Uganda Annual Report 2018

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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Acronyms

AFSRT	Agency for Sustainable Rural Transformation
IIRR	International Institute of Rural Reconstruction
IITA	International Institute of Tropical Agriculture
ISSD	Integrated Seed Sector Development
MSC	Microfinance Support Center
NaCRRI	National Agricultural Crop Resources Research Institute
NARO	National Agricultural Research Organisation
NECOFAM	Network for Commercial Farming and Marketing
SWU	Southwestern Uganda
WENIPS	West Nile Private Sector

1 Introduction

This report covers the period 1st December 2017 to 30th November 2018. During this period, the project activities expanded to Pader, Agago, Alebtong, Dokolo, Kwania, Rubanda and Amuru bringing a total number of reached districts to 42 since the project started (Figure 1). The project activities largely focused on building an exit strategy to sustain access to input and output markets using business-led approaches. The concentration of these activities were in the northern region.

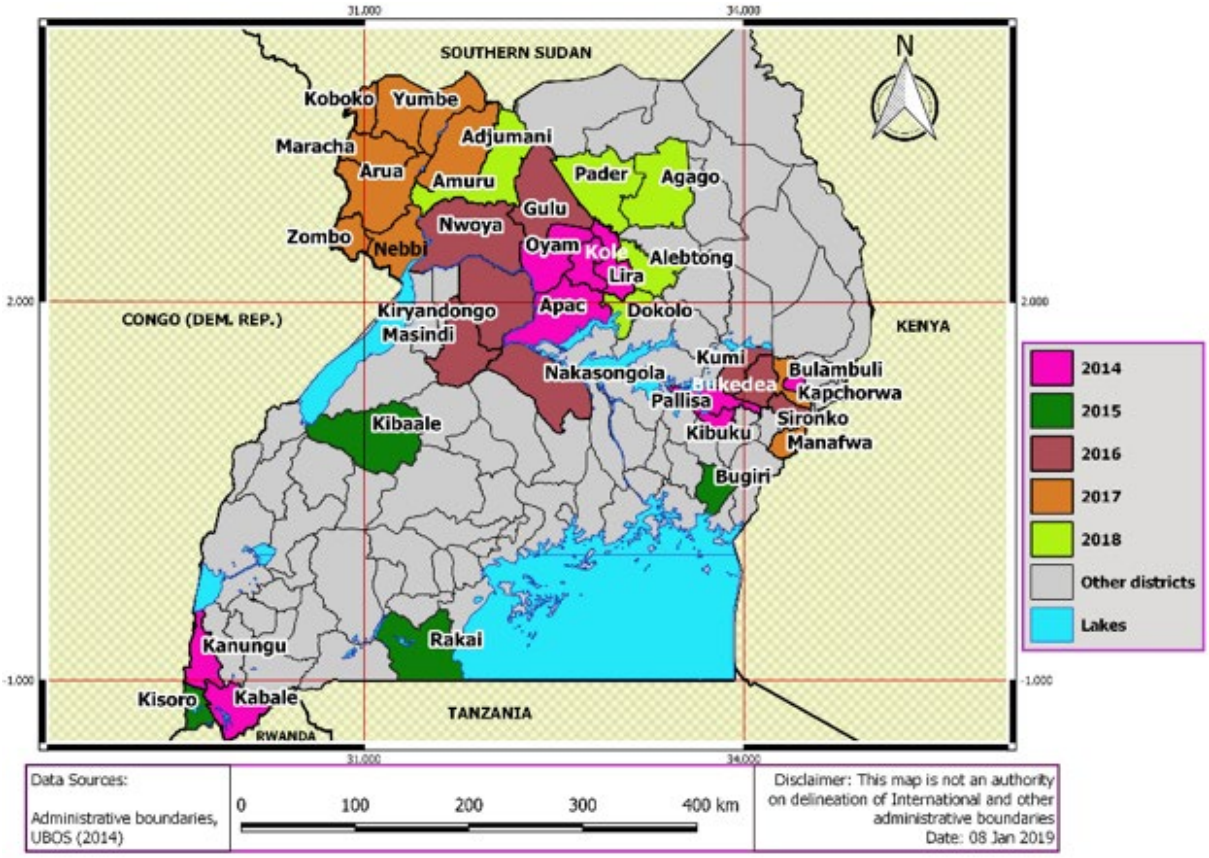

Figure 1. Project areas in 2014- 2018. (Note that newly created districts of Rubanda in SWU, Pakwach in west Nile and Kwania in Northern Uganda are not in the shape files of the countries administrative boundaries and are thus not shown in the map)

2 Results achieved per project objective

2.1 Project strategy, coordination and implementation and capacity strengthening

2.1.1 Project strategy

The overall goal of the N2Africa project is to build sustainable partnerships that enable smallholder farmers to access inputs for intensification of production systems and diversification of livelihood opportunities through improved nutrition and incomes from grain legumes. A business-led approach is envisaged to result in sustainable partnerships if 'win-win' opportunities exist for respective partners involved in the grain legume value chains. This has been employed in facilitating partnerships along the grain legume value chains. The overarching framework of the project strategy for sustainability is anchored on four pillars of capacity building, dissemination, input access and output market access. This approach is guided by the project theory of change to improve productivity, input and output market access, women's benefits from legume production, and building capacity to sustain a pipeline for continuous delivery of legume technologies. A private sector-led approach using a knowledge information–village agent model (KIVA) is being developed as the main a project exit strategy for sustaining project initiatives in Uganda. It uses an ICT-based platform, m-Omulimisa (https://m-omulimisa.com/) with country wide coverage, originally developed for extension support and now expanded to include other value chain actors such as input traders, output buyers and village agents. The village agents act as the last mile deliverers of technologies and aggregators of output as well as resident local capacity for dissemination of new technologies and sourcing of any new or relevant information to support smallholders. The model is now expanding to provide brokerage services to bridge the input demand and output market gaps, as well as facilitate linkages and networking for sustainability.

By 2018, most of the individual partner agreements between IITA and various dissemination organization had come to an end although informal collaboration continued (Table 1). Only AGINSBA had a running agreement till September. AGINSBA took the mantle of building a consortium of public and private partners to advance input and output market access using a bundled services approach that includes crop insurance coverage, access to finance, seed, fertilizers, inoculants and profiling of farmers and brokerage services (Table 1). Agrinet in particular supported farmer groups in developing two-year business plans as a way of strengthening the farmer groups to become more business oriented.

Table 1. Partnerships in Uganda in 2018

SN	Partner	Type of partnership	Focus
1	Africa 2000 Network (A2N)	Previous Partnership Agreement into early 2018	Dissemination Partner
2	CARD Uganda	Previous Partnership Agreement into early 2018	Dissemination Partner
3	Agency for Sustainable Rural Transformation (AFSRT)	Previous partnership agreement into early 2018	Dissemination Partner
4	Simlaw seeds	A memorandum of understanding	Input/seed company
5	Makerere University	A partnership agreement	Research
6	AGINSBA[1]	A partnership agreement	Bundled services, seed, fertilizer, inoculants agricultural insurance, grain legume production information, storage and drying technologies, Farmer Institutional Development
7	Palladium Uganda	Informal collaboration	Input market chains development

[1] Created a consortium with private and public institutions: MUNU Technologies, Vision Fund, Micro-Finance Service Center, Makerere University, NARO-NACCRI, CARD Uganda, A2N, NECOFAM, IIRR, Agrinet, WVU

Through the m-Omulimisa platform, AGINSBA was able to bring on board different partners based on the needs to play different roles, with her taking the information and brokerage roles (Table 2). AGINSBA also continued to build a network of village agents across the Lango and Acholi sub-regions to collate and aggregate input demand information and volumes of aggregated grain for sharing in the platform to facilitate linkage to input suppliers and output buyers.

Table 2. Roles and responsibilities of partners along the grain legume value chains

Dissemination Partner (s)	Information and brokerage/ capacity building	Input partners	Finance service partner	Insurance cover	Region
AFSRT IIRR	AGINBSA	Makerere University* NECOFAM	Vision Fund Uganda Microfinance Service Center	Uganda Microfinance Center	Northern
WENIPS		Makerere University*	Palladium Group Uganda		West Nile
A2N	AGINSBA ISSD	Bugara Women Seed Producers Association**; NECOFAM***; NaCRRI**			Southwestern Uganda (Kabale Kisoro)

* for soyabean seed and Makbiofixer inoculants; ** Climbing bean seed; ***Post harvest Inputs – PICS bags and silos

2.1.2 **Degree training**

The student research topics and progress by 2018 are as follows:

1. Eriya Kuule, Msc Agric extension (Makerere University) – Completed his thesis and the main findings as in Box 1

> Box 1 This study was conducted in Kabale District to establish gender based factors influencing men and women farmers' participation in the market segment of climbing beans. Results showed that 86% of male respondents were employed as mobile bean traders compared 14% females; 53% males owned retail bean stores compared to 47% females while 67% of female respondents were employed as casual laborers 33% male casual laborers. Men sold an average of 71% of their bean produce while women sold about 54%. Harvesting, winnowing, sorting and drying roles were performed by women while men dominated the storage, transportation, bargaining of price, receiving payment from sales and saving the incomes. Business opportunities such as; agro-inputs, transport services, bulking and selling of beans were dominated by men while women participated in small cash sales to solve urgent family welfare needs. Women's low participation in bean-related businesses and control of income was attributed to; time-consuming reproductive roles, restrictive cultural norms, low literacy and numeracy skills, lack of financial capital and ownership of transport means. Based on the findings, there is need to sensitize both women and men to overcome gender stereotypes on marketing roles. Organize farmers into collective bean marketing groups to enable women to access better markets, business skills and financial capital to invest in seed multiplication, supply of agro-inputs, bulking and selling of dry beans. Also there is need to invest in technologies that improve bean productivity, simplify winnowing, drying, sorting, value addition, transportation and other labor saving technologies that frees up women's time from reproductive roles in order to create time for women to participate in business.

2. Kennedy Mwesigwa (MSc Makerere University) – Submitted for examination. Main finding from the thesis was a need for new fertilizer blends to be formulated for soyabean as I+P treatment did not close yield gaps of soyabean in smallholder farms of central Uganda.

3. Doreen Muhumuza (Makerere University) – Writing her dissertation on How superior are Seedco varieties over Maksoy varieties and where in Uganda?
4. Connetie Ayesiga (new PhD Wageningen University) – Started a PhD at Wageningen University, evaluating the role of ICTS in marketing and adoption of grain legume technologies – the case of m-Omulimisa platform in Uganda
5. Ochieng Allan – PhD at Wageningen University was terminated
6. Grace Akuru, Makerere University – Shelf-life of rhizobia inoculants in municipal solid waste compost-peat carrier formulations. Thesis being finalised and looks at replacement of peat with composted municipal waste for cost effectiveness of Makbiofixer inoculant production. Carrier formulation of 60:40 (MSWC: Peat) i.e. peat can be substituted by 60% for cost effectiveness and maintenance high populations of bacteria over 3 months.

2.1.3 Non-degree training

Non-degree training continued through partners and covered various aspects including agronomy, post-harvest handling, use of ICTs, business skills, business planning and financial literacy. Over 22,000 farmers were trained (includes all those under M-Omulimisa in Table 3)

Table 3. Farmers reached by gender and district through m-Omulimisa in 2018

District	No. of Groups	No. of Females	No. of Males	Total
Agago	34	755	176	931
Alebtong	80	1341	982	2323
Amuru	33	692	232	924
Apac	35	764	600	1364
Dokolo	25	417	313	730
Gulu	34	754	234	988
Kole	83	1674	870	2544
Kwania	46	782	516	1298
Lira	88	1715	968	2683
Nwoya	34	702	305	1007
Oyam	48	1021	536	1557
Pader	35	628	320	948
Totals	**575**	**11245**	**6052**	**17297**

2.2 Delivery and dissemination, sustainable input supply, and market access

2.2.1 Farmers reached

In 2018, the farmers directly reached through demonstrations were 849 by AFRST and indirectly through 575 new groups, registered through new partnerships, created through the ICT platform. These groups had a total of 17,297 members, comprising of 11,245 women (65%) and 6,052 men (35%) (Table 3). This brings the cumulative reach of farmers since the project inception to 83,111 (Figure 2).

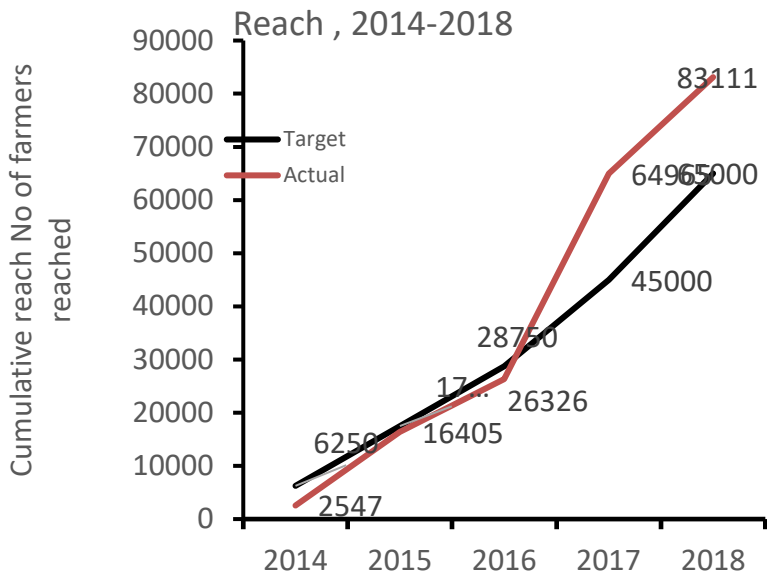

Figure 2. Cumulative reach of farmers in Uganda 2014-2018

2.2.2 Sustainable Input supply

Through our network of 36 agents we have aggregated input demand for five selected value chains including maize, sunflower, sorghum, soya bean, and beans. Based on this, input demand for the 1st season of 2019 stands at 140 tons for Mak Soy 3N, 61 tons for Mak Soy 5N, 31 tons for NABE 17 beans, 2,850 packets of inoculants and 8 tons of DAP (Table 4). For actual sales of inputs, an example by AFSRT is summarized in Table 5 and for post-harvest technologies by CARD (Table 6). These examples show differences in the inputs demanded in different regions.

Table 4. Demand Aggregation for 1st Season 2019 in northern Uganda by AGINSBA

Crop	Soyabean		Beans	Fertilizer	Inoculants (Packets)
Variety	Mak Soy 3N	Mak Soy 5N	NABE 17	DAP	Inoculants
Kgs	140,258	61,124	30,549	8,206	2,850

Table 5. Volumes of Input sold by agro-dealers to farmers in different project areas under AFRST in 2018

District	Input type								
	Soyabean Seed	Bush bean seed	Pesticides	Herbicides	Foliar Fertilizers	DAP	Urea	CAN	NPK
	kg	kg	Liters	Liters	Liters	kg	kg	kg	kg
Lira	1900	-	40	-	-	-	-	-	-
Masindi	-	-	60	900	-	600	250	-	800
Kiryandongo	-	400	-	-	24	200	-	-	-
Apac	1400	800	-	-	24	300	230	300	-
Oyam	2581	400	-	-	16530	-	400	-	40
Total	5881	1600	100	900	16578	1100	880	300	840

Access to inputs is improved by having village agents who also act as a last mile delivery of inputs and also having partnerships with micro-entrepreneurs (eg NECOFAM for postharvest technologies). Through the village agents, the demand information is collated, and this is shared through the platform with input suppliers. The village agents also link with large input traders and become commission agents of such traders selling quality inputs directly to smallholders. These arrangements are envisaged to contribute to long-term sustainability. The key challenges related to sustainability of the input supply strategies are mainly due to sometimes input suppliers failing to meet the demand by farmers. This is especially true for seed. This leaves farmers with no option to use poor quality seed or grain. Climate change is also a major factor affecting production. There is a need for mitigation of drought by provision of appropriate irrigation technologies.

Table 6. Post-harvest handling technologies sold in Eastern Uganda by NECOFAM, 2018

DISTRICT	Pics bags	Silos	Tarpaulins	Farmers' Group/Cooperative
Kapchorwa	115	2	13	Basari Intergrated Farmers' Association
Bugiri	18	0	3	Nankoma ACE
Mbale	10	1	2	Namanyonyi Shalom farmers Association
Bulambuli	7	1	2	More orders have made
Total	150	4	20	

2.2.3 Access to output market

To access output markets, collective marketing models such as the cooperative model continue to be promoted, although they face side selling challenges. In 2018, mapping of buyers was undertaken. In northern Uganda, 1440 farmers bulked 496,882 kg of soyabean while in eastern Uganda 2000 farmers were involved and bulked 30 tons of soyabean. Through the ICT platform the buyers are alerted by the village agents. The challenge often is that still middle men are the ones that respond and set lower prices. Sometimes the varying quality of the product does not attract good pricing.

2.3 Empower women to increase benefits from legume production

No new activities were initiated during this reporting period. The women businesses set up in 2017 continued to run in 2018 but, being local seed businesses, they were set back by poor rains

2.4 Tailor and adapt legume technologies to close yield gaps and expand the area of legume production within the farm

2.4.1 Demonstration and Adaptation trials

During the reporting period only 21 demonstrations on inoculation and P-fertilizers and 221 adaption trials were set up by AFRST. Outcomes from these were not different from the known trend of I+P performing best. These results are included in the overall analysis of soyabean response across agroecological zones in Uganda (Figure 3). This overall analysis of data from the demonstration trials provides useful insight of where the opportunity with soyabean in the country is: in Northern as well as in West Nile regions.

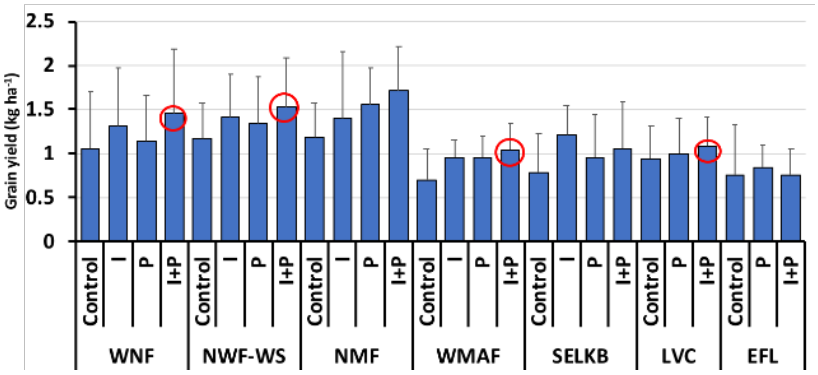

Figure 3. Soyabean response to inoculation and P-fertilizers across AEZ in Uganda

In limiting nutrient studies in Central Uganda, highest soyabean yield response was obtained with I+P treatment but thus was less than attainable yields of 2.5 t ha^{-1} (Figure 4). Compositional nutrient diagnosis studies however revealed that even with the best treatment of I+P there were nutritional imbalances (Table 7) that should be addressed to increase yields. This implies that new fertilizer formulations should be developed with better balance of nutrients in them – with more K included.

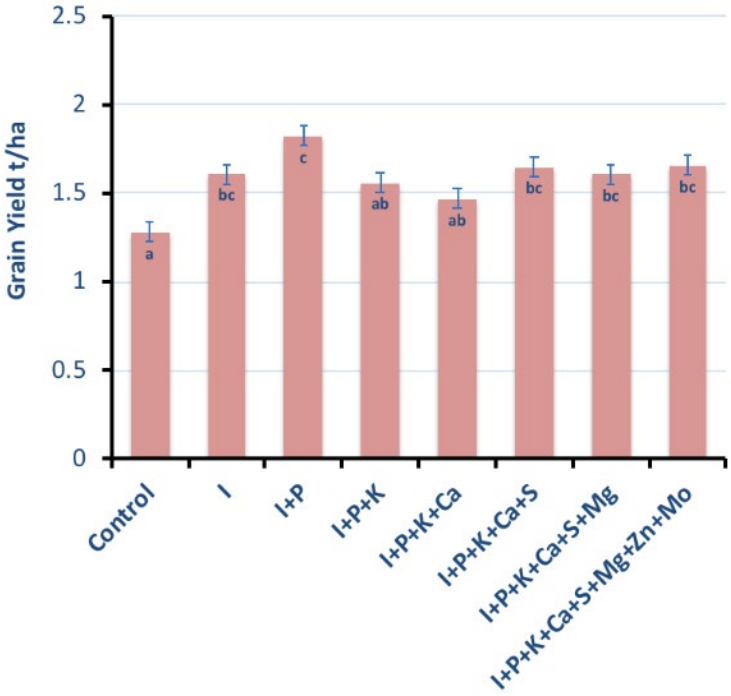

Figure 4. Limiting nutrient diagnosis in central Uganda (n=36 fields)

Table 7. Compositional nutrient diagnosis (CND) r2 and nutrient limitations in soyabean in Central Uganda.

Treatment	CND r2	Order of limitation
Control	172.96	Zn<Mn<Rd<P<Cu<N<Na<K<Fe<Ca<Mg
I	13.07	Cu<N<Rd<Mn<Zn<P<Fe<K<Mg<Ca<Na
I+P	3.32	Na<P<N<Mg<Ca<Zn<Mn<Fe<Cu<Rd<K
I+P+K	27.73	N<Na<Rd<P<K<Mn<Cu<Zn<Fe<Mg<Ca
I+P+K+Ca	92.19	N<Rd<Na<P<Cu<Mn<K<Fe<Mg<Zn<Ca
I+P+K+Ca+S	12.28	P<N<Zn<Mn<Cu<Rd<Mg<Ca<Fe<Na<K
I+P+K+Ca+S+Mg	21.77	Zn<N<Mn<Rd<P<Fe<Cu<Na<K<Ca<Mg
I+P+K+Ca+S+Mg+Zn+Mo	10.25	N<Fe<P<Rd<Mn<Cu<Zn<K<Ca<Mg<Na

2.4.2 Rhizobiology

Evaluation of carrier materials for improved shelf life of inoculants In Uganda, legume inoculants are mainly produced at Makerere University. The strains available and used by at Makerere University include USDA 110 of soyabean and CIAT 889 for beans. The carrier material used is peat obtained from South-western Uganda (about 450 km from Kampala). The challenge is increased cost of carrier material. The production unit at Makerere University explored an alternative of reducing the amount of peat with Organic Waste Compost (MOWC) as a carrier material. Compost and Peat mixed and the shelf life spiked with either strain CIAT 889 or USDA 110, stored either under room temperature or refrigerated conditions for 270 days evaluated using the Drop plate method (Somasegaran and Hoben, 1994) to obtain the number of colonies. Municipal Organic Waste Compost carrier alone (100:0) maintained the highest rhizobia population (Figure 5). Peat carrier was able to support high populations of rhizobia in both refrigerated and room temperature storage conditions for 270 days.

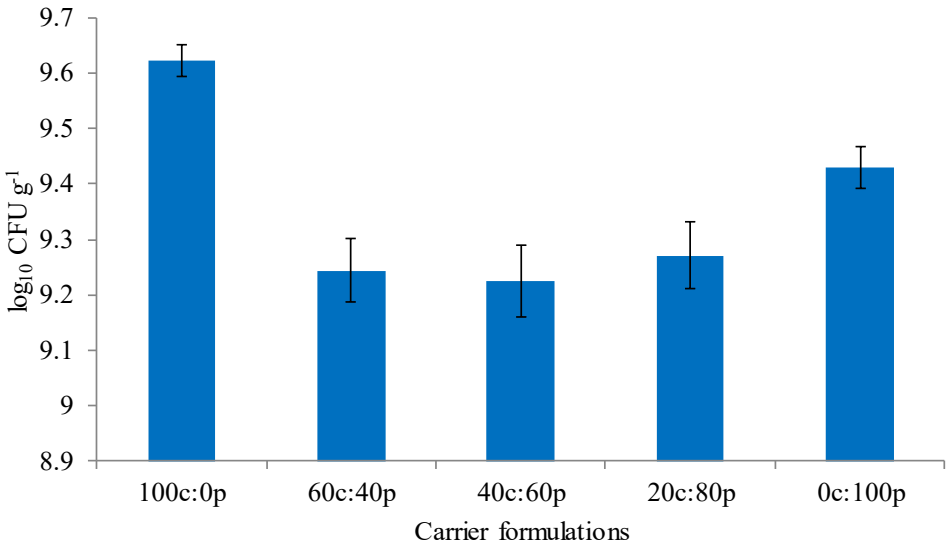

Figure 5. Population of rhizobia in different carrier formulations at room temperature (≈ 26 °C)

The results indicate that the legume inoculant production unit at Makerere University can consider Municipal Organic Waste Compost as a carrier material. The major challenge is high pH (about 8 -10). In this study, powder sulphur was used to reduce the pH to 6.5 – 7.5 before spiking the carrier material with bacterial cells. All the carrier formulations maintained high rhizobia populations above the minimum standard of 1x 107 CFU g^{-1} set in most inoculant production countries. The bacterial population for Bradyrhizobium diazoefficiens (USDA 110) remained unchanged from an initial population >109 bacteria g^{-1} at 14 days to 120 days in all the carrier formulations. However, the decline of one magnitude lower in bacterial population was observed in all carrier formulations including the peat (0%MSWC: 100%P) from 150 to 210 days. A difference was noted from 240 to 270 days with 40%MSWC: 60%P having the lowest bacterial population. Even though 40%MSWC: 60%P had the lowest bacterial population, it was not significantly different (P>0.05) from 60%MSWC: 40%P. All carrier formulations were able to support growth of rhizobia (i) Rhizobium tropici CIAT 899 and (ii) Bradyrhizobium diazoefficiens USDA 110 for 270 days with a population of 108 CFU g^{-1} (Fig. 6 and 7).

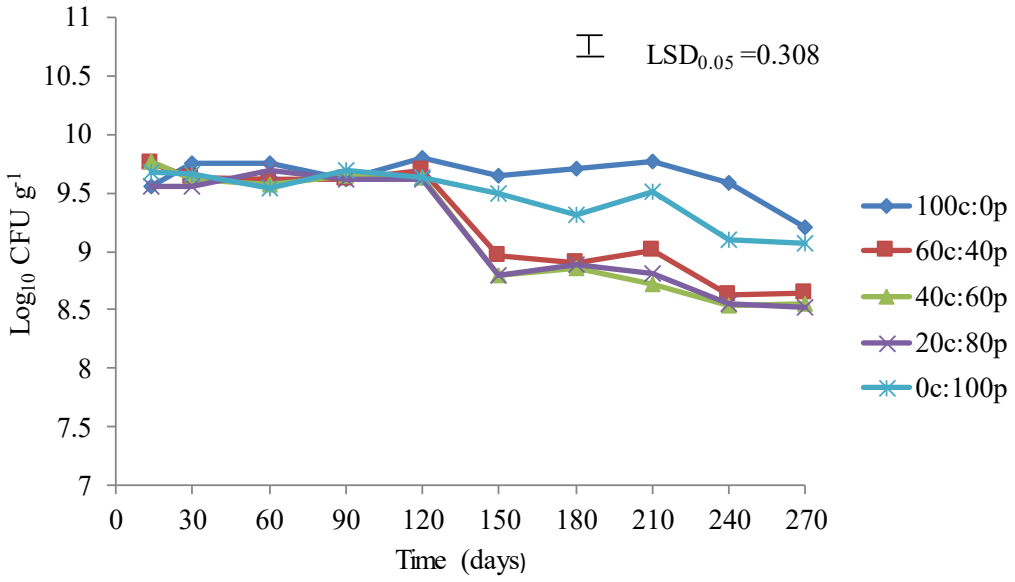

Figure 6. Survival of Rhizobium tropici CIAT 899 in different municipal solid waste compost: peat carrier formulations at room temperature (≈ 26 °C)

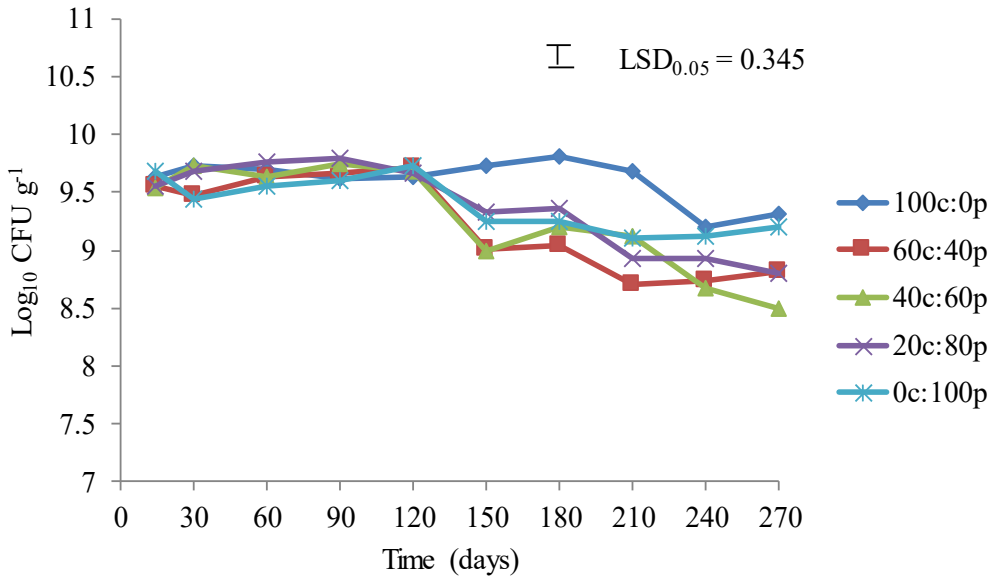

Figure 7. Survival of Rhizobium diazoefficiens (USDA 110) in different municipal solid waste compost: peat carrier formulations at room temperature (≈ 26 ºC)

The Municipal Organic Waste Compost maintained over 108 CFU g^{-1} of carrier material after 270 days for both strains (CIAT 889 and USDA 110). Therefore, the carrier material formulations containing Peat and Compost were suitable for both strains used at Makerere University. It is interesting to note that Compost (100%) was often a better carrier than Peat (100%) as carrier material for both strains.

It was noted that room temperature and refrigerated storage conditions were not different in viable cell within the Peat carrier materials, which offers hope that farmers can store any unused packets of purchased legume inoculants in their homes for use in the following season. This is also important in marketing and distribution of legume inoculants in Uganda without refrigeration infrastructure. These findings are now already being implemented in the inoculant production regimes of the lab at Makerere.

The challenges with inoculant use in Uganda are a lack of market/distribution systems, as well the forecasting of demand. This will hopefully be solved through a close coordination through the KIVA model. The risk with inoculants is the uncertain weather with prolonged droughts and dry spells which can easily render them ineffective. Besides, the non-use of P fertilisers will lead to limited economic benefits from their application. So far, the use of inoculants is mostly associated with soyabean only, and thus has a limited scope of use with grain legumes. The collapse of markets for such a commodity will pose a great risk for its production and sustainable use. The short-term shelf life of inoculants (3 months) limits the agro-dealers and stockists in investing in its business.

2.5 Enable learning and assess impacts at scale through strategic M&E

2.5.1 Effectiveness of dissemination approaches

A combination of approaches in the dissemination of grain legumes has contributed to the impact of the grain legume technologies. For awareness creation, radio is the most effective as it reaches many masses at a go. Building skills for technology application has been through demonstrations. Farmer try-outs were most preferred to create demand for the technologies and led to a greater reach of smallholders. Market information sharing through SMS has also been very helpful in reaching mainly the traders. A risk analysis of soyabean technologies shows a likelihood of getting low yields (less than

1 t ha^{-1}) when only improved varieties (control treatment), which farmers usually prefer, are promoted (Figure 8) leading to unsustainable production systems. It is therefore imperative to create awareness that the production of soyabean is accompanied with the use of nutrient inputs, as the soils are poor in fertility. Models that promote both soyabean seed and accompanying inoculants and P fertilisers together or side by side should therefore be developed and encouraged.

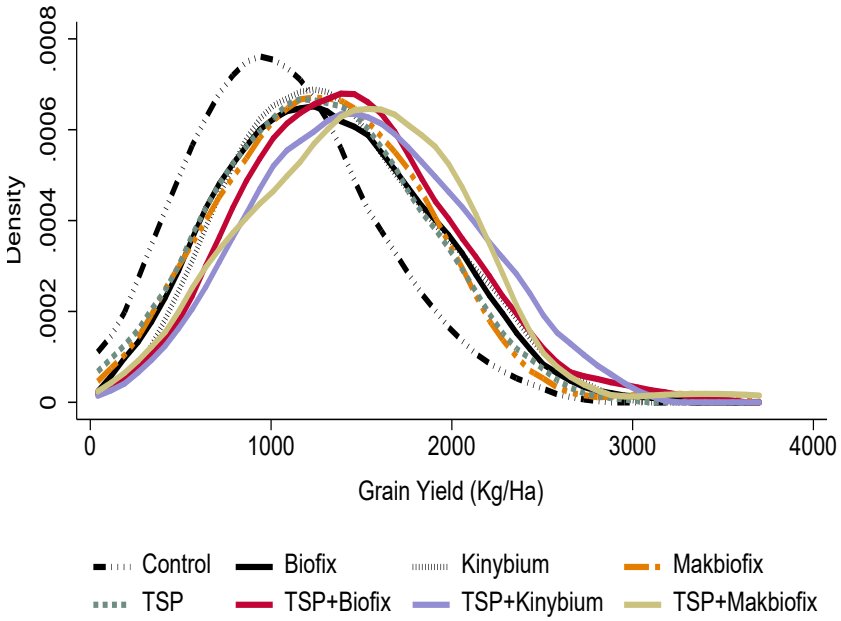

Figure 8. Risk analysis of soyabean production technologies in Uganda

Kinybium is a soyabean inoculant produced by Kinyanra Sugar Works Ltd

3 Achievements in relation to Specific Project Milestones

Table 8. Achievements with related Milestone Targets

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
Objective 1						
1.3. Engage research, development, private sector, and other relevant partners in each of the target countries	1.3. Partners along the legume input and output value chains cooperate actively towards achieving the overall N2Africa goals	# of partnerships developed and active	0	2	12	*The project was to continue with existing partnerships. The 2 new partnerships were created by AGINSBA under the m-Omulimisa platform*
	1.3.1. By Q2 of year 1, potential partners operating within priority legume value chains mapped	# partners within N2Africa legume value chains mapped				
	1.3.2. By Q3 of year 2, MoUs with priority partners in each of the target countries signed	# MoUs signed with priority legume partners				
1.5. Develop country-specific research and dissemination implementation plans, including a	1.5.1. By Q4 of year 1, country-specific research and dissemination implementation plans formalized, including an exit strategy. Links to 2.4.1	# of specific research and dissemination plans formalized	0	1	2	*No new research plans had been planned but a new one emerged for a PhD*

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
sustainable exit strategy	1.5.2. By Q4 of each year, implementation plans are updated based on M&E feedback	# implementation plans updated with M&E feedback				
1.6. Organize seasonal/yearly project-wide and country-specific planning workshops	1.6 Scientists and other stakeholder groups are empowered to further the N2Africa research and development	# Scientist and stakeholder groups leading implementation of activities in N2AFrica yearly plans	-	30	94	*30 village agents trained by AGINSBA as resident memory for the N2africa project*
	1.6.2. By Q4 of each year, 1 or 2 seasonal, in-country implementation plans developed, evaluated, and revised through in-country- planning meetings	# Seasonal in-country plans developed				
1.7. Develop and implement a degree (PhD and MSc)-related research plan	1.7.1. By Q4 of year 1, a research plan, engaging at least 5 PhD and 10 MSc candidates, developed	# of Project wide research plans to engage PhD and MSc students developed & # of PhD and MSc students (men/women)engaged	0	1	5	*1 PhD at Wageningen evaluating ICTS in enhancing market access and technology adoption*
1.8. Develop and implement a non-degree-related capacity strengthening plan	1.8.2. By Q4 of each year, at least 4 relevant and demand-driven training materials developed in cooperation with the African Soil Health Consortium (ASHC)	# training materials developed with ASHC				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
for relevant partners working within legume value chains	1.4. By Q4 of year 5, at least 320 partners trained in N2Africa technologies and approaches	# of persons trained (gender disaggregated data) in N2Africa technologies and approaches & # of N2Africa technologies (by type) in which the persons were trained. *(Note: Count the total number of persons trained from the collaborating partners for dissemination. Disaggregate data by gender, topics and ToT level i.e. the type of or the capacity within the trainer is operating like extension officer, partner-M&E officer, agronomist etc.)*	20,000	17,332 (11,245F; 6087 M)	24,178	*AGINSBA trained village agents and micro village agents on input demand data acquisition, AGRINET trained farmer group leaders in Business planning*
Objective 2						
2.1. Constitute and facilitate in-country/in-region N2Africa stakeholder platforms	2.1. Country-specific inoculant, seed, and fertilizer supply strategies guarantee the sustainable supply of high quality seeds and inoculants and legume-specific fertilizer	# and types of input supply strategies related to seed, fertilizers and inoculants. Performance of various strategies identified in relation to sustainable input supply	4 Local seed businesses	4	6	*The LSB were established*
	2.1.1. By Q2 of year 1, N2Africa stakeholder platforms operationalize	# N2Africa stakeholder platforms operational				
	2.1.2. By Q4 of years 1-4, stakeholders agree on specific roles and responsibilities across the various N2Africa objectives	# N2Africa stakeholders with agreed roles and responsibilities				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
2.2. Facilitate N2Africa-led dissemination campaigns in the context of development-to-research learning cycles with specific attention to gender	2.2. Dissemination partners attain/surpass the anticipated number of households targeted and continue to engage in legume intensification post-project	# of target households (men/women) reached *(outcome level: these farmers continue to engage in legume intensification activities after participating in dissemination activities)*	35	17, 297	83,111 (65% women)	*Cumulative number for project surpassed*
	2.2.1. By Q1 of years 1-4, specific dissemination guidelines for legume intensification assembled	Document indicating specific dissemination guidelines for legume intensification.				
	2.2.2. By Q4 of years 1-4, specific dissemination guidelines evaluated by a preset (see Returns-on-Investment calculations) number of male and female farmers	# of farmers (men/women) who evaluate the guidelines (Note: # of farmers (men/women) who have evaluated technologies and dissemination activities and methods (Disaggregated by type of dissemination activity)				
2.3. Create widespread awareness on N2Africa technologies and interventions	2.3. Local agro-dealers marketing fertilizer, seed, and inoculants are aligned with grass-root producer groups and input wholesalers and manufacturers	*Volume of seeds, fertilizers and inoculants used per targeted producer groups per land area, *Volume of seeds, fertilizers and inoculants sold by agro-dealers	Seed – 780 t; Fertilizer- 1300 t; Inoculant- 32t	7.5 t seed; 19.7 t fertilizer; 0.9 t inoculant	Seed- 128.7 t seed; 89.7 t fertilizer 1.8 t inoculant	*There is fractured demand and most farmers still use grain to plant;* *Fertilizer demand is too low and so is the demand for inoculants*

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
	2.3.1. By Q4 of years 1-4, at least 2 media events (e.g., radio, newspaper articles, field days, etc) per country implemented	# of media events implemented				
2.4. Facilitate partner-led dissemination campaigns with specific attention to gender	2.4. A preset (see Returns-on-Investment calculations) number of households engaged in the collective marketing and value addition of legume grains and value-added products	# of individual households (men/women) engaged in collective marketing, value addition of legumes and value added products. Volume of produce sold through collective marketing, volume of value addition products and types of value added products				
	2.4.1. By Q4 of years 2-4, household targets (see Returns-on-Investment calculations), dissemination approaches, and content for partner-led dissemination activities agreed and implemented, with specific attention to gender. This links to 1.5.1	# of partner-led agreements/ partnerships with agreed target households, dissemination approaches & activities focusing on gender				
	2.4.2. By Q4 of years 3-5, feedback on the performance of the dissemination models and the demonstrated content fed back to N2Africa	*Performance reports of dissemination models *Type of performance feedback fed back into N2Africa				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
2.5. Facilitate private-public partnerships towards the sustainable supply of inoculants and fertilizer	2.5.1. By Q4 of years 1-4, inoculants available through public-private partnerships, through importation and/or local production, the latter facilitated by the inoculant production pilot plant	# of inoculant outlets in the target areas Volume of inoculants imported and /or produced with the identified outlets	1	0	0	*The discussions with Ag Farm as agent in SSA for legume fix; product registered in Uganda but has not yet taken off*
	2.5.2. By Q4 of years 1-4, legume-specific fertilizer made available to smallholder farmers by fertilizer companies/retailers	# of fertilizer outlets in the smallholder target areas				
		Volume of legume-specific fertilizer at the retail shops				
2.6. Facilitate the establishment of private sector-led and/or community-based legume seed systems	2.6.1. By Q4 of years 1-4, sufficient legume foundation seed produced by private enterprises and/or government institutions	# of private enterprises & government institutions producing legume foundation seed in the target countries.				
		Volume of legume foundation seed produced by private enterprises & government intuitions in the target countries				
	2.6.2. By Q4 of years 1-4, sufficient quality legume seed available to farming communities	Volume of quality legume seed available to target farming communities in the target countries				
2.7. Engage agro-dealer and other last-mile delivery	2.7.1. By Q4 of years 1-2, a minimum number of agro-dealers and other delivery network partners trained in	# of agro- dealers & other delivery network partners				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
networks in supplying legume agro-inputs	the storage, handling, and use of inoculants	trained in storage, handling and use of inoculants				
	2.7.2. By Q4 of years 2-5, agro-dealer and other last-mile delivery networks engaged in the commercial supply to farmers of agro-inputs, including inoculants	# of agro-dealers & other last mile delivery networks in full business of supplying agro-inputs to target farmers including inoculants	0	30	50	*NECOFAM is last mile delivery agent now working with the 30 village agents*
2.8. Establish agri-business clusters around legume marketing and value addition	2.8.1. By Q4 of years 1-4, opportunities for collective marketing and value addition for smallholder farmer associations identified	# of collective marketing and value addition opportunities identified for smallholder farmer associations				
2.9 Assess the effectiveness and efficiency of various input delivery and marketing systems especially for women	2.9.1. By Q4 of year 2, inventory and analysis of input supply and marketing systems conducted across all countries	Report of inventory and Analysis of the input supply & marketing systems in target countries				
Objective 3						
3.1. Sensitize partners, farmer associations, and farming households and mainstream approaches to address gender	3.1. Female farmers increasingly lead N2Africa promotion and dissemination activities	# Female farmers leading N2Africa promotion and dissemination activities				
	3.1.1. By Q4 of years 1-4, all partners and households engaged in N2Africa activities that address gender inequity	# of Partner agreements with gender specific activities				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
inequity in farming and decision-making						
3.2. Assess business opportunities for women in agro-input supply and legume marketing and value addition opportunities	3.2.1. By Q4 of years 2-4, business opportunities for women identified	# business opportunities identified with focus on women				
	3.2.2. By Q4 of years 4-5, at least 2 businesses led by women established per country	# of businesses established and led by women & # of women involved in the businesses established	0	0	3	*These were identified in 2017*
3.3. Conduct dissemination campaigns targeting women farmers	3.3. Better knowledge of and access to household-level legume processing tools improves the nutritional status of women and children in at least 2 target countries	# of women using household level-legume processing technologies				
	3.3.1. By Q4 of years 1-4, themes and models for women-specific dissemination campaigns identified	# and types of women specific dissemination campaign themes and models identified.				
	3.3.2. By Q4 of years 2-5, at least 25% of the female farmers participating in the overall N2Africa dissemination activities are also actively engaged in the women-specific dissemination campaigns	% female farmers participating in women specific dissemination campaigns				
3.4. Develop labor-saving pre- and post-	3.4. Women use pre- and post-harvest labor-saving tools, resulting in	# of women using pre- and post-harvest labour-saving tools				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
harvest legume tools for female farmers	higher net profits from legume production and processing					
	3.4.1. By Q4 of year 2, prototype labour-saving pre- and post-harvest tools for female farmers validated	# and type of prototype labour-saving pre- and post-harvest tools for female farmers validated				
	3.4.2. By Q4 of years 2-4, labour-saving tools included in the various dissemination campaigns	# pre and post-labour saving tools included in dissemination campaigns				
3.5. Evaluate the impact of environment (E) and management (M) on nutritional quality of legume grain	3.5.1. By Q4 of year 3, relationships between grain nutritional quality and management / environmental conditions quantified	# of relationship equations quantified				
Objective 4						
4.1. Develop variety x inoculant x nutrient management recommendations for the target legumes and legume production areas based on yield gap analysis	4.1. Recommendations for the intensification of legume production result in at least 50% increase in legume productivity	% change in legume productivity among target households participating in adaptation trials (early adoption instead of adaptation trials. Can look at progressive farmers). # of target households (men/women headed) with 50% increased productivity through adaptation trials				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
	4.1.1. By Q4 of years 1-4, seasonal research campaigns towards legume intensification and yield gap closure implemented	# and type of Diagnostic trials conducted by N2Africa				
	4.1.2. By Q4 of years 2-4, improved legume production recommendations integrated in the dissemination campaigns	# of improved legume production recommendations (based on diagnostic trials) integrated in dissemination campaigns	3	3	3	
4.2. Develop recommendations for rehabilitation of non-responsive soils for legume production	4.2. Inoculant producers avail improved inoculant formulations for the target legumes resulting in at least 10% increase in legume productivity and BNF	# of inoculant formulations applied/used by inoculant producers for target legumes in core countries (Productivity will be measured by milestone 4.1)	1	1	1	*Composted Municipal Waste: Peat (60:40) and used by Makerere in production of Makbiofixer*
	4.2.1. By Q4 of year 2, major mechanisms leading to non-responsiveness understood	Major mechanisms contributing to non-responsiveness identified, analyzed & documented				
	4.2.2. By Q4 of years 3-4, prototype rehabilitation measures for non-responsive soils validated	Validated measures (Prototype) for non-responsive soils				
4.3. Intensify crop-livestock interactions through enhancing feed availability of	4.3.1. By Q4 of year 2, niches for use of legume crop residues within and between farms identified	# niches for use of legume crop residues documented				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
legume crop residues	4.3.2. By Q4 of years 3-4, feed availability and quality enhanced through appropriate use of grain legume residues	% of livestock feed quality dependent on appropriate use of legume residues				
4.4. Evaluate the medium- to long-term impact of legumes on overall farming system productivity and natural resource conditions	4.4. Overall farming system productivity and soil fertility status is improved through increased legume productivity	% increase in overall productivity and soil fertility of various farming systems as a function of increased legume productivity				
	4.4.1. By Q4 of year 2, at least 1 long term legume monitoring site established per priority region/country approaches	# long term monitoring sites established				
	4.4.2. By Q4 of year 5, the medium- to long-term impact of legumes on overall system productivity and natural resource conditions evaluated using time series analysis and modelling	% contribution of legumes production on overall productivity and natural resources evaluated				
4.5. Isolate, authenticate, and evaluate new strains of rhizobia for the target legumes for high symbiotic effectiveness	4.5.1. By Q4 of years 2-4, at least 50 new strains of effective rhizobia genetically characterized using molecular techniques	# candidate strain evaluated # New rhizobia strains collected	4	4	4	*Candidate elite strains yet to be sequenced for characterisation*
	4.5.2. By Q4 of year 5, newly identified effective rhizobium strains for common bean, cowpea, groundnut conserved in a rhizobium gene bank	# Newly identified rhizobium strains conserved in a gene bank. % of identified effective rhizobium strains used for inoculant production				

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
	and at least 5% of these used for inoculant					
4.6. Identify elite rhizobium strains and inoculant formulations for beans, groundnut, and cowpea	4.6.1. By Q4 of year 3, at least 5 new effective and elite rhizobia for beans, groundnut, and/or cowpea identified	# new effective and elite rhizobia identified				
	4.6.2. By Q4 of year 5, elite strains used for inoculant production for beans, groundnut, and/or cowpea	# of elite strains used for inoculant production				
4.7. Evaluate competitiveness and survival of introduced rhizobium strains as affected by M x E	4.7.1. By Q4 of year 4, environmental and management conditions affecting the competitiveness and survival of introduced rhizobia elucidated	Documented explanation of M x E on introduced rhizobium strains				
4.8. Develop standard operating procedures for the production, quality control and application of rhizobium inoculants	4.8.1. By Q4 of year 2, standard operating procedures of quality control (storage), product registration and application of inoculants used by inoculant producers and retailers	# of inoculant producers and retailers (public private suppliers) using standard operating procedures	-	-	1	*Used by Makerere*
Objective 5						

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
5.1. Develop an innovative framework for strategic M&E, allowing for timely feedback loops	5.1. National system scientists use the G_L x G_R x E x M framework and the obtained information to advance legume research for development within their countries	# of national institutions partnering N2Africa in D2R activities (Also # of participating scientists in those institutions) # of national institutions in target countries using G_L x G_R x E x M for research				
	5.1.1. Throughout the project, a strategic M&E framework provides timely feedback to learning and future planning	Existence of M&E framework that outlines the types of feedback for planning, and provides timely data.				
5.2. Set-up data collection, management, and analysis infrastructure	5.2. Dissemination partners integrate effective and efficient dissemination approaches for legume technologies in their future development initiatives	# of dissemination partners integrating effective and efficient dissemination approaches in their programmes across target countries. (Effectiveness and efficiency of dissemination approaches will be measured by activity 5.6)	1	2	6	*Palladium & IIRR in 2018*
	5.2.1. By Q4 of year 1, data management infrastructure is in place and data population initiated	Data Management system established with all project data				
5.5. Unravel G_L x G_R x E x M interactions for legume production towards the development of	5.5.1. By Q4 of year 4, the relative important of G_L, G_R, E, and M understood for specific legumes and production environments and	# of quantified relationships integrated in improved recommendations. Best-fit recommendations available to	3	2	2	*Where inoculants, fertilisers fit best across 7 AEZ of Uganda and where liming is*

Activity per Objective	Milestone	Indicator	Milestone Target 2018	Achieved 2018	Achieved so far- Cumulative (2017+ 2018)	Reasons for Variance with Planned Target (if any)
best-fit recommendations	integrated in improved recommendations	all target legumes in each country				*required for common bean*

4 Lessons Learned

- The greatest opportunity with soyabean is in Northern Uganda, followed by West Nile where yields were increased 3 to 5 times compared with the baseline of 300 kg ha^{-1}. The promotion of soyabean should be with I+P giving yield gains of 15 to 30%.
- To mitigate the risk of low yields and to enhance and sustain production systems, a package including improved varieties and I+P should be encouraged.
- Partnerships for sustainability should have good internal systems, human resource and be working from a market-led perspective in order to reach many partners.
- The success in the promotion of grain legumes has largely been with soyabean. Groundnut did not proceed due to aflatoxin issues and could not access better markets. The success with soyabean is due to ever increasing prices. Challenges still remain with seed access and other inputs (inoculants).
- A sustained effort to provide information for the partners across the value chain is needed, but – more critically – providing information to align input and output market asymmetries will be important. M-Omulimisa needs to fill this void but needs a capacity strengthening in areas of market research, business model development and networking.
- The ICT- village agent exit strategy is enabling to scaling the reach of farming communities with technologies to areas where N2Africa had worked till 2017. This has been possible through information sharing through the platform and village agents and has attracted other development partners and public organisations including the Uganda Microfinance Center to provide loans to access inputs.
- There is a clear traceability of famers engaged with the platform through the profiles being developed.
- Clear demand forecasts of required inputs are getting more organised and aggregated through the village agents that have direct contacts with farmers and farmer associations.
- A diversification in information services is taking place in the context of farming system and this is interesting for more actors and players in the farming system
- Interface with the village agents is building trust for aggregation of grain for marketing as they are a kind of assurance for follow up to link with markets.
- Village agents are enthusiastic with their work because they have found business opportunities that sustain them such as commissions from sale of aggregated produce from farmers and farmer associations and marketing of inputs from input traders.

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 soyabean, common bean, cowpea, and groundnut varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launching 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 seeds 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 seeds 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
55. Market analysis of inoculant production and use
56. Soyabean, common bean, cowpea, and groundnut varieties with high Biological Nitrogen Fixation potential identified in N2Africa impact zones
57. A N2Africa universal logo representing inoculant quality assurance
58. M&E workstream report
59. Improving legume inoculants and developing strategic alliances for their advancement
60. Rhizobium collection, testing and the identification of candidate elite strains
61. Evaluation of the progress made towards achieving the Vision of Success in N2Africa
62. Policy recommendation related to inoculant regulation and cross-border trade
63. Satellite sites and activities in the impact zones of the N2Africa project
64. Linking communities to legume processing initiatives
65. Special events on the role of legumes in household nutrition and value-added processing
66. Media events in the N2Africa project
67. Launching N2Africa Phase II – Report Uganda

68. Review of conditioning factors and constraints to legume adoption and their management in Phase II of N2Africa
69. Report on the milestones in the Supplementary N2Africa grant
70. N2Africa Phase II Launching in Tanzania
71. N2Africa Phase II 6 months report
72. Involvement of women in at least 50% of all farmer-related activities
73. N2Africa Final Report of the First Phase: 2009-2013
74. Managing factors that affect the adoption of grain legumes in Uganda in the N2Africa project
75. Managing factors that affect the adoption of grain legumes in Ethiopia in the N2Africa project
76. Managing factors that affect the adoption of grain legumes in Tanzania in the N2Africa project
77. N2Africa Action Areas in Ethiopia, Ghana, Nigeria, Tanzania, and Uganda in 2014
78. N2Africa Annual Report Phase II Year 1
79. N2Africa: taking stock and moving forward. Workshop report
80. N2Africa Kenya Country report 2015
81. N2Africa Annual Report 2015
82. Value Chain Analysis of Grain Legumes in Borno State, Nigeria
83. Baseline report Borno State
84. N2Africa Annual Report 2015 DR Congo
85. N2Africa Annual Report 2015 Rwanda
86. N2Africa Annual Report 2015 Malawi
87. Contract Sprayer in Borno State, Nigeria
88. N2Africa Baseline Report II Ethiopia, Tanzania, Uganda, version 2.1
89. N2Africa rhizobial isolates in Kenya
90. N2Africa Early Impact Survey, Rwanda
91. N2Africa Early Impact Survey, Ghana
92. Tracing seed diffusion from introduced legume seeds through N2Africa demonstration trials and seed-input packages
93. The role of legumes in sustainable intensification – priority areas for research in northern Ghana
94. The role of legumes in sustainable intensification – priority areas for research in western Kenya
95. N2Africa Early Impact Survey, Phase I
96. Legumes in sustainable intensification – case study report PROIntensAfrica
97. N2Africa Annual Report 2016
98. OSSOM Launch and Planning Meeting for the west Kenya Long Rains 2017
99. Tailoring and adaptation in N2Africa demonstration trials
100. N2Africa Project DR Congo Exit Strategy
101. N2Africa Project Kenya Exit Strategy
102. N2Africa Project Malawi Exit Strategy

103. N2Africa Project Mozambique Exit Strategy
104. N2Africa Project Rwanda Exit Strategy
105. N2Africa Project Zimbabwe Exit Strategy
106. N2Africa Annual Report 2017
107. N2Africa review of policies relating to legume intensification in the N2Africa countries
108. Stakeholder Consultations report
109. Dissemination survey Tanzania
110. Climbing bean x highland banana intercropping in the Ugandan highlands
111. N2Africa Annual Report 2018
112. N2Africa Annual Report 2018 Ethiopia
113. N2Africa Annual Report 2018 Ghana
114. N2Africa Annual Report 2018 Nigeria Borno State
115. N2Africa Annual Report 2018 Tanzania
116. N2Africa Annual Report 2018 Uganda

Partners involved in the N2Africa project

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