farmers and was allocated the largest average area.

Table 2.13: Percentage of farmers continuing with the cultivation of the crop for which they received inputs in the previous season (Zimbabwe)

	no. of farmers that received this legume in 2010-2011	% of farmers that cultivated this legume in 2011-2012
Common bean	82	61%
Cowpea	38	61%
Groundnut	85	96%
Soyabean	76	47%

As far as the adoption of promoted management practices is concerned, many farmers planted in lines and adopted the recommended plant and row spacing. However, less than 1/3 of the farmers still applied fertilizer in the second season for the same crop and in case of soyabean this was even only 18%. The use of inoculants for soyabean was continued by 41% of the farmers, whereas this was only 3-4% for cowpea and groundnut and 14% for common bean (Table 2.14). Only 8% of the farmers continued with the combined use of fertilizer and inoculants for soyabean. The low percentages of farmers continuing with the technology do not imply low adoption rates or farmers not appreciating the technologies. Farmers mention the product not being available or being too expensive as the main reason for not using it.

Table 2.14: percentage of farmers continuing the use of inoculants in the season following input distribution in Zimbabwe

Legume received in 2010-2011	no. of farmers that received accompanying inoculants in 2010-2011	% of farmers that cultivates and inoculates this legume in 2011-2012	% of farmers inoculating another legume in 2011-2012
Common bean	77	14%	13%
Cowpea	30	3%	10%
Groundnut	66	5%	11%
Soyabean	74	41%	8%

We do see difference in behaviour between male and female farmers as well as lead and satellite farmers. For example, lead farmers more often apply inoculants, synthetic fertilizer and more readily adopt other N2Africa techniques than satellite farmers and male farmers apply inoculants more often than female farmers. Further details are presented in the country progress report available on the intranet. The early impact assessment will complement the use survey for the 2012-2013 season.

Though differences in average legume area between male and female farmers, male and female headed households, and Lead and Satellite farmers were small (Figure 2.5), we do see marked differences in the area allocated to legume crops between districts, which is less than 0.15 ha in Makoni on average. The share of total cultivated land for legume crops seems to be around 10% in all situations. Besides being the most popular legume in terms of the number of farmers cultivating it, groundnut also had the largest total average area compared to the other grain legumes (see Figure 2.5)

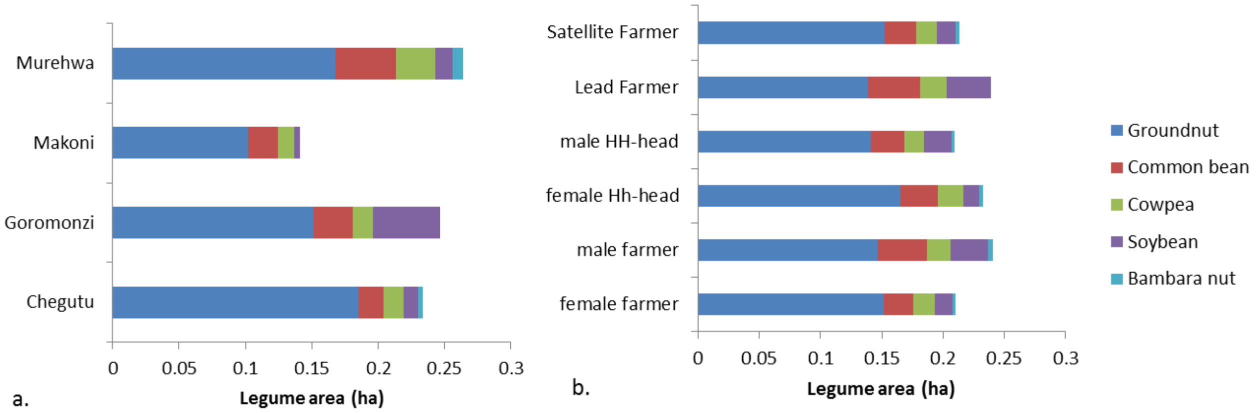

Figure 2.5: Average legume area per farm in Zimbabwe mandate areas, categorised per district (a) and per type of farmer (b)

Agronomy and Rhizobiology

The SeedCo varieties have proved to be superior in terms of grain yield compared to promiscuous varieties (see Figure 2.6). The larger grain size and the their short to medium duration characteristic makes them the varieties favoured by the farmers, with the erratic rainfall patterns and high risk of short term drought in Zimbabwe. As a result, only the SeedCo varieties were included in the D&D activities this season.

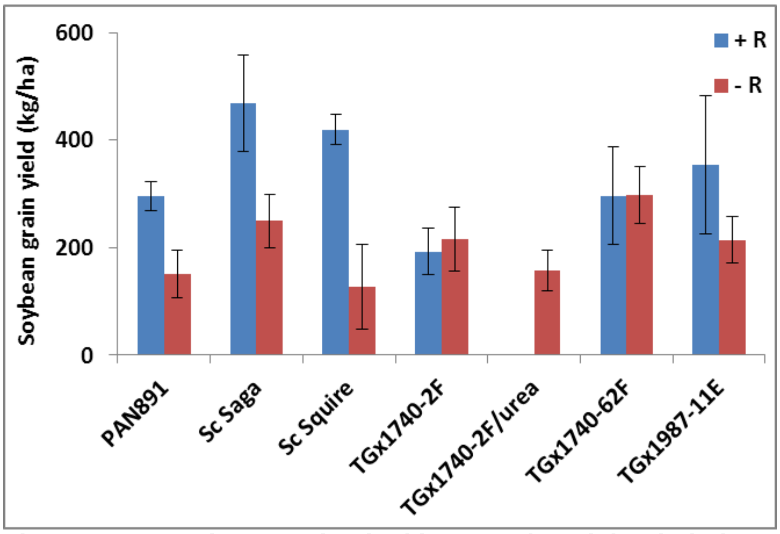

Figure 2.6: Soyabean grain yield in a sandy soil in Zimbabwe

As for common bean, Cardinal and Speckled Ice showed high yielding potential, but no response to inoculation. Therefore dissemination targeted these varieties, but not the inoculant technology.

For groundnut, Natal Common is most preferred in the market and is rated as the best for making peanut butter and is therefore being promoted under D&D.

The establishment of the multipurpose tree legumes failed in the previous season because of poor rainfall. The legume trees were replanted and the evaluation of the biomass productivity will not be possible until October this year. We expect to harvest enough seed for further dissemination though once they mature. The following tree species are considered: *Acacia angustissima*, *Cajanus cajan* (pigeonpea), *Gliricidia sepium, Leucaena esculenta, L. leucocephala, L. pallida* and *L. trichandra.*

The following fodder crops have been planted: velvet bean (*Mucuna pruriens* var. *utilis*), trailing cowpea (*Vigna unguiculata*), lablab (*Lablab purpureus*), sunnhemp (*Crotalaria juncea*). The plants produced already seed in the first season, which dairy farmers have shared among themselves. Biomass yield, as expected, increased with when mineral fertilizer was used. Sufficient seed will be available after harvesting from the farmers' fields for further dissemination of the promising species in the next season.

This season 25 agronomic trials were established, spread over the various districts: 2 common bean variety trials, 6 soyabean inoculation trials, 5 soyabean input trials, and 4 groundnut input trials; for forages, 9 trials for the annual crops. The 12 trials on tree legumes are being continued and are not included in the total.

The following agronomy practices (treatments) are being explored for the input trials:

- Rhizobium inoculation;
- P-fertilizer additions;
- Combinations of different P-fertilizers with cattle manure
- Fertilizer blends;
- Soil liming (dolomitic lime);
- Addition of organic manures;
- Timely disease control in cowpeas using pesticides.

Data from the field book season 2011-2012 has been analysed; this is data collected by the lead or satellite farmer him/herself from the demonstration plots and 'adaptation' trials, often with assistance of the field worker. Conclusions are:

- Soyabean responded positively to P-fertilizer and inoculation. Safari was the highest yielding variety.
- Groundnut responded positively to P-fertilizer and gypsum.
- Cowpea responded positively to P-fertilizer. Harvesting leaves during growth did not decrease final grain yield.
- Common bean responded positively to both P-fertilizer and inoculation, supporting a continuation of inoculation in common bean in dissemination programs. Cardinal was by far the highest yielding variety.
- Farmers in Guruve obtained much higher yields for all four legumes than farmers in the other regions. Farmers in Makoni generally obtained lowest yields.
- Farmers who weeded their plots only once obtained much lower yields than farmers who weeded two or three times.
- Early planting in the first half of November was associated with lower yields for all legume crops. Late planting of soyabean in January also led to low yields.

Below the results from the field book presented, in which the response of soyabean to treatment is indicated (yield of the treated plot against the untreated or control). It is clear that errors are made in the yield estimates (e.g. yield estimates of over 4 t/ha), but errors are made systematically it seems. In which case the data could still be used to analyse trends.

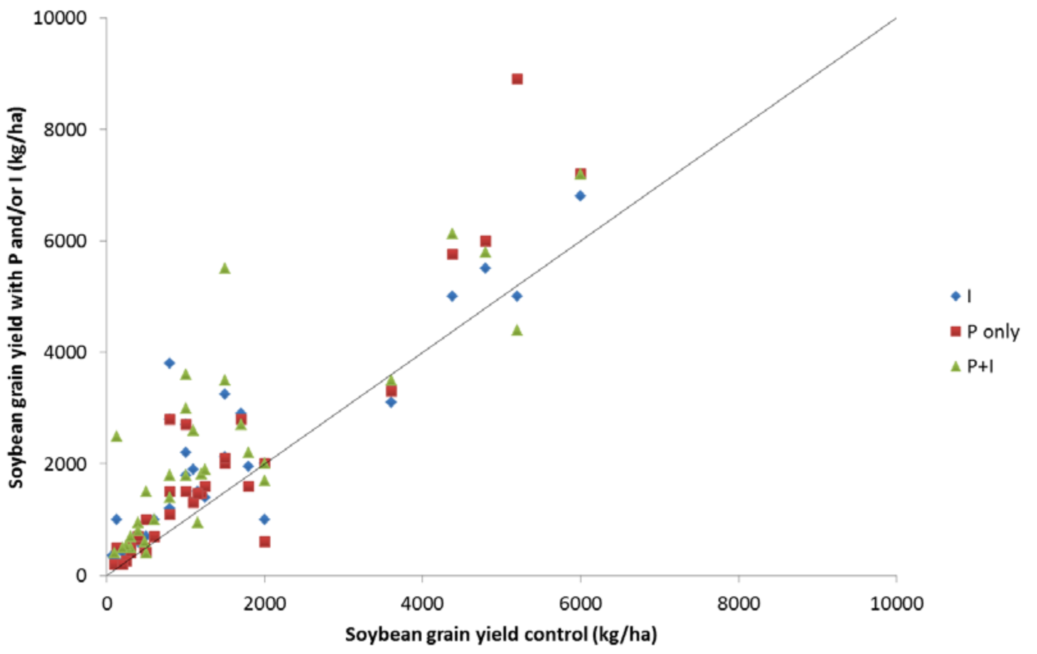

Figure 2.7: Soyabean grain yield using inputs plotted against the control yield (no inputs applied). Data from the Field Book, 2011-2012 season in Zimbabwe

The rhizobiology work is carried out by the Soil Productivity Research Lab (SPRL, under of the Chemistry and Soil Research Institute in the Department of Research and Specialist Services (DR&SS) in the Ministry of Agriculture, Mechanisation and Irrigation Development). Their work continues to be seriously delayed.

The second (repeated) experiment to screen indigenous rhizobium strains was completed and the top 5% strains (that included both strains isolated from Zimbabwean soil as from elite strains from Kenya) were selected for field-testing. However, the results from the greenhouse experiments do not show any strain that is significant better than either the un-inoculated control or the reference strain. The reference strain, CIAT 899, did not optimally nodulate sugar bean. The root development and growth in the pots was restricted, which might have limited rhizobia infection. The results are for s yet inconclusive.

Further experiments are carried out to test 'shelf live'*.* For this purpose inoculants sachets for both soyabean and common bean are distributed to 3 farmers in 7 districts, who will store the inoculants either in (i) clay pot (ii) moist soil pit (iii) under a shade (iv) on cement / cow dung floor or (v) refrigerator. Two packet size as used, *viz.* (i) small size (40 g) and (ii) normal size (80 g).

DR&SS in collaboration with SPRL and N2Africa are developing a marketing strategy to improve availability of the inoculants to communal farmers. This will inform the transition planning to the second phase of the project.

Technology dissemination

Partners 'opened' several satellite sites during the period of reporting. The Lower Guruve Development Association (LGDA), has expanded into sites in Guruve (wards 1, 4, 6, 8 and 22) and Mbire districts (wards 3, 12, and 17), based on farmers' demand. Ward 1 in Guruve district provides an interesting point as farmers in this ward are only receiving training such as post-harvest handling, marketing and farming as a business. The farmers were not trained on N2Africa legume technologies.

The Cluster for Agricultural Development Services (CADS) has moved into 5 additional sites in Goromonzi district, namely wards 1, 3, 4, 15 and 16. The expansion into satellite sites has been made possible by exploiting synergies with other projects being implemented by CADS.

CTDO (Community Technology Development Organisation) added two satellite sites in their districts of operation. In Murehwa district ward 28 was added and in Chegutu ward 27 was also added. In Makoni district, two new sites were added, and these are ward 26 and ward 27. The new sites that have been identified have a lot of interest in the project since all the wards hosted field days.

In the 2012/13, the manuals that were developed and tested under the IFAD funded project were finalised. The following four manuals were developed:

- “Post-Harvest Handling and Storage”,
- “Farmers Handling book for Agricultural Marketing” and lastly,
- “Farming as a Business”.
- “Legume production notes” (1200 copies distributed).

These manuals were distributed to our partners as indicated in Table 2.15.

Table 2.15: Distribution of training materials to partners in N2Africa Zimbabwe

Partner	Post-Harvest Handling	Marketing	Farming as a business
Agritex Mudzi	150	150	150
Agritex Hwedza	150	150	150
Agritex Makoni	150	150	150
Lower Guruve Development Association	150	150	150
Cluster for Agricultural Development Services	150	200	200
Community Technology Development Organisation	300	200	200

The D&D campaigns were done in all seven districts within the agricultural year. The partner organisations were provided with training materials and stationery to train all the lead farmers, who then cascaded the training to their follower farmers. The Farm Liaison Officer would assist with backstopping where necessary. There were three main types of trainings done within the season: pre-season training, mid-season training and end-of-season training.

Farmers and partner organisations conducted field days in their impact zones in all the districts. The field days provide a platform for farmers who were not engaged in the project to learn about technologies that are being promoted by the project. In some districts government officials attended the field days and issued prizes to the farmers who had won. In Hwedza district, the Member of Parliament attended all the field days, which were hosted by the project and thanked the project so much for the work that is being done in the district. In Mudzi district there were two members of parliament who attended the field days.

Marketing and Value Addition

Despite the 2012-13 season being a bad season because of poor rainfall, farmers in Guruve managed to get surpluses of common beans, cowpeas and soyabeans, while those in Mudzi got some surplus of groundnuts. Market information has been provided to inform marketing of the grain. The farmers in Mudzi district have planned to sell 10 tonnes of shelled groundnuts to Fructas on the 3rd of June at a price of $1.20 per kg and 20 tonnes at a later stage. This is a good price compared to the current market price.

LGDA is in the process of sending common beans samples to Fructas as they prepare to make a sale. LGDA also availed market information to farmers in Mbire district. These farmers intend to sell 12 tonnes of cowpeas. Farmers in Hwedza district inquired about the price for soyabeans and arrangements are made to share price bulletins (by email) with one of the extension officers at the AGRITEX district office.

The managing director of Fresca Fruta contacted the N2Africa team in Zimbabwe, after having read about the project activities on the N2Africa website, who then linked him to Mudzi farmers through

Agritex. As a result the farmers organized themselves and ferried 2.5 tonnes to Harare where it was sold at USD 1300 per tonne.

The process of linking farmers to markets involves the following stages:

1. Identifying market information sources for instance Zimbabwe Farmers Union, Agricultural Market Authorities among others.
2. Conveying the market information to farmers.
3. Initiating discussion amongst farmers on who to sell to, based on the market information.
4. Facilitating farmers to select a sales committee.
5. Facilitating farmers to negotiate with the buyers.
6. Facilitating farmers to select a quality control committee.
7. Facilitating farmers to select a collection point.
8. Organizing farmers to bulk their produce.
9. Facilitating farmers to share proceeds and reflecting on sales.

Farmers in the N2Africa action sites in Zimbabwe have been trained on post-harvest handling and storage. The N2Africa Markets and Farm Liaison Officers trained farmers in Guruve, Hwedza and Makoni. Agritex Mudzi, CADS and CTDO trained the farmers in Mudzi, Goromonzi, Mutoko and Mhondoro respectively. N2Africa is planning to conduct training in Value Addition and Nutrition in all districts but Mudzi, Hwedza and Guruve. In Goromonzi district CADS, who has the expertise in value addition and processing, have established groups that are being trained on value addition and processing. They also facilitate a national event on value addition and processing.

Farmers are yet to conduct 'dry' shows and food fairs, which are targeted to be done in the months of June-August. During these shows farmers will be showcasing value added products from their legume crops. Farmers will also be competing among themselves. Dry shows and food shows encourage the farmers to do value addition to their produce. ZAVSAP usually coordinates different partner organisation to come to Harare and showcase their products.

Capacity building

N2Africa facilitated Mr Tumbure and Mrs Mushangwe from SPRL to attended a Master class in rhizobial technology entitled 'The isolation, identification and utilisation of root nodule bacteria (rhizobia) in promoting sustainable agricultural productivity' from 2 to 12 December 2012 in Sri Lanka. The aim of the training was to provide participants with advanced research training in skills and techniques to work with root nodule bacteria, since there have been numerous advances in technological and research methodologies.

Mazvita Chiduwa departed to Australia to start her N2Africa sponsored PhD research at Murdoch university. Tatenda Kainga has been given an extension of her stipend and N2Africa committed to fund additional costs of fieldwork to enable her to collect the required 2nd season data for MPhil. One student, Sibonginkosi Dunjani seems to have dropped out.

As mentioned all the lead framers have been trained. Whereas in previous seasons N2Africa project staff facilitated all the trainings, this season we capacitated the implementing partners to conduct the trainings. We target 80 participants per district, though the number can be increased to 100 in districts where the wards are spaced, like Guruve. On occasion some follower farmers have participated in the training as well..

A total of 80 agro-dealers were trained during the 2012-2013 agricultural season, of which 43 males and 23 females. Agro dealers in Zimbabwe are not actively involved in the sale of inoculants and P-based fertilizers for legume production. So there is need to invest more in the engagement of agro-dealers in the distribution of inputs and also to ensure that they have access to the inoculants and P-based fertilizers.

2.6 **Mozambique summary**

Program update and BNF impact

A market survey was conducted to gather information on prices of inputs in the major project areas and also to investigate the farm-gate prices of the most common grain legumes and maize. Prices of grain legume seeds generally vary from $0.35 to $0.50 per kg depending on the source and the grade (Table 1.2). Seed prices are relatively high when bought from the seed companies perhaps due to the assumption that the quality is assured (Table 2.16). Common beans and groundnut seeds are the most expensive, whereas cowpea seed is the least expensive among the grain legumes. Cowpea is mainly a food crop and a major food security crop grown on subsistence basis in an intercropping system. The market for cowpea is not developed as those for the other major grain legumes and a high percentage of the seed used are from their own farm-saved seeds. In terms of grade, there are certified seeds typically sold by retail agro-dealers, certified or uncertified seed purchased from farmers trained as seed producers and sold to farmers and farmers associations directly or indirectly in the form of seed loan, and grains used as seeds. For example soyabean grain use as seed is around $0.85/kg compared to $2.00-2.54/kg for certified seed. Maize seed is cheaper than the grain legume seeds and it is easily available in most communities.

Fertilizer use is very limited in Mozambique. They are not easily accessible to farmers since prices are very high, but also they may not be available when needed by those who can afford. The common fertilizers on the market are NPK (12-24-12), Urea and Single Super Phosphate. Prices for 50 kg bag of fertilizer across the major producing areas range from an average of $64 for SSP to $85 for NPK (Table 1.1). The price for Urea and Ammonium Sulphate are on average similar across the farming communities. In Maputo, the cost of 50 kg bag of SSP at a major Agro-dealership was $42.37 at the beginning the growing season but the price in Nampula was about 34% higher in a retail store in Nampula. The high cost of fertilizers is due in part to the high transport cost.

Inoculants were not popular in Mozambique a few years ago, but through N2Africa several brands of inoculants are being imported into the country and inoculants are enjoying increasing popularity. Through the intervention of the N2Africa project and Technoserve, Agri-Focus Lda, is now importing soyabean inoculants from Brazil for sale. The price for 200 g peat-based inoculant - sufficient for a hectare of soyabean - was $4.06 during the 2012/2013 growing season (Table 2.16).

Table 2.16: Average prices of inputs during the 2012/2013 growing season in Mozambique

Crop	Price ($)/kg	Fertilizer/Inoculant	Price (50 kg bag)
Cowpea	1.35-1.70	SSP	$64
Common bean	2.50-3.50	NPK (12-24-12)	$85
Groundnut	2.50-3.50	Urea	$76
Soyabean	2.03-2.54	Ammonium Sulphate	$76
Maize	1.19-1.36	Peat-based Inoculant	$4*

Table 2.17: Average farm-gate prices per kg (US$)† of major legume grains and maize in Mozambique in 2013

Crop	Late March	April-May	June-July	Aug-Sept*	Oct-Nov*
Soyabean		0.44	0.51	0.61	0.61
Groundnut		0.78	0.88	1.02	1.35
Cowpea		0.37	0.47	0.54	0.65
Common Bean		0.74	0.85	0.91	0.91
Maize	0.10	0.15	0.20	0.29	0.31

†29.5MZN =US$1.00; *Values for Aug –Nov are last year farm-gate prices

Most farmers sell their produce soon after harvest and therefore sell at very low prices. Maize is the first crop that is harvested and sold but prices generally doubles only 3 months after harvest. In late March 2013 when farmers began harvesting maize, the farm gate price was $0.10/kg; however, the price increased to $0.20/kg almost 2 months later and can triple by August (Table 1.2). For the grain legumes, harvesting begins around the end of April and farm-gate prices at this time range from $0.37 -$0.78/kg (Table 2.17). However, prices are expected to increase by 23-46% around August and September. Farmers who are able to keep their produce for relatively long period benefit from price increases.

A case study on seed production and delivery models started at the beginning of June 2013. The survey has been completed in Angonia district (Tete province), Gurue district (Zambesia province), and Susundenga district (Manica province). Data collection from the remaining district, Mogovolas (Nampula province) will be completed by the first week of July 2013. In particular, the study will look at where and how farmers access soyabean, groundnut and cowpea seeds and the importance of farmer-farmer seed exchange. Soyabean is a cash crop but also a relatively new crop, so farmer-farmer exchange is expected to be important whereas cowpea farmers would be expected to rely more on own farm-saved seed. Groundnut is both cash and food crop and cowpea is mostly food crop. We expect to find differences in production and distribution models for these three crops.

The IIAM Socio-Economics team is leading the survey for the early impact assessment. Data collection is completed in Angonia (Tete), Gurue (Zambesia), and Susundenga (Manica) districts and that in Mogovolas (Namupla province) will be completed by the first week of July 2013. The final report is expected by the end of July 2013.

Agro-dealers survey in Nampula, Angonia, Sussundenga and Gurue districts was completed in mid-June 2013. Information on farmer adaptations is also being collected across project areas in conjunction with collection of Field Book data and will be completed by mid-July 2013.

Agronomy and Rhizobiology

During the 2011/2012 growing season, adaptive trials were established at 7 sites in 4 provinces (Nampula, Zambezia, Manica and Tete) using either soyabean or groundnuts. Six soyabean and 4 groundnut varieties were evaluated. For soyabean, the BNF technologies tested included inoculants, SSP application, planting date and row spacing whereas, SSP, lime and starter N application, and row spacing were tested in the groundnut trials.

Results from the soyabean trials indicate that:

1) Soyabean responds to inoculation at most of the sites
2) Yield increases ranges from 500-2200 kg/ha
3) Significant interaction occurs between variety and inoculation and also between sites and inoculant application
4) Urea application alone improved soyabean yield only at one site
5) Applying P, a combination of P and inoculant, and a combination of P and urea increased yields at some sites, but the effects differ between the 2 soyabean varieties at least in some cases.
6) All the treatments increased soyabean yields and only few differences occurred between the treatments (evidence from two sites: Figures. Figure 2.9 and Figure 2.10)
7) Where inoculation or P application alone did not increase soyabean yield significantly, combining inoculation and P application did increased yield (Figure 2.11).

The conclusion are illustrated by the figures Figure 2.8: Responses of soyabean varieties to inoculation and Urea application at Nkhame site, Mozambique (2011/12 growing season), Figure 2.9, Figure 2.10 and Figure 2.11 below

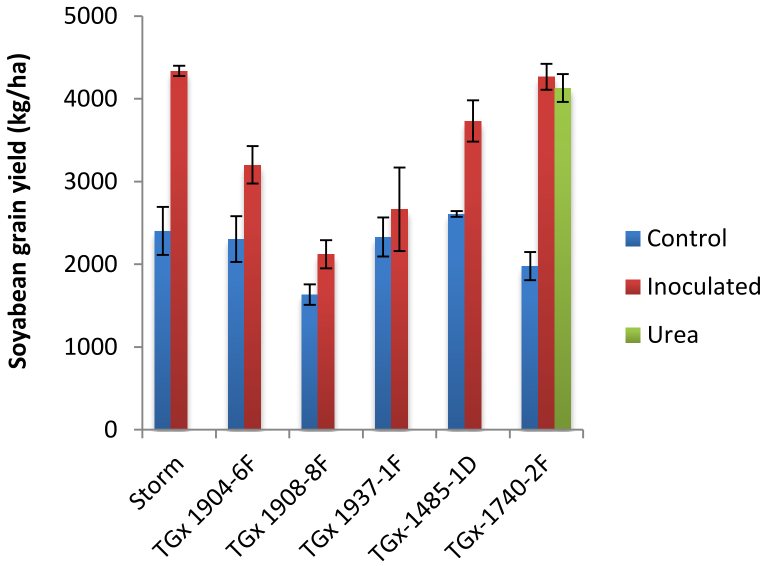

Figure 2.8: Responses of soyabean varieties to inoculation and Urea application at Nkhame site, Mozambique (2011/12 growing season)

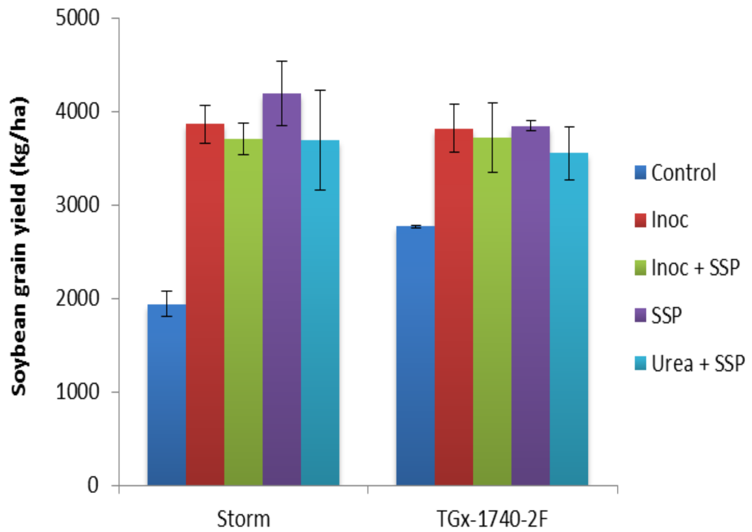

Figure 2.9: Responses of soyabean varieties Storm and TGx-1740-2F to inoculation, SSP, inoculant and SSP, and Urea and SSP at Nkhame site (Tete province, Mozambique) - 2011/2012 growing season

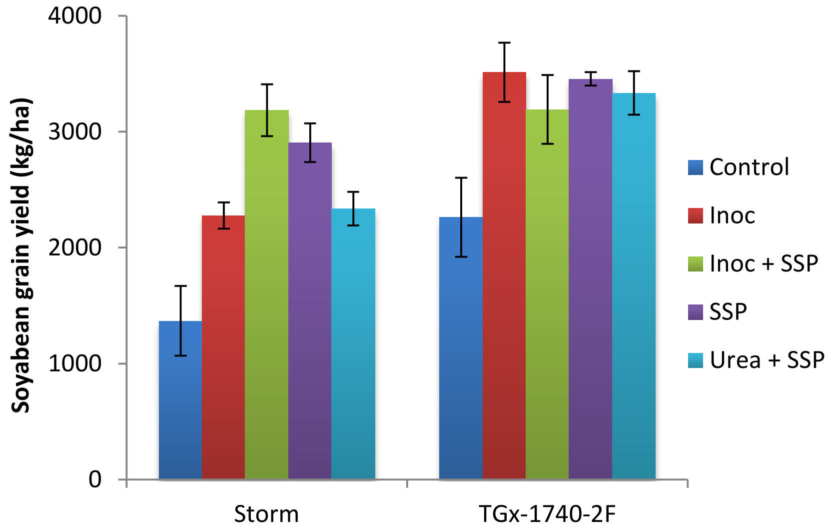

Figure 2.10: Responses of soyabean varieties to inoculation, SSP, inoculantion and SSP, and Urea and SSP at Ntengo Umodzi site (Tete province, Mozambique) - 2011/2012 season data

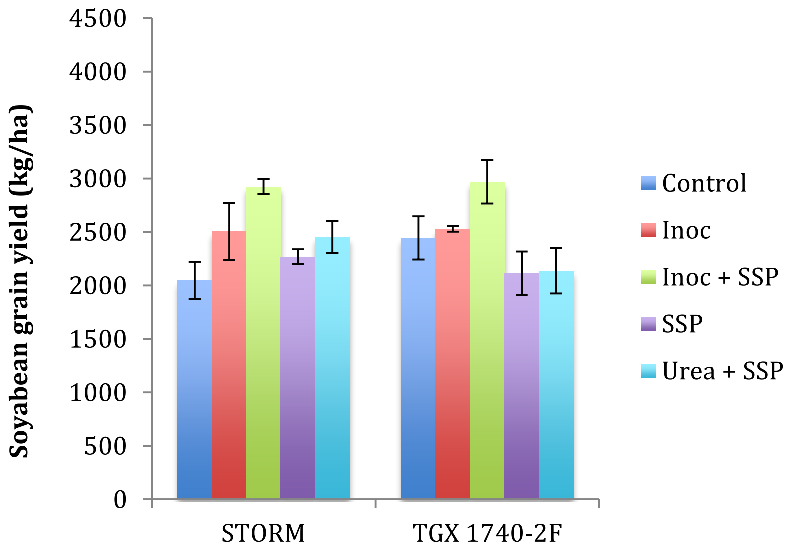

Figure 2.11: Responses of soyabean varieties to inoculation, SSP, inoculant and SSP, and Urea and SSP at Sussundenga (Manica province), Mozambique; data from the 2011/2012 season

The groundnut trials were conducted at two sites and the results indicated that:

1) Yields for the narrow spacing (50 m x 15 m) were higher than that for the wide spacing (75 m x 20 m);
2) Two groundnut varieties used responded to P application
3) For the narrow spacing, applying P alone increased yield compared with applying a combination of P and lime;
4) Using four varieties and 50 m x 15 m spacing, only one variety didn't respond to P application at the 2 sites.

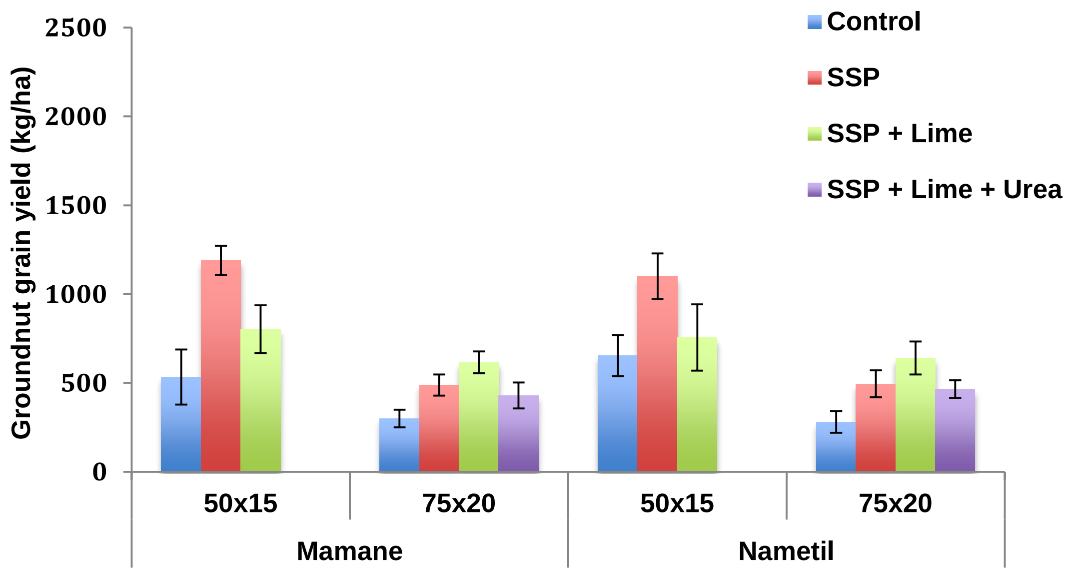

Figure 2.12: Response of groundnut varieties to varying plant densities and different input regimes (SSP, SSP+lime and SSP+lime+Urea), Mozambique

During the 2012/2013 growing season, twenty-one trials were established in four provinces (15 on soyabean and 6 on groundnut). The soyabean trials include assessment of input requirements (using two varieties), variety evaluation study (using 6 varieties), and evaluation of inoculants (5 strains) using determinate and non-promiscuous soyabean variety (Storm) and an indeterminate and promiscuous variety (Zamboane, TGx 1904-6F) across three agro-ecologies. The sources of the inoculants are indicated in Table 2.18.

Table 2.18: Strains used for the 2012/2013 strain evaluation trials in Mozambique and their sources

Inoculant	Strain	Source
Soycap	WB74	Soygro (Pty) Ltd, South Africa
CellTech	USDA 61A101	Novozymes, Canada
Biagro	Semia 4077 and semia 4080	Laboratorios Biagro S.A, Argentina
MasterFix	Semia 5079 and 5019	Stoller do Brasil, Bazil
BioFix	NAK 96	University of Nairobi, Kenya
HiStick	Unknown (for groundnut)	Becker Underwood, USA

The groundnut trials consisted of two varieties for the soil amendment trials, six varieties were in the varietal evaluation trial and two varieties were used in the inoculation response trial.

Soil samples are taken from each of the sites prior to planting for analysis; nodule assessment is done and mid-season plant biomass is registered. Rainfall data is also collected. Harvesting at all sites was completed by mid-June. Results will be available by the end of July 2013.

Regarding rhizobiology work, MPN counts will be done once the lab has been set up (expected for July 2013). In the meantime, the second batch of nodule samples has been sent to the microbiology lab at IITA, Ibadan for isolation, characterization and authentication. In addition, and additional 2,161 nodules samples, collected across the project sites, have been sent to Brazil-EMBRAPA for isolation, characterization and authentication.

Technology dissemination

During the course of project implementation, 24 additional sites outside the original N2Africa project domains have been identified to scale out technologies. In some cases the project team were invited by the communities or farmers associations to facilitate the implementation of similar activities in their communities. In other cases farmers or community associations made requests to our partners. In all cases these satellite sites are located in districts so far not covered by the project and in some cases these refer to provinces where the project had not conducted any activities before (.e. Niassa).

Two hundred and ninety eight (298) demonstration plots were established during the last season (221 soyabean demo plots by the project team 77 demo plots by TechnoServe, both within and outside the project areas). The plots demonstrate the effects of inoculation, SSP application, and SSP application in combination with inoculation. Figure 2.13 shows the results from the IITA demo plots indicating a general good response to the use of the various inputs and the maximum response being linearly related to the control yield (higher control yield gives higher maximum response though response ration remaining constant). Similar results were obtained from the results of the plots established by Technoserve, which also emphasize that a combination of SSP and inoculation in most instances performed better than each of the inputs applied alone. However, the cost of the SSP is an issue to be considered and further economic analyses will indicate whether it makes economic sense to apply SSP. Applying 200 kg SSP (20 kg P/ha) will cost about $256. To break even, yield increased due to SSP application should be about 545 kg/ha if the farm-gate price is 14 meticais per kg ($0.47/kg). Examining the figures above, it shows that such productivity increase is often not achieved when considering application of SSP in addition to inoculation.

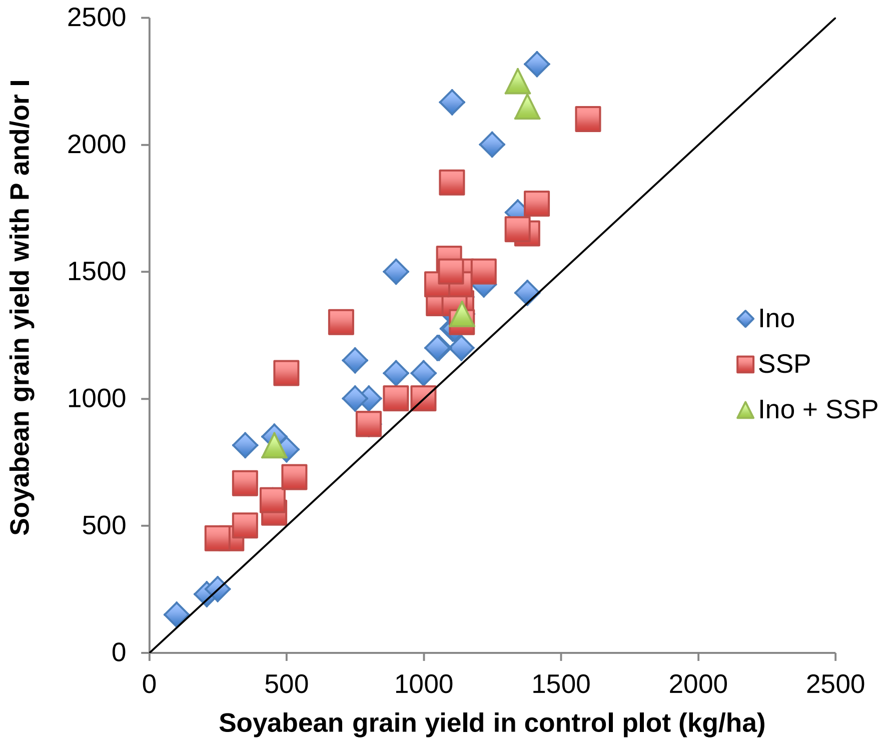

Figure 2.13: Soyabean yield for 'inoculation', 'SSP' and 'Inoculation plus SSP' treatments displayed against control yield, N2Africa Mozambique

During the 2012/13 growing season, D&D activities were carried out in Mogovolas, Rapale, Gurue, Sussundenga, Angonia, Tsangano and Macanga districts. The major activity involved the establishment of demonstration plots across the project area. Three hundred and one (301) demonstration plots were established. Thirty-five per cent (35%) of the farmers involved in establishing the demo plot were females. We expect Technoserve to have established an additional 90 demo plots in Zambesia, Manica and Niassa provinces, making a total of 391 demo plot for the season.

This season 406 tons of seeds (400 tons soyabean and 6.3 tons groundnuts) were distributed In collaboration with our partners (this includes seed distributed to farmers in the satellite areas). Out of this quantity, IITA sold I7.4 tons as soyabean foundation seed to seed companies and projects, including Mozseed Ltd, Phoenix Seeds Ltd, Lozane Farms, CLUSA, Technoserve, and IKURU. Some quantities were given for free to other agencies for promotional activities. Our partners provided seeds to farmers and farmers association as seed loan to be paid back after harvest in cash or with seed or grain at an agreed interest. Thousand seven hundred and ninety (1790) kg of inoculants were distributed during the growing season. Technoserve procured 1500 kg peat-based and 100 L liquid formulated inoculant and IITA procured 190 kg peat-based inoculants. In addition 5.6 tons of SSP and 350 kg of lime were distributed. In total, more than 9111 farmers received inputs (this excludes the number of farmers who received inputs from Technoserve outside Tete province). The breakdown of the figures is given in Table 2.19: Inputs distributed and number farmers reached with inputs during the 2012/13 growing season – N2Africa Mozambique.

Table 2.19: Inputs distributed and number farmers reached with inputs during the 2012/13 growing season – N2Africa Mozambique

Sources	Provinces	Input Distributed				No. of Farmers Inputs received		
		Seed[†] (Kg)	Inoculant (Kg)	SSP (Kg)	Lime (Kg)	Male	Female	Total
IITA*	Nampula	100	20	500	0	7	5	12
IITA	Zambezia	500	55	500	0	11	2	13
IITA	Manica	750	35		0	5	13	18
IITA	Tete	3000	80	1000	0	221	200	421
IKURU*	Nampula	6200		120	350	7	6	33
TNS[‡]	Angonia/ Tsangano/Macanga	68200	1160	-	-	-	-	-
CLUSA	Angonia/ Tsangano/Macanga	310025	440	3500	-	5150	3464	8614
Total		**388775**	**1790**	**5620**	**350**	**5408**	**3703**	**9111**

During the 2012/13 growing season, IITA established 32 ha of soyabean and 5 ha of groundnut for seed multiplication at Nkhame, Mutequelesse, Muriaze and Nametil, to supply seeds to partners including seed companies, farmers and farmers associations and also for project activities on D&D and demonstration for the next season. IKURU also established 10 ha soyabean multiplication fields in Gurue and about 117 ha of groundnuts in Mogovolas, Moma and Angoche districts in Nampula province.

Over 55 field days/visits were organized to showcase and demonstrate technologies on-station, on-farm as well as on demonstration plots during this season. Evaluation of varieties and practices, and also discussions were held to obtain feedback from participants. In total, 2964 farmers and stake holders participated, again with the majority being held in Tete (2099 particpants in 34 fields days devided over three districts). Some field days were attended by the Minister of Agriculture who visited on 11 and 12 Feb 2013, the DDG of IITA on 13-17 March 2013 and the N2Africa Program Officer at BMGF on 17-20 April 2013.

Capacity building

N2 Africa and our partners (IIAM, SDAE, ADEM and the Catholic Church) organized over 53 training sessions in the four provinces. The training focused on crop management, including best time to plant, row spacing, plant population, variety selection, scouting, disease prevention and control; inoculant application, handling and storage; establishing demo plots; harvesting and storage; and record keeping. Many training sessions were organized in Tete province, reflecting the large-scale seed and inoculant distribution campaign undertaken by CLUSA, Technoserve and IITA. In total, 2693 farmers were trained (excluding the number of farmers trained by Technoserve in the other provinces). The group size may vary considerable between training events. Table 2.20 provides details of the training events.

Table 2.20: Number of direct beneficiaries of training activities conducted by the project and its partners during the 2012/13 growing season in Mozambique

Provinces	District/Vialllage	No. of Training	Female	Male	TOTAL
Nampula	Rapale/Muriaze	6	145	111	256
Nampula	Mogovola/Nametil	2	4	11	15
Zambezia	Gurue/Ruace	2	9	24	33
Manica	Chimoio	2	14	31	45
Manica	Sussundenga/Gondola	3	42	20	62
Tete	Angonia/Tsangano/Macanga	30	-	-	1368
ADEM[1]	Angonia	2	-	-	97
SDAE[2]	Angonia	2	-	-	90
IIAM[3]	Angonia	2	-	-	89
Catholic Association	Angonia	2	-	-	84
IKURU[**]	Mogovola, Moma and Angoche	4	-	-	554
Total		**57**	**214**	**197**	**2693**

*IKURU trained 30 TOTs and the TOTs in turn trained 554 farmers.
[1-] ADEM =Associacao para o Desenvolvimento Economico de Moçambique
[2-] SDAE = Serviços Distritais de Actividades Económicas
[3-] IIAM = Instituto de Investigaão Agrária de Moçambique

Two (2) MSc. students from Mozambique started their program at Bunda College, University of Malawi in October 2012 and one Ph.D. student began his program in June 2012 at State University of Londrina, Brazil. The MSc. Students are not expected to finish before October 2014 whereas the Ph.D. student is expected to graduate in 2015.

Eight final year students (6 males and 2 females) from two local universities: Catholic University, Cuamba and Musa Bin Bique University joined the project team in January 2013 for a 6-month training. The program provided the students with hands-on practical training on field experimentation and field plot techniques. They will use part of the data they collected to write their thesis in partial fulfilment of their Bachelors' degree.

2.7 Nigeria summary

Program update and BNF impact

Technology (input) packages consisting of improved legume seed, legume inoculants and P fertilizer were disseminated to almost 30000 households in three mandate areas of Nigeria (Kano, Kaduna, and more recently Niger states) during the 2012 season. Farmers largely appreciated the rhizobium inoculants. Preference for specific legume varieties is also emerging: in Kano, the soyabean variety TGX1835-10E, and cowpea varieties IT97k–499-35 (for *Striga* resistance), IT90k–277-2 (dual purpose high yielding and fodder producing) and IT99k – 573-1-1. We observed that the pesticide (CYPR DICOT) is ineffective in controlling cowpea Maruca pest (bugs) in particular locations. Media events, both at the local government and states' levels, and field days have been organized to raise awareness on BNF technology. In response more than 70% of the participating farmers were willing to pay for inputs.

To assess early impact of the project a household survey was carried out among 500 randomly selected households. Data from one local governments area (LGA) is still expected before analysis can be done. In the meantime inoculants have been made available to farmers for the current upcoming making use of the private company for the distribution. The project, however, imported and paid for the inoculants. The funds used for this serve as matching funds allowing the contracted company to source inoculants themselves from the proceeds of the sale.

Agronomy and Rhizobiology

During the 2012 season the project conducted a variety of trials: On-station trials for the selection of best groundnut and cowpea varieties under different input regimes, demonstration of legume-maize crop rotations both on station and on-farm, variety trials to evaluate the response of cowpea (5 varieties) to inoculation and P-fertilizer application.

Preliminary results of the crop rotation trials indicate no apparent residual effect of the previous inoculated legume crop, which may be because of the removal of crop residues after the first year. Also the application of urea to the maize crop (up to half the local recommended maize N fertilization rate) could have masked any possible residual effect. The results are obtained from data from 7 replicated trials on farmer's fields across Sudan and Northern Guinea savannas. Residual effect of P fertilization of previous soyabean was demonstrated on subsequent maize yield. P applied to soyabean the first year improved total biomass and grain yield of succeeding maize by 19.6% and 20.1%, respectively. The application of P to maize at the rate of 20 kg ha^{-1} the second year further enhanced biomass and grain production by 14.7% and 16.1%, respectively (Table 2.21). Minus P fertilization of maize resulted in about 5% higher biomass and grain yields compared to the non-P fertilized treatment in the first year.

Table 2.21: Productivity increase of maize following soyabean cultivation using different P fertilizing strategies in Nigeria

P Fertilization	^{x}Maize yield	
	Total DW	Grain
Previous legume	---- x 1000 kg ha^{-1}------	
- P	7.7 ± 0.4	2.8 ± 0.2
+P	9.2 ± 0.4	3.4 ± 0.2
Succeeding maize		
- P	8.1 ± 0.3	3.0 ± 0.1
+P	9.2 ± 0.3	3.4 ± 0.1

^{x}: values are means ± SE

Suitability of both cowpea and groundnut as dual-purpose legume crops was demonstrated. The trials were established on-station in Sudan Savanna (SS) and on farmers' fields in Northern Guinea Savannas (NGS). Two (2) groundnut varieties (SAMNUT 22 and SAMNUT 23) and two cowpea varieties (573-1-1 and the local 'Kananado') were tested for response to nutrient (P, K and micronutrients) and manure application.

For the SS the Kananado variety produced highest biomass but hardly any measurable grain yield, compared to variety 573-1-1, which produced 26% less biomass but more than 1000 kg per ha (Figure 2.14). In the NGS both cowpea varieties perform less, with about half of the biomass produced from that produced in the SS zone and with lower yield. However, in the NGS the Kananado variety had higher grain yield than variety 573-1-1, but 573-1-1 had up to 83% more biomass. Where cowpea outperformed groundnut in the SS zone (more than 75% in grain yield), groundnut grain yield was 1.5 times that of cowpea in the NGS. Groundnut yields in the NGS were four to fivefold the yields observed in the SS, where biomass production was 54% up. SAMNUT 23 showed higher grain yield than SAMNUT 22 in both zones, though SAMNUT 22 produced more biomass in the SS zone. The local cowpea variety 'Kananado' is late maturing and spreading type, while 573-1-1 is an improved early maturing one. Attempts to generate new legume technologies through the management of fertilizers and legume germplasm varieties need further investigation.

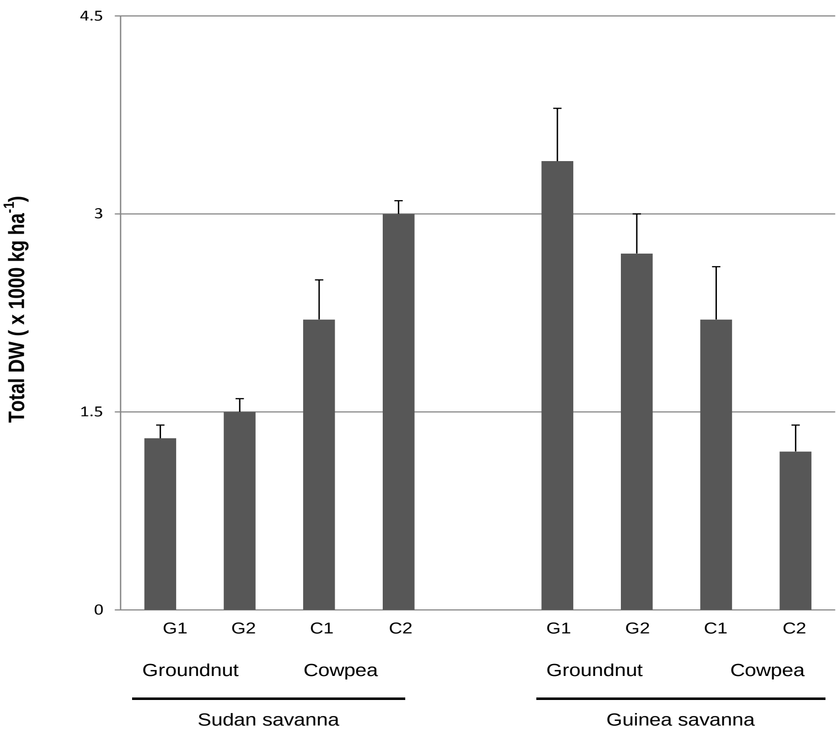

Figure 2.14: Grain yield of cowpea and groundnut varieties in Sudan and Northern Guinea savannas of Nigeria (G1 – SAMNUT22, G2 – SAMNUT23, C1 – Kananado, C2 – 573-1-1 varieties)

The collection of rhizobial isolates by IAR/Zaria has reached the 250 since early 2013. Fifty of them have already been authenticated and tested in the screen house for BNF effectiveness on soyabean. About 40 others are currently under evaluation in the screen house. New rhizobial isolates are expected from bio-prospection of soyabean nodules to be collected across different agro-ecological zones during the coming rainy season. How the number of isolates in Nigeria compares to the number of isolates obtained in the other countries is shown in Table 2.22. The progress is hampered by the delay in the establishment of the screen house in at IAR.

Meanwhile, the elite Kenyan strains (NAK115 and NAK128) are currently being evaluated on station for their symbiotic effectiveness on soyabean under irrigation conditions, alongside USDA136, and USDA110 and commercial inoculants BIOFIX and LEGUMEFIX (which also contain the strain USDA110).

Students from Bayero University of Kano (BUK) are investigating nutrient requirements in relation to BNF (response to nutrient application in combination with application of inoculants) for soyabean and cowpea for the SS AEZ.

IITA/N2Africa have taken the initiative to establish a pilot inoculants production unit at IITA campus, Ibadan. This facility is going to be part of the business incubation unit, with the aim to stimulate inoculant production by private enterprises through the demonstration of state of the art technology and processes to produce high quality rhizobial inoculants at industrial scale and by providing business services like training of technical personal, provision of information services and doing research on improved formulation of inoculants especially with respect to the use (and processing) of various carrier materials. The design of the facility was finalized with the input from the various experts and construction has started in the meantime.

Table 2.22: Number of isolates contributed by the various N2Africa countries to the rhizobia germplasm bank

Country	**Rhizobial isolates** (Number)	**Screen house test**	**Field Test**
DRC	114		
Mozambique	On-going		
Ghana	21		
Nigeria	250	≥ 50	
Kenya	386	≥ 100	16
Rwanda	292		
Malawi	≥ 50		
Zimbabwe	38	6	
Germplasm Bank	≥ 1151		

Technology dissemination

The project engaged the Federal University of Technology of Minna (FUT Minna) as a new partner in agronomy research, together with Niger State Agricultural Development and Mechanization Authority (NSADMA) for D&D activities to be implemented in Niger state for the 2012 campaign.

For the campaign 2013, the N2Africa project has partnered with the Seed Project Co Ltd / Kano, for the distribution of rhizobia inoculants among smallholder farmers. The Seed Project produces seed and distributes fertilizer and other agricultural inputs through its extensive agro dealer network. The N2Africa project supplies the inoculants free of charge and the Seed Project will invest in the appropriate storage facilities and will use the proceeds from the sale of the inoculant for the purchase and importing of the inoculants for the next season. The Seed Project Co has access to cool room facilities, which is one of the reasons why we engaged with this partner.

N2Africa Nigeria aimed to double the number famers reached in the previous season for the 2012 season. We realized over 70% of the target with an estimated 22627 reached in 2012, including both lead and satellite farmers. The dissemination package consisted of 2 kg of improved seed and 8 kg of P fertilizer (SSP) for lead farmers and 0.5 kg of seed and 2 kg of SSP for satellite farmers respectively. In addition, rhizobial inoculant was provided in quantities sufficient for the respective plot sizes. Lead farmers of cowpea and groundnut were supplied with 1litre of insecticide. Inputs were distributed against a token fee of 200 – 1200 Naira (1.25 – 7.5 USD) depending on the crop and the category (lead or satellite) of farmer in the project".

Table 2.23: Number of demonstration and satellite plots realized in the 2012 season Nigeria

State	**LGAs**	**Demo plots target**	**Plots realized**		**Total**	**Achievement**
	#	♯	Demo	Satellite	#	%
Kano	9	576	388	9586	9974	67
Kaduna	7	437	373	8952	9325	85
Niger	5	200	128	3200	3328	64
Total	21	1213	889	21738	22627	73

A series of field days and media events were conducted to create more awareness about the project activities. A field day was organized for each of the Kano, Kaduna and Niger states, followed by field days organized at the level of the local government area. In Table 2.24 you find the field days held in Kano state and number of participants. The percentage of women participating in the field days was 10.6%. The data on field days for Kaduna and Niger states still needs to be compiled.

Table 2.24: Local field days organized by SG2000 in Kano state, Nigeria, 2012 season

Local Gov. Areas	Date	Location	Demonstration topic	Male	Female	Total
Bunkure	16/10/2012	Marke	Soyabean	243	43	286
D/Kudu	26/10/2012	Kwanar dawaki	Soyabean	47	4	51
Gaya	03/11/2012	Amarawa	Soyabean	60	-	60
Doguwa; Wudil	05/11/2012	Dakin Kowa; Darki	Soyabean	71	-	71
Albasu; Garko; T/Wada	06/11/2012	Albasu; Yaryasa; Gurjiya	Soyabean	103	3	106
Bichi	08/11/2012	Saye	Cowpea	34	16	50
Total				**558**	**66**	**624**

Media events were held often in conjunction with the field days. Table 27 gives the list of media events.

Table 2.25: Television and radio programs aired in Nigeria during the 2012 season

Date in 2012	Medium	Event (Field Day)	Program time
10th October	ARTV; Radio Kano Freedom Daily Trust	Bunkure;	7:00-7:30 pm
3rd November	Radio Kano	Gaya	7:30-8:00 pm
5th November	Radio Kano; AM/FM	Doguwa	7:00-7:30 pm
6th November	Radio Kano; AM/FM	Albasu; Garko	5:00 pm; Repeated at 7:00 pm
"	CTV44; 101.1 FM	T/Wada	7:00 pm-News
8th November	Radio Kano-AM	Bichi	7:00 pm-News

In Northern Nigeria it is difficult to secure a high percentage of women participation in project activities. In the 2011 season female participation in dissemination activities was 7-8 %, which was considered to be a great performance. Data from Kano state for the 2012 season indicates that 8% of the lead farmers are female. Women constituted 47% of the satellite farmers in the project. Women groups were target for training in food processing and grain legume recipes.

Capacity building

In Nigeria usually pre-season and mid-season trainings are conducted, focusing on seed inoculation, field design, and management of the demonstration field and crop husbandry. Table 28 provides the details of lead farmers being trained. Extension agents (EA) also attended the pre-season trainings in Kano (81), Kaduna (40) and Niger States (23). One mid-season training was conducted for EAs and APCs of the 3 states on data collection, data management and ranking of crop performance for evaluation. The mid-season training in Kaduna state was held on 31st October 2012, with 52 attendees (42 males and 4 females).

Table 2.26: Summary of lead famers participation in the 2012 pre-season training in Nigeria

State	Date	Center	Local Gov. Areas	Male	Female	Total
Kano	13/06/2012	Tudun Wada	Doguwa; Tudun Wada	112	19	131
	14/06/2012	Wudil	Wudil; Gaya	105	7	112
	15/06/2012	Bunkure	Bunkure; Dawakin Kudu	98	15	113
	16/06/2012	Garko	Garko; Albasu	123	18	141
	17/06/2012	Bichi	Bichi	67	2	69
Kaduna	11/07/2012	Kajuru	Kajuru	38	4	42
	12/07/2012	Lere	Lere	57	14	71
	13/07/2012	Soba	Soba; Giwa	135	37	172
	14/07/2012	Zago Kataf	Zago Kataf; Kachia	80	16	96
Niger	09/07/2012	Kuta	Paikoro; Shiroro;	77	7	84
	10/07/2012	Kontagora	Kontagora; Mashegu; Magama	102	16	118
Total				**994**	**155**	**1149**

In preparation for the 2013 season the project organized training for agro-dealers (selected by the Seed Project Co) and extension (selected by the N2Africa D&D partners) on the handling and use of inoculants. In total 80 persons were trained (of which only 2 women): in Kano state 37, In Kaduna 28, and in Niger state 15 persons.

2.8 Ghana summary

Program update and BNF impact

This report details the progress made by the N2Africa-Ghana during the end of the 2012 season and up to month 42 of the project. During this period, MSc students funded by the project completed their field works, early impact survey was conducted, willingness to pay for inoculums and legume grain marketing systems studies were completed, new partnerships were formed, and adaptive research trials and dissemination activities carried out. Furthermore, several training programs and farmer field days were conducted and a data management assistant joined the N2Africa team in KNUST.

Many new opportunities were identified during the last six months. Two agrodealers, namely Kaakyire and Antika agro-chemical companies, are going to distribute and sell import Legumefix inoculum in Ghana. Esoko Ltd developed a marketing platform through which linkages for soyabean farmers to industrial processors such as Ghananuts and 3KD are being strengthened.

Three hundred (300) farmers were interviewed for the early impact assessment, of which 28% from Chereponi (northern region), 44% from Bawku West (upper east region) and 28% from Karaga District (northern region). Thirty-eight (38) % of the farmers interviewed were lead farmers, the remaining were satellite farmers. Forty (40) % of the respondents were females of which 45% indicated that they were household heads. Average household size was 11persons of which 5 children and two people above 60 years. These means only four household members are economically active to cater for the household. About 75% of farmers hired labour for agricultural activities and some 57% of the households had at least one member working as casual labourer on other people's farms. The main income sources were found to be crop production (65%), livestock (15%) and trading/commerce (10%). On average, each household owned about six cattle, nine sheep, nine goats, four pigs and 20 chickens. Important assets owned by grain legume farmers were found to be bicycle (95%), radio/sound system (93%) and motorbike (44%).

About 95% of the respondents confirmed that they had received inputs/training from N2Africa project in previous seasons. About 29% of respondents indicated they had received similar training from institutions such as Ministry of Food and Agriculture (MoFA) and Savanna Agricultural Research Institute (SARI) of the Council for Scientific and Industrial Research (CSIR).

Legume seed for last season's cropping activities were sourced from agro-input dealers, N2Africa/NGOs and fellow farmers/relatives. Non-legume seeds were obtained from agro-input dealers and MoFA. Inoculum was supplied by N2Africa only, and agro-input dealers and MoFA are the source of fertilizers and pesticides.

The study showed that about 78% of farmers did cultivate grain legumes before N2Africa project, however, with minimal use of improved seeds and agrochemicals. About 48% of farmers reported an increase in acreage for grain legume production, 36% reported no change in acreage and 9% reported reduction in scale of production. As well, 45% of farmers reported to have increased the percentage of grain legumes sold from total harvested and about 16% reported a decrease.

Total arable land available for crop production was estimated at 10.19 acres and the average fallow period to be two years. The acreage put under cultivation of the main grain legume crop more than doubled; from 2.1 acres on average four years ago to 4.8 acres currently. However, the increase in yield recorded was marginal (from about 305 kg last four years to about 317 kg now). Farmers reported to have increased the amount of grain sold, from about 91 kg four years ago to about 123 kg now.

The frequency of legume consumption was found to be three times per week during the main season and twice a week during the minor/lean season. Except soyabean, grain legumes were largely consumed either as a main dish or an important ingredient in a main dish. This gives an indication that grain legumes contribute significantly towards household food security in the project districts.

It can be concluded that N2Africa has made some modest successes that the project could build upon to improve legume production in the project districts. The modest impact of the N2Africa project on the ground currently could be attributed to the short period of its implementation so far. One would expect a significant impact on production scale and crop yield and improved farmers' income and household food security if the project would continue operating, in only a few years.

Because the *N2Africa Project* had so far provided *Bradyrhizobium* inoculum for free, willingness to pay for inoculants was assessed to determine the potential market. The case study covered a total of 188 Soyabean producers from Bawku West, Karagara and Nadowli District in Upper East, Northern and Upper West region respectively. Fifty (50) % of the sampled farmers were *N2Africa* project beneficiaries and 50% were non-project members from the same communities to serve as control group. About 35% of the respondents were females, 95% were married, and 27% belonged to farmer associations. The total annual income of a typical soyabean farmer was found to be GHC 1,136.27 (US$ 583) and on average GHC 181.70 (US$ 93.18) was received as credit to support general legume production activities during the previous year. *Jenguma* was the predominant soyabean variety used by farmers I a monocropping system in the three northern regions. Results indicate that a farmer cultivates 1.8 acres of land to soyabean (on average) and harvests 532 kg of grains (271 kg per acre) out of which about 65% is sold. Area of soyabean cultivated, total output and percentage of output sold differed significantly across the four study districts, but soyabean yield did not. We also found no significant difference between grain yield obtained by farmers who experimented with inoculum and that of the control group. This could possibly be explained by the fact that inoculum was used on very small plots of land for demonstration purposes only. About 40% of farmers were aware of inoculum and its use in soyabean production. About 80% of farmers indicated their willingness to pay for inoculum. Willingness to pay for inoculum is significantly (5%) influenced by experience in soyabean production, access to credit, percentage of produce sold and awareness about inoculum. Male farmers are more willing to pay for inoculum than female farmers, and distance from home to farm relates negatively to farmers' willingness to pay for inoculum, *ceteris paribus*. The study concludes that to increase the future use of inoculum extension visits, awareness creation about inoculum, credit access and distance to farm should be targeted as the key variables in any strategy or policy formulation.

In a developing country like Ghana, emphasis is usually placed on policies to increase food production with little or no attention on how to efficiently distribute the food produced in a manner that will drive productivity at the farm level. Marketing of agricultural produce in most African countries has yet to achieve the degree of competitiveness and transparency to ensure fair market prices for small-scale farmers, processors and consumers (Peterson, 2004). Costs for marketing produce are very high and lowering these costs through efficient marketing system may be as important as increasing agricultural production and would increase farm incomes and reduce the amount produce that goes to waste. In addition, more efficient markets would help to lower transaction costs, increase the volume of trade, lower food prices and offer greater food security, leading to greater benefits for the economy as a whole (FAO, 2003).

The main objective of this case study was to examine the costs, returns and efficiency levels associated with the activities of key players in the grain legume marketing chain in northern Ghana. Also, we examined the impediments to the efficient functioning of the grain legume marketing system were examined. A total of 140 market participants comprising 93 retailers (66%), 39 wholesalers (28%) and eight (8) assemblers/aggregators were selected from major and satellite markets in the three Northern Regions of Ghana through a multi-stage sampling approach. Grain legume marketing is largely a women's business and those involved had less than two years of formal education. Annual income of households of traders in grain legumes was estimated at GHC 1,974.53 (US$1,012.58).

Evidence from the study showed that there was a long chain with more than three different channels/pathways through which grain legumes moved from the farm gate to final consumers. The estimated number of wholesalers and retailers in the markets surveyed ranged from four (4) to 200 with a mean of 30 traders. The average distance between the source/supply market and destination market ranged from 'low' of 1.3 km in Upper West Region to 'high' of 32.64 km in Upper East Region, with the mean distance being 22.1 km. A typical grain legume trader would travel 5 times to source grains from the source/supply market and sell at the destination market in a typical month and would handle a total of 893.36 kg of grain per week at total cost of GHC 1,109.12. Wholesalers travel about six (6) times a month, retailers and assemblers travel four times per month. Generally, volumes of grain legumes handled on weekly basis by wholesalers were 2059.63 kg, much higher than that handled by assemblers (1335.85 kg) and retailers (390.39 kg). The study showed that grain legume traders were able to sell at least 74% of their weekly stocks.

Marketing of grain legumes was found to be profitable, with only 18% of the gross marketing margin spent on marketing cost. Generally, assemblers/aggregators realized a margin that was about 152% and 204% higher than that realized by wholesalers and retailers respectively. Considering the whole marketing value chain, while wholesalers' share of total marketing costs was about 60%, they received only 23% of the net margin accrued from the sales of grain legumes, assemblers/aggregators paid only 26% of the marketing costs obtained as high as 59% of the net marketing margin. Trading in all the grain legumes was found to be very profitable, but trading in groundnut is far more profitable than trading in cowpea and soyabean, in northern Ghana. The net marketing margin obtained on a kilogram of groundnut handled by traders was estimated at GHC 0.36 compared with GHC 0.25 for cowpea and GHC 0.11 for soyabean.

The main constraints identified by grain legume traders were limited access to credit, high cost of transportation, poor road network linking grain markets to producing communities and inadequate storage facilities. The study recommends strategies to be adopted by key stakeholders (especially, central and local government authorities) to address the key constraints faced by actors in the grain legume marketing chain to improve on its performance further in order to drive socio-economic development in the rural economy of northern Ghana.

Agronomy and Rhizobiology

The results of the soyabean trials showed a varied response of soyabean varieties to the *Rhizobium* inoculant, *Legumefix,* at the different locations. We only found significant effect of inoculation on TGX1448 at the Nyankpala location in Tolon district. There seems to be a positive effect for this variety also in Achuma and Duko locations, but not significant. Otherwise there is no clear evidence of effect of inoculation and there is no significant difference between the varieties tested within the different locations. There seems to be some marked differences in the performance of the various varieties between locations but further statistical analyses need to confirm this. The data is presented in Table 2.27. For Jenguma and Quarshie varieties at Nyebsobga and Duko locations respectively, we did find significant higher nodule dry matter weight as result of inoculation.

Table 2.27: Effect of rhizobium inoculation on grain yield (t/ha) of six soyabean varieties grown in six locations spread over four districts in Ghana in 2012

District	Tolon	Karaga		Chereponi		Savelugu-Nanton	
Location Variety	Nyankpala	Komoayili	Nyebsobga	Achuma	Jakpa	Kanshegu	Duko
TGX1834 – Ino	2.49 ab	1.84 ab	1.72	2.33	1.32	1.52	2.71
TGX1834 + Ino	2.23 ab	2.11 a	1.81	2.52	1.49	2.26	2.49
TGX1448 – Ino	2.00 b	1.94 ab	1.75	1.72	1.44	1.99	1.87
TGX1448 + Ino	3.71 a	2.05 ab	1.90	2.46	1.77	2.05	2.52
Quarshie – Ino	2.81 ab	1.58 ab	1.64	1.99	1.42	1.89	2.50
Quarshie + Ino	2.69 ab	1.81 ab	1.63	2.34	1.96	1.52	2.24
Jenguma – Ino	2.17 ab	1.91 ab	1.86	2.42	1.78	2.08	2.60
Jenguma + Ino	3.10 ab	2.00 ab	1.89	1.73	1.54	2.31	2.90
Jenguma+Urea+Ino	3.19 ab	1.93 ab	2.26	2.34	2.02	2.16	2.43
Anidaso – Ino	2.62 ab	1.68 ab	1.89	2.19	1.83	2.09	2.17
Anidaso + Ino	3.17 ab	1.66 ab	1.89	2.00	1.94	1.90	1.73
Salintuya 1 – Ino	2.62 ab	1.66 ab	1.80	2.24	1.24	1.88	2.57
Salintuya 1 + Ino	2.68 ab	1.47 b	1.80	2.03	1.51	2.19	2.32
Tukey (5%)	1.58	0.60	1.18ns	0.88ns	1.35ns	1.17ns	1.24ns
CV (%)	26.30	16.65	23.34	18.81	32.53	23.54	23.00

Means with the same letters are not significantly different according to the Tukey Post Hoc Test at 5% probability level. CV = coefficient of variation, ns = not significant at 5% probability level

Similarly, the soyabean input trials showed some trends in the response to fertilizer application, though no significant differences. The combined application of TSP, Fertisoil and *LegumeFix* inoculant significantly enhanced Jenguma variety grain yield, as it did to above-ground biomass at Nyankpala. This same significant effect of this treatment was observed at Nangunnayili. Although there seems to be a response compared to the control for all locations, not significant differences were found between the various treatments.

Table 2.28: Grain yield (t/ha) of Jenguma soyabean variety in response to application of different fertilizer types at four locations in the Northern Region of Ghana

	LOCATION			
Treatment	Nyankpala	Yong	Nangunaayili	Komba
None-Ino	1.60 bc	2.23	0.83 b	0.79
None+Ino	1.56 c	2.06	1.07 ab	0.91
SSP-Ino	1.76 bc	2.24	1.21 ab	0.93
SSP+Ino	1.87 abc	1.88	1.28 ab	0.80
TSP-Ino	2.45 abc	2.55	1.34 ab	1.07
TSP+Ino	1.87 abc	2.87	1.60 ab	1.40
TSP+Fertisoil-Ino	2.86 abc	2.54	2.13 ab	2.02
TSP+Fertisoil+Ino	3.33 a	2.61	2.32 a	1.56
TSP+Fertisoil+BoostXtra-Ino	3.18 ab	2.62	1.97 ab	1.45
TSP+Fertisoil+BoostXtra+Ino	3.05 abc	2.66	1.99 ab	1.51
Yaralegume-Ino	1.80 abc	2.79	1.04 ab	1.80
Yaralegume+Ino	1.84 abc	1.58	1.06 ab	1.53
TSP+N-Ino	2.53 abc	2.58	1.67 ab	1.23
Tukey (5%)	1.55	1.29	1.38	1.47
CV (%)	35.56	24.88	47.58	52.65

Values are the means of 4 replicates. Means with the same letters are not significantly different according to the Tukey Post Hoc Test at 5% probability level. CV = coefficient of variation, ns = not significant at 5% probability level

For cowpea similar variety and input trails have been conducted. The results from the variety trials are inconclusive in the sense that no singular variety is emerging that outperforms all other varieties for the various locations or that shows a marked response to inoculation. Various criteria are used for screening. These involve biomass production, grain yield, haulm production, seed size and nodulation (number and weight). The results for each of these criteria might differ between the various varieties and per location. For detailed account of the results see the original country report for Ghana.

As far as the effect of the various input treatments is concerned, only at Nangunnayili clearly different responses were observed, with the TSP+Fertisoil+BoostXtra giving the highest yield using Songotura as reference crop. Similar pattern was observed at Jakpa especially. Songotura failed to respond to any of the fertilizers at Duko and Nyankpala (Table 2.29), but did significantly increased haulm yield in both locations. Remarkable is the poor response to Yaralegume in all locations.

Table 2.29: Effect of different fertilizer types on grain yield (kg/ha) of Songotura cowpea variety grown at four locations in the Northern Region of Ghana in 2012

Treatment	Nyankpala	Doku	Nangunnayili	Jakpa
None	454	1168	855 d	750
SSP	343	938	1048 cd	667
TSP	361	1005	1383 bc	852
TSP+Fertisoil	435	1238	1758 ab	954
TSP+Fertisoil+Boostx'tra	458	1299	1885 a	963
Yaralegume	384	872	959 d	815
lsd (5%)	191	552	379	307
CV (%)	37	39	25	37

Values are the means of 4 replicates. Means with the same letters are not significantly different according to the LSD Test at 5% probability level. CV = coefficient of variation

For effect on pod yield and pod number as well as on grain size, see the original country progress report. Figure 2.1Figure 2.15 gives the effect of the various treatments on the nodule dry weight at Nyankpala. The difference with the control is not significant, but the TSP+Fertisol+BoostXtra treatment did produce significantly higher nodule dry weight compared to Yaralegume.

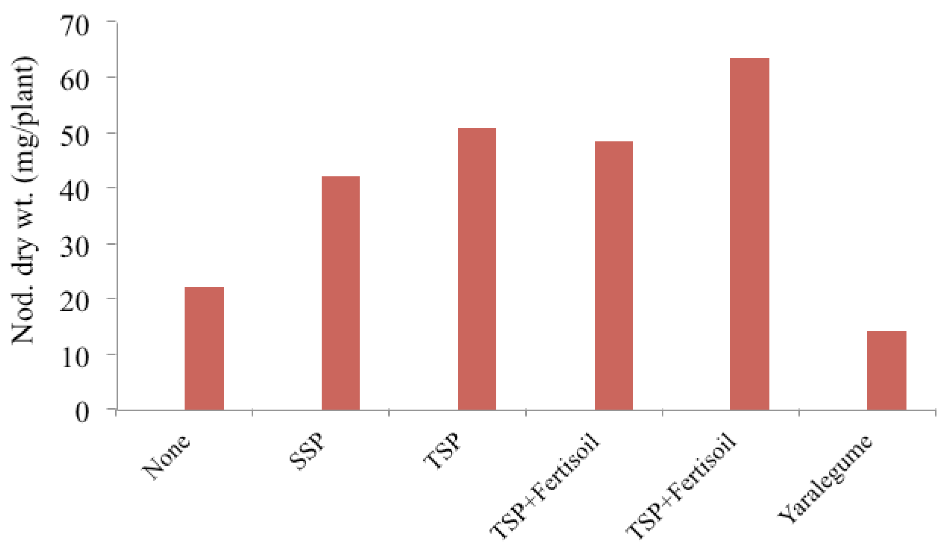

Figure 2.15: Effect of different types of fertilizer on nodule weight in cowpea (Songotura) at Nyankpala, Ghana

A total of 44 MPN counts and 39 “need to inoculate” trials for soyabean across the impact zones have been conducted. Soils were collected from three sites in each district across the impact zones. Generally, the soils have small indigenous rhizobia populations with only 11 sites out of the 44 (i.e. 25 %) where the soils has population counts of more than 100 rhizobia cells per gram of soil and only 4 sites where the counts exceeds the 200 cells/g. One site in Achuma showed the highest score of 379 cells/g of soil. Otherwise there was no pattern, only that the sites in Karaga district seem to have a somewhat higher score consistently. There is the need for inoculation in areas with rhizobia population counts of less than 50 cells gram-1 of soil in order to improve nodulation and crop yield in these areas. Results of the MPN counts for the 44 locations are presented in the month 42 country progress report.

Symbiotic effectiveness of indigenous bradyrhizobia isolated from nodules of the need to inoculate trial was assessed by comparing the biomass yield of plants inoculated with these isolates to that of USDA 110 (reference strain). A total of 53 isolates were screened for symbiotic effectiveness relative to USDA 110. There was not one strain performing better than the reference. Out of the total of 53 isolates screened, 22 (41%) had symbiotic effectiveness index between 80% and 93% and were classified as effective. Twenty seven (51%) of the isolates had symbiotic effectiveness index ranging between 65% and 78% and were classified as partially effective, while 5 isolates representing 8% of the total had effectiveness index of less than 65% and were classified as ineffective.

Technology dissemination

A total of seven hundred and seventy three (773) demonstrations were established on-farm across the three mandate regions of Ghana. These consisted of five hundred and eighteen (518) soyabean demos, one hundred and seventy five (175) demos of cowpea and eighty (80) groundnut demos. Herewith 96.6% of the target of 800 demos for the 2012 season was reached. With the 2012 dissemination campaign we reached 22417 satellite farmers, with 68% producing soyabean, 22% producing cowpea and 10% producing groundnut. At all locations the combined use of P fertilizer and Legumefix inoculum led to higher grain yields than the other treatments, with only very few exceptions (see Figure 2.16 and Figure 2.17). Grain yields varied strongly.

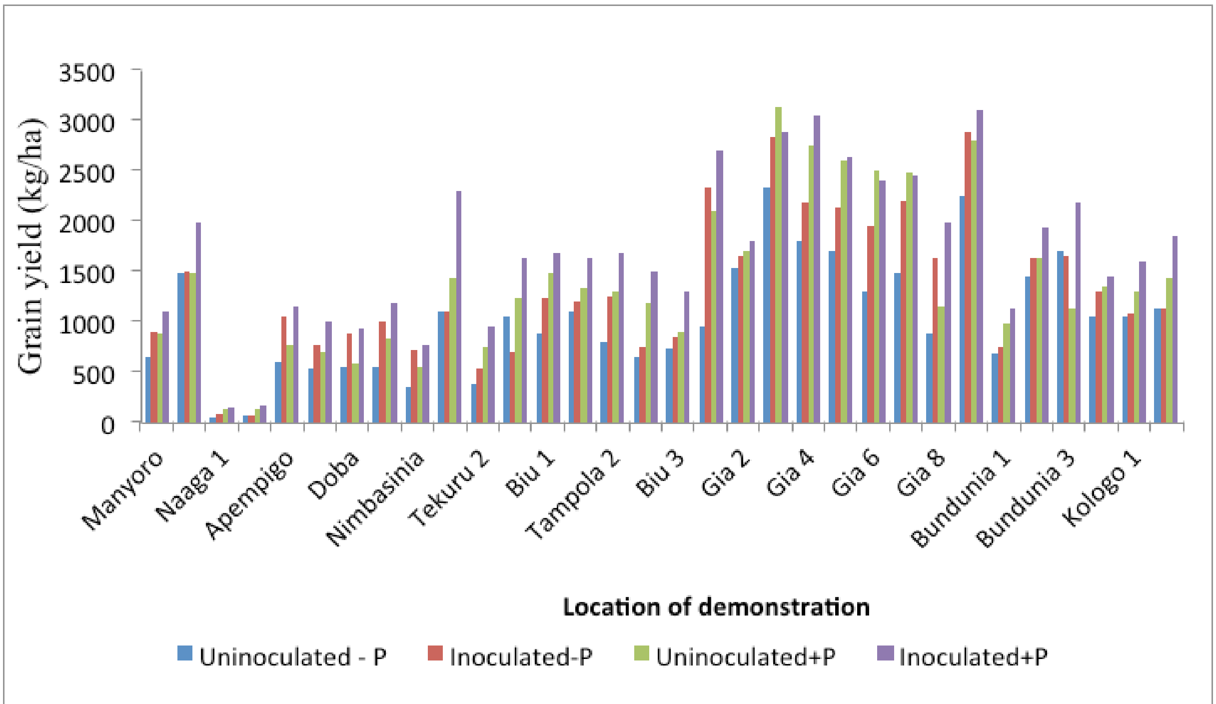

Figure 2.16: Grain yield of inoculated and fertilized soyabean grown at different locations in the Kassena-Nankana East district in 2012 (data from the demonstration plots)

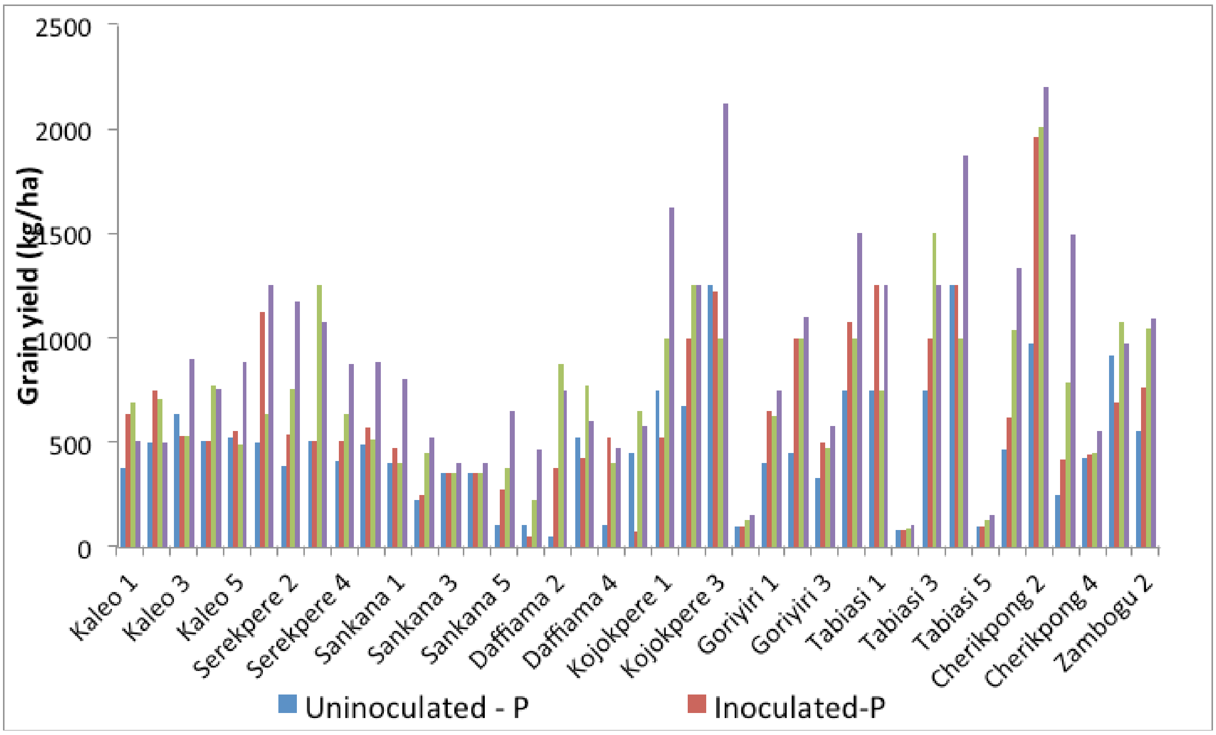

Figure 2.17: Grain yield of inoculated and fertilized soyabean (Jenguma var.) grown at different locations in the Nadowli-Kaleo district, Ghana in 2012

A total of 65 farmer field days were conducted in as much communities selected from the three mandate areas. Out of these, 30 field days where organised SARI and MoFA in Upper East and West regions. The other number of field days was divided among the D&D partners Urbanet, EPDRA, ACDEP and Advance. The average attendance per a location was 58 farmers with 46% being women (total number of farmers reached through field days: 3770).

Farmers generally rated the 'Fertilizer+inoculants' treatment highest, followed by the 'Fertilizer only', the 'Inoculant only', and 'control' lowest. At some locations however, farmers could not differentiate between the performance of the 'Inoculum only' and 'Fertilizer only' treatment. This attested to effectiveness of the inoculum treatment.

Media firms were invited to attend nine field days, three in each of the three mandate regions. Media houses that covered the events included, MIGHT FM, Daily Graphic, Viasat One Television, Citifm and Ghana Broadcasting Cooperation.

Events on human nutrition were conducted in ten communities in each of three mandate regions (30 in total). The training attracted women groups from the targeted community and beyond. The average attendance per location was 65 persons. Legume recipes demonstrated included soya khebab, soya milk, soya tubaani, soya koose, soya apapransah/sawalla, soya TZ, banku and soya sauce, and Rice + soya stew. We compiled the recipes in a handbook for distribution to the participants.

Marketing and Value Addition

A total of 540 farmers have been linked to aggregators, agro-processors and individual buyers of legume the Esoko marketing platform. These farmers obtain regular alerts on market prices of legumes and agro-inputs, weather information and information on potential buyer within their region. A total of 1000 farmers would be migrated onto this marketing platform by the end of the Project. A major challenge has been the collation of mobile phones numbers, as most the farmers do not use mobile phones. In addition a forum for the actors in the marketing of grain legumes would be organized in August 2013 to sensitize farmers on good practices for premium prices.

Capacity building

The two MSc students in soil science students have completed their field and laboratory investigations and have submitted a draft of their theses to their supervisors. Mr Jacob Ulzen worked on non-responsive soils and wrote a thesis on assessing the need for inoculation of soyabeans and cowpea in the Kessena Nankana districts of Ghana. Mr Abdul-Aziss Abdul-Latif conducted research on the contributions phosphorus fertilizer and rhizobium inoculant to biological nitrogen fixation and grain yield of three soyabean varieties.

A training programme was held in the Upper West region to equip ten agro-dealers with the knowledge and skills related to the handling and use of agrochemical, legalities and hazards associated with the use of pesticides, inoculums storage and transportation and sourcing of inoculums for commercial purposes. Participants were offered hand-outs on safe handling of agrochemicals and proper uses of protective clothing. The same training programs are still planned for the Northern and Upper East regions to introduce more agro-dealers to rhizobium inoculants and set the stage for commercial distribution of the inoculants.

3 Milestone achievements

3.1 Objective 1 - Targeting N_2-fixing legumes in the impact zones, M&E and impact assessment

Milestone 1.1.4. Hold a project interim assessment workshop (completed)

This is a recurring event related to the annual leadership and steering committee meeting. The year three meeting was held in Nairobi from 17 to 20 October 2012. An elaborate report was generated and distributed to participants and steering committee members. The findings are summarized below. With the report we consider this milestone to be completed.

Progress was considered to be quite satisfactory with the M&E showing that dissemination targets have been reached or will be reached (even likely to exceed targets) in the current or upcoming season in all countries. Of particular note is the strong representation of women in activities at all levels, with over 50% participation in most regions apart from those areas where culture restricts women's participation such as northern Nigeria. Even though training also reached it targets a concern is the production of training materials that is behind schedule.

The project has facilitated new varieties being entered into national varietal testing and release programs in East Africa, particularly with soyabean, which is a relatively new crop in this region. A modest effort has been placed on identifying and testing forages in areas where livestock enterprises are active.

Comforting is the strong responses to inoculation that are seen with soyabean in all countries and all regions, with large positive interactions with phosphorus fertilizer. Experimentation has revealed multiple nutrient deficiencies – of K, Ca, Mg, S and Zn – depending on the region, offering an explanation for the lack of response to simple inputs of P, that has been observed in most countries in particular instances. New blends of fertilizer to address these problems that have been developed and launched on the market through the initiative of N2Africa are a very positive development (e.g. Sympal fertilizer that is now commercially available in Kenya and Malawi).

On rhizobiology, bioprospecting has resulted in a large collection of rhizobial strains, and several 'elite' strains are already passed several screening phases and are being tested in the field. The quality of inoculants that are produced locally and regionally is steadily improving though the intervention of the N2Africa project (through research, training and advice).

Of concern is the availability and quality of the data, as this is made available to the central database held at Wageningen University. The data gaps have been identified; responsibilities assigned and measures taken to improve data management. N2Africa decided to organize a "Science Meeting" in early 2013 to focus on ensuring that more emphasis is taken from an early stage to writing up project outcomes and learning that is starting to emerge. Of particular note is the focus in the project on knowledge and communication - both internal and external – with novel deployment of video and other media.

Dr John Lynam presented the major findings of the external review of N2Africa. The review was particularly complimentary on the "Development to Research" approach that the project has developed. This approach puts the farmer at the center through delivery and dissemination and uses M&E to develop feedback loops through research to strive for continuous learning and improvement. A lot of discussion during the meeting was focused on how to improve the speed and efficiency of these feedback loops, particularly in East Africa where the bi-modal rainfall allows two seasons a year and there is little time between seasons for analysis. Much of the discussion of the report focused on how different approaches to dissemination can be tested and evaluated, to allow the project to move rapidly to scale. Suggestions were made to make more structured use of the (GL x GR) x E x M model to explore the performance across agro-ecologies, and to ensure that there are clear connections to ensure rapid uptake of varieties and strains emerging from the breeding and strain selection pipelines. The evaluation or review of the dissemination approaches will be explicitly addressed in the final year to the project and linked to the early impact assessment (also to address the concern on the limited progress made on the D&D inventory).

For the last year of the project, and with the aim to improve the sustainability of the project intervention, the project decided to direct attention more to sustainable supply of inputs. The project will depart from an incremental 'lead farmer' approach and withdraw from its role in distributing and providing inputs to farmers. The project will also retract from being directly involved in the dissemination and transition to a more dispersed model that relies on partners for much of the direct dissemination as part of transitioning to a second phase. Now already CRS have held field days for 14000 farmers profiling N2Africa technologies in Malawi, and in Ghana N2Africa partners with ADVANCE to reach many thousands of farmers, for example.

Plans for an "Early Impact Assessment" were extensively discussed and further developed. The decision was taken to broaden the scope from impact on the livelihoods of farmer households reached by the project (and the assessing achievements towards reaching the vision of success) to include impact on partners and co-operators of the project in their delivery and dissemination approaches as well as on agrodealers in distribution of inputs and influence the project has had on markets. At the core will remain a household survey that will use a standard form of questionnaire. Addition instruments will be employed to gather information on prices of inputs and produce, and will include an agro-dealer survey, a partner survey and case studies. Particularly novel is the planned use of a PESTEL analysis to allow an inter-country analysis of some of the broader drivers and constraints.

Further it was decided to pay more attention to 'feedback' from stakeholders to the project and vice versa.

Milestone 1.2.6 and M 1.3.4: Detailed country-by-country marketing support and marketing demand for legumes documented. (completed)

J. Rusike et al (2013) completed the value chain analyses of the four target grain legumes –common bean, cowpea, groundnut and soyabean – in the N2Africa countries and herewith are the reports for milestones 1.2.6 and 1.3.4 completed.

Five different aspects are identified in the analyses: (1) the role of the target grain legumes in smallholder farmers' strategies for cash incomes, food security, nutrition, natural resource management and gender equity, (2) trends in production, (3) the structure and dynamics underway in the value chains, (4) opportunities and constraints on improving performance of the value chain and (5) the nodes for leveraging research investments to resolve constraints and permit smallholders, traders, and agribusiness firms to exploit the end market opportunities. Generally, common bean is important in eastern and southern Africa, cowpea in western Africa and groundnut and soyabean across the three regions. In all regions, production of marketable surplus is geographically concentrated in areas characterized by soils and climatic conditions favourable for these crops, preferences for different legumes for home consumption and grain legume development projects. Overall, there is an upward trend in area, yield and production, mainly driven by increasing end market demand, increasing procurement from the farm gate by large-scale agribusiness firms that integrate logistics with markets and technological change. The value chains are rapidly evolving. End-market demand opportunities with significant potential for improving performance lie in the increasing and currently unmet demands in urban centres in domestic and regional markets, substitution for imported food and international markets. Constraints include erratic production and lack of capacity to supply end-markets with products with consistent quality, quantity and timeliness and at competitive prices; lack of input supply systems for certified seed of improved appropriate varieties, inoculants, fertilizers, agro-chemicals, tractor and machinery hire services; weak public extension services; poor access to output markets and lack of farmers' capacity to participate in markets; difficulties honouring contracts; lack of financing; competition from imports; and policy inconsistencies. Priority research interventions identified include development, testing and promotion of new varieties adapted to the local agro-ecological conditions; crop and post-harvest management practices; input supply systems for seeds, inoculants, fertilizers and agro-chemicals; output marketing systems; the provision of information; the development of micro-finance markets; farmers' organizations; and the creation of an enabling environment for business.

Milestone 1.2.9: Approval of detailed implementation plans in milestones 1.2.1-1.2.7 by BMGF (completed)

The implementation plans for milestones 1.2.1 to 1.2.7, that relate to identifying action areas, plans for extension, improving access to P-fertilizers, increase in seed production and interaction with TLII for each of the countries, were reported already early in the project (see reports 004, 006, 007 and 008), apart for the marketing support. The formal approval from the BMGF has been pending until recently through notification by email from Prem Warrior. With the milestone 1.2.6 report now also completed we consider this milestone completed.

Milestone 1.3.2: Eventual new opportunities have been identified prior to each new cropping season (finalized, completed)

This is an annual recurring milestone for the first three years in the project. One report (report 033) has been issued. Since we are in the last season of the project this milestone is no longer relevant. We do see that the project made adaptation to the agronomic trials during the course of the project, based on the results from the previous trials, to further improve management of legume crops. The development and/or test specific legume fertilizer blends illustrates this. These technologies were subsequently also introduced in the demonstration plots. This is a process that takes place at the country level and reported in the country progress reports. In the same way the country programmes report on the opportunities that presented themselves to form new partnership and expand the dissemination of legume and BNF technologies to new areas. The country progress summaries give a number of examples where this has happened, but we will also capture that information in the milestone 4.1.3 report. In the mean time we will built on and strengthen the existing partnerships for transitioning to the second phase of the project. In Kenya for example, the node leadership continues to operate under Western Region Agricultural Technology Innovation Platform (WeRATE) and seasonal technology demonstrations and farmer field days continue among partner groups, for which funding opportunities are investigated.

Milestone 1.3.3: Complete market analyses for inoculum (draft report, waiting final comments and revision to finalize)

Milestone 1.3.3 requires "complete market analysis for inoculant in the areas where the project is operating, including cost/benefit analysis at smallholder level; leading to recommendations for private sector engagement". The action sites in Kenya and Zimbabwe offer the best opportunity to analyse these costs and benefits because these countries rely upon a locally produced, commercialized inoculant and N2Africa has established close working relations with their manufacturer. Furthermore, an economic analysis of inoculant use by small-scale farmers was performed in these two countries and Malawi. Inoculants of 100 g are produced for $1.34 and $3.20 in Kenya and Zimbabwe, respectively, and retailed at 46% and 36% profit. Inoculants from Kenya routinely meets standards of 1x 10^9 cells per gram, but likely does not meet their advertised six month shelf life. Across multiple trials in Kenya, Malawi and Zimbabwe, inoculants represent a small fraction of the input costs of soyabean cultivation (1 to 4% depending on rate) but result in substantial gain (457 kg ha^{-1} ± 48%). Return to investment in soyabean input packages that include inoculants range from 2.3- to 5.2-fold, compared to only 1.5- to 2.5-fold for ones that do not. West Africa does not produce inoculants, but there are 556,000 ha of soyabeans grown in Nigeria and Ghana alone. Production of 334 tons of inoculant worth $8.3 million, stand to increase soyabean value by over $105 million per year. A factory for production of legume inoculants is under development in Nigeria and two contrasting approaches to inoculant manufacture are discussed.

Milestone 1.5.1& 1.5.2 Indicators for monitoring and evaluating progress of project activities and their impact are developed (final draft)

The M&E framework, including indicators, was developed already some time ago. Also the M&E tools have been developed and have been in use by the country programs for monitoring D&D activities but also to monitor use and adoption of technologies. The final draft of the report is ready which explain the framework and lists the indicators used. Also the different instruments are introduced, which are available at the project intranet. The country M&E reports for the 2011 and 2012 seasons are available. The country M&E reports for the 2013 season will be issued by the end of July 2013.

Milestone 1.5.3: An external project review has been conducted, with representatives of the Bill & Melinda Gates Foundation (completed)

BMGF commissioned Dr John Lynam to conduct an external review of the project. The findings of the review were presented and discussed during the Project Leadership and Steering Committee meeting of October 2013. During the LT and SC meeting actions were already taken to address the concerns voiced in the review report and these are reflected in the country workplans for the final year of the project. A report was presented to the BMGF and distributed for inspection to project leadership and steering committee members. Further distribution is at the discretion of the BMGF.

3.2 Objective 2 - Select multi-purpose legumes (food, fodder, stakes, and soil fertility management) for enhanced BNF and integrate these into farming systems

Milestone 2.1.2, 2.1.3, 2.2.2, 2.3.2 and 2.4.2: Identify 3 new soyabean varieties with high BNF potential and forwarding materials (soyabean, cowpea, g/nut and beans) to TLII to be included in their breeding programme (completed)

The identification of materials with high BNF potential for soyabean, cowpea, groundnut and beans, as well as fodder and tree legumes has been reported earlier in the project (reports 009 and 025 respectively). For soyabean, the milestone to identify an additional three varieties with high BNF potential and milestones related to materials to be forwarded to TLII to be included in the breeding programme has now been completed.

The report provides data on biomass, the amount and percentage of N fixed biologically and grain yield of the identified varieties for the various agro-ecological zones covered in the various countries, as resulted from the agronomic trials. Not in all cases the amount of N fixed could be determined from experimental data, because the results from laboratory analyses of ^{15}N content in plant tissue are still pending. In those cases use is made of known transfer functions for estimating N from BNF. Once results from the lab are obtained we will update the report with the accurate assessment of the amount and % of N from fixation.

There is close collaboration of the project with TLII in the release of especially soyabean varieties. N2Africa project staff participating in the TLII project directly facilitates this collaboration. The country progress reports mention progress made with the release of new varieties and seed production. In Rwanda 4 soyabean varieties will be release still this year and in Kenya progress is made with the community based seed multiplication. In Mozambique, the project, through IITA, is quite instrumental the release of new varieties and in producing breeder and foundation seed as well as in producing seed required for the various research and development programmes. The soyabean, common bean, cowpea and groundnut varieties released in the eight N2Africa countries up to and including 2011 is reported in Milestone 1.2.6. We will update the list with the recent released varieties.

Milestone 2.4.3 and 2.5.2: Forage legume performance within the impact zones documented and research campaigns focusing on fodder and tree legumes have been implemented

The research campaigns on fodder and tree legumes have not been implemented in all the n2Africa countries. Moreover the trials with tree legumes are longer term and will extend beyond the project closing date. In Zimbabwe the trials had to be replanted because of the poor establishment of the trees in the first season. The first reliable data is expected later this year. Nevertheless there is enough data to report on and milestone report is expected ahead of schedule by mid-July.

Milestones 2.6.1 (and 2.3.1): Household benefits from specific BNF interventions quantified for the four major grain legumes in the impact zones (in progress).

This milestone is subsumed in the early impact assessment (EIA). The household survey, which is the major instrument for the EIA, has been conducted in all countries and preliminary results are available for Kenya, which shows quite promising adoption rates of BNF technology, for example. Currently the data is being analysed and this will give us a good picture of the adoption of the BNF technologies and household benefits derived from this.

3.3 Objective 3 - Select superior rhizobia strains for enhanced BNF and develop inoculum production capacity in sub-Saharan Africa, including private sector partners

Milestone 3.1.3: At least 2,000 strains screened for effectiveness under greenhouse conditions to select the top 5% for field-testing (in progress)

Expansion of the Rhizobium database continues. The MIRCEN laboratory collection currently stands at 387 NAK isolates with the last 179 entries being tested for effectiveness under greenhouse conditions but unlikely that the best will reach field-testing. DR Congo reports 111 NAC isolates, and Rwanda reports 268 NAR isolates. Nigeria claims 227 isolates but the data assembled around them is very incomplete. Ghana, Malawi, Mozambique and Zimbabwe still have not contributed to the rhizobium database. The database entries currently stand at 993, about 49% of the 2000 targeted isolates. A renewed effort is undertaken to complete the screening for effectiveness under greenhouse conditions for the isolated strains.

Milestone 3.4.4: Engaging private in inoculant production (completed)

The design of a pilot inoculant factory was completed during a stakeholders' meeting held at IITA in Ibadan early May and built into a proposal for the new IITA agribusiness incubation program. The construction of the facility has started in the meantime. The factory has seven main "workspace" rooms devoted to 1) carrier preparation, 2) material storage, 3) transfer and starter cultures, 4) fermentation and injection, 5) supervisors office, 6) curing and packing and 7) sales. The rationale for the pilot plant is described in its concept note: "IITA is now ready to take this next important step through its newly-founded business incubation centre... The production of legume inoculants in West Africa using elite rhizobial strains and quality control procedures identified through N2Africa's research program by technicians and scientists it has trained, and that are marketed through business channels developed through its outreach activities is clearly a candidate for this business incubation approach." Key decisions concerning its implementation (equipment) are scheduled for mid-July. We aim the have the official opening of the factory by the end of November 2013.

Milestone 3.1.2: At least 200 MPN counts and need-to-inoculate trials conducted for soyabean and beans, representing existing soil heterogeneity in the impact zones

This work has been seriously delayed in all countries except for Kenya. Efforts have been taken to catch up during this reporting period and data from the various countries is being collated and reporting on this milestone is scheduled for the end of July.

Milestone 3.3.2: Cost effective inoculant production methods including fermentation technologies, carrier selection, inoculant formulation, enhanced shelf life developed

Progress has been made especially in Kenya (see Kenyan progress report on research on shelf live under the various storage conditions and research into alternative carrier materials). Experience gained in the project and further investigation into effective production methods will be used in the development of the business plan and design (production process) for the inoculant factory at Ibadan (see also M3.4.4). The business plan will serve as the report for this milestone will be completed by July 31st 2013.

3.4 Objective 4- Deliver legume and inoculant technologies to farmers throughout sub-Saharan Africa

Milestone 4.1.3: At least 10 additional satellite sites have been identified per impact zone

During the later part of the N2Africa outreach activities, the program is expected to work with about 30 Satellite Partners. Satellite Partners are those that adopt N2Africa technologies and build on its momentum, but at no cost to the program itself. We have six such examples in Kenya (see chapter 2, Kenyan progress report). We can distinguish two sorts of Satellite Partners in Kenya, one that works directly with farmers and practices legume enterprise promoted by N2Africa, and another that advances broader program goals in terms of input supply, marketing and legume processing. Indeed, Kenyan satellite partnership has extended well beyond legume producers, but rather extends along the entire value chain in a manner that assures quality farm inputs and drives greater demand.

With respect to the first group, four of these Satellite Partners will work directly with 461 farmers on 506 ha, with expansion foreseeable in the future through creation of outgrower networks by Mumias Sugar and ADC, as well as greater attention to grain legume enterprise by One Acre Fund in response to the spread of Maize Lethal Necrosis Virus in Kenya.

The requirements for satellite partnership are, however, vague and changing. For example, The Reckoning International (see www.thereckoning.org), a faith-based outreach partner joining in the final season in west Kenya outreach, only received farm inputs but no operating funds Two of our outreach co-operators, (KESOFA and MFAGRO) have extended their numbers of participating farmers well beyond the targets set and supported by the program, opening new opportunities through revolving funds and marketing collection points for all members. In some cases, a single Outreach Co-operator will contain several categories of farmers, including first-time BNF technology testers, Progressing Farmers receiving inputs on credit that pay back in soyabeans, Promasidor Outgrowers receiving credit that is deducted from deposited payment and farmers that grow soyabean but have never worked directly with N2Africa but rely on its market collection points, further obscuring differences in partnership category. Differences between subsidized Outreach Co-operators and independent Satellite Partners are clear in principle, but in practice intermediary cases exist, particularly when co-operators reach beyond program targets, enter at later stages or are awarded additional grants. Indeed, at project's end there will be no difference between Kenyan co-operators and satellite partners as each will be required to sustain their momentum in BNF technologies and grain legume enterprise without further support from N2Africa.

The target of 30 Satellite Partners across the program is intrinsic to its larger and longer-term impacts and it is important at the closing phase of N2Africa to reach out to other organizations and agribusinesses with simple and reliable products that promote BNF. In other countries we see a similar transition from partners to co-operators, but may not have progress as far as in the case of Kenya. This is partly because of the infrastructure of local NGO, farmer associations and CBO is less advanced.

- In DRC 8 satellites sites have been established with 5 added recently (during the last season), reaching and additional 1675 farmer households.
- In Rwanda the satellite sites refers to existing partners scaling out of activities to new districts or new sectors within the districts where they were already operating in the context of the N2Africa project. This has added an additional 10650 farmers/households reached to the numbers reported for the N2Africa project.
- The situation is similar in Malawi. Partners have added 9 sites to the 57 sites operated by the project, which is about a 16 per cent increase in number of sites. Data on the number of households reaches is not available.
- In Zimbabwe 17 satellite sites have been reported for the last season, again relating to existing partners scaling out to new wards in the districts where they are operating.

- In Mozambique the N2Africa project operates a number of sites herself directly, and the partners operate other sites. In both cases additional sites have been added to the program, generally at the request of farmer groups and communities. In total 24 sites have been added during the course of the project. It is not clear whether the project facilitates farmers in these sites with inputs, but that is probably the case.
- For Nigeria and Ghana the data on satellite sites and partners is missing. Once this information is received we will conclude the reporting on this milestone.

Milestone 4.3.4: At least half of the farming communities engaged in the project are linked to legume processing initiatives (in progress)

Three small-scale soyabean processing factories (as part of a UNIDO project) have been officially inaugurated in May 2013, for which the N2Africa have been supplying the first 30 tons of soyabeans. The total capacity of the three facilities combined is 200 t/yr, and they will rely largely on the N2Africa co-operators for their supply. Also reported is the 659 tons of SB19 purchased by Promasidor through our network of 16 marketing collection points.

In Rwanda the SoyCo factory will start operating later this year and is already generating an enormous demand. In collaboration with the N2Africa project trying to stimulate production of soyabean and sourcing for soyabean within the country. Part of this effort is directed towards the production and distribution of seed. N2Africa farmers in Bugusera and Kayonza are involved in this campaign. More locally in Kamonyi district, all N2Africa farmers sell their produce to the COCOF processing facility, where soyabean milk and flour is being made. They are trying to expand the market for the products by creating market outlets in the capital Kigali.

Likewise in Mozambique the N2Africa farmers have been linked to the processing industry (mainly for chicken feed) and are selling their soyabean. Also for groundnut, through the collaboration with IKURU, the farmers are linked to the market. IKURU is grading the groundnuts and selling on the international market.

Apart from these large processors, there is development in the more local processing and selling of legume derived foodstuffs and drinks. We will report on the importance of the local market for value added product for all of the countries. Very preliminary results from Kenya indicate that about 20% of the total produce is sold on the local market for processing and value addition (with another 20% used for home consumption and 60% sold on the market). The household survey will shed more light on the different markets and uses of the produce.

Milestone 4.5.3 Events on the role of legumes in household nutrition and value added processing (completed).

We have updates on events organized in late 2011 and 2012. Detailed information is available in the milestone report. Even though activities are still continuing in the countries we consider this milestone to be completed.

Table 3.1: Number of events on nutrition and value added processing held in the N2Africa countries and number of men and women reached

	Events	Men	Women	Comments
DRC	12	170	265	Training mostly, some demonstration
Ghana	3	21	233	Training and field days
Kenya	16	NA	NA	Events held in conjunction with field days included cooking contests and exhibition of value addition. Publication of extension material on grain legume processing including information on nutritional value and recipes
Malawi	8	360	358	Training and field days
Mozambique	7	874	1996	The project conducted 7 training-of-trainers events at 5

				locations; trainees conducted grass root training events. Figures indicate total numbers reached
Nigeria	NA		282	Training activities continued in 2013 – data not included
Rwanda	NA	NA	(100) (26)	26 women trained as trainers initially, were to train at least 100 community members in the 13 actions sites. Follow-up visits were done and were encouraging but data not available
Zimbabwe	1			D&D partners conduct training and participated in fair exhibiting legume foods that farmers have been trained on; numbers of farmers reached not available

3.5 Objective 5 - Develop and strengthen capacity for BNF research, technology development, and application

Milestone 5.1.2: Annual short courses and master classes conducted to upgrade skills and expertise for at least 90 key technical staff from the impact zones

A last training course aiming to improve technical skills in inoculant production and BNF technologies will be held early July in Ibadan to serve the western Africa region, and especially Ghana and Nigeria. We expect 11 participants. With this training event conducted we will be able to produce the final report for this milestone.

Milestone 5.2.2 At least 10 MSc graduated before the end of the third year of the project.

This milestone has not been achieved in that none of the MSc student graduated before that date. However, the project has currently 18 MSc students, of which one is expected to have dropped out, eight are expected to graduate before the closing date of the project (October 30, 2013) and the remaining students before February 28, 2014, except for one student who has started only recently and is expected to graduate in October 2014.

The project organized a write shop to stimulate and assist in the publication of papers, in which 7 students participated. We expect all the students to submit papers for publication in international journals before the end of the project.

Milestone 5.5.2: Develop relevant legume and N_2 fixation technology packages and provide at least 3 training workshops on inoculation technologies, and interpretation of inoculant response trials for AGRA and TLII staff

The only thing missing for this milestone is the report. Joint workshops with TLII and AGRA have ben conducted already some a time ago. Also the technology packages have been developed early in the project. Various training and extension materials have been developed in the various countries to support the dissemination of these technologies. What remains to be done is to collate these materials and make is available.

Milestone 5.5.3: Support for undergraduate and postgraduate education will be provided through access to long distance education programs, visiting professorships or adjunct appointments in the area of N_2 fixation at 25 African Universities, and the provision of resource materials to assist in course planning and evaluation

The write workshop in which the students participated counts as support provide to undergraduate and postgraduate students. Students are studying oversees at the various universities, but little has been achieved in the visiting professorships and adjunct appointment and that will also not happen in this phase of the project.

Milestone 5.5.4: Training programs will organized in collaboration with selected private sector partners in each of the mandate zones for various categories of staff in key aspects of inoculant production and quality control

The training event scheduled to take place in July coming, on the production of inoculants and control of quality of inoculants will be the last activity under this milestone.

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 soyabeans, 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
43. Review & Planning meeting Zimbabwe
44. Howard G. Buffett Foundation – N2Africa June 2012 Interim Report
45. Number of Extension Events Organized per Season per Country
46. N2Africa narrative reports Month 30
47. Background information on agronomy, farming systems and ongoing projects on grain legumes in Uganda
48. Opportunities for N2Africa in Tanzania
49. Background information on agronomy, farming systems and ongoing projects on grain legumes in Ethiopia
50. Special Events on the Role of Legumes in Household Nutrition and Value-Added Processing
51. Value chain analyses of grain legumes in N2Africa: Kenya, Rwanda, eastern DRC, Ghana, Nigeria, Mozambique, Malawi and Zimbabwe
52. Background information on agronomy, farming systems and ongoing projects on grain legumes in Tanzania
53. Nutritional benefits of legume consumption at household level in rural sub-Saharan Africa: Literature study
54. N2Africa Project Progress Report Month 42

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