

N2Africa Podcaster no. 46

June 2017

Introduction

Last month I was delighted to host Christian Witt (Senior Project Officer for N2Africa at the Bill & Melinda Gates Foundation). In addition to updating Christian on N2Africa we joined discussions with a large, high-level delegation from Ethiopia visiting Wageningen. The Ethiopian delegation was led by H.E. Dr. Eyasu Abraha Alle, Minister of Agriculture and Natural Resources, H.E. Ato Tesfaye Mengiste, State Minister of Agriculture and Natural Resources and H.E. Prof. Fekadu Beyene, Minister of Livestock and Fisheries. I had the opportunity to chair a session about crops and soils, and together with Tamiru Amanu (N2Africa business development officer in Ethiopia), we presented N2Africa's progress in Ethiopia to them. In our discussions, H.E. Dr. Eyasu Abraha Alle impressed on us the importance of pulses in Ethiopia's food security and for export. He also expressed his strong support for the work that N2Africa is doing together with partners in Ethiopia.



Left to right: Tom Schut¹, Eniola Moses², Ben Faloye², Dianda Mahamadi², Ken Giller¹, Ojo Comfort¹, Adegboyega Taofeek², Fabamifobee Timilehin³

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H.E. Dr. Eyasu Abraha Alle, Minister of Agriculture and Natural Resources speaking at a dinner held in honour of the visit of the Ethiopian government delegation to Wageningen University & Research

I'm just back from a visit to Nigeria where I met up with Comfort Ojo (N2Africa PhD candidate) and Mahamadi Dianda (N2Africa rhizobiologist) at the IITA headquarters in Ibadan. It was great to be able to discuss ongoing research and to visit the very impressive laboratories and green-

houses. We also took the opportunity to visit some field experiments of PhD students working on N₂-fixation at IITA (see photo).

In this Podcaster we have a rich array of stories from field and country updates. We announce the Maize-Legume Cropping Guide published through the African Soil Health Consortium with strong contributions from many N2Africa staff. We also have some links to partner projects and news items. Below we introduce Eva Thuijsman who has joined the N2Africa team in Wageningen to assist with data analysis and project reporting. While some N2Africa countries in East and West Africa are in the middle of the cropping season, many staff are already on annual leave, or about to take leave. We wish you all a well-deserved rest and trust that you will be back re-energised in August and ready to Put N₂-fixation to Work!

Ken Giller

Introducing Eva Thuijsman

As of May 2017, I am working with N2Africa as a research assistant, doing data management and analysis and supporting any kind of N2Africa activities. I am very happy and grateful to be part of the N2Africa family! However, I am not a complete stranger because I have been involved in N2Africa since the end of 2015 through my [internship](#) and [thesis](#), as part of my MSc Organic Agriculture at Wageningen University. I worked together with many of you during my field work in the Eastern and South Western highlands of Uganda when I was interviewing farmers about improved climbing bean technologies on adaptation trials, late in 2015. The East African highlands stole my heart, so I returned several months later to the Kilimanjaro region in Tanzania to study maize-bean intercropping systems, again cooperating a lot with N2Africa staff. Those events have been great learning opportunities. It fascinates me to identify direct and indirect drivers that influence sustainable intensification in a challenging socio-economic environment and climate. I want to contribute to improving the livelihoods of tropical smallholders. I am eager to learn and develop my skills in doing research and data analysis, and I am looking forward to working together with you!

Eva Thuijsman, Wageningen University & Research



Eva carrying beans in Uganda

A farmer with an open mind in Nigeria

For over sixty years, Mr. Clement Hange has been a farmer in his community of Mbanor in Konshisha Local Government Area of Benue State, Nigeria. All that time he was happy with the returns he got from his farming efforts. However, when he got selected as a lead farmer to take

care of a demonstration plot for his farmer group 'Hange Multi-Purpose Cooperative Society Ltd', he changed his mind on how he had been farming soyabean for over two decades.

In his words: *"The transformation started when I attended a Pre-Season Training in 2013 that was organized by the N2Africa partner MARKETS II. I learnt about new production technologies for soyabean production in that training that changed my mindset completely".* He explained that he acquired all relevant information on the best agronomic practices for the cultivation of soybean and obtained a package of improved seeds, fertilizer and inoculants (supplied by N2Africa through its partner MARKETS II) which were planted on demonstration and later on his adaptation plots. As an eager and curious farmer, he decided to cultivate four hectares of his own land close to the demonstration plot with soyabean variety TGX1448-2E, which is considered a local variety because it had been cultivated for a very long time.

In addition to hosting the demonstration for his group, he ensured training of the members. He explained: *"Not all of our members were able to attend the trainings and so one or two were always nominated to receive the training and teach others on their return".*

In Mr. Hange's words: *"My soyabean farm with improved practices did excellently well, the improved variety gave a yield of 1760 kg per ha while I only got 400 kg per ha from the local variety without inoculant. And not only do we produce, we sell as well. MARKETS II assisted a formal linkage to sell our produce to an organized market: the processors Hule & Sons Limited in Tarka LGA and Seraph Oils Limited in Makurdi. We also thank MARKETS II for the multi-purpose thresher given to my group. This has made threshing very easy and easy to handle increased production".*

In addition to grain production, the cooperative has been producing seeds for sale to interested farmers in the communities. They even sold ten bags of seeds to the Agricultural department of University of Agriculture, Makurdi in 2016. Apart from that, the cooperative has also increased the number of fish ponds around the community. These efforts result in relief, so that the members are able to pay school fees for their children. The increased production has enabled them to be financially liquid since they can sell their produced little by little and solve challenges.

The cooperative intends to diversify by increasing their involvement in cassava production as well as increasing the area under soybean production to ten hectares by 2018. *"We are presently discussing with some banks to access funds to enable more members to have access to finance to increase their cultivated land under production as well. We are planning to purchase a tractor to enable us move around the heavy multi-purpose thresher that was donated."*



Clement Hange (with hat) with the MARKETS II Communication Officer



Clement Hange on his farm



George Ucheibe (N2Africa), Teryima Iorlamen (Egalf), James Ekele (IFDC-BSS TIM) in Gboko LGA on field inspection with an adaptation farmer



USAID-MARKETS II Soyabean Advisor Emmanuel Abam and Teryima Iorlamen (Egalf) during the joint field inspections

Mr. Hange expressed his immense gratitude for the support and knowledge that were given by MARKETS II and N2Africa.

Ucheibe George, Business Development Officer N2Africa Nigeria

My journey into agripreneurship, Borno State, Nigeria

My name is Mercy Haruna Wakawa. I am from Borno state Nigeria and I studied Food Science and Technology at the University of Maiduguri. Like every other Nigerian youth I was full of dreams and enthusiasm for a robust working career and livelihood after graduating from University. I

searched endlessly for corporate jobs that are no longer available for my generation. My dreams suddenly collapsed as I came face-to-face with the reality of vanishing job opportunities and an increasing rate of youth unemployment in my country.

The story of my journey into agribusiness is intrinsically linked with the International Institute for Tropical Agriculture (IITA) and the N2Africa project. This is because after so many futile efforts to get a job, and almost at the point of giving up on everything, IITA gave me a rare opportunity to participate in an enterprise development training alongside other youths from Borno state in September 2014.

I was a bit reluctant and did not expect that anything meaningful would come from it. The training was organized by IITA Youth Agripreneurs (IYA), at the IITA Kano Station. It was three weeks of mind-changing intensive training covering topics in agribusiness, entrepreneurship, ICT in agribusiness, fish farming and science-driven agricultural practices.

Based on my background (but initially against my wish) I was counselled and mentored to venture into the post-harvest processing of groundnut. The business took off in January 2016. I was given a starter package by IITA/N2Africa project in the form of machinery and working capital which is worth 2.5 million naira (almost 8000 USD). Groundnut processing is a profitable business, as a good one ton of groundnut seed will produce an average of 450 litres of oil and 400 kg of groundnut cake which is a major raw material for animal feed mills. Confianza Global Resources is currently employing four youths from the host community. The business has also created livelihood opportunities for many women in sludge processing and marketing in neighbouring communities.

A major challenge of the business is the periodical stop in production due to the seasonal nature of groundnut. During the lean season there is scarcity of raw material and my inability to stock-pile at harvest because of low capital often affects my production.



My advice to young entrepreneurs out there is to always believe in their capacity to succeed and not to be discouraged if they are taking only small steps at this moment, because they do not know where it will take them. My most satisfying accomplishment in business is creating job opportunities for youths, providing market for groundnut farmers, and providing a solution to the customers yearning for genuine products of processed groundnut. Good and properly refined groundnut oil and cake is highly nutritious both for human and animal consumption.

The sky is my starting point and this is a step for the journey ahead. My life as an entrepreneur is an interesting one: when you have challenges you have to face them, and where you see opportunities you have to explore them. It is really challenging but eventually rewarding to be an entrepreneur. My life as an entrepreneur is about working round the clock.

In the next 10 years I want to be one of the key players in groundnut oil production. I would like to experiment with backward integration such that I can develop the capacity to produce my raw materials directly on my farm, and possibly also establish livestock production units that can utilise the groundnut cake from my mills as feedstuff. I will then be in a position to employ more youths, not only from the host community but youths all over Nigeria and Africa at large.

Mercy Haruna Wakawa, Managing Director at Confianza Global Resources

MALAM ISAH WAKILI: An Enthusiastic Cowpea Farmer from Nigeria

It started some time ago in 2012 when the N2Africa project Nigeria extended its dissemination activities to Niger State located in the North Central Zone of Nigeria. There, the campaign was further devolved to Shiroro Local Government Area (LGA) where Malam Isah Wakili lives with his family, in a community called Gwagwa which is largely

dominated by the Gwari tribe. N2Africa activities were launched in this area to introduce legumes in a farming system that is dominated by tuber crops and cereals. During this launch, Malam indicated his interest to participate. He was trained as a lead farmer by the project because of his good knowledge and experience in farming and his ability

to organize and lead other farmers. This story highlights Malam Isah Wakili's achievements as a lead farmer and commercial seed grower through his involvement with the N2Africa project.

Malam Isah received an N2Africa package with cowpea seed to demonstrate on a variety trial on his farm in Shiroro as outlined in the N2Africa agronomy protocol. The objective was to test whether cowpea production would succeed in a humid climate, and to try a crop and soil improvement programme based on a rotation of cowpea and cereals. Malam Isah was guided by the extension agent named Mr. Tanko Mairogo to establish a trial with promising cowpea varieties (including IT99K 573-1-1 and IT90K 277) and he committed himself to tending the field. The crops performed great and resulted in good yields, and this attracted neighbours and other farmers in the area. Indeed Malam Isah was impressed and he guarded his field devotedly.



Malam Isah in one of his cowpea fields located at Gwagwa in Shiroro LGA of Niger State



The cowpea field is in the early reproductive growth stage

Having seen the good performance of the crop in his field and given that cowpea is a rare crop in the area, Malam Isah decided to preserve the seeds with the intention of continuously multiplying these varieties on his own without any further direct involvement and supervision by the project. Occasionally, the extension agent still gave some training to address that cowpea is vulnerable to pests and diseases, especially in a humid climate. Armed with knowledge about the best possible management options, Malam Isah did not hesitate to apply the appropriate agro-chemicals.

The produce from these efforts was usually sold to other farmers who now showed interest in cultivating cowpea and other legumes. In view of this novel idea, he has found a niche for himself as a local agrodealer in cowpea seeds. Malam Isah has a good income from these activities. He has become a dependable agro-dealer in cowpea seeds that other farmers could easily access. In a good season, he could harvest up to 2 ton ha⁻¹ from his farm from which a part is sold to people, a part is preserved for the next season and a part is used for domestic consumption and processed into local dishes.

As such, the introduction of cowpea has brought diversification to a monotonous farming system, cowpea production was adapted to the local farming system through pesticides and crop rotation, and Malam Isah became established as a key figure in the community by linking farmers to the state ADP and seed companies.

Malam Isah's approach to legume production moved from demonstration to a more effective and result-oriented adoption. He did so with inspiring determination, capped with entrepreneurial ability. This all has connected him strongly to the project, in the context of one of N2Africa's principal objectives of **enhancing commercialization and sustainable agro-input supply**.

Malam Isah stands out among the resource-poor smallholder farmers and he is willing to learn, adapt and practice new things and thereby adding value to agriculture even in a rural setting, not minding the daunting challenges farmers face including a low resource base, use of low-yielding crop cultivars, adverse weather events caused by climate change, the menace of exotic pests and diseases and ultimately, low soil fertility. **He said that he got to know that legumes, particularly cowpea and soya-bean, could thrive in his location, thanks to the N2Africa project.**



Malam Isah's household and other neighbours who are often nourished by legume recipes

Congratulations!

The project is pleased to have Malam Isah Wakili as one of its numerous farmers and indeed wishes that this outstanding effort will be sustained, and also encourages other N2Africa farmers to take a cue from Malam Isah who can make business in agriculture even at communal level and at low-scale production. We will not relent in our dissemination campaigns until we all get there! **Carry on Malam Isah and best wishes.**

Acknowledgement:

It is with good intention that we recognize and sincerely

appreciate the efforts of the MD and staff of Niger State Agricultural Mechanization and Development Authority (NAMDA) along with the resourceful extension agent who discovered Malam Isah Wakili during the first phase of implementation of the project dissemination in Nigeria. Particularly, we thank Dr. Idris Usman Gbogan-Director of Extension Services of NAMDA for the tireless extension services he rendered and effective coordination of N2Africa project activities in Niger State.

Bassey Ukem and N2Africa project Nigeria Team

Product Testing of BNF Technologies in Kenya

This report describes the supply of BNF technology products by the N2Africa Project in Kenya during the 2017 long rains. This is the penultimate growing season of our activities in Kenya, and one that undertook a difficult transition from the grassroots focus of the past to an agribusiness orientation. We now work with agrodealers and input suppliers through the One Stop Shop Operation Mechanism (OSSOM, sounds like ‘awesome’) as a key component of our N2Africa Project exit strategy in a manner that reinforces commercial supply of BNF technology products to farmers in West Kenya beyond the lifespan of the project. In the past recommendations were made concerning which products should be used by farmers, and in what proportions, and we developed a test-marketing approach to find out how well they translate within a commercial context. This activity was slightly rushed because funds were released the same month that OSSOM was launched (February 2017). Nevertheless, a rigorous input supply effort was started, in large part through our solid working relations with product suppliers, namely SeedCo and MEA Fertilizers. Also central to our approach is quality assurance of legume inoculants, largely through testing by the University of Nairobi Microbial Resource Center (MIRCEN). This laboratory not only conducts routine tests of biofertilizers used in Kenya, but continues to evaluate elite rhizobial strains identified during Phase I of the N2Africa Project.

One of the first tasks of OSSOM was to test market BNF technology products among OSSOM members. To do this, soyabean seed, legume inoculants and blended legume fertilizers were purchased from commercial suppliers and distributed to members who then maintained standardized sales records. Results were compiled and interpreted both in terms of product sales and member success in marketing these products. Overall, 13 products totaling over 4.5 tons were test-marketed. There was reasonable balance between the sales of soyabean seed, BIOFIX legume inoculant and recommended Sympal fertilizer. This suggests that farmers are buying into the N2Africa recommendations and are also ready to invest in seed of new soyabean varieties as they appear in the market. Test-marketing also included some fertilizers not provided by the OSSOM supply chain and sales of these non-recommended fertilizers was considerably less.

Eight agrodealers were provided with three input products (Saga seed, BIOFIX for soyabean and Sympal fertilizer) totaling 204 kg and were encouraged to carry additional inputs as well. Four out of eight only reported test-marketing of products they had received through the OSSOM supply chain. One of these, AFDB, failed to establish their new shop in time for test-marketing and was excluded from further analysis. Three of the agrodealers placed large additional orders with MEA Ltd. and tested marketed inoculants and fertilizers far in excess of what was provided



Soyabean seed, Sympal legume fertilizer and refrigerated BIOFIX legume inoculants offered for sale by Dick Morgan Ongai at a One Stop Shop in Vihiga County, Kenya

through OSSOM. On average, each of these agrodealers test marketed 567 kg of five different BNF technology products, with 75% of this volume sold in the few weeks before the onset of the 2017 long rains growing season. This sort of success bodes well for the commercial delivery of BNF technologies in the future and is central to the N2Africa-Kenya exit strategy.

Testing of BIOFIX legume inoculants continues at the University of Nairobi MIRCEN laboratory. Quality assurance tests were conducted for several different host products (e.g. *Desmodium*, green gram, pea and alfalfa) but in this report we focus primarily on results for soyabean and bean (Table 1). Tests were performed by drop plating Congo Red YMA following N2Africa protocols. As with previous reports of BIOFIX quality control, the rhizobia exceed the minimum standard (Colony Forming Unit > 1×10^9 per gram) but the contamination threshold is consistently exceeded as well. Nevertheless, the manufacturer indicated that contamination levels are decreasing because they have started to autoclave the carriers twice in an industrial device. Visual inspection of plates reveals that contaminants are mostly Actinomycetes rather than other bacteria or fungi. Clearly the BIOFIX ordered by the One Stop Shops and

Table 1. BNF technology products test marketed by OSSOM members

Type of input	Products number	Volume kg	Marketed %	Comment
Soyabean cv Saga	1	334	80	new released SeedCo variety
BIOFIX inoculant	5	18	68	mostly for soyabean, some cowpea
Sympal fertilizer	3	3430	76	from MEA in 10, 25 & 50 kg bags
Other fertilizers	4	753	48	not from N2Africa supply chain
Total (average)	13	4535	0.68	

others for the 2017 Long Rains contain adequate rhizobia, but contaminants may pose a hazard to product storage in absence of refrigeration. Again the MIRCEN laboratory kindly agreed to test a batch of NoduMax (SN-186) from Nigeria. Despite being a few months old, the sample contained large numbers of USDA 110 (bv. BioNext Tiny) and no contaminants (Table 2).

The transition from grassroots to agribusiness focus during Kenya's final year is proceeding with reasonable success. OSSOM members enthusiastically embraced this opportunity, and several farmer groups are prepared to privatize their input supply to members. OSSOM slightly underperformed in terms of product marketing and in completion of the recently developed M&E tools (more on this in future reports). Nonetheless, the test-marketing exercise was largely a success and it indicated that customers are purchasing BNF technology products in a proportionate manner. Furthermore, OSSOM members are making separate arrangements with BNF technology product suppliers. MIRCEN continues to perform well in its inoculant quality assurance duties and all tested inoculants met threshold

Table 2. Quality control testing of legume inoculants at the MIRCEN during March & April 2017. Parentheses denote Coefficient of Variation (%).

Product (host)	Batch No.	Rhizobia (x 10 ⁹ g)	Contaminants (x 10 ⁷ g)
BIOFIX (soyabean)	21702S	6.3 (± 9%)	1.5 (± 33%)
BIOFIX (soyabean)	01602S	8.3 (± 31%)	1.5 (± 57%)
BIOFIX (soyabean)	81602S	5.2 (± 15%)	1.0 (± 50%)
BIOFIX (bean)	11602B	5.3 (na)	0.8 (na)
BIOFIX (bean)	71602B	4.2 (± 18%)	1.8 (± 69%)
NoduMax (soyabean)	SN-186	6.4 (± 14%)	0 (none detected)

rhizobial targets, but the BIOFIX product continues to harbor excessive contaminants. Finally, elite strains for soyabean identified during Phase I continue to perform well in field tests and perhaps the development of a mixed strain inoculant product should be considered.

Paul L. Woomeer, Nancy K. Karanja, Welissa Mulei and Josephine Ongoma

Educating Tanzanian Smallholder Farmers about Modern Bean Cultivation – What Works Best and at What Costs?

Most smallholder farmers in Tanzania depend on beans for daily subsistence. However, yields remain significantly below their potential, which is partly due to the lack of information about improved farming practices and the appropriate use of agricultural inputs. Therefore, N2Africa and its partners, notably the Centre for Agriculture and Bioscience International (CABI) and Farm Radio International (FRI) launched the Maharage Bingwa Campaign (MBC). This campaign aims to “raise awareness of the benefits of improved common bean varieties combined with fertilizer (where appropriate) and good agricultural practices to support livelihood, food security and soil health benefits in smallholder farming families in Tanzania (especially Northern Tanzania)”. The MBC utilizes several information channels such as radio shows, while N2Africa facilitated demonstration plots.

The key questions any project is guided by are, does it generate impact and at what cost does it do so? Therefore, my MSc. thesis research with Wageningen University & Research (WUR) under the N2Africa project aimed to evaluate the cost-effectiveness of the information dissemination approaches (IDAs) employed by N2Africa and its partners.

The research included the analysis of the different effects of the radio campaign and demonstration plot on the knowledge level of farmers regarding the improved cultivation of beans and their willingness to adopt the practices promoted by the IDAs. To determine their cost effectiveness, the increase in knowledge level was mirrored against the cost per farmer reached for each IDA.



Women farmers answering a questionnaire to assess their level of knowledge on bean cultivation

The field work took place in Nov-Dec 2015, first covering interviews and meetings with N2Africa and its partners to gain a more detailed understanding of the IDAs and associated costs. Secondly, 166 farmers were interviewed in four villages in Lushoto to assess their level of knowledge with regard to the cultivation of beans. Forty of these farmers also answered a second questionnaire on the evaluation of the two IDAs (Table 1).

Table 1: Overview of sample sizes in the different villages.

Farmers / Village	Boheloi	Milungui	Mkunki	Mwangoi	Total
Demonstration Plot Exam	10	10	10	10	40
Demonstration Plot Exam and Evaluation	5	5	5	5	20
Radio Program Exam	11	10	10	5	36
Radio Program Exam and Evaluation	5	5	5	5	20
Control	17	10	15	8	50
Total	48	40	45	33	166

Table 2: Quantification of the cost-effectiveness analysis for both IDAs.

	N	Mean Score	SD	Ø Knowledge Level Increase	Ø Costs per Farmer	Cost-Benefit Ratio
Control	50	0.3660	0.1645			
Demonstration Plot	60	0.5283	0.1510	16.2%	1.88USD	0.13
Radio Program	56	0.4589	0.1488	9.3%	0.36USD	0.065
Total	166	0.4560	0.1671			

Table 2 shows the results of the cost-effectiveness analysis, showing that the average exam score of the demonstration plot group was significantly higher than the score of the radio program group and the control group at a 5% confidence level. Therefore, the increase in knowledge level was greater for the demonstration plot group. Cost-benefit ratios for both IDAs were calculated with use of the following formula;

$$\text{Average Cost to Effectiveness} = \frac{\text{Net Cost}}{\text{Net Benefit}}$$

It was found that the cost-benefit ratio for the radio program was lower compared to the demonstration plot, which means that the effect of the radio program on the knowledge level of farmers was greater per USD spent.

Although the radio program had the potential to reach more farmers in a cost-effective way, the demonstration plot had a greater effect on the knowledge level of farmers and their intention to adopt the promoted practices.



Farmers listening and providing feedback on the Farm Radio International campaign in Tanzania. Photo credits Dharmesh

Partner Profile: Global Change Learning Lab highlights participatory legume-based research in Malawi

The [Global Change Learning Lab](#) is an integrative web-based site that facilitates research and information sharing by global change scientists and partners collaborating on action research in Sub Saharan Africa. The learning lab website is designed to both inform and engage research partners, extension educators, and the public. Many collaborators are engaged in agricultural research for development efforts focusing on the role of legumes in smallholder systems. The website highlights challenges facing smallholder farmers primarily in Malawi and explores interdisciplinary, participatory action research and agroecological

Table 3: Components influencing farmers' willingness to change their behavior (factor analysis). The sign between parentheses shows the direction of the effect.

Willingness to Change Behavior	Demonstration Plot	Radio Program
Age of Household Head	0.010* (-)	
Household Head Finished Primary	0.064* (+)	
Information Credibility		0.002*** (+)
Presentation Quality	0.076* (+)	
Presentation Access	0.006*** (+)	

*p<0.1; **p<0.05; ***p<0.01

The factor analysis on the components influencing the farmers' willingness to change their behavior revealed that the access to the demonstration plot and the credibility of the information presented during the radio show have a highly significant positive effect on the willingness of farmers to adopt the improved practices promoted by the IDAs, as shown in Table 3.

Based on this research, it is recommended to improve accessibility of demonstration plots and to take care that the information sources and the presenters of the radio program are trustworthy and credible. Most importantly, a mix of different IDAs is advisable, such as demonstration plots, radio programs, comics and SMS. When doing so the following factors must be kept in mind; (a) the information of both/all IDAs need to be coherent, (b) the information needs to be presented in a way that farmers can understand (including local terms and no scientific words), and (c) the IDAs should include explanations about the target agro-ecological zone and region.

Lastly, it is crucial to conduct further research on the actual adoption of modern agricultural practices by the farmers to verify the results of this research. Also, the research could be scaled up to evaluate the cost-effectiveness of the radio program and the demonstration plot in other regions within Tanzania and the other IDAs employed by N2Africa and its partners.

[My thesis report](#) can be found on www.N2Africa.org

Verena Mitschke, Wageningen University & Research

approaches to support farmers as they face global change forces such as resource degradation, globalization, and climate change.

Many Global Change Learning Lab researchers and partners, including N2Africa, are engaged in legume-based research efforts, including: investigating best bet legume options, biological nitrogen fixation, soil fertility and soil quality matter benefits, increased biodiversity, tradeoffs, climate change resilience, and important secondary uses such as nutrition, fodder, and fuelwood. Multipurpose legumes that include

long-duration growth habits and ratoon management have been highlighted as key innovations in sustainable agriculture for development.

The Global Change Learning Lab research platform includes multiple sites in Central Malawi using an innovative participatory action learning method called Mother Baby Trials. The Mother Baby Trials include researcher and farmer (on-farm) assessment of maize/legume intercrops that include groundnut, soyabean, and pigeonpea. Additionally, researchers and farmers are exploring the Doubled Up Legume Rotation (DLR) in which two legumes are intercropped in one year, based on complementary growth habits and plant architecture, followed by the staple crop maize in year 2. The DLR and related legume-cereal intensified systems are key to markedly enhance biological nitrogen fixation, diversified diets, and soil rehabilitation for a more secure future.

Years of partnerships and cross-pollination with N2Africa and related organizations have led to these farmer-approved varieties, integrated nutrient use, and biologically-smart combinations such as “doubled up legume innovations” being released by governments and taken up by communities in Malawi, and neighboring countries. Commitment to strong, quality partnerships is at the foundation of the Global Change Learning Lab approach, which involves long-term ties with Malawi farmers, scholars, educators and development activists.

Visit <http://globalchangescience.org/eastafricanode/> to learn more.

Dorothy Sirriner and Sieg Snapp, Global Change Learning Lab



Global Change Learning Lab participatory soil characterization exercise

Can you re-close an ecosystem once it's been opened? Reflections on the role of legumes in central DR Congo

As Nile and Brady's classic text, *The Nature and Properties of Soils* notes, the slash-and-burn system is not inherently unsustainable. In theory, natural vegetation is cut and burned from a plot of land and crops are grown for several years until the nutrients, built up over years, have been used and yields begin to decline. The farmer then moves on to the next plot to continue the cycle. Only after an undefined period of time, after the original 'slash' plot has re-established natural growth and replenished soil organic matter and nutrient pools, does the farmer return to cultivate the plot. With an adequate land base and rotational cycle, new deforestation is avoided.

But this system breaks down when farmers are forced to return to regrowth plots (for various reasons – population increases, food insecurity, changing land tenure, etc) before they've had an opportunity to re-initialize some level of stability. In a closed system, external inputs are unnecessary because the essential nutrients/inputs to sustain the system are available and continuously recycled in a perpetual cycle of growth and rejuvenation. By definition, agriculture necessitates an 'opening' of the system. Farmers grow crops, which leave the field to be sold at the marketplace or consumed directly. Contained within these products are a multitude of nutrients, carbon and water that also leaves the ecosystem with the commodity. This alteration of the ecosystem also implies that to maintain the same level of productivity, external inputs are now necessary to replenish

inputs leaving the system or new woodlands must be cut down, which furthers the damage of deforestation.

Farmer-to-Farmer (F2F) is a USAID-funded program that 'provides technical assistance from U.S. volunteers in developing and transitional countries with the goal of promoting sustainable improvements in food security and agricultural processing, production and marketing.' As a F2F volunteer working with local ACDI-VOCA staff in the Bandundu District in (central) DR Congo, I found the slash-and-burn system commonly practiced in the region to be particularly concerning. In discussions with farmers, they noted that increasing land pressure has forced them to fallow fields for only a few years before they must be cropped again. A lack of capital and access also means that the majority of farming is done without improved seed or external fertilizer inputs. All of this occurs on fairly sandy soils, which under the best conditions creates a naturally leaky system with inherently low organic matter. Therefore solutions for improving yields and sustainability of farming in this region must include pathways to return nutrients not just at replacement levels, but at levels exceeding the amount of nutrients leaving the system.

It appears likely that stagnant or even declining yields in this region are the result of negative nutrient balances and a lack of organic matter input is driving soil degradation. The Bandundu farmers understand that their most



fertile soils are those just coming out of forest. The higher organic matter in these plots can vastly increase the water holding capacity of the soil while supplying much-needed nutrients. Prior to burning, it is a relatively closed system in that the trees' extensive root system incorporate nutrients and water that have leached down into the soil profile into new biomass, which then falls to the ground, decomposes and releases the nutrients to start the cycle again. When they burn the forest to produce grain, the system is open. The root system no longer reaches the depths required to retrieve leaching nutrients and additional nutrients leave the field in the grain. In these degraded soils, the yields are low and so too is the biomass/residue production, generally the only source of carbon and nutrients being returned to the soil. The biomass added back to the soil is not nearly enough to balance the losses (let alone increase) so the soil is degraded further.

Through our farmer discussions and townhall-style debates, we devised a series of approaches, which draw heavily on the framework provided through the practices of integrated soil fertility management (ISFM). For example, the seasonal farming pattern in Bandundu is governed by bimodal rains distributed by a longer 'A Season' and a shorter rainy period in the 'B Season.' A primary tenet of ISFM is that to increase both short- and long-term soil fertility, a combination of organic and inorganic nutrient sources is necessary because neither nutrient source is available in sufficient quantities. Currently farmers do add back crop residues, but these sources are generally of lower quality (high C:N) and lack adequate tonnage. To be successful, however, re-aligning the two seasons to adhere to the principles of ISFM is critical. Historically, due to a longer rainy period, the A Season is the most likely period to produce a profitable crop. During this season, along with the organic inputs, farmers will begin small-scale experiments incorporating inorganic nutrients to offset any nutrient deficiencies, nutrient immobilization by organic sources and/or to improve synchronicity of nutrient release from organic sources.

In this manner, the combination of the two nutrient sources complement each other by providing an immediate nutrient supply along with a slow-release across the growing season. The more stable/recalcitrant carbon from the organic matter will begin the rebuild the soil organic matter pool for long-term soil resilience. The farmers will target fertilizers to specific plots, identified as those of medium to higher fertility where organic matter is present, which will likely provide the greatest benefit.

A new guide to maize-legume systems

The Africa Soil Health Consortium (ASHC) have just released an all-encompassing guide on maize-legume cropping systems with major contributions from N2Africa. The guide aims to provide all the most important information needed to design and implement effective systems

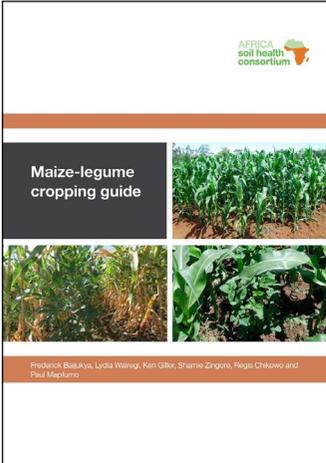
Additionally, matching crops to cropping seasons is critical. Maize is likely a riskier option in the B season. Farmers noted that the varieties they have available are generally longer maturity varieties while the rains are limited in the B season and less predictable. Even in the best conditions during this time, maize production is likely to have severe yield reductions due to nutrient limitations. When combined with the higher probability of water stress, farmers may be better off growing shorter season legumes or improved fallow. For the former, our discussions illustrated that soybeans and cowpeas are potentially viable and available options provided they can produce high biomass and adequate yields. With promiscuous varieties or access to inoculation, this substitute may be far less risky under the prevailing short season variability. Where this inoculation can be procured is less clear. Their most likely option is in Kinshasa. Moreover, despite not producing a crop, legume fallows can still be incorporated with the full season cassava that is the other staple crop of this region. Even when planted alone, green manures may increase yields of the subsequent maize crop in the A season and reduce overall risk to crop failure over the long-term. In my discussions with local farmers, I found that they were aware of this practice, but had not tried it in their fields.

In concluding, the sense I got from the farmers in Bandundu is that they felt the slash-and-burn system as it exists locally is fundamentally unsustainable. If slash-and-burn agriculture is to remain the dominant form of agriculture in the region, farmers must have the ability/flexibility to rest and improve severely degraded fields. Access to adequate capital, fertilizers, supplemental organic inputs, rotated (inoculated) legumes and improved seeds can help to stem some of the 'leakiness' of the system. Any future investment by the farmers or any other group interested in agriculture in the region must acknowledge the constraints and limitations placed upon farmers to provide immediate food and/or income, and devise interventions that reduce the need for long fallow periods. It may not be possible to ever fully close this system once it is open, but an integrated approach that matches inputs and crops to both fields and cropping seasons may be a viable path toward closing the loop.

Acknowledgement: This paper stems from work funded by a joint effort between USAID and ACIDI-VOCA through a program called Farmer-to-Farmer

Chris Graham, Assistant Professor, South Dakota State University

which combine maize and legumes, with a primary focus on maize. The overall objective is to provide guidance on how to achieve sustainable increases in yields through the adoption of best practises that exploit the advantages of maize-legumes systems, increasing maize yields from



around 0.5-1.2 tonnes per hectare (or even less) to 1.5-6 tonnes per hectare and increasing legume yields from less than 0.5 tonnes per hectare to 1-3 tonnes per hectare.

The guide showcases options for best practices that are based on the characteristics and requirements of maize and the 'big five' legumes - common bean, groundnut, cowpea, soybean and pigeon pea. It starts with simple clear explanations of the underlying principles of intercropping before going on to provide practical guidance. The guide gives a detailed overview of management strategies, as well as potential constraints and how they can be overcome.

Sub-humid climates are most appropriate for maize. However, many farmers try to produce maize in more marginal areas that are sometimes considered to be too dry. This guide therefore provides practical guidance for growing maize-legumes in the sub-humid zones as well as in more challenging environments in Africa.

The guide was compiled by Frederick Baijukya (N2Africa and IITA), Lydia Wairegi (CABI), Ken Giller (N2Africa and WUR), Shamie Zingore (IPNI), Regis Chikowo (N2Africa and University of Zimbabwe) and Paul Mapfumo (University of Zimbabwe), and can be downloaded from the following link: <http://africasoilhealth.cabi.org/materials/maize-legume-system-colour-cropping-guide/>

Thanks to N2Africa Uganda

A PhD student from Warwick, after hearing Ken Giller talk about N2Africa at her University, opted for a 10 day research placement within N2Africa and was given the opportunity to visit N2Africa Uganda. After her return she wrote:

Dear Ken,

I returned from Uganda this week. I must say I have been amazed by the work that is done there! It is an incredible idea and the science communication is excellent! The team of N2AFRICA seems to be very carefully chosen. Inspiring, strong people that love their job and they taught me a lot.

Peter Ebanyat managed to create a great schedule for me so I get an experience of almost everything. I visited Makerere university to see how they isolate and study rhizobia strains, as well as how they make the inoculants. I learned about the financial and technical management of the project, about businesses and markets. I met some of the partners (Africa 2000 Network (A2N) and Agency for Sustainable Rural Transformation (AFSRT)), I attended a post harvesting training and visited farmer groups in differ-

ent phases at the west and northern Uganda for swot analysis. I had the opportunity to talk with them and ask about the challenges but also their opinion of the project. They knew about rhizobia and they were asking me questions! There has been a big change of mindsets and a change of lives for so many people. They were asking for new technologies and linkages to better inputs or reliable banks so they can get loans or even bigger markets that they can access because they have enough production! They want to grow and keep improving. It is really amazing to see and really inspiring. The work that is done there gives a great value to my job!

Thinking as a scientist, the experimental design is very smart and the data you will get back are valuable. I would really love to analyse the microbiome of the soil and the plant root before and after each demo, with the different parameters, it would be a treasure for microbiome research



since the experimental design is already there! It could give massive information about the microbial dynamics and how they are influenced by the different parameters, but also what is their impact on the plant and its performance. It is certainly something to think for the future.

Furthermore the interaction with the farmers, the people from IITA and Makerere changed completely the way I am thinking about my research. I learned a lot about agriculture, applied science and what really needs to be done for the field. I got many new ideas for my current research but also for my future career.

Related newsletters

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- IITA news on Borno State: [Nigerian Finance Minister visits IITA](#);
- IITA blog: [Celebrating IITA50 in Rwanda: How collaboration between CGIAR and scaling partners can make science work for farmers.](#)

Overall it has been an unforgettable experience, it inspired me as a person and as a scientist. I cannot thank you enough for giving me this opportunity! I am sure I will go back to Africa and I would love to do some research there, but also I hope I will get the chance to work with you again.

Thank you very much,

Chrysi Sergaki, PhD student, Patrick Schäfer group, School of Life Sciences, University of Warwick, funded by NERC funded (Natural Environment Research Council)

Announcement

Consultants for the Global Crop Diversity Brigitte Maass and Bruce Pengelly shared a new edition of the Newsletter on “Forages for the Future”.



The newsletter is meant to start re-building a community that is interested and engaged in tropical and subtropical forage genetic resources, their conservation and utilization.

All previous issues of the Newsletter can be downloaded from <http://www.tropicalgrasslands.info/index.php/tgft/pages/view/News>.

They are very much looking forward to hearing and reading from you to strengthen the network and invigorate tropical and subtropical forages. Please send your contribution (not more than 250-500 words and some good photos/figures) as we will soon start the next edition of the Newsletter to Brigitte.Maass@yahoo.com.

The Podcaster is published six to eight times per year – we look forward to receiving news and contributions – particularly from partners. Please send in contributions well in time. Contact address for this newsletter is: N2Africa.office@wur.nl

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