Adoption constraints with climbing beans in Kashambya subcounty

N2Africa

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SUMMARY

This N2Africa study was to have a better understanding of adoption constraints for climbing beans in Kashambya subcounty (Kabale district). This region is present in South Western Uganda where climbing beans has been used for generations as a staple food. The region had been facing multiple problems such as food availability, poor soil quality etc. based upon the baseline research conducted earlier by N2Africa. To resolve these problems N2Africa had provided farmers with different climbing beans varieties and fertilizers in multiple treatments to increase productivity wherein 5 out of 6 parishes participated in the project and 67 farmers were selected and provided the necessary inputs. The goal of this project was to make the farmers self sufficient and helped them tackle problems related to using these climbing beans. To identify their problems and constraints this study consisted of interviewing the farmers to investigate into the adoption constraints they are facing. The focus of these interviews was to look at adoption constraints from a marketing perspective.

The diffusion of innovations i.e the penetration of these innovations can be perceived through these interviews. The focal point of this research underlines the difference between different markets available for the farmers and how much they have been explored. Various findings owing to the weak and fluid market structure were identified as major concerns. Through the interviews with the farmers and traders it was found out that availability of stakes and information access were major problems for the farmers. Apart from these additional constraints are also highlighted in this report. This report aims to zoom in on major adoption constraints and provide marketing suggestions for successful adoption on future trials of climbing beans.

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CONTENTS

1. INTRODUCTION

1.1 IMPORTANCE OF LEGUMES IN THE CONTEXT OF AFRICA

To address the problems of food and nutrition insecurity, and to increase the incomes of rural households, productivity of smallholder farmers in Sub-Saharan Africa has to increase. A key component of improving agricultural productivity and therefore achieving food and nutrition security is the diversification and intensification of farming systems. Regarding the diversification of farming systems, grain legumes play a key role, as they are able to capture the infinite resource of transforming atmospheric gas into protein. Not only does the protein-rich grain directly addresses the food and nutrition needs of rural households, but the crop residuals of those grain legumes also provide a high-quality feed for livestock. Additionally, these residuals add nitrogen to the soils, which enriches infertile soils and stimulates productivity of crops grown in rotation. Lastly, as important cash crops, grain legumes also provide more income than other kinds of crops (N2Africa, 2013). However, in order to make rural farmers reap the benefits of grain legumes and nitrogen fixation, research is necessary to investigate why, when and how farmers adopt new technologies like the one put forward by N2Africa. Not only technological aspects play a role, but socio-economic & market factors have to be known and understood to provide an enhancing and enabling environment for farmers to adopt grain legumes.

To understand how the socio-economic factors and market factors influence the process of adoption in Kashambya subcounty in Uganda, the following questions need to be answered:-

How adoption and diffusion processes have transpired in the current season of November 2014-January 2015 in Kashambya subcounty?

What are the potential marketing elements to resolve adoption constraints pertinent to Kashambya subcounty?

This report follows the structure of explaining the N2Africa model to form as a foundation and highlighting the domain/section this report wishes to strengthen. An introduction to the topic adoption and diffusion encompasses of various research and theories on the processes of adoption and diffusion and how they are influenced by socio-economic and market factors. A theoretical framework forms the structural body of this report. The framework gives an overview of how N2Africa technologies are curbed by adoption constraints and the marketing elements help in levelling out these constraints. The results and discussion section contextualizes this framework to N2Africa climbing bean varieties in Kashambya subcounty, South Western Uganda. Plausible conclusions and derivations from this report would from the final section of this report.

2. BACKGROUND

2.1 N2AFRICAMODEL

The starting point of an adoption process is to develop a technology for a particular scenario/situation and perceive its consequences. N2Africa has perceived agricultural problems with small older farmers in Africa and aims to resolve these issues by introducing legume technology for nitrogen fixation in Africa. The technologies developed by N2Africa aim at not only resolve existing agricultural problems but should outcompete the existing competition in various aspects such as price, quality, technological prowess, dissemination, marketing etc. The research done by N2Africa has been following the structure below:-

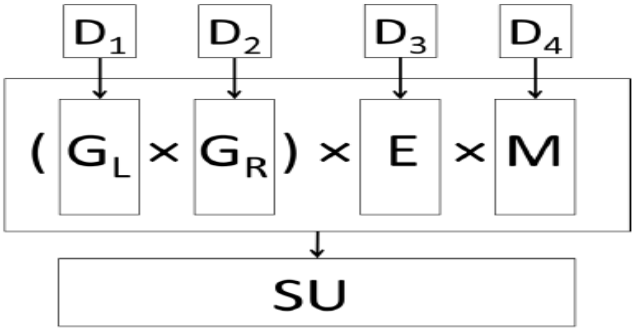


Figure 1: N2Africa model for research (Andrew Farrow, 2014).

where "G_L and G_R are the legume genotype and the strain of *Rhizobium sp*. Here 'G' refers to genetics of the bacteria. E refers to environmental factors on G_L (and G_R) and includes soils (limiting nutrients, toxicity, soil texture, physical barriers etc.), temperature, solar radiation and rainfall during the growing season, pests and diseases; M refers to the management of the crop, the rhizobium and the local (farm scale) the delivery of / availability of strains of *Rhizobium sp*. D refers to a set of delivery factors wherein D_1 &D_2 refers to delivery of delivery of genotype and strain of bacteria. D_3 is the delivery / availability of inputs to tackle environmental issues; D_4 is the delivery of / knowledge of management practices, and; SU is the marketing for sale and utilisation of the legume crop (Andrew Farrow, 2014). For each region the crops to be used, cropping pattern, fertilizers, pesticides and other necessary inputs are developed with different partners. This report focuses on strengthening D4 and SU to facilitate marketing in future N2Africa trials.

2.2 ADOPTION AND DIFFUSION

The need to understand the two phenomenons of adoption and diffusion is necessary to give a clear insight into this research. Adoption process in essence is defined as the process wherein a customer moves from a state of awareness to the emotional state of liking and preference and

finally to the behavioural state of deciding and purchasing. 'Diffusion of innovations' is a terminology built upon adoption and is defined as the theory that is built on customer variability. Every market has sections of customers who diffuses through a market not in one straight course but in successive, overlapping waves (http://www.businessdictionary.com, 10th April, 2015).

This report has its roots from Andrew Farrow's report *"Review of conditioning factors and constraints to legume adoption, and their management in Phase 2 of N2Africa"* in 2014) covers the adoption constraints in Ethiopia, Tanzania and Uganda. A review matrix was constructed to identify the adoption constraints through peer viewed literature journals wherein 16 factors were identified as constraints and 5 such constraints were found to be common in Ethiopia, Tanzania and Uganda (Appedix 1). They were labour, knowledge, collective action, capital/Assets and relevance of technology**.** These constraints form the core of adoption problems in the mentioned countries. In Andrew Farrow's report the identification of adoption issues was dealt in mainly from a socio-economic perspective.

Apart from most of the socio-economic factors discussed in Farrow's report market based factors could influence the adoption process; market access is one such factor. It refers to the access of input and output markets (Negatu and Parikh, 1999; Feder et al., 1985; Abdulai and Huffman, 2005). Accessibility is associated with distance in common terms. Market distance in agriculture is defined as "the distance to the point of sale of the farm output, notably a market center where buyers congregate" (Schalkwyk, 2012: 97). In case of greater distance to the market it becomes more difficult for the farmer to sell his/her products as several logistical problems arise. Among others, the availability of transportation, high transport costs (Schalkwyk, 2012) and time constraints might hinder farmers to engage in selling and buying activities at central markets.

A market system is not uniform throughout. There would be regions which would be closer to the central market and regions which are farther away from the central market. These regions which are farther away from the central market would not have direct access to various facilities in the centre of the market. Since the access would be difficult these regions would depend on markets which are closer and more accessible and easier for trade. From an agricultural scenario farmers would want to sell their products to the easiest accessible markets. As the accessibility to the central market decreases the ted in information transfer from the centre market to the peripheral markets reduces. According to Fafchamps (2004) markets can be distinguished into primary, secondary and tertiary markets. Undeveloped markets as can be seen in Ghana can be classified as a tertiary markets, intermediate markets such as the one present in Kenya as secondary markets, and well developed markets such as in Zimbabwe as primary markets. This has to be taken into account as information exchange in primary markets functions better and smoother than in secondary or tertiary markets, possibly strengthening and supporting the process of adoption and diffusion.

Understanding of adoption stems for aggregate adoption behavior which is characterized by two main processes, namely adoption and diffusion (Feder et al., 1985, Feder and Umali, 1993). The level of adoption of a technology depends on how fast the technology reaches from one consumer to another; in other words diffusion. According to the study on '***Diffusion of innovations'*** by Rogers, adopters of a technology are classified as innovators (2.5%), early

adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%).(Rogers, 2003). Adoption in any form is possible according to Rogers only if it is trialable, compatible, simple, and observable and has a relative advantage. It is hypothesized that the early adopters are closer to or part of a primary markets whereas laggards are part of secondary or tertiary markets. This means that the market system in which potential users are located may increase or decrease the rate of adoption due to different levels of information transfer. A theoretical framework to address the process of adoption involving the enlisted variables forms the foundation of this report. It gives an insight into the process of visualizing the discussion above.

2.3 THEORETICAL FRAMEWORK

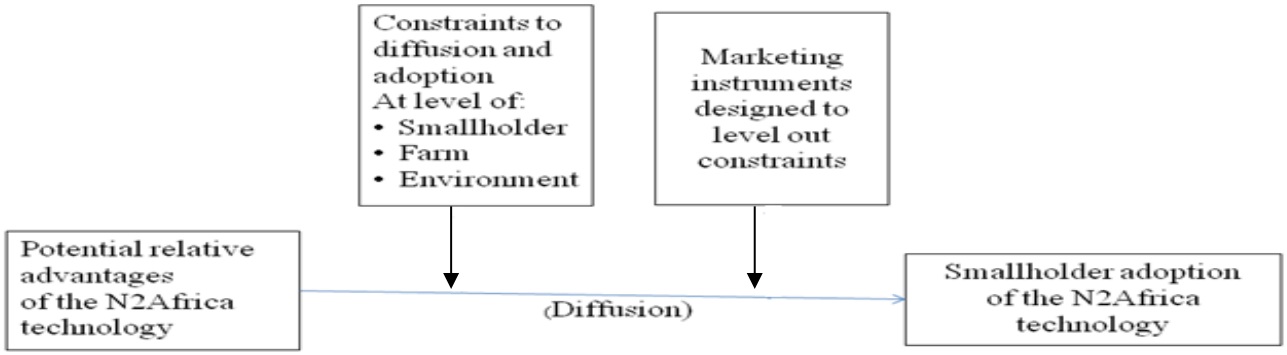


Figure 2: Conceptual framework for adoption strategy

This framework aims at showing a generic approach to understand smallholder adoption of new technologies. It can serve as a basis for contextual studies in Uganda, Tanzania, Ethiopia and elsewhere. The framework reads from the left to the right. The left box shows the potential relative advantages of the N2Africa technology. It therefore assumes that the technologies within the N2Africa project are designed to solve certain problems related to the existing technologies used by the smallholder. Hence, we speak of relative advantages: the advantages only exist in comparison with current alternatives. Advantages are also potential, because they are only experienced if the technology is properly understood and applied by the smallholder.

Technologies that have substantial advantages in principle sell themselves. Hence a direct line with adoption, suggesting that higher relative advantage leads to higher adoption, an often-found connection in the marketing literature across all possible contexts. Part of the relationship is attributed to diffusion because farmers those aren't in contact with the source of the technology

(the research institutes and universities involved in N2Africa), may hear about it from others, or see other famers applying the technology. They adopt it by copying their behaviours. Logically, this will be the case for the majority of smallholders that eventually adopt the technology.

The diffusion process may however be hindered because it is constraint by factors at the level of the smallholder, farm and environment (W. Muzari et al., 2012). These factors hinder a proper understanding and/or application of technology. At the smallholder-level, one can think of education, age, personality factors, etc. At the farm level the constraints can be resource conditions (soil, water, fertilizer, capital, etc.), and at the environmental level of all the institutional factors (like a road, energy and communication infrastructure, presence of cooperatives, financial institutions, etc.), and natural conditions (like rainfall) (Andrew Farrow, 2014). The exact factors that hinder the diffusion of technologies may depend between research contexts.

The factors that hinder the adoption of the technology can to some extent be compensated for by using marketing instruments effectively. These are tools that offered to smallholders in addition to the products bearing the technology and that compensate for certain constraints (development people probably put is under their general heading of "interventions").

3. SITE INFORMATION AND METHODOLOGY

3.1 SITE INFORMATION

The framework discussed in the previous section has been contextualized to Kashambya subcounty. This place is located at an altitude of about 2000 metres in Kabale district located in south western Uganda. This region is about 30km form the city of Muhanga which is a major agriculture market. This subcounty had 6 parishes where each parish comprises of a few villages. N2Africa. Through the baseline data it was seen that among that climbing beans was a common staple crop among the people. Additionally it was found that this region had average soil quality and people had problems with food scarcity in the months of October-December. These are problems arising due to small holder constraints mentioned in the framework. N2Africa conducted its research in this region towards the end of 2014 by introducing climbing bean varieties of Nabe 12C (existing variety) and tested Nabe 26C (new variety). These bean varieties were much heavier, improved soil quality and fetched better prices in the capital market. These varieties essentially counter the problems of average soil quality and potentially could result in higher yield. Thus in hindsight it can reduce food scarcity as these varieties can be used in the season from October-January (food scarcity time) apart from March-June.

In this research aimed at resolving the small holder issues of adoption of beans; 5 out of 6 parishes participated in the N2Africa trials for this season (October-January). From all these parishes in total 67 farmers were provided climbing bean seeds of the variety Nabe 12c and TSP for growing this season. Nabe 26 C was used only for demonstration purposes for this time

frame. Africa network 2000 has been a key partner in Kabale district for facilitating this research. Demonstration plots about 128m^2 consisting of four treatments were on display on each parish. The land to these plots was provided by selected farmers. The plots consisted of different staking methods and fertilizer (TSP) treatments of climbing bean varieties Nabe 12C and Nabe 26C. The farmers who attended the demonstration of these trials were the ones who were provided the seeds for usage this season. On the field day before provision of the seeds, inoculants from Makarare University and fertilizers from trade partners the farmers were given information on the process of usage, spacing, height of stakes, number of treatments and weeding process(3 times weeding was prescribed for this season).

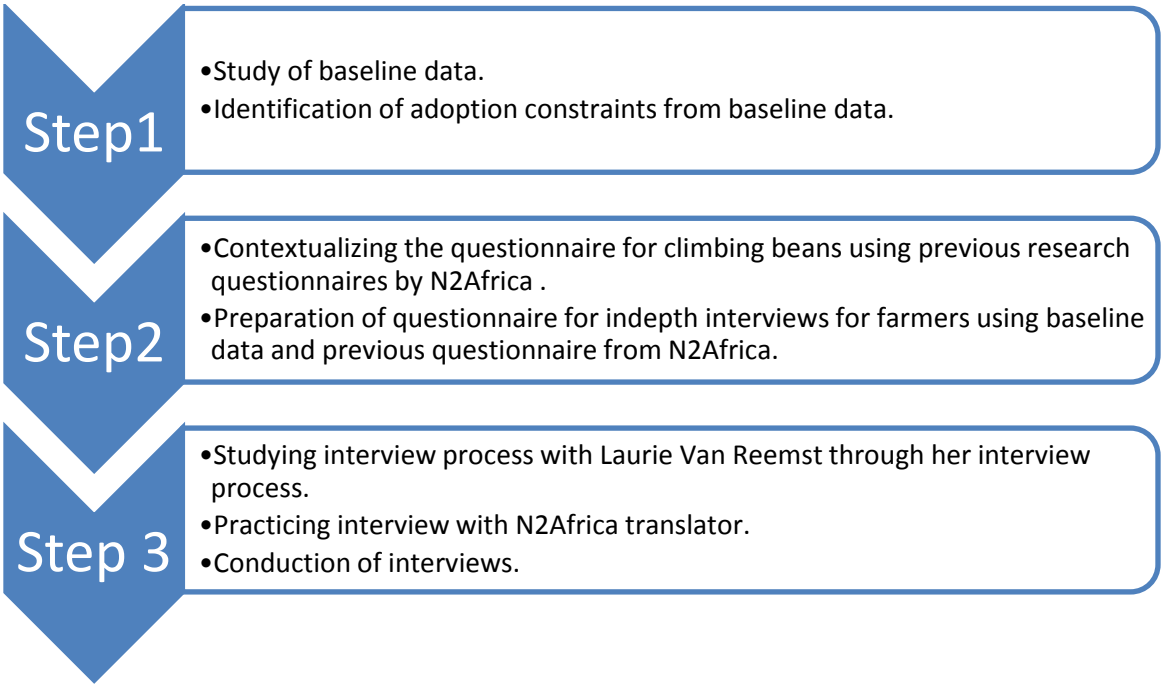
3.2 METHODOLOGY:-

This section consisted of several activities each aimed at perceiving farm level, small holder level and/or environmental level constraints which hindered the adoption process of N2Africa technologies. Farm level constraints were identified using field measurement activities. The environmental level and small holder adoption constraints were identified using famer interviews. The field day activities aimed at collective interaction for resolving small holder issues and the chain actor interviews aimed at identifying environmental constraints of farmers. Though the farm level constraints were studied in this research through field measurement activities, this research focused more on small holder and environmental adoption constraints. This is done as researching into problems in genotype of legumes, strain of *Rhizobium sp.*, growth rate of plants and detailing on other farm level adoption constraints require a longer duration not in the scope of this internship. On the other hand the small holder and environmental constraints can be societal and market related constraints which can be provided with functional marketing solutions even in a short term period.

Table 1: Methodology measures to counter constraints

Constraints	**Methodology**
Farm level	Field measurements
Small holder level	Farmer interviews and Field day activities
Environmental level	Farmer interviews and Chain actor interviews

1. **Farmer interviews:**



This research was done to identify small holder issues and environmental problems of farmers. Information was collected from baseline data to know about a variety of important adoption constraints for small holders in this region. In this information adoption constraints such as average soil quality and food scarcity were identified as major constraints prevalent in Kashambya subcounty for climbing beans. Research questionnaire from Esther Ronner, Phd student at Wageningen University was studied. This questionnaire was elaborate and focused on farm level and small holder level adoption constraints. This was modified to suit the requirements of this research by including questions to analyse environmental constraints much better. Apart from the structural development of interview questions a practical field interview session by Laurie (Msc. Plant Sciences) was attended in Kapshorwa district for climbing beans. Through this process; the interviewing style, translation lag and the farmer responses were identified. This helped in strengthening and facilitating the questionnaire for the farmer interviews which were created after this mock interview session.

The interview questionnaire were loaded onto a tablet and processed via a software application. This tablet had the facility to note down the gps coordinates as well wherein gps of fields and the respective farmer house could be recorded. A person who speaks English and who had been working with N2Africa trials was trained to understand the nature of the questions and arrange the logistics for organizing the interview process. This fitted strongly with the conceptual framework where the potential constraints were hypothesized at environment level and small holder level. Semi-structured in depth interview questions were framed in the process and subsequently tested as part of this research.

Field day activities: Two field day activities were attended to address farmer concerns involving various concerns in bean production process. The aim of attending these field days were to perceive public problems with respect to climbing bean adoption (small holder adoption constraints). During these events N2Africa introduced its fertilizer partners and unveiled a set of technological innovations to farmers. The innovations included new types of fertilizers, solar powered lighting for house settings to aid electricity requirements. Farmers, N2Africa people, local governing bodies and police force were part of such events. During the events farmers were asked to reflect upon the last season, their current struggles and how N2Africa could assist them. I was extremely happy to have answered some farmer questions along with imminent N2Africa experts. The questions voiced by farmers to availability of stakes, pest issues, stacking height, growing period etc. These field activities provided further insight on what exactly farmers struggled as a group. These field activities showcased the potential advantages of N2Africa fertilizer and seed varieties and constraints voiced by farmers. This helped in forming a relation between these two elements in the framework.

Chain actor interviews: These interviews were brief (15 minutes) and were asked to shop keepers, traders and N2Africa business developers to gain further understanding to improve marketing solutions. The idea behind this is to understand how the farm business works and to gain knowledge on the value chain process. Additionally it helped in understanding how the farmers were getting their produce to the market. This would account for an environment level constraint which could be resolved by better access to markets. These interviews helped in identifying environmental level constraints mainly relating to logistic and economic process of climbing bean production

Field measurements: Spacing, height of stakes, number of treatments (two treatments as per protocol) and number of weeds were the measurements taken to analyse the level of adoption of the farmers. This helped in understanding the farm level constraints in the adoption process of climbing beans.

4. RESULTS AND DISCUSSION

4.1 CAUSE AND EFFECT RELATIONSHIP OF ADOPTION PROCESS

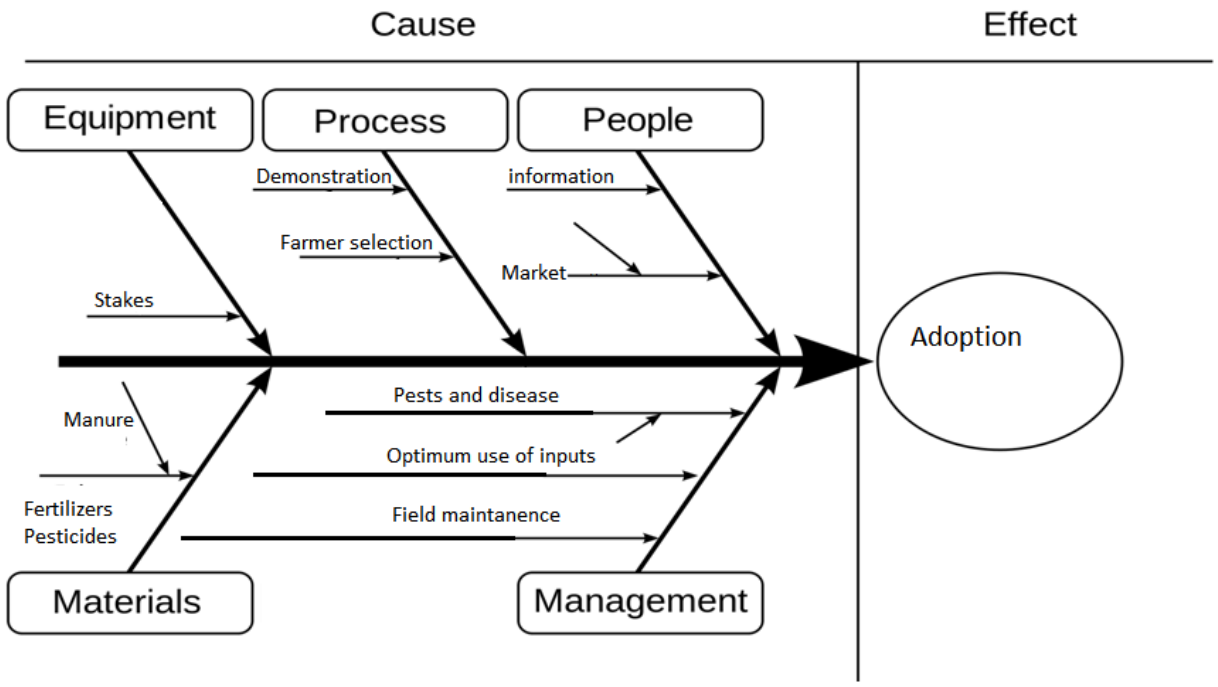


Figure 3: Cause and effect analysis

The cause and effect diagram is a relationship explaining the relationship between different causes and having an impact in the effect. This kind of representation was brought by Ishikawa in 1968 (Ishikawa, 1968). The figure above represents the operational picture of the adoption process for climbing beans in Kashambya subcounty, Uganda. It provides a clear picture on the different frontiers were adoption constraints are seen.

For a successful adoption the arrows along the sides need to be addressed at all levels. The materials (seeds, inoculants etc.) and equipment for adoption need to available as preliminary necessities to effect adoption. Manure, fertilizers and pesticides were available for the farmers but proper sized stakes were lacking. This is the immediate concern for N2Africa at address the adoption constraint. Next in line comes process and people factor to effect adoption. Demonstrations and farmer selection are successfully done but information to people seems not to have been communicated effectively. Also people seem to lack major marketing knowledge.

Apart from people and process management of fields need a stronger strengthening from N2Africa's point of view. Stressing the importance of field maintenance by following N2Africa protocols should be enforced comprehensively to increase adoption rates. Farmers tackle problems on how to use inputs and when to use it. This leaves them with an agricultural knowledge gap as well. Additionally problems of rats and birds are quite deterring to the

climbing bean crop in this region. It is seen that N2Africa prevents adoption constraints at the process and material sectors but need more strengthening on equipment, management and communication to people for improving adoption process. This forms the majority of the small holder level and environment level constraints analysed through this study.

This leaves us with a number of adoption constraints at various levels. The following Pareto analysis would simplify analysing the adoption constraints dealt in the research.

4.2 PARETO ANALYSIS

This analysis carried out helped in majorly identifying small holder and environmental constraints in the adoption process. This is a result depicted from farmer and stake holder interview analysis. It was found through the analysis of interviews that 61 out of 67 farmers successfully adopted the beans and used them in the field. Though this information is promising the constraints in the process of adoption are quite evident. Over 80% of the farmers who have planted the beans have planted the beans without following the protocol completely. They had adapted the planting style of beans as per their field setting. Literature studies on adoption and diffusion by Andrew Farrow enlists a number of adoption constraints as part of reporting. This process of enlisting the adoption constraints and analysing them individually would create a deep understanding on each constraint and comprehending solutions for them. However on the bigger picture certain constraints could be redundant and consistent for individual crops i.e scenario of climbing beans and specific to regions. While going specific on understanding constraints it becomes important to identify the intensity of the constraint specific to the region and the crop. This intensification of identifying key constraints is brought about through the Pareto principle. It gives a clearer picture of the problems and zooms in few problems to resolve major constraints of farmers.

It is a statistical technique in decision-making used for the selection of limited number of tasks that produce significant overall effect. It uses the **Pareto** Principle (also known as the 80/20 rule) the logic behind this principle is that by doing 20% of the work one can generate 80% of the benefit of doing the entire task (projectsmartuk.org, 13/3/2015). This Pareto analysis helps in identifying 80% of the problems from 20% of the causes. Using this information the following results are discussed. Through this result it would help facilitate quick action to distinguish major constraints from minor ones. The following figure depicts the Pareto results obtained :-

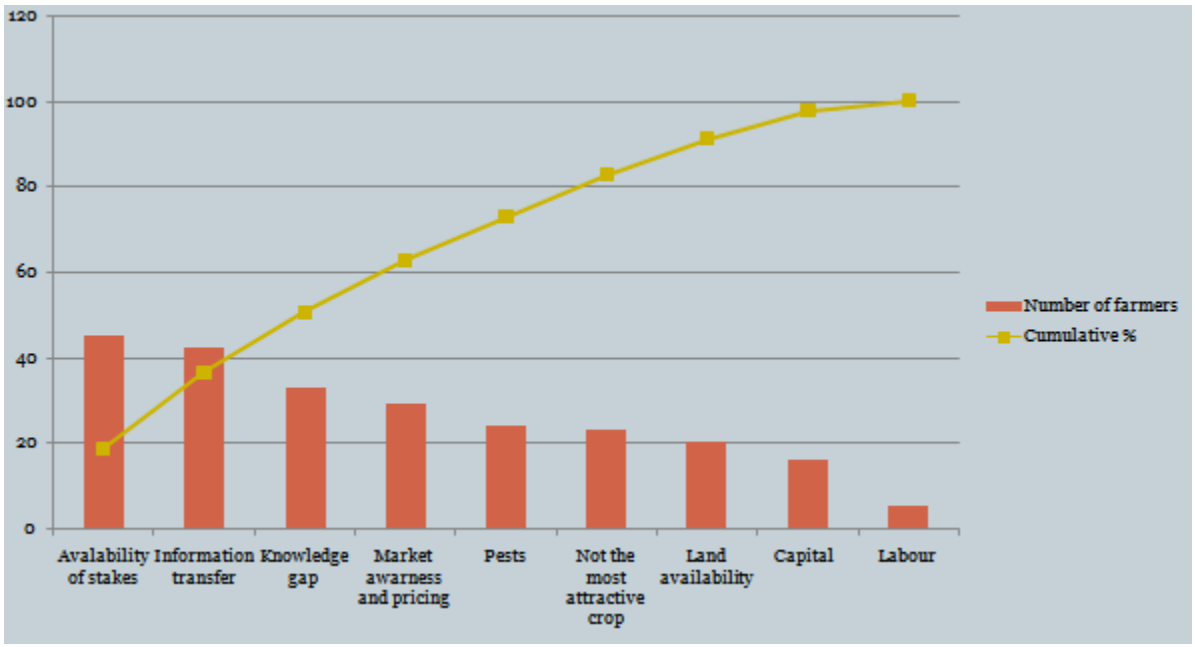
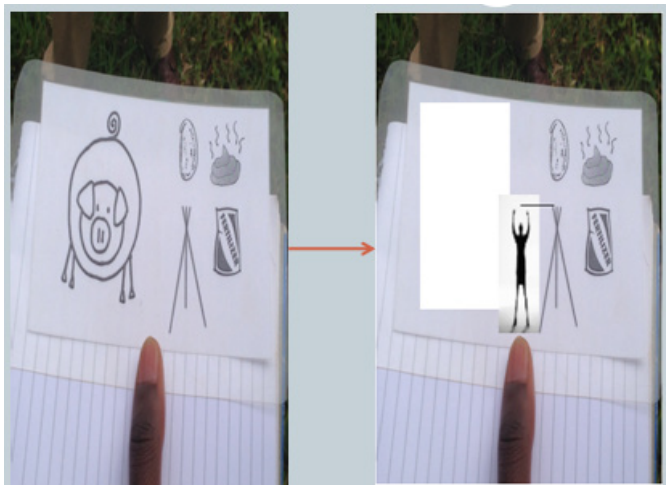


Figure 4: Pareto analysis: The yellow line represents the cumulative effect of adoption constraints of farmers.

Stakes: Availability of stakes was reported as a major problem with over 80% of the farmers having this problem. As per the internship report of M.S.Breure and J.Kool in Kisoro district which is about 70 kilometers from Kashambya subcounty a large majority of the farmers buys the stakes from the car which sells these stakes at around 100 Ush/stake in bundles (stacks of around 10 stakes) (Breure and Kool, 2014). These stakes were made from bamboo and could be used for up to 6 seasons. 45 farmers out of 67 farmers found this as a major problem. Growing trees to be self sufficient on stakes was the solution provided in the last season but N2Africa is already working on this through an alternative solution of using banana fibers instead of stakes. The use of banana fibres already in the demonstration plots is the easiest positive solution. This is because labour was not the major concern and transport of these stakes from Kisoro would increase the price of the stakes which could end up too expensive farmer. Moreover banana is consumed as a staple crop and is consistently available throughout the year. Exploiting this usage of banana fibres would encourage farmers to grow banana crops before beans to extract the fibres before the season.

Information transfer: Though some farmers used the beans upon their will to use it as per their needs, most of them had adapted the bean plantation citing to the reason that there was no clear idea and explanation on several factors for example:-

- Many farmers who used the stakes also did not have a clear idea on how tall the stakes must be. They were using stakes of different heights from 80 cm to 300 cm. Though some of them knew about staking heights most of them were not informed about the staking heights to be used. An example of one of the descriptive cards given to a farmer is as shown in the figure.



Here the picture of the pig is used as a reference for similar treatments and it occupies half of the page. Replacing it by a reference number or code number would occupy much lesser space. It would help in better diffusion of innovation and prompt better adoption by changing it to the image on the right wherein the picture of a human standing next to the stakes showing how tall the stakes should be. The preferred staking height is at least 180 cm and the picture on the

Figure 5: Current picture card (left)

And improved (right)

- Another problem with information transfer is that the farmers received information leaflets purely in English. The leaflet is quite descriptive but it could be more depiction of pictures than information in English. The picture below shows that the leaflet given in English. Most of the people in Kashambya subcounty don't read and write in English language. Another factor is that some of them don't know to read and write in any language. So the leaflet information given to the farmers is not perceivable by them. This information can be combined with the information in picture cards for better understanding. A clear case of confusion was perceived by one farmer where information was provided as 5metres is around 17 feet. The farmer understands metres. He saw too numbers and made one plot as 5x5 and another as 17x17. This perceivable confusion must be avoided. Additionally, information in the leaflet we see is that the amount of manure applied should be equal in the fields. Here it's stated that apply equal amounts of manure in the field wherein the quantity is not mentioned or depicted in any form. This is a classic case of differential threshold where the information passed is received differently.

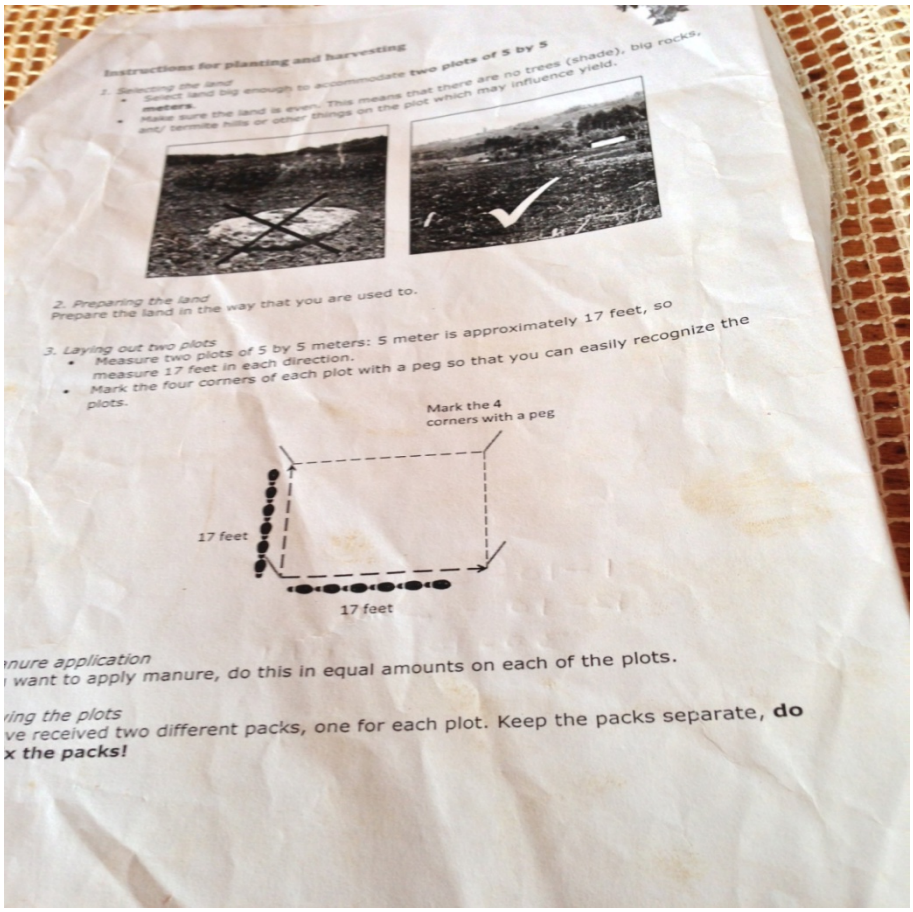


Figure 6: farming protocol

- A third problem in information transfer is the fact that the N2Africa people hire translators to communicate to the farmers. There could be an information lag in this process as the transmission of information is language dependant. To resolve this problem hiring N2Africa personnel who speak the language of target regions or N2Africa people learning the local languages is the way to reduce this information lag.

Just by improving better access to stakes and improved information transfer over 80% of the common constraints faced by the farmers would be improved. About 55 farmers out of 67 faced either one of these constraints. Thus this Pareto analysis helped in narrowing down on 20% of the work done to improve 80% of the common constraint faced by the farmers. Beyond this analysis there is scope for improving and resolving other constraints depicted in the figure3.

Knowledge gap:

When a question related to what the farmers learnt from N2Africa in a group discussion on field day, the farmers replied that they learnt about spacing and different staking methods. The staking methods are tripods, banana fibres and vertical stakes. Their knowledge gap lied outside this wherein they were applying fungicides such as dithane from the local market on a variety of

crops (irish potatoes, beans and banana).Some of these crops had pest issues, some of them had bacterial infections, some fungal infections and most of them didn't have any infection. Fungicides were used predominantly as a precautionary measure. As a method of use these pesticides are used upon the advent of an infection. This shows a clear case of lack of knowledge as a fungicide doesn't control the activity of rats, birds, bacterial infection etc. The precautionary use by application of these chemicals is a more cultural trend and has been followed from previous generation. It's a cultural activity in the part of these farmers. A better understanding on farm chemicals by N2Africa would improve their agricultural knowledge and adopt better farming practices.

Market knowledge and land availability: 11 farmers out of the 67 farmers produced crops only for home consumption. This is a very significant number around 20%. These farmers even when they have adopted beans quite well are struggling to meet their food necessities mainly in and August and September. The farmers in this region led a sedentary life style when it comes to exploring the market potential for their beans. The N2Africa beans were sold to local traders at a price of 1000Ush/kg. The local bean variety Katuna was sold at 1200 Ush/kg. These traders sell it to the shop keepers in Muhanga. The Katuna beans are sold at 2200-2500/kg while the N2Africa Nabe 12C are sold at 2400Ush/kg. Considering that this market is just 30 kilometres from Kashambya but farmers lack access to this market. In Kampala shops the N2Afica beans are sold at 3500 Ush/kg while the Katuna beans are sold at 3200 Ush/kg. The main problem with market access is that:-

- The farmers produce in small quantities with good yields ranging (2-3 tonnes/acre). The beans were grown in smaller land area than an acre. Hence the yield is less than a tonne in some fields. The shop keepers in Muhanga buy these beans in bulk from the traders who have connections with farmers. The price of the beans sold at farm gate is usually negotiated by the traders and the farmers have no say in the pricing of their beans. A farm cooperation set up would improve their market potential as the farmers can bulk their produce together and sell them at better profit.
- As a first step knowing about price of beans in different markets is very necessary information for the farmer to understand the value of the product. This information would allow farmers to identify about their markets and produce accordingly.

Pests and diseases: The issue of pests and diseases especially that of rats and birds is quite dominant in this region. Provide farmers with adequate knowledge on preventive and control treatments would help them visualize better yields.

Other constraints: About 20 farmers said that beans were not their most attractive crop in terms of returns. Irish potatoes were the most popular crop with the farmers. The most popular crop is planted along flat lands in this region. Irish potatoes were given flat land plots for cultivation and beans were plotted along the slopes with over 50 farmers. A way to create more attraction towards climbing bean varieties would be to grow varieties which are compatible with irish potatoes. This would help in more vigorous climbing bean cultivation among farmers via sublimal conditioning. Sublimal conditioning is a phenomenon where the farmers realise the value of beans by improved yields of irish potatoes.

The other constraints such as land availability, capital and labour account for less than 15% of the total adoption constraints. These are factors are inherent factors with many African countries and though currently a concern would be resolved as the farmers progress in their agricultural production and marketing. Labour was not seen much of a concern as the farmers had lands of very small areas in most cases. Potential assists in these factors is quite difficult for N2Africa.

Thus through this Pareto analysis it was found that just ensuring that enough stakes are available is a common problem for around 80% of the farmers would resolve 20% of their issues. Resolving information transfer and availability of stakes issue would resolve 40% of farmer issues. Additionally adding knowledge gap, market pricing and pest issues concern nearly 80% of the farmer issues. If these issues which are prevalent are addressed adequately in the next season of trials it would improve adoption processes multi fold.

4.2 FIELD ASSESSMENT

In the following table the field analysis for various sects of farmers is identified. Four parameters were measured in the fields and the number of farmers is segregated according to their adoption strategies based on these four parameters. In total 56 farmers planted the beans-6 farmers didn't adopt as per instructions in the manual for these four parameters and 5 farmers adopted quite well when measured for these parameters. Most of the farmers thus have adopted the beans but adapted them to their field necessities.

Table 2: Field assessment -red boxes represent lack of adoption and green boxes represent succesful adoption on the paramters measured

Number of farmers	Spacing(40-50cm)	Staking height(>180cm)	Number of weeds/sqm(<10)	Number of treatments(2)
6				
15				
5				
3				
7				
13				
7				
5				

Through this table it could be seen that management of weeds in the fields is a big problem in the fields but on the contrary it is not an adoption concern as farmers don't want to weed their fields that often as it is a labour intensive activity. 6 farmers who had planted the beans planted without much of importance to the inputs by N2Africa and adapted them completely as per their requirement. The stakes are a problem as only 15 farmers were able to find stakes of over 180 cm, A third of the farmers had been using only one treatment in their fields. Some of them used only one treatment citing poor fertility in the soil and using fertilizer in both the treatments. One big plus from N2Africa is that a majority of farmers reported that they learnt good spacing techniques from N2Africa and have implemented good spacing techniques. This field assessment reflects the constraints of knowledge gap, information transfer and availability of stakes.

Through this study it is seen that weed management and staking height are major field issues Weed management is identified as an exclusive farm constraint which the farmers did not address in the interviews wherein the weeds are dominant in 49 out of 56 farmer fields. This is also identified as a problem of knowledge gap of farers to tackle the issue of weeds. The information transfer issue is perceived here again with staking height and number of treatments. Staking height is a problem due to lack of information as well as lack of availability of stakes. The biggest positive in this field assessment was that about 45 farmers spaced their plants at adequate distances between each other (between 20cm and 40cm) and farmers have acknowledged in their interviews that N2Africa had educated them on spacing between plants and cited that as their biggest learning.

5. CONCLUSION AND IMPLICATIONS

This report had aimed to identify the adoption problems in Kashambya subcounty, Uganda. The Several marketing solutions were hypothesized for future implementation and trials. Through this research in Uganda, a generalized problem of information transfer has been specific feature in Kashambya subcounty. The diffusion process had been limited largely due a few factors as discussed in pareto analysis and information transfer is a major problem. N2Africa feels the importance of information transmission but this area needs strengthening to make farmers understand how to use climbing beans.

On a general issue availability of stakes was a problem in earlier research and has been continuing still with the farmers. The alternative idea of using banana fibers could resolve this issue as its plantation is quite plentiful. The farmers of Kashambya subcounty have gained knowledge on spacing and different staking methods. Though this knowledge is very useful for them, the farmers look for benefits such as better irish potato varieties from N2Africa. Since potato is not a legume crop, N2Africa could focus on beans varieties which can be grown to favour the growth of irish potatoes. Apart from this research on different varieties, making the farmer knowledgeable on the farm product he/she is selling could prove to be quite important. The necessity of farmers to understand pricing different markets and subsequent market access to better markets would facilitate the reach of N2Africa bean varieties to larger markets. Other issues such as pests which are post adoption problems need to be addressed appropriately to resolve current issues of adoption. For a major improvement in adoption N2Africa must focus on

the ‘people’ segment of the cause and effect relationship with strengthening in information transfer required for a faster adoption of climbing beans. The following table splits these issues into farm level, small holder level and environmental level constraints

Table 3: Constraint Categories

Farm level	Small holder level	Environmental level
Weeds and Pests	Availability of stakes, Information transfer and knowledge gap	Market awareness and pricing

Resolving these small holder problems first before proceeding to farm level and environmental level constraints would facilitate the adoption process as the small holder issues account for 50% of all farmer issues and is faced by nearly 90% of the farmers.

Farmers are the major stakeholders or business partners for N2Africa and that is how N2Africa must visualize them. Transparency and clear communication would facilitate project development between business partners. This would potentially fasten the adoption process and diffusion of innovations quickly. Making a slight shift from the perception of helping farmers to aiding mutual business development by providing them knowledge on their business (knowledge gap in marketing) and better information transfer would certainly be beneficial for adoption.

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7. APPENDIX

APPENDIX1: REVIEW MATRIX

A. Africa
B. Ethiopia
C. Tanzania
D. Uganda
E. Labour
F. Seed
G. Knowledge
H. Capital / Assets
I. Output market
J. Other inputs
K. Relevance of technology
L. Collective action
M. ARD system
N. Gender
O. Education
P. Experience
Q. Land availability, quality or tenure
R. Cultural factors
S. Alternative technologies or livelihoods
T. Government support
U. Adaptability of technology
V. Risk Perceptions
W. Opportunity cost / time lag to benefits

		Location				Constraints																	
Study #	Legumes	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Common Bean, Chickpea, Lentil	1	1							1		1	1	1										
2'	Soybean	1				1		1	1		1				1	1	1							
3	Green manure & dual purpose legumes	1							1	1	1	1		1				1	1	1	1	1		
4	cowpea	1					1	1	1		1	1	1											
5								1						1										
6	cowpea	1					1	1		1		1				1		1						
7	pigeonpea	1		1		1	1	1	1					1			1	1		1				
8	chickpea, pigeonpea	1	1	1		1	1	1	1			1		1				1						
9	forage legumes	1	1									1	1					1		1				
10		1							1		1				1		1	1			1	1		
11		1			1									1				1			1			
12	rhizobium inoculation							1			1	1		1										
13	BNF							1	1			1								1	1			
14	cowpea	1							1	1		1												
15	rhizobium inoculation	1					1	1	1		1			1							1		1	
16	Common Bean	1		1			1			1		1					1							
17	Common Bean	1		1	1		1																1	
18	forage legumes	1	1																					
19	cowpea	1			1	1		1	1				1			1		1		1		1		
20	groundnut	1					1					1												
21'	mucuna	1												1				1						
22	legumes	1					1																	
23	grain legumes & green	1				1	1			1								1					1	1

	manure legumes																							
24	Green manure & dual purpose legumes	1						1		1		1	1		1			1	1			1	1	
25	cowpea	1				1		1		1					1			1						
26	Green manure & dual purpose legumes	1				1	1											1						
27	dual purpose legumes	1				1	1		1	1	1	1		1				1	1					
28	cover crops	1				1	1	1				1	1	1										
29	herbaceous legumes	1					1					1												
30	cover crops	1		1				1		1		1		1				1	1	1		1		
31	cowpea, groundnut & soybean	1						1	1	1			1	1		1	1							
32	cover crops	1			1	1			1			1										1	1	1
33	soybean stover, green manures	1						1			1	1												
34	mucuna	1				1		1	1	1		1	1	1	1			1	1	1	1			1
35		1				1			1														1	1
36	forage legumes					1	1	1	1			1		1				1		1				1
37	dryland legumes	1					1			1			1											
38	pigeonpea	1		1			1	1	1					1		1								
39	legumes													1										
40	green manure legumes	1										1												
41	pigeonpea	1		1			1	1	1					1				1						
42	perennial legumes	1				1	1		1	1	1	1			1					1				1
43	Green manure & dual purpose legumes	1												1										
44	Green manure & dual purpose legumes	1				1	1	1	1	1		1			1			1		1			1	
45	common beans	1	1										1	1										
46																								
47*		1													1		1	1						
48*	legumes	1							1															1
49	legume rotations with CA	1					1			1		1						1	1	1			1	1
50		1											1	1	1						1			1
51	fodder shrub legumes	1					1	1		1	1		1	1	1									
52*	legumes	1																						
53		1							1	1		1		1		1			1				1	
Study #	**Legumes**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**
Totals						15	22	22	22	18	10	25	12	23	10	6	6	21	7	11	7	6	9	9

Study # refers to number in the reference list

* Full text not available, assessment made using abstract

FIELD BOOK FOR FOCAL ADAPTATION TRIALS

Meta-data, farm typology and agronomy questions (Part 1, homestead

1. Name of the person filling the form:_____

2. Date when form filled (DD/MM/YYYY): _____ /_____ /_____

3. Action site

Country: _____

State/District: _____

LGA/ Sector / Ward/ Parish:_____

Village: _____

4. GPS coordinates of the homestead (measured at front door) **in decimal degrees**:

Latitude (North/South):_____ Longitude (East/West): _____

Altitude:_____ (meters)

Introduce yourself and N2Africa project. Explain purpose of survey and assure the interviewee

of the confidentiality. Make sure to check if the farmer has any questions at this time.Please note that 'you' always refers to the farmer unless indicated otherwise.

5. Name of the N2Africa farmer: _____

Sex of farmer (tick): Male ___ /Female ___ Age: _____years

Phone number of farmer or contact person:_____

FarmID:_____ (please assign a unique ID)

6. Did farmer participate in N2Africa demonstrations in previous season(s)?: Yes ___ / No ___

Did farmer fill the Field Book in previous season(s)? Yes___ / No____

If yes, in which season(s)? _____Old Farm ID (look up later) _____

7. Is farmer head of the household: Yes ___ / No ___

8. If no, head of household is Male ___ /Female ___ and A.10Age:_____years

9. Total number of people in the household (i.e. people currently living in the homestead).

Age	**No. of females**	**No. of males**
0 – 16 years		
17 – 35 years		
35 – 60years		
Over 60 years		

10.What is the education level of the person with the highest education in the household, and the education level of the household head? **Specify the number of years** this education was attended.

(**specify number of years, write 0 for none**)?

Schooling level	**Within household**	**Household head**
1. Primary		

2. Secondary		
3. Post-secondary		
4. University		
5. A.15.11 Other, specify:_____		

11. How much arable land do you have available for crop farming (incl. fallow land)?

Area: _____ Unit: _____

12. Number of valuable livestock species owned by the household

Cattle (no.):_____ Sheep (no.):_____ Goats (no.):_____

Pigs (no.):_____ Poultry (chickens, turkey, etc.) (no.): _____

Other valuable livestock, type: _____no: _____

type: _____no: _____

12. Do you hire labour from outside the household to work in your fields? Tick what best describes your situation:

	Tick
1. Yes, permanently (i.e. every year, throughout the cropping season)	
2. Yes, regularly (e.g. at peak periods during the cropping season)	
3. Yes, sometimes (e.g. not every season or peak period, only if money allows)	
4. No, never	

13. What proportion of your total farm produce (cash and edible crops) is used for home consumption and what proportion for sale? Tick what best describes your situation:

	Tick
1. All produce used for home consumption	
2. Most produce used for home consumption, small part used for sale	
3. Half of produce used for home consumption, half of produce used for sale	
4. Small part used for home consumption, most produce used for sale	
5. No produce used for home consumption, all produce used for sale	

14. In a normal year (not a drought year for instance), which months of the year (if any) do you struggle to find sufficient food? Please tick the months with food scarcity.

	Jan	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Tick the months when												

you struggle												

14. Importance of agriculture in the household. Please provide an estimate of the relative importance of different sources of income by dividing the total income into different portions. Write 0 if type of income does not apply.

	Estimated proportion of total income (in %, make sure the total equals 100%)
Cropping	
Livestock	
Casual labour in agriculture	
Casual labour off-farm	
Trade	
Other business	
Salaried job	
Pension	
Remittances	
Other_____	

15. Does your household possess any of the items below? Please tick owned items.

	tick		tick
Bicycle		Tractor	
Motorbike		Plough	
Car		Ox cart/ donkey cart	
Cell phone		Tap (piped) water	
Radio		Private well	
Television		Electricity	

Fridge		Solar Power	
Sofa		Generator	
House with tiled roof and/or cement/ brick walls		Any other valuable items not listed?_____	
Iron sheet roof		Any other valuable items not listed?_____	

16. Apart from living what are your major expenses and how much?

Category	**Expense (%)**
Labour	
Farm inputs	
Transport	
Loans	
Others_____	

Estimated wealth category of household, **based on interviewer's perception, not asked to respondent** (tick)

Very poor: _____Poor: _____ Medium: _____Wealthy: _____

QUESTIONS ON AGRONOMY

17. If you are buying inputs which inputs are you buying and from where? What crops are they applied for? Why? Do you trust the seller for the input?

18. How many fields did you crop **last** season: _____

For the fields mentioned above in C.3 (or for the 3 most important ones),please provide the following information related to the previous cropping season. If legumes are grown on another field than these 3, please fill in data on the legume field under field 4.**Please pay attention to units**.

	field 1	field 2	field 3	field 4
D.1 Size (**specify unit**)				

D.2 Walking distance of field from homestead. (in minutes)					
D.3 1st most important crop in field					
Other crops in field					
D.6 Amount of mineral fertilizer applied (0 for none, **specify unit!**)					
D.7 Type of mineral fertilizer					
D.8 Organic inputs applied Y/N					
D.9 Rhizobium inoculant applied? Y/N					
D.10 Fertility of the field (good/ moderate/poor)					

19. For your 3 most important crops, how much do you harvest (per area of land) in a normal year?

crop 1:_____amount:_____unit:_____area of land:_____unit: _____

crop 2:_____amount:_____unit:_____area of land:_____unit:_____

crop 3:_____amount:_____unit:_____area of land:_____unit:_____

INFORMATION ON THE N2AFRICA PACKAGERECEIVED BY THE FARMER AND ON THEFIELD WHERE THE PACKAGE WAS PLANTED.

20. Which legume package did you receive?

_____

21. Did you plant the legume that you received? Yes___ No____

22. Did you use all the proved inputs for this legume? Yes___ No____

In case you did not plant the legume or did not use the inputs, what did you do?

_____

_____

_____What was the reason for not planting the legume or using the

inputs?

_____

_____

_____

23. We would like to know if the technologies offered in the N2Africa package were new to you, or if you already used some of these technologies before. Please tick the items in the table which were new to you.

Part of package	**Tick if this was new**
Legume species	
Legume variety	
Use of mineral fertilizer in this legume	
Inoculant	
Other _____	
Other _____	

INOCULATION

24. Did you inoculate any legume in your N2Africa field ? Yes ___ /No ___

If yes, please answer the following questions:

25. Was the inoculant stored at the farm before applying? (Y/N) ___

If yes, how was it stored? _____

If yes, for how long (days/weeks/months) was it stored before use? _____ days _____ weeks _____ months

26. How many minutes/hours/days passed between mixing seed with inoculants and planting the seed?

_____ minutes _____ days _____ hours

27. If the field with the N2Africa trial**was described in part 1**, please provide the field number _____

Please record the crops that were cultivated previously in the field where the N2Africa trial is now planted. Also record the inputs that were used. Do this for the **previous season**(1 season ago) and the **season before the previous season**(2 seasons ago).

	Previous season	*Season before previous season*
D.18 Crop(s) grown in N2Africa plot (**inorder of importance**)	Crop 1:	Crop 1:
	Crop 2:	Crop 2:
	Crop 3:	Crop 3:
D.19 Mineral fertilizers used (put "none" if none was used)	Type:	Type:
D.20 Organic inputs used (put "none" if none was used)	Type:	Type:
D.21 Inoculants used (put "none" if none was used)	Type:	Type:

PROBLEMS EXPERIENCED DURING THE GROWING SEASON ON THE N2AFRICA FIELD

28. Please tick whether the problems listed in the table were absent / mild / moderate / severe. Also record any other problems that occurred.

Problem	**absent**	**mild**	**moderate**	**severe**
drought				

water logging				
storm/hail				
pests				
weeds				
disease				
Other_____				
Other_____				

29. *If weed/pest/disease problems were reported, provide the following information (if known):*

Type of pest _____

Type of disease _____

Type of weeds _____

OBSERVATIONS DURING THE GROWING SEASON - CROPPING CALENDAR OF N2AFRICA FIELD

Please fill in the dates at which the following events occurred (if applicable)

D.22	**Activity**	**Date(approx)**
1.	Date of land preparation	
2.	Date of organic manure application	
3.	Date of planting	
4.	Date of mineral fertiliser application	
5.	Date of 1st weeding	
6.	Date of 2nd weeding	

7.	Date of 3rd weeding		
8.	Drought period/dry spell (from-to)	From:	To:
9.	Start water logging/flooding		
10.	Storm damage		
11.	Frost		
12.	Start pest/disease		
13.	50% flowering		
14.	50% maturity		
15.	Date of (final) harvest		

Price and market awareness related questions

30. Where do you sell your farm produce?

31. To whom do you sell your farm produce? Is the price fixed by you?

32. How is the produce collected from the farm?

33. Do you know what price other farmers are selling their crops at?

34. Are you aware of the seed prices in different markets? (Nearest trading -------capital market). How far is each market?

35. How many times do you sell your products/ season and what is the profit you net each time?

36. Can you describe the process of how you sell you sell your produce?

37. How would you like to improve the market value of your farm produce?