# Farm Households in Eastern Congo

## *Baseline Survey Report*

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## 1. Motivation, background and objectives

Promoting sustainable agriculture in Sub-Saharan Africa is an important objective of many governments, donors and international, or local implementing organizations, who spend large sums of money and resources on interventions that are believed to help achieve this goal. Yet little is known about the effectiveness of such interventions. Agricultural extension services are among the most common type of interventions that seek to introduce and increase the diffusion of (new) agricultural practices. Effective extension is expected to raise yields and income faster than would occur in the absence of extension and may close both technology and management gaps (Birkhaeuser et al 1991). Early (non-experimental) studies have shown some positive effect of extension on knowledge, adoption, farm productivity and farmer' profits although results vary widely across areas and type of crops studied (e.g. Evenson, 2001; Feder, 1985). Although there is a general consensus that (local) formal (e.g. markets) as well as informal (e.g. customs) institutions explain part of the variation, the exact mechanisms are not clear. Besides, in recent years, a participatory extension approach has gained increased popularity as a "bottom up" process where all stakeholders are involved in identifying constraints and opportunities for knowledge generation and dissemination of new crops, techniques and (or) inputs. Yet rigorous evidence on its effectiveness is still limited.

Another popular type of intervention (often implemented jointly with extension services) is the provision of (subsidized) inputs. Yet participation in such schemes is often low, despite people being are aware about its potential benefits, and little is known what hampers participation. Policymakers are therefore increasingly emphasizing the need for rigorous evaluations of these interventions to know what works (or not) and identify underlying mechanisms.

This reports presents the first phase of a study to rigorously assess the socio-economic impact of an agricultural intervention in Eastern DR Congo. The intervention comprises two distinct groups of activities. The first group relates to a participatory extension approach that combines training activities with the provision of small input packages to farmers to experiment with new inputs that improve the nitrogen fixing capacity of leguminous crops (hereafter *intervention A*). The second group of activities centers around a subsidized inputs scheme, that allows interested farmers to buy packages of improved seeds and new inputs at a subsidized price through a (sometimes newly installed) local institution (hereafter *intervention AS*). We will discuss each intervention in more detail below.

The trainings and inputs provided under intervention A are executed as part of a large-scale and long-term program (N2Africa) to support agriculture in eight Sub-Saharan African countries. The N2Africa program aims to improve agricultural yields, food security, and incomes through supply and promotion of new inputs and seeds that help increase nitrogen-fixation in grain legumes: the main source of protein for most poor African households (Woomer et al., 2014).

The N2Africa program in Eastern DRC is concentrated along three "axes" located in the province of South Kivu. The Northern Axis stretches north from the provincial capital Bukavu along Lake Kivu, at an altitude of some 1500m. The Western Axis is located in the highlands, west of Bukavu. The Southern axis comprises the Ruzizi plain, south of Bukavu at 600m altitude.

The program is implemented by Wageningen University the Netherlands, in collaboration with the International Center for Tropical Agriculture (CIAT), the International Institute for Tropical Agriculture (IITA), Consortium for Improving Agriculture-based Livelihoods in Central Africa (CIALCA); Catholic University of Bukavu, Diobass, PAD, SARCAF, Women for Women, IPLCI and CDC/Kiringye. CIAT and IITA are overall

responsible for the implementation of N2Africa technologies in Eastern DRC. They perform identical tasks, yet in different regions. CIAT oversees work along the Northern and Western axis, while IITA bears responsibility for executing these same tasks in the Plaine (the southern axis). The six NGOs (Diobass, PAD, SARCAF, IPLCI , CDC/Kiringye and Women for Women) are all implementing partners, with an equal split of three NGOs active along the Northern and Western axis, and the other three along the southern axis.

## Objectives

The first objective of the research project is to assess the effectiveness of N2Africa in Eastern DRC. We are specifically interested in answering the following questions:

1. What are the main characteristics of farm households in Eastern DRC?
2. What is the impact of the N2Africa intervention on yields, income, knowledge, attitude and adoption of new inputs (e.g. fertilizer and inoculants[1])?
3. How does technology and information diffuse through rural societies? (e.g. who takes up first, and does information spread more easily to members of particular social networks?)

Our intervention comprises a subsidized inputs scheme, where interested villagers can buy a subsidized package of inputs relevant to growing N-fixating crops. The input subsidy scheme is *not* part of standard N2Africa activities but has been developed as a *complement* to the standard N2Africa methodology. The use of specific inputs is expected to improve yields and increase farmer's income (e.g. Evenson and Gollin, 2003; SOAS et al., 2008). Subsidizing these inputs may lower opportunity costs of experimentation and increase demand that could further increase agricultural production and income.

The second objective of the research is to investigate the impact of a subsidy scheme and examine to what extent N2Africa and the subsidy scheme are complementary. We therefore also include the following research question:

*What is the impact of subsidized inputs, on yields, income, knowledge, attitude and adoption of new inputs relative to receiving N2Africa intervention only?*

Below we provide details on the methods used in data collection including the sampling frame, the sampling strategy, household and community surveys, the impact evaluation research design, and describe the main demographic and socio-economic characteristics in the data including farming characteristics and agricultural knowledge.

[1] Inoculant refers to a commercially available product. Grain legumes are coated (inoculated) with bacteria that fix nitrogen gas from the air into a form usable by plants. The nitrogen fixation thereby contributes to the production of high-protein legumes, increases yields and improves soil fertility (N2Africa, 2014).

## 2. Baseline Data Collection

The research was originally planned in both South and North-Kivu yet due to ongoing security issues around Goma we decided, prior to collecting any data, to only work in South-Kivu. The sampling frame comprised all villages spread across the northern, western and southern axes. The sampling frame was developed in collaboration with the partners listed above and included all villages that satisfied the following criteria: (i) the village was located in a an area where at least one of the partners had contacts on the ground and that the village was accessible by motorized transport; and (ii) the village had not been part of any N2Africa intervention before. We used a two-stage cluster sampling procedure with villages as the primary and households as the secondary sampling unit.

After selection of 102 villages for our sample we conducted a census in each village between 24-1-2013 and 24-2-2013. We obtained lists of all households within each village and randomly selected ten households from the list.

We hired 37 local enumerators from Bukavu to conduct the surveys. Recruitment of local enumerators was done in close consultation with the Catholic University of Bukavu (UCB). Prospective enumerators were interviewed and trained for two weeks and administered a short test afterwards. The outcomes of the test enabled us select the best candidates. Staff from the six partner NGOs accompanied enumerators in the field to obtain permission for conducting research and explain the purpose of the research to the village authorities. Interviews were conducted mostly in Swahili and data were recorded using Android tablets.

The household survey was conducted by visiting each household at their home. The questionnaire included modules on demographics, housing, agriculture and sources of agricultural knowledge, food security, social networks, and tried to elicit respondents' opinions on local governance.

In addition to the household interviews, we organized community meetings to ask questions related to conflict, diseases, rainfall, shocks and proximity to public services (e.g. markets, schools, hospitals). All community members and authorities were invited to join these sessions.

We have complete information for 904 households in 93 villages. Community data was collected in 99 villages. Unfortunately household data in six villages was not properly recorded or stored.

### Baseline household and community survey

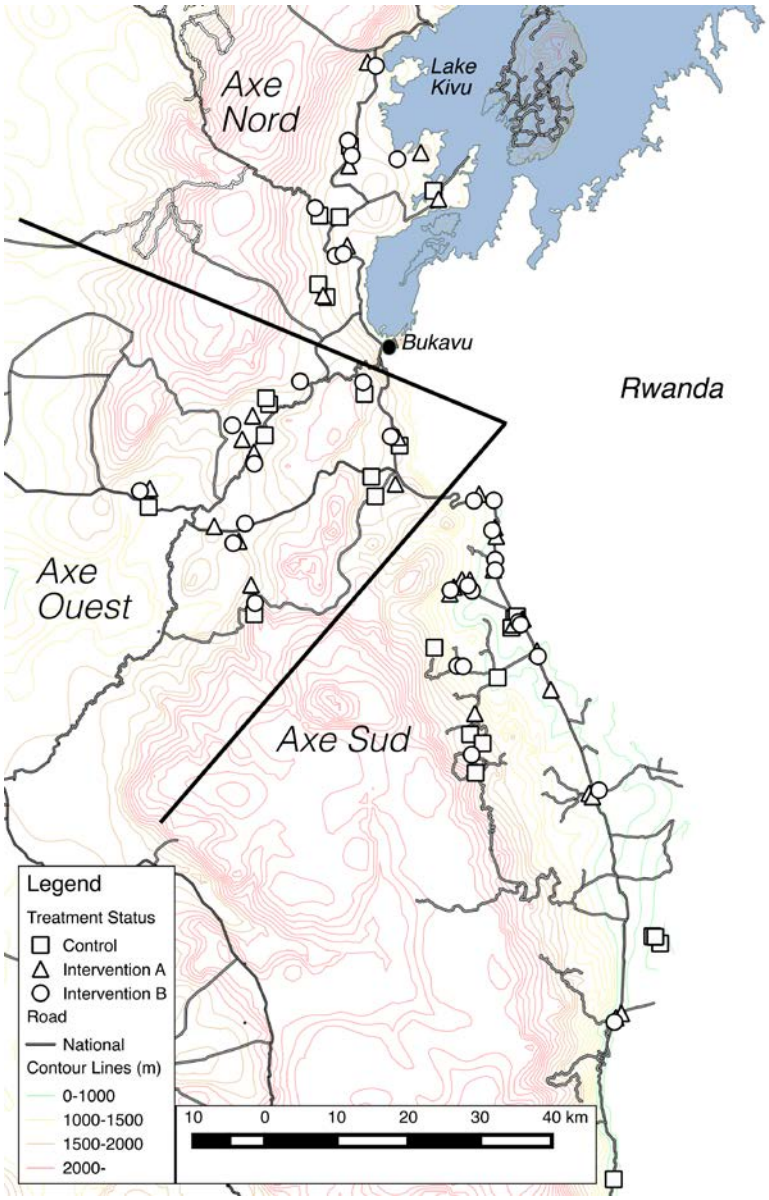
Baseline household and community surveys were conducted between in July 2013. Table 2.1 lists the number of villages and number of households included in the survey by axe.

**Table 2.1: Villages and households included in baseline survey, by Axe**

| Axe | Villages in community survey | Villages in household survey | Households in household survey | Average sample size per village |
|---|---|---|---|---|
| Nord (Bukavu - Kalehe) | 20 | 17 | 153 | 9.6 |
| Ouest (Bukavu - Mwenga) | 26 | 23 | 227 | 9.9 |
| Sud (Bukavu - Uvira) | 53 | 53 | 525 | 10.0 |
| Total | 99 | 93 | 905 | 9.9 |

Figure 1 maps the research locations, identifying communities that received the N2Africa intervention (described as *intervention A*); communities receive both *intervention A* and the opportunity to buy input packages through the local development committee (*intervention B*), and communities that received neither intervention.

**Figure 1.1 Research sites for the treatments and comparison groups**




Note: locations are approximate

## 3. Research Design

All 99 communities within the sample were scheduled to receive the N2Africa intervention between February and August 2013 (*intervention A*). Yet due to logistical constraints only 70 were treated, leaving a non-random sample of 33 villages as "pure controls". In order to rigorously assess the incremental impact of a subsidy scheme, we randomly assigned half of intervention A communities to also receive intervention AS (also see Table 3.1)

**Table 3.1 Communities by intervention/control group**

| Intervention A (N2Africa) | Intervention AS (N2Africa + subsidy) | Control |
|---|---|---|
| 35 communities | 35 communities | 33 communities |

### Intervention A

Extension workers start by visiting the village, consult with the local authorities and "sensitize" interested households and farmers' groups to the use of new techniques and inputs. Extension workers engage famers in a so-called 'situation analysis' to identify local needs and constraints. Community-based organizations, in consultation with the NGO representative, select a 'master' (also sometimes referred to as 'lead' or 'demo') farmer able to read and write, with access to (own) land, and has extensive experience in farming related to e.g. the diagnosis of soil nutrient problems, identification of the need for specific inputs and access to external sources for agricultural advice and supply of inputs and (improved) seeds. Master farmers receive training from extension workers in applying new techniques and inputs for growing grain legumes. In addition, they are expected to organize regular meetings with the group and act as a general coordinator between the group, the wider community and the extension worker(s). Experimental trials are set up where production of legumes (mostly soybean intercropped with maize or cassava) using traditional techniques is compared to legumes that were grown using new techniques and new inputs. These trials are usually conducted at a research station and managed by the researcher. Other farmers interested in applying these new practices can attend demonstration trial meetings (usually some 20-35 farmers per community). Farmers' groups and extension workers visiting these trials then select those options they expect to be most successful given their own conditions. Demonstration trials are then set up, usually on lead farmers' plots or group fields, where other farmers can observe different management techniques for different crops, compared against a control. Interested farmers receive small input packages to experiment on their own fields afterwards. Extension workers regularly visit the communities during the growing season to assess results, listen to farmers' experiences and advise them how to proceed. After the harvest, the extension workers organize field days for community members not participating in the project and exchange visits between communities where households can visit demonstration trials or other households' fields in agro-ecological zones different from their own. Field days were however not systematically organized but rather ad hoc in some of the more 'active' communities

### Intervention AS

After the implementation of intervention A had been completed (August 2013) intervention AS was implemented. All members in randomly selected communities are offered to buy one or multiple input packages similar to the ones farmers had experimented with in intervention A, through local development committees (CLD). CLDs were usually already present within the community and usually comprise a selected number of community representatives (sometimes including the village chief) that, among many other things, facilitates contacts with external (development) agents. The intervention looks as follows: CLD members first inform community members of the possibility to buy new inputs at (1) a reduced price (75% of

the going market price) and (2) offer a delayed payback scheme (with an advance payment of 500 FC) after harvest where participants could choose between (a) pay back in money; (b) pay back in harvested seeds or (c) a combination of (a) and (b). If people chose (b) they were requested to pay back 150% of the original seeds received. Participants can choose between six types of packages (worth 26 US dollars) that all contain a combination of improved seeds, fertilizer and (or) inoculum. Input packages slightly vary according to local conditions and farmers' preferences. After providing information about the contents of the packages, the price and the process of repayment CLD members register buyers and their choice of input packages and collect advance payments. After registration is completed a CLD representative hand over the list to the extension worker engaged in intervention A. The research team on the ground collects all lists and contact agro-dealers in Bukavu and surroundings to order the inputs. Prices for inputs are agreed upon beforehand with all dealers involved. Agro-dealers are expected to deliver the inputs to the communities before the start of the new planting season (September 2013). Inputs are delivered to the CLDs who are responsible for distributing the inputs to the buyers and collecting remaining payments after harvest. Yet, a follow-up survey in September 2013 revealed that only in 45 percent of the cases orders were received on time.

## Controls

The remaining 33 villages participate only in the research and do not receive the N2Africa program or the subsidy scheme. Table 3.2 lists the number of households interviewed in the baseline household survey by axe and intervention group. Compared to the two intervention groups (intervention A and intervention B as described above), the group of control villages has a relatively high number of households from the South axe, and few in the North and West.

**Table 3.2 Households in baseline household survey, by axe and intervention/control group**

| | Control | Intervention A | Intervention B | Total |
|---|---|---|---|---|
| Nord (Bukavu - Kalehe) | 39 (14%) | 57 (18%) | 57 (19%) | 153 (17%) |
| Ouest (Bukavu – Mweng | 61 (22%) | 88 (27%) | 78 (26%) | 227 (25%) |
| Sud (Bukavu - Uvira) | 176 (64%) | 180 (55%) | 169 (56%) | 525 (58%) |
| Total | 276 (100%) | 325 (100%) | 304 (100%) | 905 (100%) |

Each village is part of the operating area of one of the six local NGOs. CDD/Kiringye and Women for Women are active only in the Sud axe, whereas the other NGOs operated in two or three different axes, as indicated in the first column of Table 3.3. The distribution of villages across control and treatment groups varies across the NGOs. The distribution of villages across the NGOs was based on their experience in the area. The rationale for not randomizing NGOs across the villages was as follows: the local NGOs were working mostly with existing local groups with whom they interacted in the past and had built relationships of trust and support. If we would have randomly allocated NGOs across villages, villagers would have been confronted with a new NGO working on similar activities with them as the one(s) they had interacted with in the past. This could have created confusion, but also would have required new investments from both parties in terms of mutual knowledge, trust and support.

**Table 3.3 Households in baseline household survey, by NGO and intervention/control group**

| | Control | Intervention A | Intervention B | Total |
|---|---|---|---|---|
| CDC/Kiringye (Sud) | 84 | 30 | 38 | 152 |
| Diobass (Nord, Ouest, Sud) | 40 | 60 | 58 | 158 |
| IPLCI (Ouest, Sud) | 0 | 79 | 91 | 170 |
| PAD (Nord, Ouest) | 20 | 77 | 67 | 164 |
| SARCAF (Nord, Ouest, Sud) | 72 | 10 | 10 | 92 |
| Women for Women (Sud) | 60 | 69 | 40 | 169 |

| | | | | |
|---|---|---|---|---|
| Total | 276 | 325 | 304 | 905 |

## 4. Demographic and Socio-Economic Characteristics

Across the 99 villages for which we have census data, village size ranges from 40 to more than 1400 households per village. The average village has 207 households. Villages in the South axe are substantially larger, with 265 households on average. Villages in the West (Bukavu-Mwenga) are smallest, with 134 households per village.

**Figure 4.1 Average number of households per village, by axe**

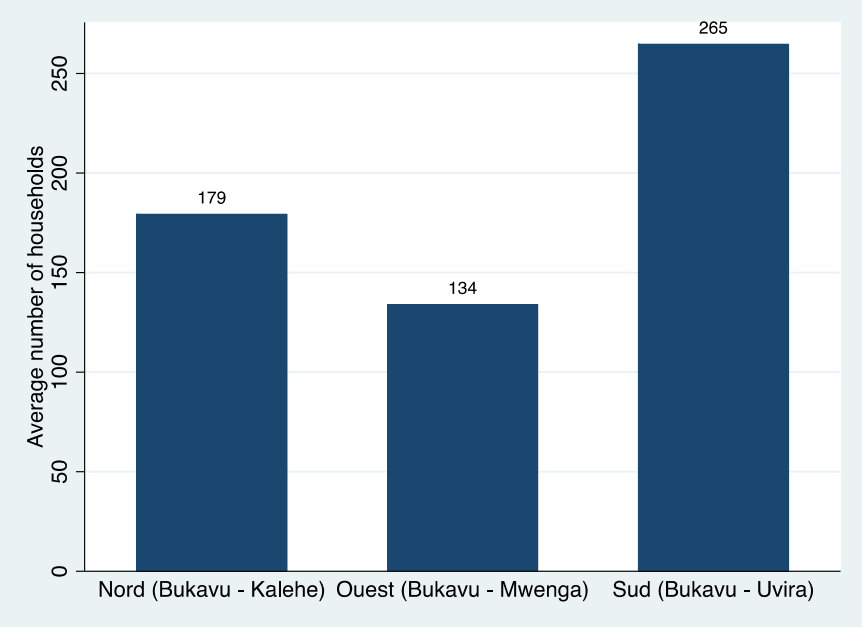



Table 4.1 describes the average household size in the sample and each of the axes. Household size is 6.5 on average and varies from 1 to 19 persons. The last two columns in the table show that in all axes, the overwhelming majority of households are male-headed: only 12% of households have a female head.

**Table 4.1 Household size**

| | | Household size | | | | Male household head | |
|---|---|---|---|---|---|---|---|
| **Axe** | **Obs** | **Mean** | **Std. dev.** | **Min** | **Max** | **Mean (%)** | **Std. dev.** |
| Nord (Bukavu - Kalehe) | 153 | 7.12 | 2.98 | 1 | 19 | 88.5 | 0.32 |
| Ouest (Bukavu - Mwenga) | 226 | 6.56 | 2.73 | 2 | 14 | 93.2 | 0.25 |
| Sud (Bukavu - Uvira) | 525 | 6.39 | 2.58 | 1 | 15 | 86.4 | 0.34 |
| Total | 904 | 6.56 | 2.70 | 1 | 19 | 88.5 | 0.32 |

Table 4.2 summarizes the self-reported literacy rates for household heads, spouses, and children in the age group 6-15. On average, 65% of household heads reports being literate, with little variation across axes. The literacy rate for spouses is only 42% and is much lower in the Nord axe compared to the Ouest and Sud axes. For children, reported literacy rates are higher: they vary between 69% in the Ouest axe and 76% in the Sud axe.

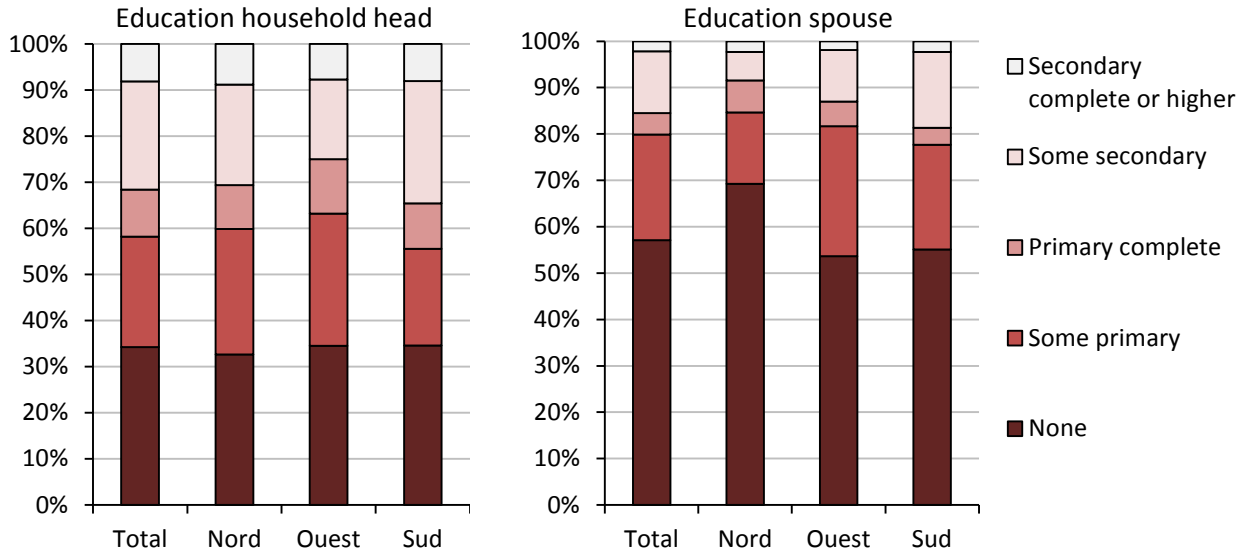
**Table 4.2 Literacy rates of household heads, spouses, and children**

| | Head | | | Spouse | | | Children age 6-15 | | |
|---|---|---|---|---|---|---|---|---|---|
| **Axe** | **Obs** | **Mean** | **Std. dev.** | **Obs** | **Mean** | **Std. dev.** | **Obs** | **Mean** | **Std. dev.** |
| Nord (Bukavu - Kalehe) | 148 | 0.65 | 0.48 | 132 | 0.31 | 0.46 | 340 | 0.74 | 0.30 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ouest (Bukavu - Mwenga) | 222 | 0.64 | 0.48 | 208 | 0.46 | 0.50 | 395 | 0.69 | 0.32 |
| Sud (Bukavu - Uvira) | 522 | 0.65 | 0.48 | 441 | 0.43 | 0.49 | 1015 | 0.76 | 0.30 |
| Total | 892 | 0.65 | 0.48 | 781 | 0.42 | 0.49 | 1750 | 0.74 | 0.31 |

Figure 4.2 summarizes the educational attainment of household heads and their spouses. About one third of household heads, and more than half of the spouses, have no formal education. On average, eight percent of household heads and two percent of spouses have completed secondary education or higher.

**Figure 4.2 Educational attainment**




As Table 4.3 shows, among those households interviewed, almost 80 percent report farming as the primary occupation of the household head. Some 16 percent of household heads in the North axe work as wage laborer, which we take as agricultural wage labor. This share is much lower in the South and West.

**Table 4.3 Occupation of household head**

| | Total | Nord | Ouest | Sud |
|---|---|---|---|---|
| Farmer (own field) | 77.80 | 67.57 | 72.07 | 83.14 |
| Wage laborer | 7.62 | 16.22 | 6.76 | 5.56 |
| Petty trading | 3.70 | 4.05 | 4.50 | 3.26 |
| Mining | 1.35 | - | 4.50 | 0.38 |
| Unemployed | 2.35 | 4.05 | 2.70 | 1.72 |
| Student or “other” | 7.17 | 8.11 | 9.46 | 5.94 |
| Total | 100% | 100% | 100% | 100% |

We also asked for the occupation of the spouse of the household head. In about 95 percent of all households in our sample, the spouse of the household head works as a farmer on the household’s own field.

## Assets

Table 4.4 lists the household ownership for several assets. Most households own an machette and how (farm tools) and a cooking pot. On average, households own 5 of the listed assets. There is some regional diversity, in particular with respect to bycicle ownership, which is as low as 1% in the western axis, its up to 24% in the south.

**Table 4.4 Asset ownership**

| | Total | North | West | South |
|---|---|---|---|---|
| Machette | 86.4% | 84.3% | 88.1% | 86.3% |
| Hoe | 97.1% | 98.0% | 96.9% | 97.0% |
| Bicycle | 15.5% | 4.6% | 1.3% | 24.8% |
| Radio | 44.6% | 47.1% | 47.1% | 42.9% |
| Mobile phone | 41.3% | 41.8% | 40.1% | 41.7% |
| Pan | 97.5% | 99.3% | 97.4% | 97.0% |
| Bed | 62.9% | 69.3% | 69.2% | 58.3% |
| Mattress | 42.1% | 40.5% | 42.7% | 42.3% |
| Canoe | 1.2% | 3.3% | 0.4% | 1.0% |
| Bed net | 1.9% | 3.3% | 0.4% | 2.1% |
| Television | 1.9% | 5.2% | 0.0% | 1.7% |
| Motorcycle | 3.1% | 5.9% | 1.8% | 2.9% |
| # of assets | 5.0 | 5.0 | 4.9 | 5.0 |

## Food insecurity

We asked households nine questions related to food security. These questions are part of the Household Food Insecurity Access Scale, developed by the Food and Nutrition Technical Assistance Project (FANTA) (see Coates et al., 2007). We identified nine specific types of food insecurity experience and asked households to indicate whether they occurred during the past four weeks (yes or no), and how often (1 = once or twice; 2 = three to ten times; 3 = more than ten times). The average scores are summarized in Table 4.5.

**Table 4.5 Food insecurity items and average scores (N=903)**

| Au cours des quatre dernières semaines, | Yes (%) | If yes, how often (mean) | Domain |
|---|---|---|---|
| 1. avez-vous préoccupé que votre ménage n'avait pas assez de nourriture? | 85.7 | 2.26 | Anxiety |
| 2. est-ce que vous ou un membre de votre ménage n'a pas pu manger les types d'aliments que vous préférez à cause d'un manque de ressources? | 91.0 | 2.29 | Quality |
| 3. avez-vous ou un membre de votre ménage a mangé une variété limitée d'aliments à cause d'un manque de ressources? | 89.5 | 2.27 | Quality |
| 4. avez-vous ou un membre de votre ménage a mangé certains aliments que vous n'avez vraiment pas envié de manger à cause d'un manque de ressources pour obtenir d'autres types d'aliments? | 90.8 | 2.28 | Quality |
| 5. avez-vous ou un membre de votre ménage a mangé un repas plus petit que vous aviez besoin parce qu'il n'y avait pas assez de nourriture? | 84.4 | 2.22 | Intake |
| 6. avez-vous ou un membre de votre ménage a mangé moins de repas par jour parce qu'il n'y avait pas assez de nourriture? | 84.9 | 2.23 | Intake |
| 7. était-il jamais rien à manger de toute nature dans votre maison à cause du manque de ressources pour obtenir de la nourriture? | 65.3 | 2.02 | Intake |
| 8. avez-vous ou un membre de votre ménage est allé au lit en ayant faim parce qu'il n'y avait pas assez de nourriture? | 58.8 | 1.85 | Intake |
| 9. avez-vous ou un membre de votre ménage a passé toute une journée et nuit sans rien manger parce qu'il n'y avait pas assez de nourriture? | 47.3 | 1.83 | Intake |

Note: Answers for 'if yes, how often' are 1 = once or twice; 2 = three to ten times; 3 = more than ten times.

The two questions were combined into a single score for each of the nine food security items. This score indicates the frequency of occurrence in the past four week (0 = never; 1 = once or twice; 2 = three to ten times; 3 = more than ten times). We calculate an index of food insecurity, called the *Household Food*

*Insecurity Access Scale Score*, as the sum of the scores across all nine items. The index ranges from 0 to 27, using a reverse scale: a higher score indicates more frequent experience of food insecurity while a lower score demonstrates lower frequencies of experiences of food insecurity. Table 4.6 summarizes the index values. The average household's food insecurity index is 15.2, indicating that the average household experiences seven to eight types of food insecurity three to ten times per month. Households in the West axe have the highest level of food insecurity, but the regional differences are small.

**Table 4.6 Food Insecurity Index**

| Food Insecurity Index | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Nord | 152 | 15.4 | 7.1 | 0 | 27 |
| Ouest | 226 | 16.7 | 6.0 | 0 | 27 |
| Sud | 525 | 14.5 | 6.6 | 0 | 27 |
| Total | 903 | 15.2 | 6.6 | 0 | 27 |

Household food insecurity data can also be summarized according to three domains of insecurity (see Coates et al., 2007). These three domains are anxiety about insufficiency, insufficient quality of food, and insufficient quantity of food intake. Each domain is measured by a subset of the nine questions, as indicated in the last column of table 4.5. The first survey items measure anxiety, quality is the average across items 2-4, and intake quantity is the average across items 5-9.

Table 4.6 below shows the percentage of households experiencing food insecurity along each dimension. Anxiety about food security and insufficient quality of food are the main domains of food insecurity, with 85 to 90 percent of households indicating they experience insufficiency on these domains. On the quantity of food intake, almost 70 percent of households indicate insufficiency. Households in the West score worse on all three domains compared to households in the South and North.

**Table 4.7 Food insufficiency across three domains**

| | Percentage of households that indicate insufficiency | | | |
|---|---|---|---|---|
| **Domain** | Total | Nord | Ouest | Sud |
| Anxiety | 85.7% | 84.2% | 90.7% | 84.0% |
| Quality | 90.4% | 87.1% | 94.3% | 89.8% |
| Intake | 68.2% | 66.3% | 73.0% | 66.6% |

# 5. Farming Characteristics

## Plots and main crops

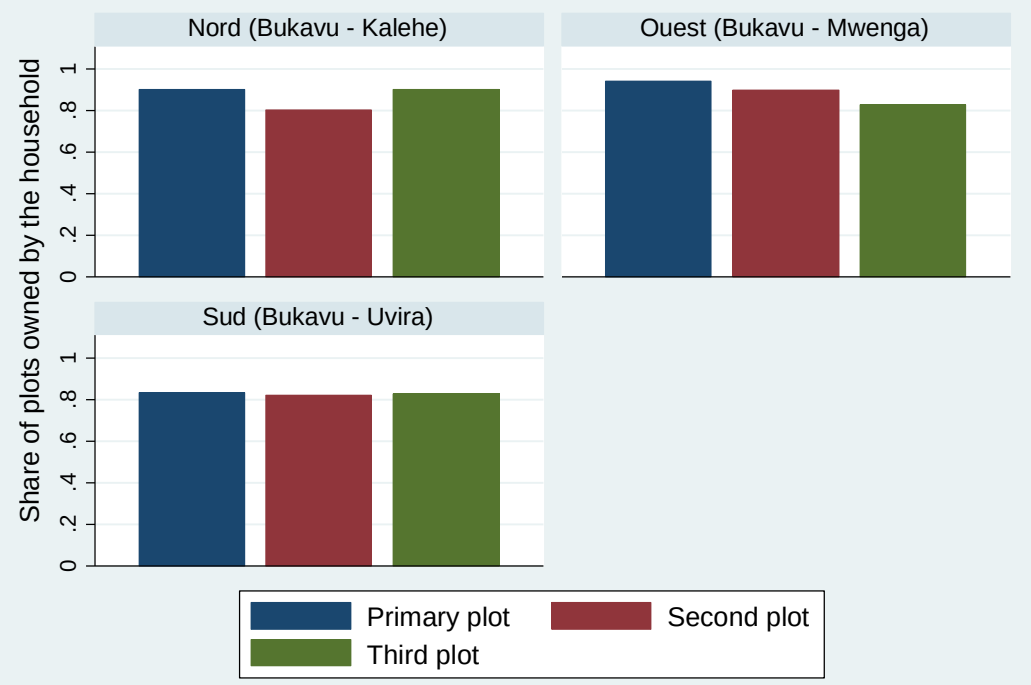
Households in the sample have up to nine plots, with an average of two plots per household (Table 5.1). The household questionnaire collected data on land, crops, inputs, and yields for the season January-June 2013 for up to three different plots per household. In total, the 904 households interviewed reported data for 1,774 plots.

**Table 5.1 Number of plots per household, by axe**

| Axe | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Nord (Bukavu - Kalehe) | 153 | 2.01 | 1.35 | 1 | 8 |
| Ouest (Bukavu - Mwenga) | 226 | 2.08 | 1.09 | 1 | 8 |
| Sud (Bukavu - Uvira) | 525 | 2.33 | 1.53 | 1 | 9 |
| Total | 904 | 2.21 | 1.41 | 1 | 9 |

Some 80 per cent of all plots is owned by the household, with limited variation across regions (see Figure 5.1). The remaining 20% of plots is usually rented – either long term (11.9%) or short term (7.7%) – from someone else in the village.

**Figure 5.1 Crop ownership – proportion of crops owned by the household**




As Table 5.2 shows, walking distance to the plots is 46 minutes on average, but is significantly higher in the South compared to the other two regions: households in the South region have an average walking distance of around one hour to their plots.

**Table 5.2 Distance to plots, by axe (in minutes walking)**

| | Primary plot | | | Second plot | | | Third plot | | |
|---|---|---|---|---|---|---|---|---|---|
| **Axe** | **Obs** | **Mean** | **Std. Dev.** | **Obs** | **Mean** | **Std. Dev.** | **Obs** | **Mean** | **Std. Dev.** |
| Nord | 153 | 20.3 | 29.9 | 81 | 25.5 | 35.5 | 41 | 22.9 | 36.7 |
| Ouest | 226 | 25.2 | 41.4 | 149 | 27.8 | 38.1 | 70 | 27.0 | 33.2 |
| Sud | 525 | 62.7 | 58.6 | 350 | 59.3 | 57.0 | 179 | 60.2 | 67.6 |
| Total | 904 | 46.1 | 54.3 | 580 | 46.5 | 52.5 | 290 | 46.9 | 59.6 |

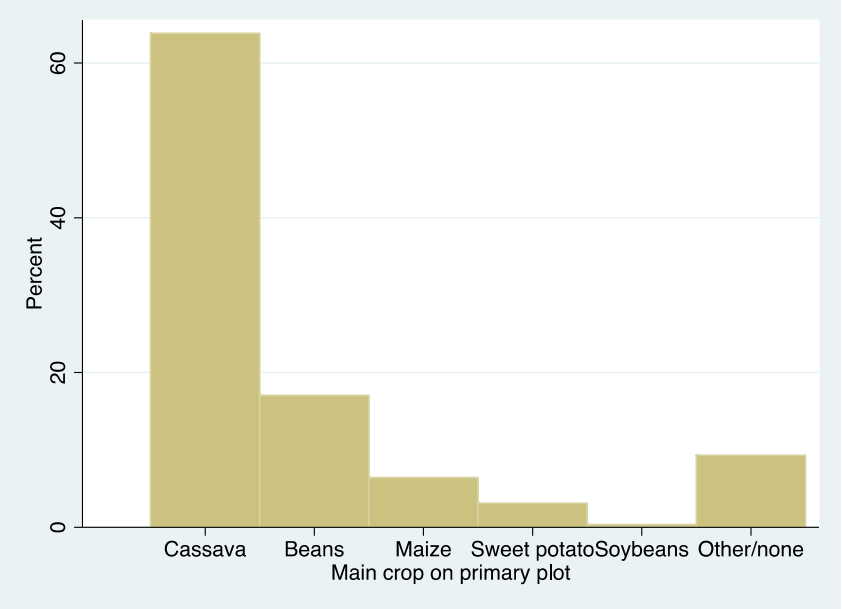
For each of three plots, we asked which household member was the plot's main decision-maker. Information on the gender of the main decision-maker is summarized in Table 5.3. In 32 percent of all households in the sample, the main decision maker for the primary plot is female. On the second and third plot, this percentage is slightly lower.

**Table 5.3 Percentage female main decision maker, by axe**

| | Primary plot | | | Second plot | | | Third plot | | |
|---|---|---|---|---|---|---|---|---|---|
| **Axe** | **Obs** | **Mean (%)** | **Std. Dev.** | **Obs** | **Mean (%)** | **Std. Dev.** | **Obs** | **Mean (%)** | **Std. Dev.** |
| Nord | 153 | 32.0 | 0.468 | 81 | 27.2 | 0.448 | 41 | 17.1 | 0.381 |
| Ouest | 226 | 32.7 | 0.470 | 149 | 30.9 | 0.464 | 70 | 37.1 | 0.487 |
| Sud | 525 | 31.4 | 0.465 | 349 | 28.4 | 0.451 | 178 | 29.2 | 0.456 |
| Total | 904 | 31.8 | 0.466 | 579 | 28.8 | 0.453 | 289 | 29.4 | 0.456 |

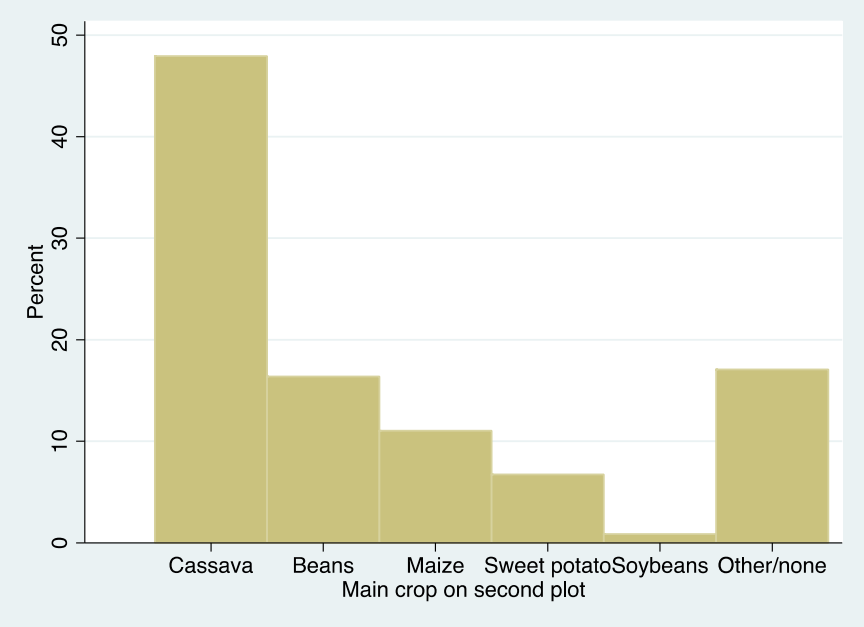
For each plot, households were asked to indicate the most important crop. The most important crops are summarized in Figures 5.2-5.4 Almost two thirds of the households (577 out of 904) indicate that cassava is the first crop on their primary plot (Figure 5.1). For almost 20% of the households, beans are the most important crop on the primary plot. Similarly, cassava and beans are the main crops for households' second and third plot.

**Figure 5.2 Most important crop on the primary plot (% of households)**



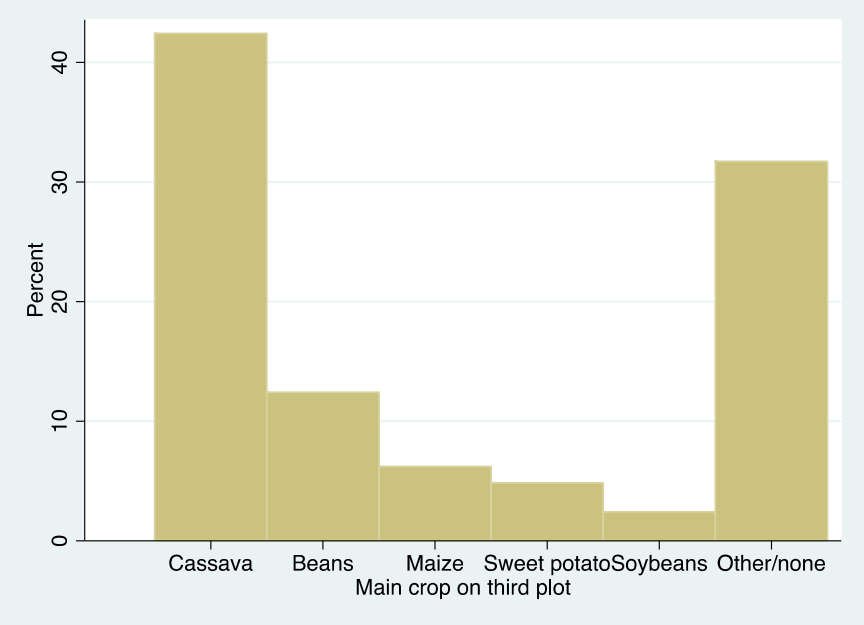

Note: N=904

**Figure 5.3 Most important crop on the second plot (% of households)**




Note: N=580

**Figure 5.4 Most important crop on the third plot (% of households)**




Note: N=290

Table 5.4 summarizes the data for all crops, for each plot and each axe. In all axes, cassava is most often mentioned as most important crop. Beans are also frequently mentioned as most important crop on the primary plot. Maize appears mainly in the South axe and sweet potato mainly in the West. Soybeans are mentioned frequently only in the North, and only on the second and third plot. Summarizing the data in table 5.4:

- Cassava, beans, and soybeans are most important in the North
- Cassava, beans, and sweet potato are most important in the West
- Cassava, beans, and maize are most important in the South

**Table 5.4 Most important crop, by axe (% of households)**

| | Primary plot | | | Second plot | | | Third plot | | |
|---|---|---|---|---|---|---|---|---|---|
| | Nord | Ouest | Sud | Nord | Ouest | Sud | Nord | Ouest | Sud |
| Cassava | 56.9 | 65.0 | 65.3 | 49.4 | 43.0 | 49.7 | 22.0 | 41.4 | 47.5 |
| Beans | 30.1 | 18.6 | 12.6 | 27.2 | 21.5 | 11.7 | 26.8 | 12.9 | 8.9 |
| Sweet Potato | 1.3 | 10.2 | 0.6 | 3.7 | 21.5 | 1.1 | - | 14.3 | 2.2 |
| Maize | - | - | 11.1 | - | 2.0 | 17.4 | 2.4 | 1.4 | 8.9 |
| Rice | - | - | 3.8 | - | - | 6.6 | - | - | 5.0 |
| Soybeans | 1.3 | 0.4 | - | 4.9 | - | 0.3 | 12.2 | 2.9 | - |
| Sorghum | 1.3 | - | 0.2 | 2.5 | - | 0.6 | 7.3 | - | - |
| Potato | - | - | - | - | 0.7 | - | 2.4 | - | - |
| Groundnuts | 1.3 | - | 1.5 | 2.5 | - | 3.1 | - | - | 3.4 |
| Sugarcane | 1.3 | 0.4 | - | 1.2 | - | - | - | - | - |
| Amaranth | - | - | 0.4 | - | 0.7 | - | - | - | 0.6 |
| Yam | - | 0.4 | - | - | - | - | - | - | 0.6 |
| Banana | 2.6 | 1.3 | 0.8 | 2.5 | 0.7 | 1.4 | - | 2.9 | 3.9 |
| Coffee | 2.0 | - | 1.5 | 1.2 | - | 0.9 | 4.9 | - | 1.1 |
| Oil Palm | - | - | 1.3 | - | - | 0.3 | - | - | 1.1 |
| Other | 0.7 | 0.9 | 0.6 | 3.7 | 2.7 | 1.7 | 2.4 | 8.6 | 2.8 |
| None | 1.3 | 2.7 | 0.4 | 1.2 | 7.4 | 5.1 | 19.5 | 15.7 | 14.0 |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Obs. | 153 | 226 | 525 | 81 | 149 | 350 | 41 | 70 | 179 |

Cassava is the most important crop, but this is often intercropped: mainly with beans, but also with sweet potato (in the West) and maize (in the South). Similarly, when beans are the most important crop, the beans are often intercropped with cassava, and sometimes with maize. Taking intercropping into account, we still observe that cassava, beans, sweet potato, and maize are the dominant crops in the region. The main patterns of intercropping are summarized in Table 5.5.

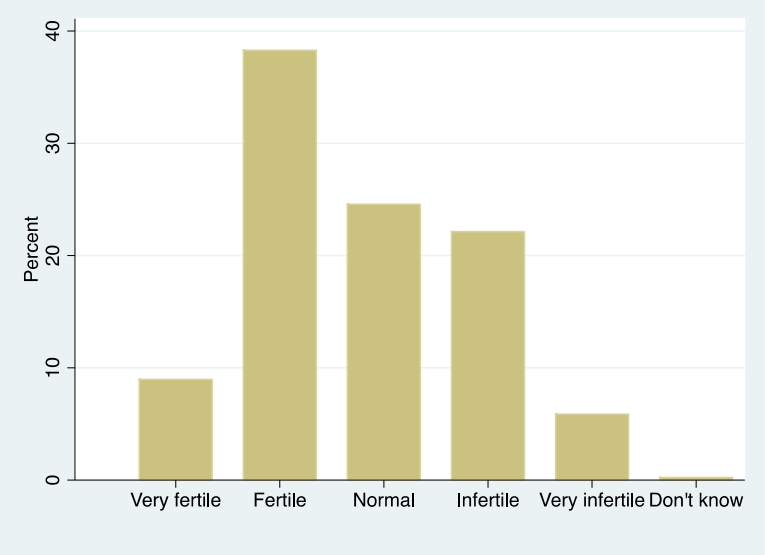
**Table 5.5 Main intercropping patterns, by plot**

| | Primary plot | Second plot | Third plot |
|---|---|---|---|
| Cassava only | 25% | 24% | 26% |
| Cassava and beans | 22% | 13% | 6% |
| Cassava and sweet potato | 11% | 6% | 6% |
| Cassava and maize | 12% | 9% | 5% |
| Other (including None) | 29% | 49% | 57% |
| Total | 100% | 100% | 100% |
| Obs. | 904 | 580 | 290 |

## Soil quality

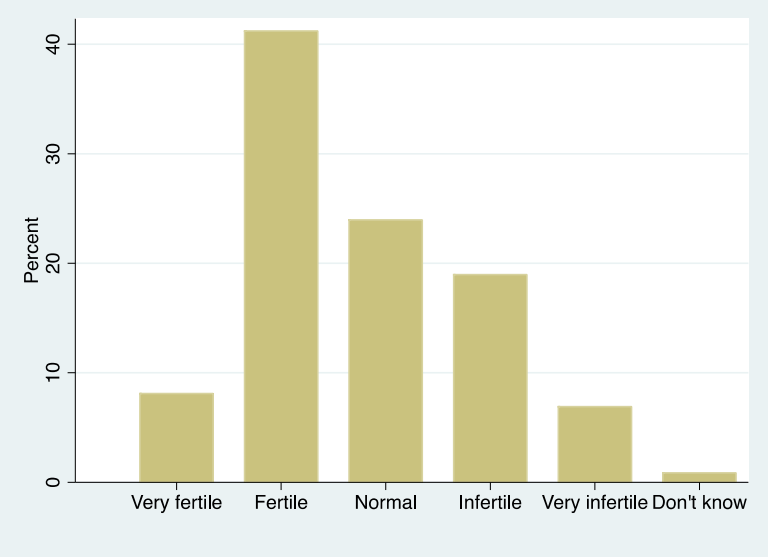
We asked households to indicate the quality of the soil on their plots, ranging from very fertile to very infertile. The distribution of plot quality of the primary, second, and third plot is shown in Figures 5.5-5.7. About 50 percent of plots are described as very fertile or fertile, while about 25 percent per cent of plots are infertile or very infertile.

**Figure 5.5 Soil quality of the primary plot**



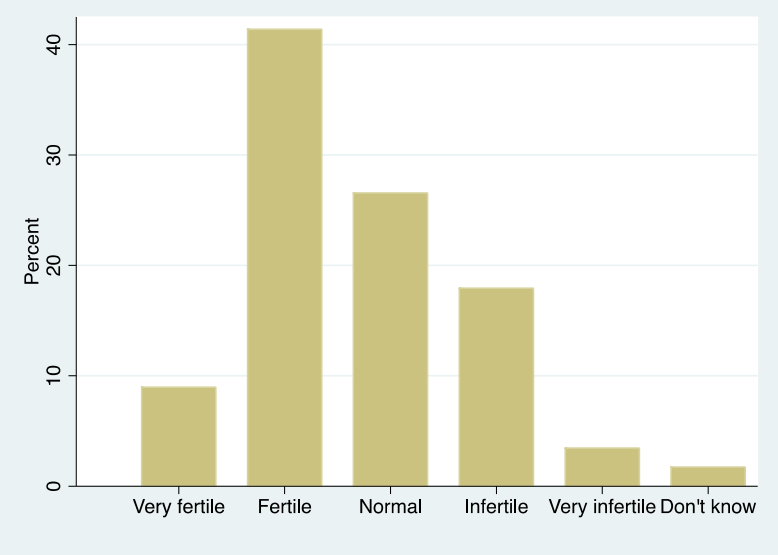

Note: N=904

**Figure 5.6 Soil quality of the second plot**




Note: N=580

**Figure 5.7 Soil quality of the third plot**




Note: N=290

Soil quality in the different axes is summarized in Table 5.6. Quality varies considerable across the axes and appears to be highest in the South, with 62 percent of households indicating their primary plot is fertile or very fertile, and some 14 percent indicating infertile or very infertile. Soil fertility seems much worse in the West, where more than 55 percent of households indicate their primary plot is infertile or very infertile.

**Table 5.6 Soil quality (self-reported)**

| | Primary plot | | | Second plot | | | Third plot | | |
|---|---|---|---|---|---|---|---|---|---|
| | Nord | Ouest | Sud | Nord | Ouest | Sud | Nord | Ouest | Sud |
| Very fertile | 7.2 | 3.1 | 12.0 | 6.2 | 4.7 | 10.0 | 9.8 | 4.3 | 10.6 |
| Fertile | 28.8 | 16.4 | 50.5 | 35.8 | 18.1 | 52.3 | 39.0 | 22.9 | 49.2 |
| Normal | 30.1 | 23.0 | 23.6 | 27.2 | 24.8 | 22.9 | 29.3 | 35.7 | 22.4 |
| Infertile | 27.5 | 39.4 | 13.1 | 23.5 | 32.9 | 12.0 | 22.0 | 24.3 | 14.5 |
| Very infertile | 6.5 | 17.3 | 0.8 | 7.4 | 18.8 | 1.7 | 0.0 | 11.4 | 1.1 |
| Don't know | 0.0 | 0.9 | 0.0 | 0.0 | 0.7 | 1.1 | 0.0 | 1.4 | 2.2 |
| Total | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Obs. | 153 | 226 | 525 | 81 | 149 | 350 | 41 | 70 | 179 |

## Use of Inputs

We asked households about the use of chemical and organic fertilizer (the type of organic fertilizer was not specified), inoculant, and labor on their plots and how they obtained the inputs. Table 5.7 shows the percentage of households that uses each type of input on at least one plot. The majority of households in the North and West use organic fertilizer, while only 13 percent of households in the South do. Chemical fertilizer and inoculant are very uncommon across all axes, with usage rates of below 5%.

**Table 5.7 % of households that uses fertilizer or inoculum on at least 1 plot, by axe**

| Axe | Obs | Uses organic fertilizer | Uses chemical fertilizer | Uses inoculum |
|---|---|---|---|---|
| Nord | 153 | 88.9% | 2.0% | 2.6% |
| Ouest | 227 | 73.1% | 4.0% | 4.8% |
| Sud | 525 | 12.8% | 3.6% | 1.3% |
| Total | 905 | 40.8% | 3.4% | 2.4% |

The sources of agricultural inputs are summarized in Table 5.8. In almost all households, organic fertilizer was obtained through own production. Chemical fertilizer was either bought from a trader or received as gift from an NGO. Inoculum was mostly received as gift from an NGO.

**Table 5.8 Sources of obtaining fertilizer and inoculum**

| Axe | Organic fertilizer | Chemical fertilizer | Inoculant |
|---|---|---|---|
| Own production | 93.8% | n.a. | n.a. |
| Bought from trader | 1.9% | 45.2% | - |
| Bought from another farmer | 1.6% | - | - |
| Gift from another farmer | 2.4% | 6.4% | 4.5% |
| Gift of NGO | 0.3% | 45.2% | 90.9% |
| Total % (N) | 100% (369) | 100% (31) | 100% (22) |

n.a. = not applicable, (-) = no information available

Table 5.9 summarizes the number of household members working on the household's fields. On average, 2.47 household members worked on the primary plot. The numbers are similar for the second and third plot and highest for households in the North.

**Table 5.9 Number of household members that worked on each plot, by axe**

| | Primary plot | | | Second plot | | | Third plot | | |
|---|---|---|---|---|---|---|---|---|---|
| **Axe** | Obs | Mean | St. Dev. | Obs | Mean | St. Dev. | Obs | Mean | St. Dev. |
| Nord | 153 | 2.87 | 1.88 | 81 | 3.17 | 1.90 | 41 | 3.15 | 2.02 |
| Ouest | 226 | 2.58 | 1.55 | 149 | 2.59 | 1.45 | 70 | 2.50 | 1.48 |
| Sud | 525 | 2.30 | 1.23 | 350 | 2.36 | 1.18 | 179 | 2.26 | 1.24 |
| Total | 904 | 2.47 | 1.46 | 580 | 2.52 | 1.40 | 290 | 2.44 | 1.46 |

In addition to household members, 37.4 percent of households also use hired labor to work on their plots. The total number of hired labor days per household (across all plots of the household) was 15 on average for households indicating the use of hired labor. This information is summarized in Table 5.10. Households in the West are less likely to use hired labor than households in the North and South. However, conditional on using hired labor, households in the South use relatively few days compared to households in the West and North.

**Table 5.10 Use of hired labor**

| | % of households that use any hired labor | Average number of hired labor days | | | |
|---|---|---|---|---|---|
| **Axe** | | **Total across plots** | **Primary plot** | **Second plot** | **Third plot** |
| Nord | 37.9% (N=153) | 23.1 (N=52) | 12.7 (N=52) | 14.1 (N=28) | 15.6 (N=14) |
| Ouest | 29.6% (N=226) | 16.9 (N=60) | 11.4 (N=60) | 9.8 (N=32) | 8.1 (N=13) |
| Sud | 40.6% (N=525) | 12.8 (N=190) | 7.4 (N=190) | 7.9 (N=104) | 8.7 (N=53) |
| Total | 37.4% (N=904) | 15.4 (N=302) | 9.1 (N=302) | 9.3 (N=164) | 9.8 (N=80) |

Table 5.11 shows the percentage of households using hired labor by main crop and by plot. Households that grow rice as their main crop are most likely to use hired labor. Differences between the other major crops are not very pronounced. Also recall that cassava is often intercropped with beans, sweet potato and maize, yet the data do not specify whether hired labor was used for a specific crop only.

**Table 5.11 Hired labor by main crop**

| | Primary plot | | Second plot | | Third plot | |
|---|---|---|---|---|---|---|
| **Main crop** | Obs. | % using hired labor | Obs. | % using hired labor | Obs. | % using hired labor |
| Cassava | 577 | 32.9% | 278 | 28.4% | 123 | 27.6% |
| Beans | 154 | 29.2% | 95 | 31.6% | 36 | 47.2% |
| Sweet potato | 28 | 32.1% | 39 | 23.1% | 14 | 21.4% |
| Maize | 58 | 44.8% | 64 | 34.4% | 18 | 22.2% |
| Rice | 20 | 40.0% | 23 | 39.1% | 9 | 55.6% |
| Soybeans | 3 | 0.0% | 5 | 20.0% | 7 | 28.6% |
| Other | 64 | 37.5% | 76 | 18.4% | 83 | 18.1% |
| Total | 904 | 33.4% | 580 | 28.3% | 290 | 27.6% |

## Yields

This section describes yields estimates, based on the plot size and harvest data based on the agricultural season of January-June 2013. In total, the dataset includes 1,774 plots with up to four crops per plot, yielding a potential total of 7,100 crops in the data. Of this potential, we have detailed information on 2,059 individual crops. Plot size is used to convert harvest into yield (kg per hectare). However, intercropping is quite common (see Table 5.5), but without data on the share of a plot that is occupied by one particular crop, one has to assume the entire plot is used for the crop. As a result, yields are underestimated. To limit this bias, yields are calculated only for the crops reported as the producer's primary crop.

Data has been recorded for 2,059 household crops. Of this, 1,633 were recorded as being a primary crops of production for the household. Cassava appears the most frequently (939 observations) and is always listed as a primary crop. Other major crops include beans, sweet potato, rice, groundnuts, and maize. A large share of respondents indicate that they had not yet finished (or even started) harvesting. In order to ensure no downward bias on harvest quantities, we include only those crops that have been completely harvested in the below summary table and yield calculation tables.

Harvest quantities are reported in numerous units, which have been converted into kilograms using a locally determined conversion table. The conversion table is included in the Appendix, Table A1. Due to missing data on units or conversion, kg harvest is available for a total of 1,679 but only 848 of these crops have been completely harvested. Table 5.11 reports the average harvests and plot size per crop for all crops where harvest is completed. For those instances where minimum harvest amount is zero, the respective crop was planted but no harvest was produced.

**Table 5.11 Crop harvest and plot surface**

| | Harvest (Kg) | | | | | Plot Size (ha) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **N** | **Mean** | **s.d.** | **Min** | **Max** | **N** | **Mean** | **s.d.** | **Min** | **Max** |
| **Cassava** | 189 | 269.31 | 628.12 | 0 | 8,000 | 198 | 0.27 | 0.57 | 0 | 6 |
| **Sweet Potato** | 26 | 309.23 | 293.72 | 40 | 1,200 | 27 | 0.15 | 0.26 | 0 | 0.96 |
| **Rice** | 32 | 291.41 | 233.71 | 25 | 1,000 | 37 | 0.31 | 0.64 | 0 | 4 |
| **Maize** | 84 | 218.53 | 295.93 | 0 | 2,000 | 120 | 0.31 | 0.61 | 0 | 6.25 |
| **Sorghum** | 4 | 312.5 | 209.66 | 100 | 600 | 7 | 0.51 | 0.47 | 0 | 1.2 |
| **Beans** | 431 | 39.27 | 65.76 | 0 | 625 | 578 | 0.32 | 0.6 | 0 | 6.25 |
| **Soy beans** | 40 | 27.18 | 31.66 | 0 | 150 | 45 | 0.27 | 0.52 | 0 | 3 |
| **Groundnuts** | 36 | 218.97 | 417.31 | 5 | 2500 | 98 | 0.32 | 0.41 | 0 | 3.13 |
| **Coffee** | 3 | 1800 | 2,771.28 | 200 | 5,000 | 7 | 0.68 | 1.47 | 0 | 4 |

Note: Based on data for all crops finished harvesting.

Lower bound of plot surface area has been artificially imposed by dropping the bottom 1% of observations. Extremely small plot sizes can upwardly bias yield estimates and are high risk for resulting from measurement error in data collection.

Average yields for these crops are shown in table 5.12. Mean yields are calculated using the quantity of harvest and size of the plot that households reported. These figures are excluding the top 5% of crop yields to minimize upward bias resulting from measurement error or extremely small recorded plot sizes which would not scale up linearly, thus resulting in some observations being dropped for each crop. The last column of table 5.12 shows the average yield calculated as the ratio of average harvest to average surface, with the numbers found in table 5.11.

**Table 5.12 Crop yields**

| | | Yields (Kg/Ha) | | | | Yield (mean harvest)/(mean surface) With values from table 5.11 |
|---|---|---|---|---|---|---|
| | N | Mean | s.d. | Min | Max | |
| **Cassava** | 176 | 2,008.18 | 2,028.81 | 0 | 13,333.33 | 997.44 |
| **Sweet Potato** | 19 | 4,460.01 | 3,186.9 | 249.90 | 9,600 | 2,061.53 |
| **Rice** | 30 | 1,584.46 | 1,220.83 | 100.00 | 4,266.67 | 940.03 |
| **Maize** | 79 | 1,147.12 | 1,624.48 | 0 | 10,000.00 | 704.94 |
| **Sorghum** | 4 | 396.01 | 216.17 | 100.00 | 600.00 | 612.75 |
| **Beans** | 426 | 598.84 | 1501.49 | 0 | 15,625.00 | 122.72 |
| **Soy beans** | 37 | 318.52 | 486.04 | 0 | 2,497.78 | 100.67 |
| **Groundnuts** | 35 | 815.13 | 1146.24 | 35.7 | 6,666.67 | 684.28 |
| **Coffee** | 2 | 650.00 | 848.53 | 50.00 | 1,250.00 | 2,647.06 |

Note: Based on data for crops finished harvesting

Global yield averages for cassava are about 5 ton/hectare. Estimates from a study in the South Kivu highlands are between 2 and 15 ton/hectare storage root yields and between 2 and 12 tons/hectare of stem yields (Pypers et al., 2011). Compared to these numbers our estimated total cassava yields calculated at the individual level are within this expected range, although very close to the lower bound. Looking at yields based on reported average harvest and plot sizes of cassava crops, the estimated yield lies below the lower bound of this range.

Ross et al. (2009) collected data on climbing beans in the North and South Kivu regions and found an average of 55 kg of beans harvested per field and an average field size of 0.14 Ha. These figures imply a sample yield average of 369 kg/ha for climbing beans. This is significantly higher than our total sample yield average of 122 kg/ha found in table 5.12. This higher value may in part arise from differences between bean varieties within the samples as well as differences in geographical regions included in the samples.

The table below gives results from linear regressions run to estimate primary determinants of farmer yields. Regressions are run using yield calculations on all crops for which harvest has completed, without distinguishing between primary or secondary crops. Standard errors are clustered at the producer level[2]. Regressions are run first on the bottom 95% of yields and then again using the log transformation of yields as the dependent variable.[3] The log transformation minimizes the potential effects of outlier observations without requiring the data to be truncated at superficially imposed cut-off points. Overall the direction of the relationships between the dependent variable and the various covariates are relatively consistent for both the truncated yield regressions and the logarithmic-transformed yield regressions.

Variables included within each regression capture financial characteristics, household characteristics, production characteristics (and use of inputs), as well as a crop dummy-variable to capture the variation in production of each crop from one another with cassava as the default reference crop. Note that land fertility and infertility have been transformed into binomial variables from categorical perception questions and thus are self-reported by the respondent and are not a result of soil analysis or other third-party opinion.

Regressions (1) and (2) are run using the dependent variable of reported yields in kilograms per hectare, excluding the top 5% of reported yields. Regressions (3) and (4) are run with the dependent variable of the log-transformed yields. Thus the coefficients in (1) and (2) can be interpreted as the amount the yield

[2] The same regressions were run clustering at the village level with no difference in results.
[3] For independent variable descriptions, see the Appendix Table A2.

changes in kilograms per hectare, while coefficients in regressions (3) and (4) are interpreted as percent changes. The constant is the mean yield of Cassava (as this is the reference crop within all four models) when all independent variables are set to zero.

A credit history within the last 12 months, access to a savings mechanism, use of organic fertilizer, and planting on fertile land have significant coefficients (at a minimum of the 10% significance level) in every regression in which they are included. If an individual has borrowed money in the last 12 months (variable "Credit" in Table 5.13) this has a negative effect on yields of between 284.17 – 339.58 kg/Ha, or between a 26% and 34% reduction in yields for Cassava. For other crops, the coefficient must be summed together with the crop-variable coefficient found in Table 5.14.

Access to savings positively affects yields, as does the use of organic fertilizer (variables are respectively named "Savings" and " Organic Fertilizer" in Table 5.13 below). Plots with fertile land appear to have a negative effect on yields (variable "Fertile lands" below). This result would seem counter-intuitive and could be the result of measurement error in the variable given it's a transformed dummy variable from a categorical perception question and thus susceptible to measurement error both in collection as well as in being transformed.

Other variables with weaker significance include the age of the household head ("HH head age" in table 5.13), which has a weakly significant negative effect in regression (2) but no significant effect in regression (4) as well as planting on infertile land ("Infertile land" in Table 5.13 below)– which had a positive and significant effect only in regression (4).

**Table 5.13 Linear Regression Results**

| VARIABLES | (1)<br>Yields (95%) | (2)<br>Yields (95%) | (3)<br>Log Yields | (4)<br>Log Yields |
|---|---|---|---|---|
| Credit | -284.17** | -339.58** | -0.26* | -0.34*** |
| | (133.945) | (134.335) | (0.135) | (0.125) |
| Lending | -234.13* | -256.67* | -0.04 | -0.10 |
| | (130.963) | (133.600) | (0.154) | (0.148) |
| Savings | 696.40* | 632.01* | 0.51** | 0.43** |
| | (375.170) | (365.373) | (0.244) | (0.207) |
| No. HH mem work on plot | 37.10 | 24.77 | -0.00 | -0.02 |
| | (48.385) | (50.107) | (0.049) | (0.049) |
| Inoculant | -424.30 | -339.29 | -0.37 | -0.21 |
| | (355.155) | (376.716) | (0.441) | (0.432) |
| Chemical Fertilizer | 399.91 | 346.59 | -0.28 | -0.34 |
| | (363.486) | (383.423) | (0.366) | (0.360) |
| Organic Fertilizer | 258.57* | 361.22** | 0.44*** | 0.60*** |
| | (146.803) | (153.763) | (0.144) | (0.144) |
| Hired Labour | 72.33 | -13.54 | -0.00 | -0.13 |
| | (128.128) | (129.813) | (0.131) | (0.124) |
| Access to media | | 72.86 | | 0.06 |
| | | (130.120) | | (0.133) |
| HH size | | 27.31 | | 0.04 |
| | | (27.043) | | (0.026) |
| HH head age | | -0.70** | | -0.00 |
| | | (0.314) | | (0.000) |
| HH head gender | | 126.42 | | 0.07 |
| | | (198.924) | | (0.213) |
| No. HH mem agri. Coop | | 71.16 | | 0.15 |
| | | (115.890) | | (0.115) |
| Total farm land | | -8.54 | | -0.02* |
| | | (5.483) | | (0.008) |

| | | | | |
|---|---|---|---|---|
| Plot ownership | | 39.26 | | -0.08 |
| | | (150.996) | | (0.158) |
| Fertile land | | -379.26** | | -0.57*** |
| | | (173.277) | | (0.158) |
| Infertile land | | 236.04 | | 0.36*** |
| | | (170.721) | | (0.137) |
| Constant | 1,909.70*** | 1,779.77*** | 7.01*** | 6.92*** |
| | (186.367) | (255.122) | (0.156) | (0.263) |
| Crop Dummies | Yes | Yes | Yes | Yes |
| Observations | 804 | 804 | 773 | 773 |
| R-squared | 0.252 | 0.272 | 0.313 | 0.370 |

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Standard errors clustered by producer

Included in each of the four regressions listed in Table 5.13 are crop dummies for each of the measured crops that have observations with complete data on each variable of interest in Table 5.13. These crops and their estimated coefficients for regressions (1) through (4) are listed below. Sweet potato is the only crop that has a higher yield than cassava, with all other crops having negative and significant coefficients, implying that they have lower mean yield levels then cassava.

**Table 5.14 Crop Dummy Variables in Linear Regression Results**

| CROPS | (1)<br>Yields (95%) | (2)<br>Yields (95%) | (3)<br>Log Yields | (4)<br>Log Yields |
|---|---|---|---|---|
| Sweet Potato | 3,695.27*** | 3,650.39*** | 1.06*** | 0.98*** |
| | (1,115.694) | (1,096.159) | (0.291) | (0.282) |
| Rice | -408.08* | -476.21* | 0.10 | -0.01 |
| | (245.934) | (258.998) | (0.199) | (0.214) |
| Maize | -758.39*** | -890.88*** | -0.61*** | -0.82*** |
| | (251.328) | (237.223) | (0.207) | (0.196) |
| Sorghum | -2,086.85*** | -2,011.05*** | -1.64*** | -1.47*** |
| | (514.409) | (489.575) | (0.482) | (0.370) |
| Beans | -1,434.82*** | -1,472.70*** | -2.07*** | -2.13*** |
| | (177.821) | (169.903) | (0.137) | (0.134) |
| Soybeans | -1,713.82*** | -1,809.25*** | -2.55*** | -2.70*** |
| | (201.292) | (204.653) | (0.325) | (0.317) |
| Groundnuts | -1,127.39*** | -1,173.73*** | -0.83*** | -0.89*** |
| | (254.137) | (250.172) | (0.221) | (0.217) |
| Coffee | -1,921.71*** | -1,708.29*** | -2.00* | -1.69** |
| | (671.123) | (472.554) | (1.168) | (0.710) |

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1, Standard errors clustered by producer

# 6. Agricultural knowledge

## Sources of information on agriculture

Respondents were asked about sources of information on agricultural methods. One question was about the types of media they used as information source. We distinguish between different types of media of which only the radio is frequently used (almost half of the respondents uses radio information at least several times a month). By contrast folders and brochures, newspapers, and internet sources are hardly used at all.

Respondents also indicated how often they obtain information on new agricultural methods from different types of personal contacts: friends, family members, neighbors, government agents, NGO agents, and input traders. Figure 6.1 below shows the maximum frequency with which they obtain information, from *any* type of contact. More than 40 percent of respondents never obtain information on new methods from any type of personal contact, whereas almost 40 percent receives information at least several times a month from at least one contact.

**Figure 6.1 Maximum frequency at which respondents obtain information on new agricultural methods**

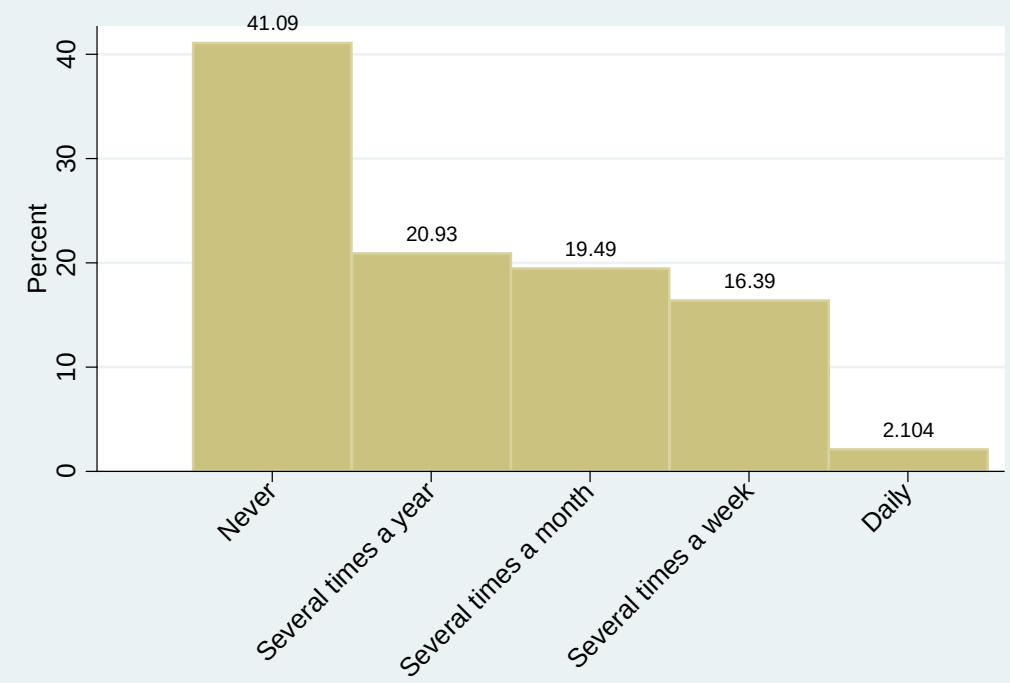



Table 6.1 shows the frequency of contact by type of contact. The most frequently contacted source is family members who live in the same village. The next most frequent sources are non-relatives in the village and family and friends from other villages, as well as NGO agents. Government extension agents and input traders are hardly ever a source of information for the respondents.

**Table 6.1 frequency at which contacts provide information on new agricultural methods (in %)**

| | Family member in same village | Friends or family in other village | Neighbours | Government agent | NGO agent | Trader |
|---|---|---|---|---|---|---|
| Never | 59.6 | 64.3 | 68.9 | 91.0 | 62.9 | 89.5 |
| Several times a year | 13.1 | 16.7 | 14.7 | 6.9 | 23.6 | 6.9 |
| Several times a month | 13.9 | 14.3 | 12.6 | 2.0 | 11.6 | 3.1 |
| Several times a week | 12.0 | 4.3 | 3.2 | 0.0 | 1.8 | 0.6 |
| Daily | 1.4 | 0.3 | 0.6 | 0.1 | 0.1 | 0.0 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |

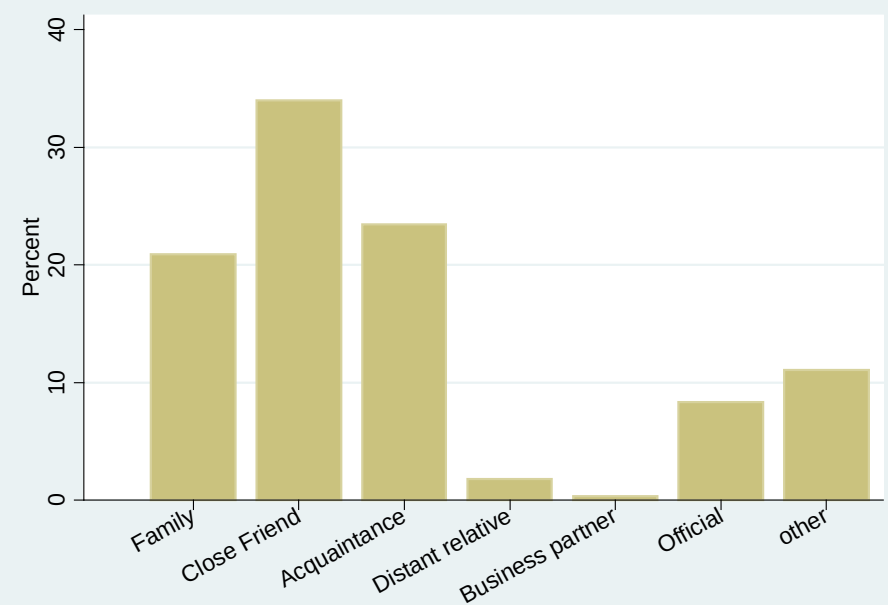
To learn more about households' social networks, we asked them the following hypothetical questions:

> *You are faced with an urgent question about your farm. For example, you are in doubt about an issue as a specific method to use, the best time to apply inputs, or a disease that has plagued your culture. Who would be the first person you want to contact outside your household to ask for advice?*

Respondents could list up to three names, in descending order of probability to contact. They then described the type of relationship and other characteristics of these persons.

The person mentioned as most likely to be contacted for advice is most often a close friend, acquaintance, or family member (see Figure 6.2). Please note that these three categories may not be clearly distinct (particularly category two and three). Friends, family, and acquaintances are also most often mentioned as second and third person.

**Figure 6.2 Relationship with person most likely to be asked for advice**




For the average respondent, the person they are most likely to contact in this hypothetical situation lives at about 11 minutes walking distance (Table 6.2). This distance varies between zero and 60 minutes, indicating some people turn to a contact quite far away when they have an urgent question about their farm. Only 210 respondents reported the distance to their second choice contact, and even fewer to their third choice. These second and third choice contacts tend to live somewhat further away, up to a maximum of five hours.

**Table 6.2 Person most likely to be asked for advice - walking distance to house in minutes**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| First choice | 437 | 10.90 | 12.02 | 0 | 60 |
| Second choice | 210 | 13.77 | 24.67 | 0 | 300 |
| Third choice | 85 | 15.92 | 18.80 | 0 | 120 |

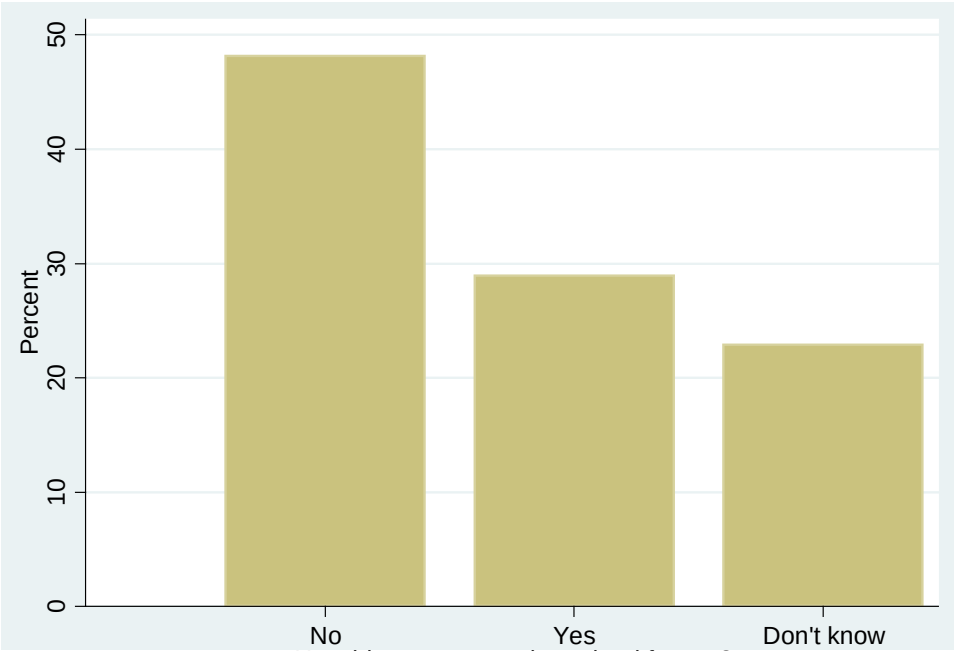
Respondents also have other ties with these contacts, besides asking for advice on urgent farm questions. These ties are summarized in Table 6.3. Half of the respondents indicate they exchange seeds, and about 20 percent of respondents are member of the same group or cooperation as the persons they would ask for advice. Furthermore, almost half the respondents have exchanged labor with the person they mention first, and 33 percent with the person they mention second (none of the respondents answered this question for their third choice contact).

**Table 6.3 Other links with persons asked for advice**

| | Do you exchange seeds? | | Are you members of the same group or cooperative? | | Have you worked for this person or has this person worked for you? | |
|---|---|---|---|---|---|---|
| | Obs | Percentage | Obs | Percentage | Obs | Percentage |
| First choice | 494 | 54.9% | 550 | 21.3% | 534 | 45.7% |
| Second choice | 233 | 50.2% | 260 | 20.0% | 252 | 32.9% |
| Third choice | 95 | 47.4% | 100 | 24.0% | 0 | - |

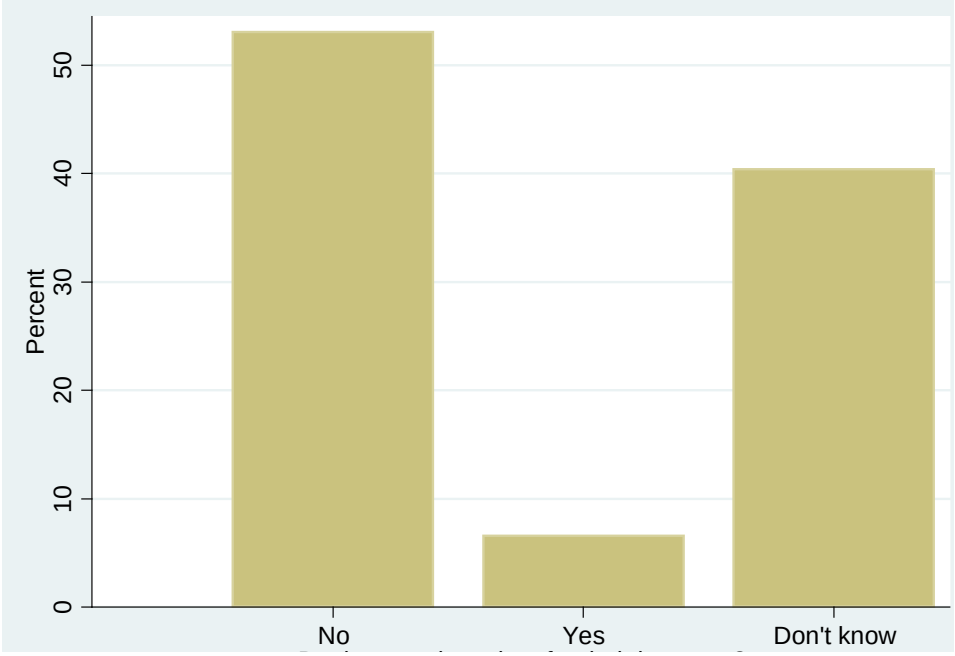
Finally, we asked some questions about NGO trainings and use of inoculum by the respondents' contacts. Thirty percent of respondents know their first choice contact participated in an NGO program to increase production, while less than 10 percent knows their first choice contact uses inoculum. Many respondents, however, are not aware whether or not their contacts participated in NGO programs or use inoculum.

**Figure 6.3 Has this person participated in an NGO program to increase production?**




Note: NGO participation of first choice contact

**Figure 6.4 Does this person use inoculants?**

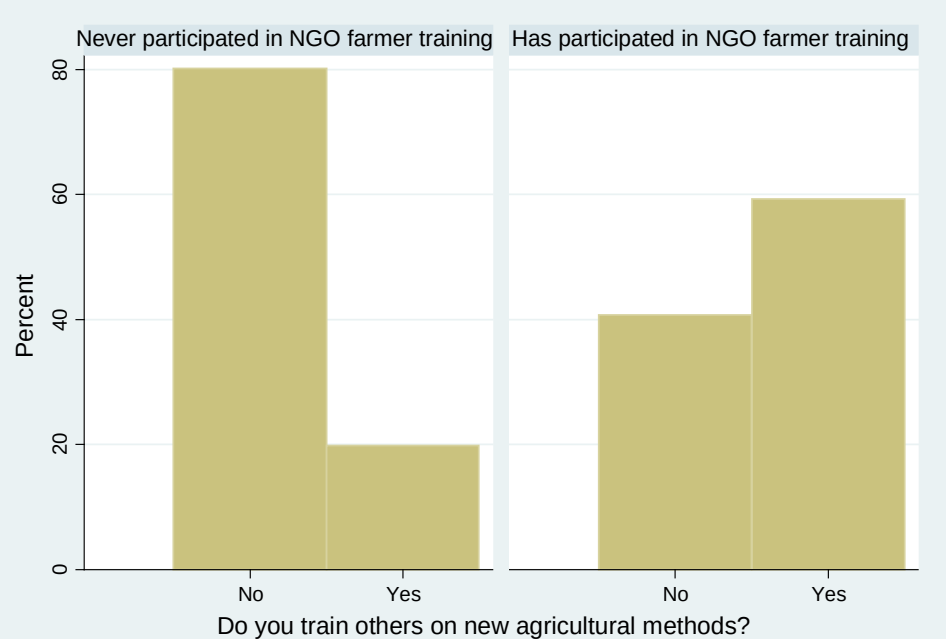



Note: Inoculum use by first choice contact

## Training and knowledge on agricultural methods

In total, 19 percent of respondent has ever participated in an NGO training to improve their farming, and the share does not differ much between the three regions. When asked whether they also give training (formally or informally) about new agricultural techniques to others, 27 percent of respondents say that they do. This percentage is a bit higher in the West (34 percent) than in North and South (around 25 percent). Importantly, persons who have participated in NGO training are about three times more likely to train others on agricultural methods.

**Figure 6.5 Percentage who trains others on new agricultural methods**




In general, 14 percent of respondents received training on legumes and 25 percent received training on a particular agricultural technique. Crop training on legumes was more common among farmers in the West (22 percent) and less likely in the North (15 percent) and especially the South (11 percent). The trainings were most often on beans and soybeans. For training on techniques, differences across regions are very large, with the share ranging from 18 percent in the South axe to 44 percent in the North. The most commonly received trainings are on the use of organic fertilizer and plant spacing, though the former is much less common in the South.

**Table 6.4 Percentage who ever received training on the use of specific techniques**

| | Total | Nord | Ouest | Sud |
|---|---|---|---|---|
| Inoculation | 3.7% | 2.6% | 4.8% | 3.6% |
| Use of mineral fertiliser | 3.4% | 4.6% | 4.0% | 2.9% |
| Use of organic fertiliser | 13.1% | 28.8% | 19.8% | 5.7% |
| Plant spacing | 13.1% | 17.6% | 13.7% | 11.6% |
| Storage | 5.9% | 8.5% | 8.4% | 4.0% |
| Processing | 3.1% | 4.6% | 4.4% | 2.1% |
| Other agronomic practices | 2.5% | 4.6% | 1.8% | 2.3% |
| Other | 2.2% | 3.3% | 1.3% | 2.3% |
| Any of the above | 25.5% | 44.4% | 30.0% | 18.1% |

We asked respondents some questions about root nodules and inoculants. In total, 38.6 percent of respondents have heard about root nodules, and this percentage is similar across axes. Opinions on the use of root nodules vary somewhat but a surprisingly large percentage (some 50 percent!) believes they are harmful. The respondents in the West axe are most positive in their opinion about root nodules.

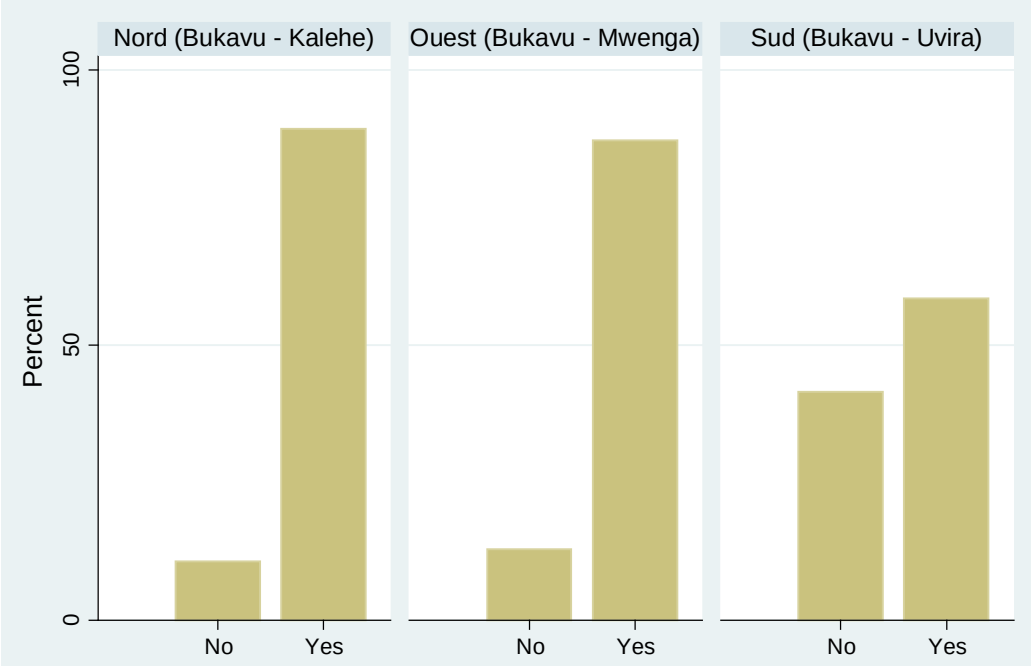
**Table 6.5 What is your opinion about root nodules?**

| | Total | Nord | Ouest | Sud |
|---|---|---|---|---|
| Harmful | 49.7% | 53.3% | 42.70 | 51.8% |
| No influence/impact | 4.0% | 6.7% | 2.25 | 4.0% |
| Beneficial | 19.8% | 16.7% | 28.09 | 17.1% |
| No opinion / do not know | 26.4% | 23.3% | 26.97 | 27.1% |
| Total (N) | 100% (348) | 100% (60) | 100% (89) | 100% (199) |

With regards to inoculants, only 7 percent of respondents answer they know what it is. The percentage is lowest in the South (5.3 percent) and highest in the West (10.2 percent). We asked which crops could benefit from inoculants. Only 112 respondents answered this question, and most often answered beans and/or soybeans.

When asked about N-fixing legumes, 70 percent of respondents indicate that N-fixing legumes need fertilizer. The averages per axe are shown in Figure 6.6. Those who answered 'yes' (638 respondents in total) were then asked to indicate which types of fertilizer could be used, and they listed up to seven different types. Organic fertilizer was mentioned most often (by 473 respondents), followed by NPK (granules gris, 101 respondents), Sympal (67), Urea (59), and TSP (53).

**Figure 6.6 Is it necessary to add mineral or organic fertilizer to N-fixing legumes?**



## 7. Credit and savings

Around 40% of households have borrowed money in the 12 months before the survey, 20% lent money to someone else, and less than 10 percent has any form of savings.

**Table 7.1 Credit, outstanding loans, and savings**

| Axe | Obs | Taken credit | Lent money | Has bank account or other form of savings |
|---|---|---|---|---|
| Nord | 153 | 37.2% | 20.9% | 7.2% |
| Ouest | 227 | 37.0% | 19.4% | 6.2% |
| Sud | 525 | 41.1% | 19.2% | 7.4% |
| Total | 905 | 39.5% | 19.6% | 7.1% |

Note: Credit taken during the past 12 months

Tables 7.2 to 7.5 summarize more details on credit and savings. Households borrow money mainly from friends and family. Credit cooperatives are the third most common source of credit in the North and South axe, but are much less common in the West (table 7.2). When households *extend* loans, this is almost always to friends and family (table 7.3).

**Table 7.2 Where did you borrow?**

| | Total | Nord | Ouest | Sud |
|---|---|---|---|---|
| Family | 29.1% | 22.8% | 34.5% | 28.7% |
| Friend | 49.6% | 56.1% | 51.2% | 47.2% |
| Money lender | 5.0% | 0.0% | 1.2% | 7.8% |
| Credit cooperative | 7.0% | 8.8% | 2.4% | 8.3% |
| Rotational savings | 0.6% | 0.0% | 0.0% | 0.9% |
| MUSO | 1.4% | 3.5% | 0.0% | 1.4% |
| Other | 7.3% | 8.8% | 10.7% | 5.6% |
| Total (N) | 100% (357) | 100% (57) | 100% (84) | 100% (216) |

**Table 7.3 Whom did you lend to?**

| | Total | Nord | Ouest | Sud |
|---|---|---|---|---|
| Family | 38.4% | 21.9% | 40.9% | 42.6% |
| Friends | 52.5% | 62.5% | 54.6% | 48.5% |
| Business partner | 4.0% | 6.3% | 4.6% | 3.0% |
| Other | 5.1% | 9.4% | 0.0% | 5.9% |
| Total (N) | 100% (177) | 100% (32) | 100% (44) | 100% (101) |

Households that borrow money most often use this for food, for social causes, or for education (table 7.4). Credit for food is most common in the West, where food insecurity is highest. In the North, a relatively high share of households use credit for the household business.

**Table 7.4 Purpose of credit**

| | Total | Nord | Ouest | Sud |
|---|---|---|---|---|
| Food | 32.8% | 19.3% | 46.4% | 31.0% |
| Marriage | 2.5% | 5.3% | 3.6% | 1.4% |
| Other social cause | 32.5% | 29.8% | 23.8% | 36.6% |
| Education | 10.4% | 17.5% | 13.1% | 7.4% |
| Agricultural inputs | 6.4% | 7.0% | 1.2% | 8.3% |
| Tools | 0.6% | 0.0% | 0.0% | 0.9% |
| Construction | 2.0% | 3.5% | 1.2% | 1.9% |
| Purchase of livestock | 0.6% | 0.0% | 2.4% | 0.0% |
| Purchase of land | 1.1% | 0.0% | 1.2% | 1.4% |
| (Small) business | 6.4% | 12.3% | 4.8% | 5.6% |
| Other | 4.8% | 5.3% | 2.4% | 5.6% |
| Total (N) | 100% (357) | 100% (57) | 100% (84) | 100% (216) |

There are a few respondents that save using a formal bank account, some 3 percent on average, although there is quite some regional variation. None of our respondents in the South have a formal bank savings accounts but some 9 (7) percent in the North (West) do. The most popular form of saving is through microfinance institutions (MFIs). Well-known MFIs include savings and credit cooperatives (COOPEC) of which there are several active in South-Kivu. COOPECS are legally registered as credit or cooperative unions. Yet there is again substantial variation across regions. In the West COOPEC has a share of some 20 percent among all forms of savings, while these figures are more than double for the North and South. Respondents in the West (and to a lesser extent in the South) apparently prefer to keep cash money in their house over other forms of savings. Rotational savings groups (often referred to as ROSCAs) are informal savings and lending groups of individuals that regularly meet and contribute to a fund that is then given to each member in rotation. They are popular in the West and somewhat in the South but none of the respondents in the North uses this form of saving.

**Table 7.5 Types of saving**

| | Total | Nord | Ouest | Sud |
|---|---|---|---|---|
| Bank | 3.1% | 9.1% | 7.1% | 0.0% |
| COOPEC | 50.0% | 63.6% | 21.4% | 56.4% |
| Cash in the house | 21.9% | 0.0% | 35.7% | 23.1% |
| Rotational savings | 15.6% | 0.0% | 28.6% | 15.4% |
| Other | 4.7% | 9.1% | 0.0% | 5.1% |
| Missing | 4.7% | 18.2% | 7.1% | 0.0% |
| Total (N) | 100% (64) | 100% (11) | 100% (14) | 100% (39) |

## 8. Community characteristics

In 99 villages, key representatives usually the village chief and one or more elders were interviewed about distance to main services, community organizations, external project activities, weather, human, animal and crop diseases, and conflict or violence related events.

**Figure 8.1 Distance to main services (in hours walking)**

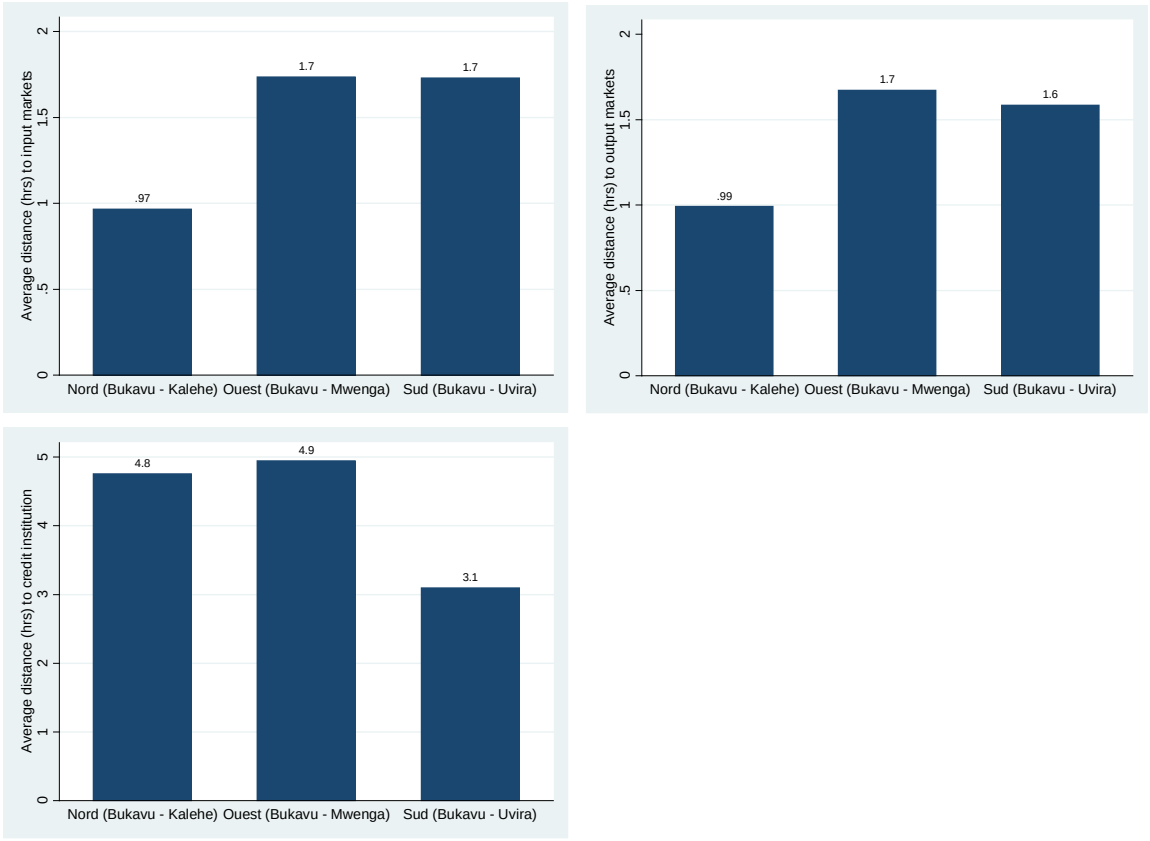



Figure 8.1 summarizes the average distance people have to walk (in hours) to reach input and output markets and credit institutions. Main input and output markers on average are 1–2 hours walking away with shorter distances reported in north axis (about 1 hour). Credit institutions are much further away, on ranging 3–5 hours, with longest distances reported in the north and west axis.

**Table 8.1 Community events**

| | Number of villages | | | | Percentage of villages | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Nord | Ouest | Sud | Total | Nord | Ouest | Sud |
| Any NGO project last 5 years | 80 | 14 | 23 | 43 | 81% | 70% | 88% | 81% |
| Any land conflicts last years | 62 | 14 | 13 | 35 | 63% | 70% | 50% | 66% |
| Any theft/robbery incidents | 70 | 13 | 20 | 37 | 71% | 65% | 77% | 70% |
| Any sexual violence incidents | 20 | 5 | 5 | 10 | 20% | 25% | 19% | 19% |
| Episodes of too much rain | 75 | 12 | 15 | 48 | 76% | 60% | 58% | 91% |
| Episodes of too late rain | 59 | 8 | 16 | 35 | 60% | 40% | 62% | 66% |
| Episodes of human epidemic last year | 44 | 8 | 5 | 31 | 44% | 40% | 19% | 58% |
| Episodes of livestock epidemic last year | 80 | 13 | 20 | 47 | 81% | 65% | 77% | 89% |
| Episodes of plant epidemic last year | 88 | 18 | 24 | 46 | 89% | 90% | 92% | 87% |
| Any agricultural cooperatives | 6 | 2 | 1 | 3 | 6% | 10% | 4% | 6% |
| Any credit cooperatives | 4 | 1 | 0 | 3 | 4% | 5% | 0% | 6% |
| Any commercial cooperatives | 1 | 0 | 1 | 0 | 1% | 0% | 4% | 0% |
| Any mining cooperatives | 0 | 0 | 0 | 0 | 0% | 0% | 0% | 0% |
| Any communal labor projects | 92 | 20 | 26 | 46 | 93% | 100% | 100% | 87% |
| Total number of villages | 99 | 20 | 26 | 53 | 99 | 20 | 26 | 53 |

In most villages, village representatives meet with community members every month or few times per year. About half the villages indicate that certain groups are hesitant to join these meetings.

As summarized in table 8.2, meetings are held most frequently in villages in the North.

**Table 8.2 Frequency of community meetings**

| | Number of villages | | | | Percentage of villages | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Nord | Ouest | Sud | Total | Nord | Ouest | Sud |
| Once a month | 59 | 15 | 17 | 27 | 60% | 75% | 65% | 51% |
| Once to 3 times per year | 28 | 4 | 8 | 16 | 28% | 20% | 31% | 30% |
| Seldom or never | 12 | 1 | 1 | 10 | 12% | 5% | 4% | 19% |
| Any group hesitant to join | 47 | 7 | 13 | 27 | 47% | 35% | 50% | 51% |
| Total number of villages | 99 | 20 | 26 | 53 | 99 | 20 | 26 | 53 |

South-Kivu has faced an almost continuous threat of insecurity since the mid-nineties up to 2013. Table 8.3 shows that there was quite some regional variation in violence, depending on which party was fighting. Villages in the South and Northern part were for example heavily attacked during the first Congolese war that ended with the victory of the Alliance of Democratic Forces for the Liberation of Congo (AFDL), while the West experienced a high incidence of villages attacks during the second Congolese war in which the Rally for Congolese Democracy (RCD) played a major role. We also observe that village attacks subsided in most areas since 2003, except for the West where violence flared up again in 2010.

**Table 8.3 Number of villages attacked during episodes of war**

| | Number of villages | | | | Percentage of villages | | | |
|---|---|---|---|---|---|---|---|---|
| | Total | Nord | Ouest | Sud | Total | Nord | Ouest | Sud |
| 1996-97 guerre de AFDL | 46 | 10 | 7 | 29 | 46% | 50% | 27% | 55% |
| 1998-2003 guerre de RCD | 63 | 6 | 21 | 36 | 64% | 30% | 81% | 68% |
| 2003-05 epoque entre RCD et CNDP | 30 | 6 | 8 | 16 | 30% | 30% | 31% | 30% |
| 2006-09 epoque CNDP | 11 | 3 | 0 | 8 | 11% | 15% | 0% | 15% |
| 2010-2013 epoque apres CNDP | 10 | 2 | 3 | 5 | 10% | 10% | 12% | 9% |
| Total number of villages | 99 | 20 | 26 | 53 | 99 | 20 | 26 | 53 |

## 9. Reflections

In this section we wish to discuss some general observations, referring back to the research questions in section 1. The first aim of our study is to evaluate the impact of N2Africa activities on knowledge and adoption of new inputs and farm management techniques. Subsequently, we are interested in measuring to what extent adoption also increases yields, incomes and food security. The initial idea was to have a random sample of villages, half of which would be assigned to receive intervention A and half of them acting as controls. Yet due to various constraints beyond our control the randomization was not conducted as planned, and we ended up with a sample of 70 villages that did receive the N2Africa treatment and 33 controls. In a second stage of the project, in the 70 villages that did receive the intervention A we randomly assigned half of them to also receive intervention AS (N2Africa training and subsidized inputs).

Proper randomization takes care that treatment and control groups are similar with respect to key characteristics, although "bad luck" may lead to significant differences between the groups. A test of balance between groups shows how successful the randomization was.

Table 9.1 presents these tests for balance on a number of baseline characteristics. The table presents the mean and standard error for the control group for each variable of interest and the relative difference with Intervention A and Intervention AS. The starts indicate the significance level of the test of equality of means with the control group. The bottom row of the table reports the p-value of a test of equality of means between both interventions.

We find that most variables are very similar across the groups. Participants in Intervention A were on average 3 years younger than those in the control group and those in Intervention AS have a higher incidence of food insecurity and are more likely to use inoculum at baseline.

**Table 9.1 Tests of balance between intervention and comparison groups**

| | (1) Household size | (2) Age household head | (3) Male household head | (4) Number of plots | (5) Food insecurity index | (6) Use organic fertilizer | (7) Use chemical fertilizer | (8) Knowledge of inoculum | (9) Use of inoculum |
|---|---|---|---|---|---|---|---|---|---|
| Intervention A vs control | 0.176 | -3.103** | 0.038 | -0.098 | 0.078 | -0.018 | -0.009 | -0.026 | 0.014 |
| | (0.218) | (1.354) | (0.024) | (0.166) | (0.792) | (0.100) | (0.014) | (0.028) | (0.011) |
| Intervention AS vs control | -0.001 | -1.657 | 0.027 | -0.252 | 1.459** | -0.094 | 0.003 | -0.015 | 0.025** |
| | (0.254) | (1.340) | (0.028) | (0.165) | (0.722) | (0.097) | (0.015) | (0.027) | (0.013) |
| Control group | 6.495*** | 48.315*** | 0.862*** | 2.335*** | 14.673*** | 0.446*** | 0.036*** | 0.084*** | 0.011* |
| | (0.172) | (0.878) | (0.018) | (0.134) | (0.565) | (0.070) | (0.010) | (0.023) | (0.006) |
| N | 904 | 888 | 892 | 904 | 903 | 905 | 905 | 901 | 905 |
| P-value Intervention A vs Intervention AS | 0.44 | 0.31 | 0.68 | 0.26 | 0.06 | 0.44 | 0.41 | 0.60 | 0.44 |

Robust standard errors in parentheses clustered at village level. * p < 0.10, ** p < 0.05, *** p < 0.01.

We wish to end with some reflections on the instruments that were used to collect the baseline data. We developed a comprehensive set of household and community surveys and behavioral experiments to measure a broad range of indicators we deemed relevant for our impact assessment. The agricultural module was the most difficult module. It contained detailed questions about the crops produced and sold, labor on the field(s) and technologies used yet in some cases questions were not detailed enough. Plot-size was not measured but self-reported. While there are good reasons not to measure individual plots, mostly

because it is very time-consuming, the self-reported plot sizes are likely to be noisy measures of the true size of the plot. Also, follow-up studies need to be precise in stating the season for which they would like to receive information and about their unit of measurement to avoid (some) unnecessary measurement errors. Lastly, we might want to consider more detailed questions on labor use (own and hired) in a follow-up, to gain more insights on whether the interventions had any impact on labor –productivity.

The module on social networks also could be improved on in a follow-up study. It is for example unclear to what extent people distinguish between family, close friends and acquaintances. Also, people were not very willing to name three persons that form part of their network. Yet, new activities are currently undertaken that include more detailed measurements of people's social networks, which might make this particular module redundant for follow-up.

The discussion above revealed some clear limitations in the design and problems in the execution of the research. Yet, we believe the baseline data presented here provides a rich source of information that will help us overcome the obvious challenges we will face when assessing the impact of the intervention(s) under study.

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## Appendices

**Table A1: Crop yield conversion measures**

| Produit | Mesure | kg |
|---|---|---|
| Manioc | Piece | 0.8 |
| Manioc | Kilo | 1.0 |
| Manioc | Coroboyi | |
| Manioc | Guigoz | |
| Manioc | Verre | |
| Manioc | Boite | 2.5 |
| Manioc | Namaha | |
| Manioc | Kidwere | 20.0 |
| Manioc | Regime | |
| Manioc | Fagot | 150.0 |
| Manioc | Panier | 42.5 |
| Manioc | Sac de 25kg | 25.0 |
| Manioc | Sac de 50kg | 50.0 |
| Manioc | Sac 100kg | 100.0 |
| Manioc | Bidon | |
| Manioc | Stere | |
| Manioc | Bumba | |
| Pommes de terre | Piece | 0.3 |
| Pommes de terre | Coroboyi | |
| Pommes de terre | Guigoz | |
| Pommes de terre | Verre | |
| Pommes de terre | Boite | 2.4 |
| Pommes de terre | Namaha | |
| Pommes de terre | Kidwere | 20.0 |
| Pommes de terre | Regime | |
| Pommes de terre | Fagot | 150.0 |
| Pommes de terre | Panier | 45.0 |
| Pommes de terre | Bidon | |
| Pommes de terre | Stere | |
| Pommes de terre | Bumba | 10.0 |
| Patate douce | Piece | 0.7 |
| Patate douce | Coroboyi | |
| Patate douce | Guigoz | |
| Patate douce | Verre | |
| Patate douce | Boite | 3.5 |
| Patate douce | Namaha | |
| Patate douce | Kidwere | 20.0 |
| Patate douce | Regime | |
| Patate douce | Fagot | 168.0 |
| Patate douce | Panier | 84.0 |
| Patate douce | Bidon | |
| Patate douce | Stere | |
| Patate douce | Bumba | 28.0 |
| Riz | Piece | |
| Riz | Kilo | 1.0 |

| | | |
|---|---|---|
| Riz | Coroboyi | |
| Riz | Guigoz | 1.4 |
| Riz | Verre | 0.3 |
| Riz | Boite | |
| Riz | Namaha | 4.2 |
| Riz | Kidwere | 20.0 |
| Riz | Regime | |
| Riz | Fagot | |
| Riz | Panier | |
| Riz | Sac de 25kg | 25.0 |
| Riz | Sac de 50kg | 50.0 |
| Riz | Sac 100kg | 100.0 |
| Riz | Bidon | |
| Riz | Stere | |
| Riz | Bumba | |
| Mais | Piece | |
| Mais | Coroboyi | |
| Mais | Guigoz | 0.7 |
| Mais | Verre | 0.2 |
| Mais | Boite | |
| Mais | Namaha | 2.0 |
| Mais | Kidwere | 20.0 |
| Mais | Regime | |
| Mais | Fagot | |
| Mais | Panier | |
| Mais | Bidon | |
| Mais | Stere | |
| Mais | Bumba | 10.0 |
| Haricots | Piece | |
| Haricots | Coroboyi | |
| Haricots | Guigoz | 0.6 |
| Haricots | Verre | 0.2 |
| Haricots | Boite | |
| Haricots | Namaha | 1.9 |
| Haricots | Kidwere | 20.0 |
| Haricots | Regime | |
| Haricots | Fagot | 100.0 |
| Haricots | Panier | |
| Haricots | Bidon | |
| Haricots | Stere | |
| Haricots | Bumba | 12.5 |
| Arachides | Piece | |
| Arachides | Coroboyi | 0.1 |
| Arachides | Guigoz | 0.6 |
| Arachides | Verre | 0.2 |
| Arachides | Boite | |
| Arachides | Namaha | 1.8 |
| Arachides | Kidwere | 20.0 |
| Arachides | Regime | |

| | | |
|---|---|---|
| Arachides | Fagot | |
| Arachides | Panier | |
| Arachides | Bidon | |
| Arachides | Stere | |
| Arachides | Bumba | |
| Colcaze | Piece | 0.6 |
| Colcaze | Coroboyi | |
| Colcaze | Guigoz | |
| Colcaze | Verre | |
| Colcaze | Boite | 4.8 |
| Colcaze | Namaha | |
| Colcaze | Kidwere | 20.0 |
| Colcaze | Regime | |
| Colcaze | Fagot | 134.4 |
| Colcaze | Panier | 67.2 |
| Colcaze | Bidon | |
| Colcaze | Stere | |
| Colcaze | Bumba | 33.6 |

**Table A2: Independent Variables for Table 5.13 Regressions**

| | | |
|---|---|---|
| Credit | Has household borrowed money in the past 12 months | Dummy Variable |
| Lender | Has household LENT money in he past 12 months | Dummy Variable |
| Savings | Does household have a savings account or othe rmeans of saving | Dummy Variable |
| Access to Media | Does household use leaflets, newspapers, radio | Dummy Variable |
| HH Size | Number of HH members | Integer |
| HH head Age | Age of household head | Integer |
| HH head Gender | Gender of household | Dummy |
| Agri. Coop. HH Members | How many household members are part of an organized agrricultural group | Integer |
| Farm Size | Farm Size | Numeric |
| HH Members work on Plot | How many household members regularly contribute to working on the plot | Integer |
| Inoculant | Inoculant used on plot | Dummy |
| Chemical Fertilizer | Chemical fertilizer used on plot | Dummy |
| Organic Fertilizer | Organic fertilizer used on plot | Dummy |
| Hired Labour | Hired labour used on plot | Dummy |
| Owns Plot | Plot is owned by producer | Dummy |
| Land Fertility | Land deemed "fertile" or " very fertile" by producer | Dummy (based against responses of "normal" ) |
| Land Infertility | Land deemed "infertile" or " very infertile" by producer | Dummy (based against responses of "normal") |