N2Africa Baseline Report II Ethiopia, Tanzania, Uganda

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N2Africa

Putting nitrogen fixation to work for smallholder farmers in Africa

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1 Introduction

This report presents the results of the baseline study for the N2Africa project as it is implemented in three countries, namely Ethiopia, Tanzania and Uganda. It is meant to provide a benchmark against which the project will be able to assess its progress and achievements towards the end of the project. The baseline is to establish the current status of livelihoods, through assessment of household characteristics (including education, occupations, sources of income), agricultural production, nutrition and market access. The analysis is also used to describe lessons learned and to provide recommendations for further improvement.

Overall, this baseline will facilitate the monitoring of project progress over time, assessment of achievement of goals through project interventions and impact at the end of the project. The project aims to reach 550,000 households by the end of N2Africa Phase II in 2018. In the second phase, we remain focused on research on and dissemination of major grain legumes in selected areas in the Core countries. The vision of success for the N2Africa project is as follows:

> To build sustainable, long-term partnerships and strong national expertise in grain legume production and N2-fixation research and development, to enable African smallholder farmers to benefit from symbiotic N2-fixation by grain legumes through effective production technologies including inoculants and fertilizers.

In each country a number of contrasting target regions or zones have been identified (Farrow *et al.*, 2014). The target regions in Ethiopia and Uganda correspond to geographic regions with specific characteristics in terms of agro-ecology, climate and prevalence of crops. These target regions are used mainly for organising the agronomy and dissemination activities and impact assessment. In each country a number of action areas have been identified (Farrow *et al.*, 2014). The action areas are sub-national administrative area within a N2Africa target region.

The baseline questionnaire was developed with participation of project staff in the different countries. It was agreed to use a relatively brief instrument, focussing on the key indicators for the project to ensure reliable data collection and avoid interviewee fatigue. The questionnaire was based on the survey used in N2Africa Phase I, with adjustments according to the Phase II results framework. In the northern regions of Tanzania a shorter questionnaire was used.

The questionnaires consisted of nine sections (Appendix I and II):

A. Demographic information: composition of household, education
B. Income: source of income, importance of farming
C. Livestock ownership
D. Labour: hiring of labour, for which crops, cost
E. Land use and crops cultivated
F. Production activities: cultivation of legumes and to a lesser extent of other crops
G. Nutrition and legume utilization: consumption in general and of legumes, used of haulms
H. Labour saving tools in legume cultivation
I. Information access
J. Nutrition

The aim was to interview 400 households in Ethiopia, Tanzania and Uganda. These target numbers were attained in all countries (Table 1.1). In Tanzania, a total of almost 1200 interviews were conducted, of which a total of 468 households was surveyed in Northern Tanzania. In the analyses some cases had to be dropped due to missing data. Consequently, the reported sample sizes differ per table and action site or region.

Table 1.1: Number of baseline interviews conducted and analysed per country and the target regions/zones where the interviews were held.

Country	Target regions/zones	Number of households interviewed
Ethiopia	Amhara, Benishangul Gumuz, Oromia and Southern Nations, Nationalities, and Peoples' Region (SNNPR)	400
Tanzania	Central, Northern, Southern and Southern Highlands	1198
Uganda	Eastern, Eastern Highlands, Northern and Southwestern	400

In the next chapters of this report, the results of the baseline survey are presented for Ethiopia, Tanzania and Uganda. Subsequently, some key results are compared across the three countries and lessons learned from the baseline survey implementation and results are presented. Finally we provide some recommendations per country to improve the implementation of N2Africa.

Table 1.2: Countries classified into target regions/zones and action sites were data was collected.

Country	Target regions/zones	Action Sites
Ethiopia	Amhara	Enemay
	Benishangul Gumuz	Pawe
	Oromia	Sinana
	SNNPR	Boricha
Tanzania	Central	Dodoma, Kongwa
	Southern	Mtwara
	Southern Highlands	Iringa, Mbeya, Njombe, Ruvuma
	Northern	Manyara, Northern Zone
Uganda	Eastern	Kibuku, Pallisa
	Eastern Highlands	Kapchorwa
	Southwestern	Kabale, Kanungu
	Northern	Kole, Oyam

2 Ethiopia

Data from 400 households were analysed. The action areas for Ethiopia were based on a stratification into adoption domains using three categories of 'uncontrollable' factors that affect adoption: biophysical relevance represented by moisture regimes, land availability and access to output markets for legumes (Farrow and Wolde-meskel, 2014a). The average population density among the action sites is above 100/km2 and the general market access is classified as good (Farrow and Woldemeskel, 2014a). Interviews were held in March 2014.

2.1 Sites

The households were located in the action areas of Boricha centred on Hawassa (SNNPR), Enemay (Amhara), Pawe (Benishangul Gumuz) and Sinana (Oromia) (Figure 2.1).

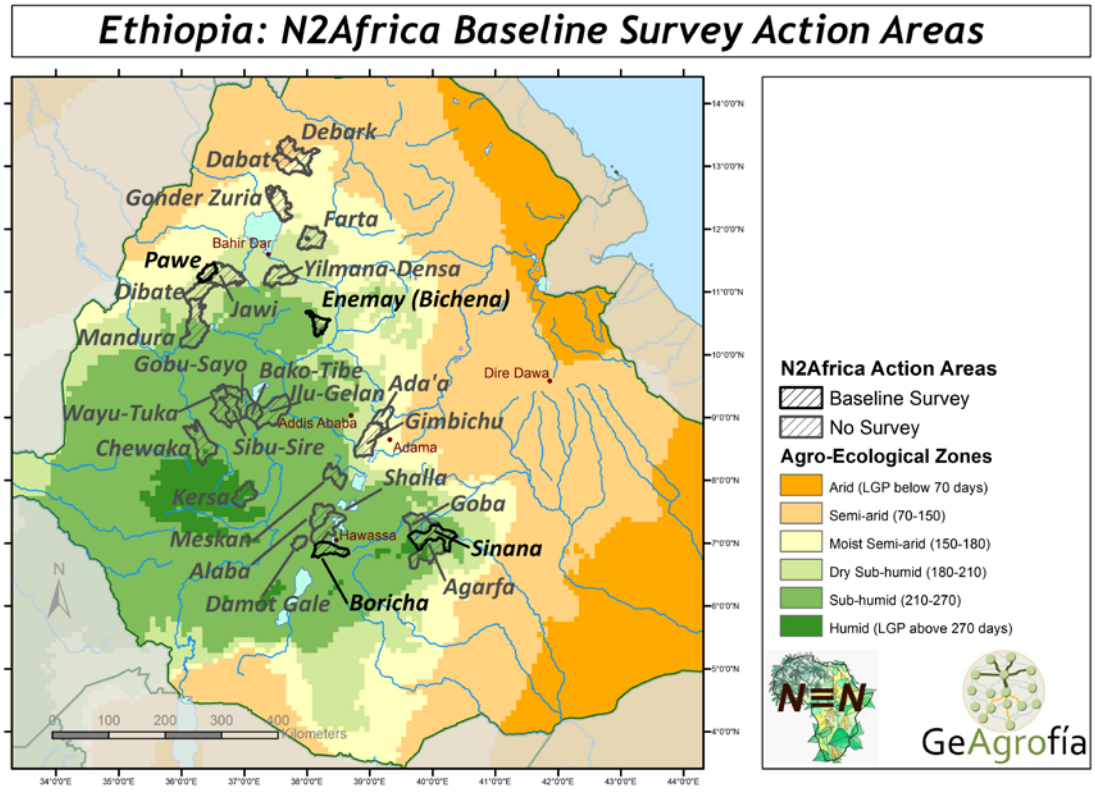


Figure 2.1: N2Africa action areas and agro-ecological zones in Ethiopia.

The elevation of the homesteads varied between 1,050 and 2,450 meters above sea level. Most households in Pawe, Benishangul Gumuz, were situated at an elevation between 1,050 and 1,200 meters above sea level. The elevation in Boricha, SNNPR, varied between 1,750 and 1,950 meters above sea level. The villages targeted were all situated in mid-elevation areas. The households in Sinana, Oromia, were situated in high-elevation areas, in which the elevation varied between approximately 2,300 and 2,450 meters above sea level. Mid-elevation and high-elevation areas (above 1,500 metres) receive substantially more rainfall than the lowlands (FAO, 2016). Elevation data for Enemay was not available.

Climatic heterogeneity is a general characteristic of Ethiopia and the action areas differ in terms of rainfall, temperature, wind and elevation (FAO, 2016). The action sites are generally characterised as sub-humid, good market access and low population density (see Figure 2.1) (Farrow, 2014b). The action sites in Pawe, Benishangul-Gumuz, are situated in hot to warm sub-humid lowlands (Deressa, 2011). The action sites in Boricha are classified as dry, with good

market access and a high population density (Farrow, 2014b). Oromia is situated in cool moist mid-highlands (Deressa, 2011). Furthermore, Sinana is relatively more humid and has a lower population density (below 100/km2) than the other action areas (Farrow, 2014b). Finally, the zone surrounding Amhara has a primarily tepid to cool moist mid-highlands.

The length of the growing period (LGP) shows a great variability among the four target regions (see Figure 2.1). It varies from 195 days in southern SNNPR to year-round growth in Oromia, on the border with eastern SNNPR (Farrow, 2014b). The average length of the growing period is 180 days (Farrow and Wolde-meskel, 2014a).

Table 2.1 shows the distribution of interviewed households over the four action sites in Ethiopia. In each action site 100 households were interviewed. In total, approximately 87% of the respondents were male.

Table 2.1: Distribution of interviewed households and gender respondents per action site in Ethiopia.

Action sites	Number of households interviewed	Gender respondents (%)	
		Female	Male
	(n=400)	(n=52)	(n=348)
Enemay	100	5%	95%
Pawe	100	14%	86%
Sinana	100	2%	98%
Boricha	100	31%	69%

2.2 Household characteristics

On average 3.9 persons lived in a household, nearly 50% younger than 16 years old. The average household size in Pawe was slightly smaller as compared to the other three action sites (Table 2.2). Most households (92%) were headed by men.

The highest education levels completed within male headed households were primary (59%) or secondary school (31%) education. This is comparable to the highest education level completed within female headed households (Table 2.3).

Table 2.2: Average adult equivalent and sex of household head per action site in Ethiopia.

	Enemay (n=100)	Pawe (n=100)	Sinana (n=100)	Boricha (n=100)	Ethiopia (n=400)
Average hh size (adult equivalent)	4.4	1.6	5.0	4.6	3.9
Sex of hh head					
F	6%	9%	1%	17%	8%
M	94%	91%	99%	83%	92%

Table 2.3: Highest education level completed within male and female headed households in Ethiopia (% of household heads).

Education level	Female headed household (n=33)	Male headed household (n=367)	Ethiopia (n=400)
Primary	42%	46%	46%
Secondary	45%	33%	34%

Table 2.4: Highest education level in households per action site in Ethiopia (% of households).

Education level	Enemay (n=99)	Pawe (n=100)	Sinana (n=96)	Boricha (n=97)	Ethiopia (n=392)
Primary	25%	48%	60%	49%	46%
Secondary	42%	28%	28%	38%	34%

Table 2.3 shows that the highest education levels of male and female headed households were primary (46%, 42%, respectively) or secondary school education (33%, 45%, respectively). The education levels between men and women did not differ much. However, this is because the number of women in the total sample is few (see Table 2.2). In general, most households in Ethiopia had at least one person who finished primary (46%) or secondary school (34%). In Enemay, the education of households is generally lower, as compared to the other three action sites (Table 2.4). Nearly one third (29%) of the households in Enemay indicated their highest level of education as 'none' or 'informal'.

2.3 Occupations and sources of household income

The majority of the households in Ethiopia received income from crop and livestock farming (see Figure 2.2). Off-farm income was mainly related to trade (16%) and casual labour (6%). The role of salaried jobs (3%) and remittances (2%) as a source of cash income appeared to be rather limited. Few differences among the four action sites in sources of income could be observed. Cropping activities were the main source of cash income for, on average, 94% of the households (data not shown). On average 3% of the households indicated their main income came from livestock farming.

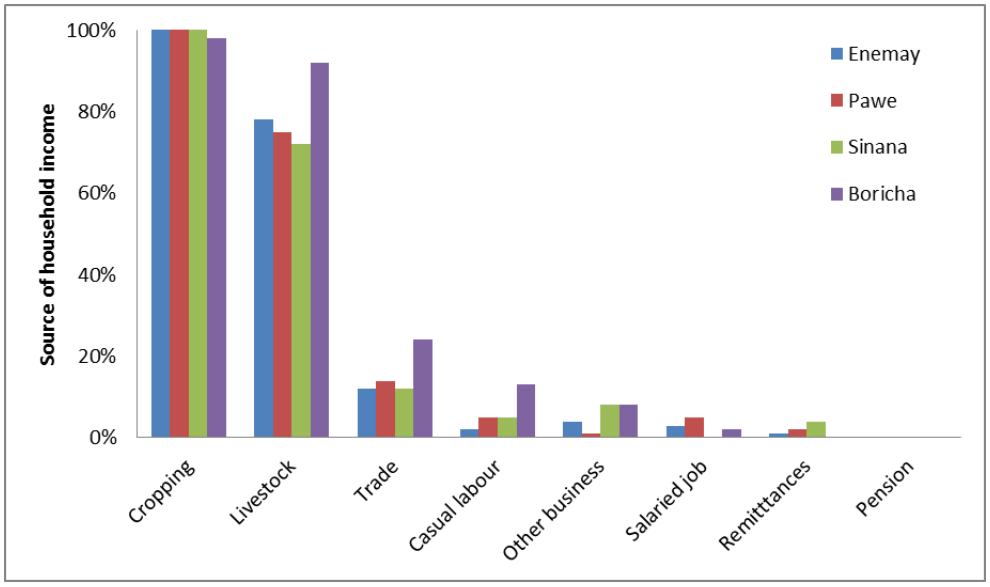


Figure 2.2: Income sources for households in each action site in Ethiopia (% of households).

Figure 2.3. shows that the vast majority of the households indicated they received most of their total income from cropping activities. Whereas livestock is often mentioned as an income source, the reported contribution of livestock to the total income is fairly limited (overall <20%). Total household income was in most cases composed of multiple income sources. In general, there were few differences among the action sites. Note that few households indicated casual labour as their main source of cash income (Figure 2.2). However, households in Sinana that depended on income generated from casual labour indicated that this income was on average nearly 60% of the total household income.

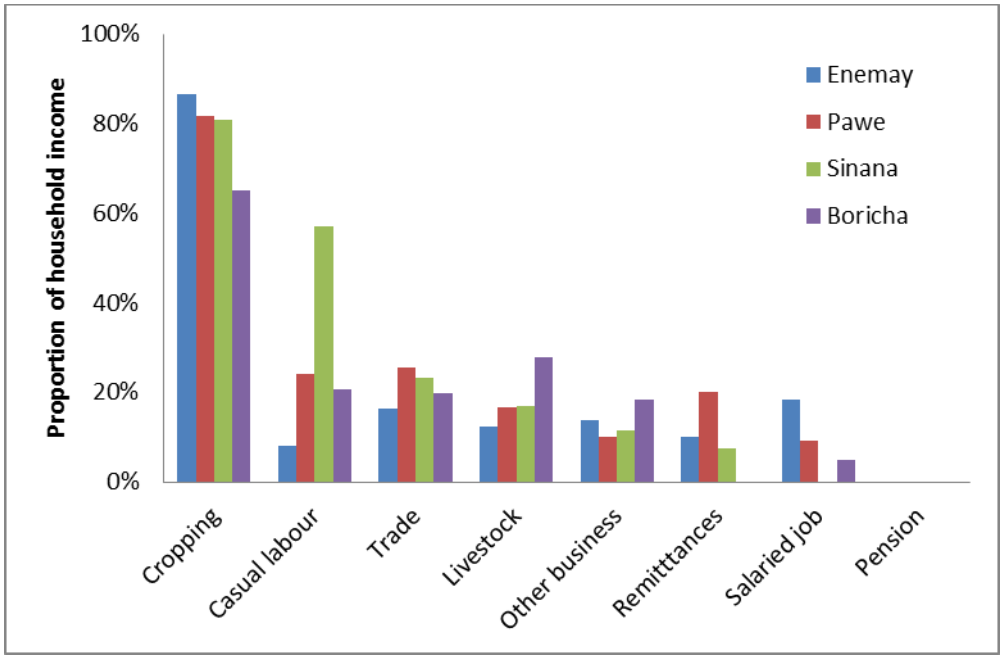


Figure 2.3: The average proportion of total household income received per income source in Ethiopia (% of total income).

2.4 Livestock ownership

The percentage of households owning livestock is not evenly spread across the country. The median Tropical Livestock Unit (TLU) per farm is lowest in Boricha (Table 2.5). This is probably related to particular farm characteristics in Boricha: a large proportion of the farms owned a small number of cattle. Another reason is that land holding is generally low (see Table 2.9). Consequently, there is hardly any grazing land available for livestock. Livestock is often reared in stall or confinements. Furthermore, 50% of the households in Enemay, Pawe and Sinana own at least 3.1 TLU livestock. Households in Sinana owned most livestock per farm (mean is 4.48 TLU).

Nearly all the households in Ethiopia owned cattle (96%). The percentage of households owning donkeys, goat/sheep and horses/ox/mule is higher in Enemay and Sinana, as compared to the other two action sites (Table 2.6). However, the average number of livestock per farm owned by households is relatively higher in Pawe and Sinana, as compared to Enemay and Boricha (Table 2.7).

Table 2.5: Mean and medium TLU per farm per action site in Ethiopia.

Tropical Livestock Unit	Enemay (n=99)	Pawe (n=96)	Sinana (n=100)	Boricha (n=94)	Ethiopia (n=389)
Mean	3.29	4.25	4.48	3.08	3.78
Median	3.10	3.40	4.00	2.50	3.13

Table 2.6: Households owning livestock per type and per action site in Ethiopia (%).

Livestock type	Enemay (n=99)	Pawe (n=96)	Sinana (n=100)	Boricha (n=94)	Ethiopia (n=389)
Cattle	97%	94%	99%	96%	96%
Donkey	68%	14%	59%	18%	40%
Goat/Sheep	60%	23%	50%	54%	47%
Horse/Ox/Mule	27%	5%	34%	2%	17%
Poultry	33%	61%	55%	60%	52%

Table 2.7: Type and average number of livestock for each household which owned the respective livestock per action site in Ethiopia.

Livestock type	Enemay (n=99)	Pawe (n=96)	Sinana (n=100)	Boricha (n=94)	Ethiopia (n=389)
Cattle	1.7	2.3	2.3	1.9	2.1
Donkey	1.6	1.1	1.7	1.7	1.6
Goat/Sheep	3.9	4.8	5.3	2.8	4.0
Horse/Ox/Mule	1.6	1.2	1.2	1.0	1.4
Poultry	4.6	7.4	6.1	6.4	6.3

The average availability of feed for ruminant livestock varied over the year. Figure .4 shows the average availability of feed, ranging from 'excess of feed availability' (10), to 'adequate feed availability' (5) to 'no feed availability' (0). The average availability of feed per year was the highest in Pawe. In general, all households indicated that the average feed availability per year is adequate. However, figure 2.4 shows that during April and May the average feed availability was not adequate for any region. Households in Boricha indicated they had a particular low feed availability from January till May. This is related to the relatively shorter growing season in Boricha and the limited availability of green forage and grass (Figure 2.5).

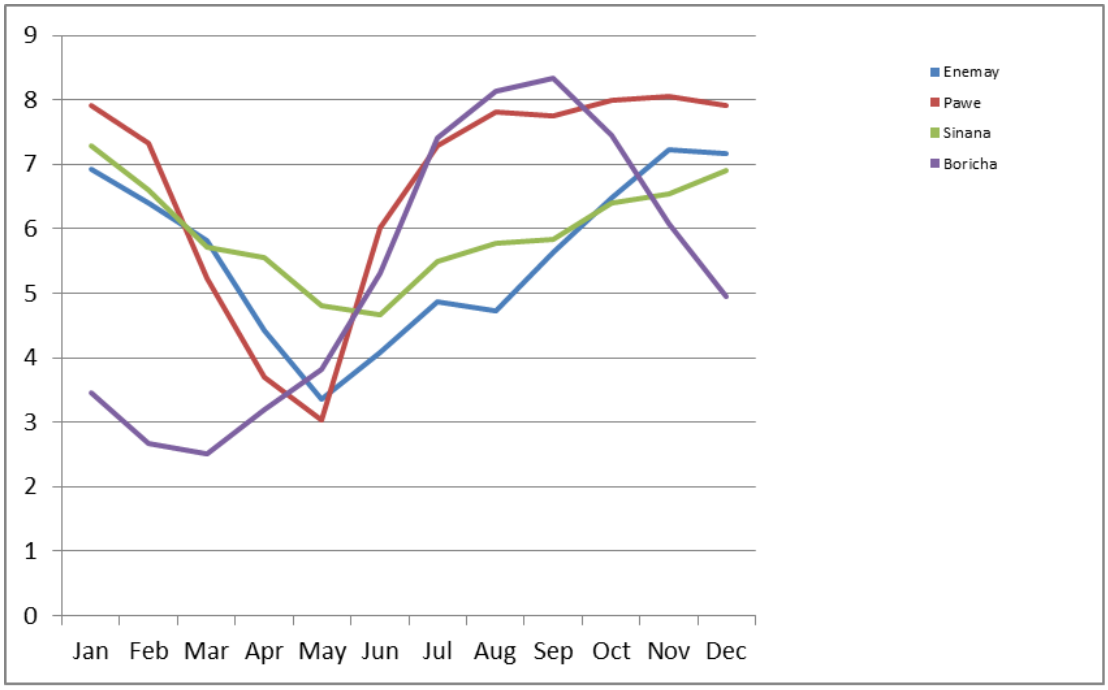


Figure 2.4: Average feed availability score per action site per month in Ethiopia.

On average, non-leguminous crop residues, grazing and green forage all contribute to the diet of the ruminant livestock. Figure 2.5 shows the monthly proportion of nutrition derived from different feed sources for ruminant livestock (in Enemay and Sinana data of the month November were not reported). Overall, crop residues and grazing are the most important feed sources for livestock. With exception of Enemay, concentrates are to a limited extent part of the total diet.

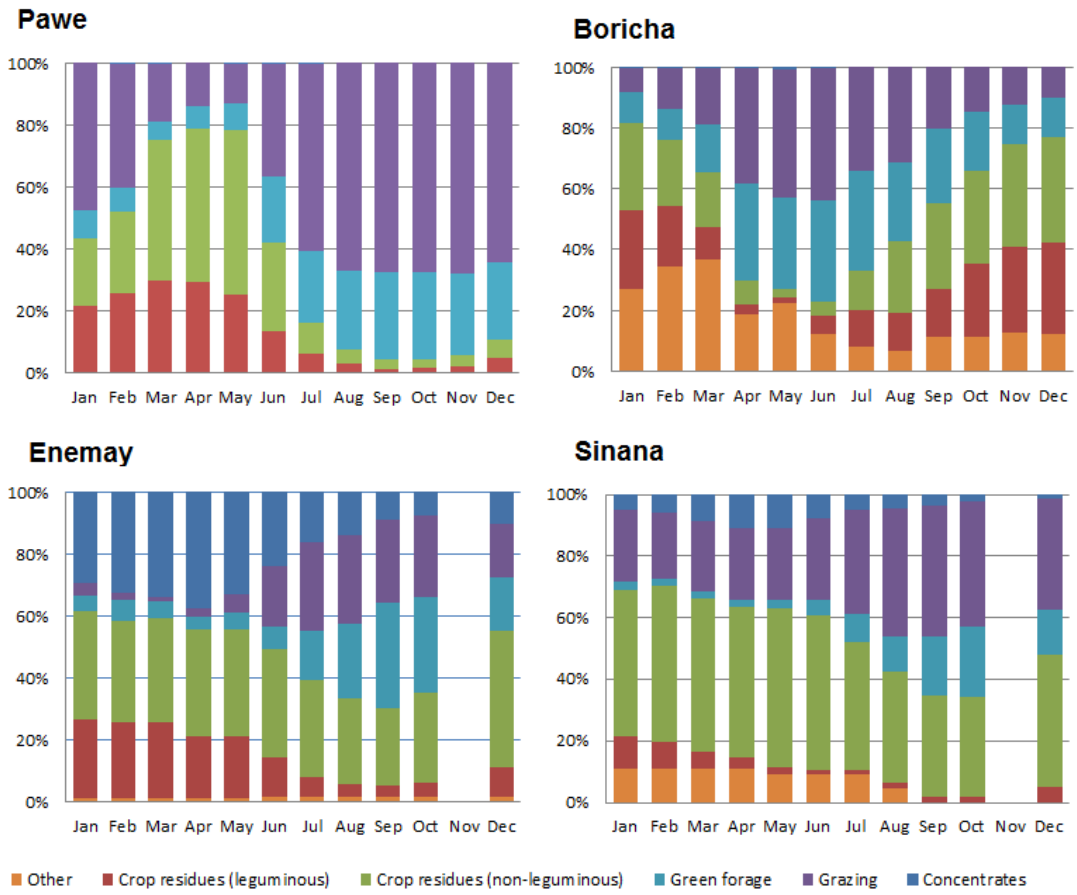


Figure 2.5: Proportion of nutrition derived from different feed sources for ruminant livestock per month and action site in Ethiopia (%).

2.5 Labour

In Ethiopia, 25%-48% of the households indicated that farming activities were delayed, because farmers were not able to hire labour (Table 2.8). Weeding and harvesting were most often delayed as compared to other farming activities (land preparation and sowing, respectively). Farming activities related to sowing were least delayed. Few farmers indicated that farming activities were delayed, because they had to work on other people's fields (2%-7%).

Table 2.8: Households indicating farming activities got delayed in Ethiopia (%).

Farming activity	Delay because farmer works on other people's fields		Delay because farmer is not able to hire labour	
Land preparation	n=352	3%	n=362	30%
Sowing	n=350	2%	n=355	25%
Weeding	n=352	7%	n=360	48%
Harvest	n=352	5%	n=361	47%

2.6 Land holding and land use

The average amount of land available per farm differed among the four action sites. The average farm size was highest in Pawe (3.3 ha) (Table 2.9). In this actio site, 50% of the households owned at least 3.0 ha. In Enemay and Boricha the farm sizes were considerably smaller: the average in Enemay was 1.5 ha and in Boricha 0.8 ha. In Boricha, 50% of the households owned less than 0.7 ha. Farms in this action site had a maximum size of 3.0 ha, which is relatively small as compared to the other action sites.

On average each farm consisted of at least 4 fields. However, in Boricha the number of fields per farm was less; on average 2.78. The field sizes varied across the four action sites. The average field sizes are the smallest in Enemay (0.3 ha per field). In Pawe the average fields were larger, on average 0.78 ha (data not shown).

Table 2.9: Farm size characteristics per action site in Ethiopia.

Farm size	Enemay (n=100)	Pawe (n=100)	Sinana (n=100)	Boricha (n=100)
Mean (ha)	1.5	3.3	3.0	0.8
Median (ha)	1.3	3.0	2.7	0.7
Maximum (ha)	4.0	12.8	10.7	3.0
Average number of fields per farm	4.86	4.22	4.86	2.78

During the current or most recent season, Ethiopian farmers mostly cultivated maize (13%), wheat (10%), teff (8%), fababean (7%), soyabean (6%) and common bean (6%) (data not shown). However, the data shows that there are big differences among the four action sites with regard to use of crops among interviewed households in Ethiopia (Figure 2.6). Households in Enemay (n=100) grew relatively more teff, grass pea, chickpea and wheat as compared to the other three action sites. Households in Pawe (n=100) cultivated relatively more soyabean, groundnut, finger millet and maize. Nearly all households in Sinana (n=100) cultivated wheat, often in combination with barly, fababean and maize. Farmers in Boricha mainly produced maize, common bean, enset, coffee and chat.

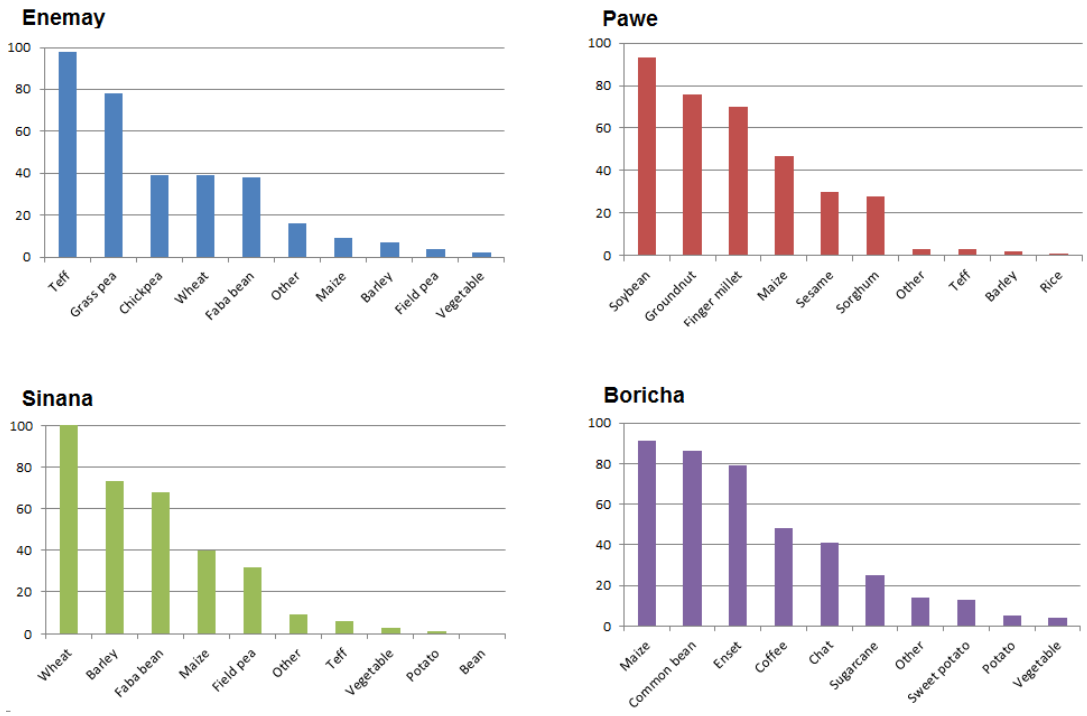


Figure 2.6: Use of crops among interviewed households per action site in Ethiopia (% of households).

The average field sizes planted with crops were usually small (Table 2.10). Faba bean, wheat, teff and maize seem to be the most important crops, with a mean walking distance that ranges from 13 to 30 minutes from the homestead. Wheat, groundnut and soyabean were cultivated on larger plot sizes. In general, common bean was cultivated near the homestead. This corresponds well to the regional walking distances (Table 2.11), as common bean was only grown in Boricha. A similar effect is visible for maize, though the walking distance is further than that of common bean due to the fact that maize is grown in the other action sites as well.

Table 2.10: Mean field size (ha) and walking distance (minutes) per crop in Ethiopia.

Crop type	Number of fields	Average field size (ha)	Mean walking distance (minutes)
Fababean	306	0.39	26
Wheat	276	0.72	29
Teff	232	0.37	28
Maize	223	0.43	13
Soyabean	132	0.88	31
Common bean	116	0.37	7
Groundnut	79	0.74	23
Chickpea	46	0.33	32

Most fields are within a walking time of 20 to 30 minutes from the homestead. Overall in Ethiopia, 50% of the fields are situated at a walking time of maximum 20 minutes from the homestead (Table 2.11). However, fields in Boricha are centred around the homestead with 50% of the fields located within a walking distance of several minutes.

Table 2.11: **Mean and median walking distance to fields per action site in Ethiopia (minutes).**

Action site	Number of fields (n)	Mean walking distance to fields (min)	Median walking distance to fields (min)
Enemay	486	27	20
Pawe	422	26	20
Sinana	486	31	30
Boricha	278	5	2
Ethiopia	**1672**	**24**	**20**

Most households indicated that they did not leave land as fallow. On average only 7% of the households left land as fallow (see Table 2.12). However, it is not clear for how long the fields were fallowed.

Table 2.12: Households that leave land as fallow per action site in Ethiopia (%).

Action site	Number of households (n)	No land left as fallow (%)	Land left as fellow (%)
Enemay	99	94%	6%
Pawe	99	87%	13%
Sinana	91	97%	3%
Boricha	85	94%	6%
Ethiopia	**374**	**93%**	**7%**

2.7 Legume cultivation and use

The greatest part of the crop harvest was used for sale (48%) or home consumption (32%) (Table 2.13). Only a very small amount of crops was used as payment for hired labour (on average 3%). On average 16% of the crop harvest was used to save seed for planting in the next growing season.

In Enemay, nearly half of the crop harvest was used for consumption (45%) and more than one third was used for sale (39%). Households also consumed the harvested chickpea (45%), faba bean (36%) and grass pea (39%).

In Pawe, crop harvests were mainly sold (66%) or saved as seed for the next growing season (24%). Households indicated that the crop harvest was hardly used for home consumption (only 4%). Households in Sinana used the crop harvest of faba bean either for sale (41%) or for home consumption (42%). In Boricha, most of the crop harvest was consumed (58%), particularly through common bean consumption. Note that the data related to maize and enset is based on a small sample.

Table 2.13: Relative crop harvest use per crop per action site in Ethiopia (%).

Crop type per action site	Number of households (n)	Average of % Sale	Average of % Consumption	Average of % Payment/ food hired labour	Average of % Seed for planting
Enemay	**153**	**45%**	**39%**	**0%**	**16%**
Chickpea	41	35%	45%	1%	19%
Common bean	2	75%	25%	0%	0%
Faba bean	34	50%	36%	0%	14%
Field pea	2	90%	5%	0%	5%
Grass pea	67	44%	39%	0%	17%
Lentil	7	58%	28%	0%	14%
Pawe	**166**	**66%**	**4%**	**6%**	**24%**
Groundnut	70	61%	6%	7%	26%
Soyabean	96	69%	3%	6%	22%
Sinana	**67**	**41%**	**42%**	**0%**	**17%**
Faba bean	67	41%	42%	0%	17%
Boricha	**117**	**33%**	**58%**	**3%**	**6%**
Common bean	94	38%	52%	3%	7%
Enset	6	0%	100%	0%	0%
Maize	17	25%	70%	4%	0%
Ethiopia	**503**	**48%**	**32%**	**3%**	**16%**

2.7.1 Use of crop residues and fertilisers

Crop residues are used to feed cattle, to mulch the fields, to burn or to sell. Most of the households used the crop residues to feed their livestock (92%) (Table 2.14). This was as expected, considering the large proportion of farmers taking care of ruminants. On average, one third of the households, used it for mulching (34%) and only a few households that used crop residues sold it (4%).

Households in Enemay indicated that they mainly used the crop residues to either feed it to their cattle or to mulch their fields. In this action site, none of the households burned the crop residues. However, a large proportion of farmers in Pawe that used crop residues (88%) indicated they also burned crop residues. This was mainly due to burning the residues of soyabean.

Table 2.14: Utilisation of crop residues per action site in Ethiopia: average percentage used for livestock feeding, home consumption, burning or sale (%).

Action site	Number of households (n)	Residues fed to livestock	Residues mulched	Residues burned	Residues sold
Enemay	100	87%	34%	0%	0%
Pawe	100	95%	31%	88%	7%
Sinana	100	99%	33%	2%	5%
Boricha	100	88%	38%	21%	2%
Ethiopia	**400**	**92%**	**34%**	**28%**	**4%**

Overall (n=1673), 54% of the fields did not receive any mineral fertiliser. In case households used mineral fertilisers, DAP/Urea was the most common (23%) (Figure 2.7).

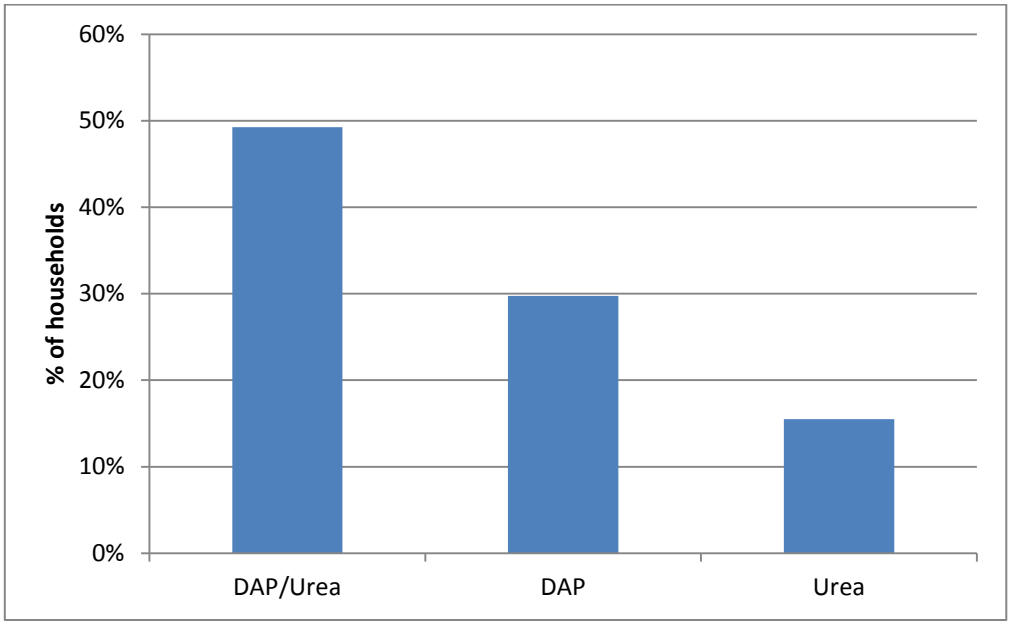


Figure 2.7: Use of fertiliser among interviewed households in Ethiopia (% of households).

2.7.2 Labour saving tools

On average, only one quarter of the Ethiopian households indicated they used labour saving tools (Table 2.15). However, this is primarily due to the high use of labour tools in Pawe. Tools were mostly used by men (83%). In Pawe, tools were mainly used for weeding (herbicides), processing (e.g. groundnut sheller, thressing machine) and planting. The herbicides were probably used for reducing the amount of striga weeds (Asosa, 2004). Farmers in Enemay indicated that the tools were mainly used for weeding (herbicides) and pest control (pesticides) (data not shown).

Table 2.15: Use of labour saving tools per action site in Ethiopia (% of households).

Action site	Number of households (n)	No use of labour saving tools	Use of labour saving tools
Enemay	100	74%	26%
Pawe	100	32%	68%
Sinana	100	99%	1%
Boricha	97	98%	2%
Ethiopia	**397**	**76%**	**24%**

2.7.3 General production constraints

Table 2.16 shows the most important production constraints of households in Ethiopia. Pests/weeds, lack of inputs/varieties, diseases and limited capital and weather effects were most often mentioned by farmers. There were differences among the four action sites. Constraints, such as pests/weeds and diseases were relatively more often mentioned by households in Enemay. Farmers in Pawe suffered relatively more often from a lack of inputs/varieties and pests/weeds. The main production constraints in Sinana were related to weather effects, pests and diseases. Most farmers in Boricha mentioned a lack of inputs (76%) and limited capital (35%) as production constraints.

Table 2.16: Farmers' perception of production constraints per action site in Ethiopia (%).

Production constraints	Enemay (n=100)	Pawe (n=100)	Sinana (n=100)	Boricha (n=100)	Ethiopia (n=400)
Pests/Weeds	82%	67%	42%	18%	52%
Lack of inputs / varieties	9%	70%	30%	67%	44%
Diseases	64%	5%	47%	17%	33%
Limited capital / High costs	34%	21%	40%	35%	33%
Other weather effects	22%	15%	53%	27%	29%
Other	20%	13%	6%	14%	13%
Low soil fertility	2%	14%	1%	19%	9%
Limited labour supply or knowledge	2%	10%	6%	16%	9%
Droughts	11%	1%	2%	12%	7%
Destruction by animals	1%	7%	0%	1%	2%

2.8 Control over land use and harvest

Most fields were managed by both husband and wife (Table 2.17). Also the harvest sale was in most households decided by both husband and wife (71%). Fields that were managed by women were mainly used for maize, soyabean, enset and groundnut (data not shown).

Table 2.17: Fields managed and harvest sale decided by household members in Ethiopia (% of fields).

Household member	Fields managed by:		Harvest sale decided by:	
	Number of fields (n)	%	Number of fields (n)	%
Both husband and wife	900	60%	1045	71%
Husband	551	37%	380	25%
Wife	46	3%	64	4%

Table 2.18 shows differences among the four action sites with regard to control over land use. In Pawe and Sinana most fields (56%, 60%, respectively) were solely managed by men. Fields in Enemay and Boricha were managed by both husband and wife (93%, 74%, respectively).

Table 2.18: Control over land use and harvest by household member per action site in Ethiopia (% of fields).

Action site	Both husband and wife	Husband	Wife	Number of fields (n)
Enemay	93%	6%	1%	457
Pawe	39%	56%	5%	417
Sinana	39%	60%	1%	427
Boricha	74%	16%	9%	196
Ethiopia	**60%**	**37%**	**3%**	**1497**

2.9 Nutrition

Table 2.19 shows that legumes were consumed both as a main (46%) and a side dish (54%). Chickpea, common bean and faba bean were the most often mentioned legumes. Households mainly consumed the legume grains, as compared to the legume leaves. Table 2.18 indicates that households consumed the leaves of groundnut and soyabean as a side dish only.

Table 2.19: Consumed grain legumes and legume leaves per type of dish in Ethiopia (%).

Legumes	Main dish			Side dish		
	Legume grain	Legume leaves	Sample size	Legume grain	Legume leaves	Sample size
Chickpea	100%	0%	3	70%	30%	61
Common bean	96%	4%	51	94%	6%	51
Faba bean	99%	1%	100	97%	3%	32
Grass pea	100%	0%	18	100%	0%	1
Groundnut	0%	0%	0	0%	100%	34
Soyabean	0%	0%	0	0%	100%	23
Grand total (n)			**172**			**202**
Grand total (%)			**46%**			**54%**

Figure 2.7 shows the consumption patterns of legumes in the four Ethiopian action sites. Almost all households indicated they consumed leguminous food items on a weekly basis, both in low and peak season. There are quite some differences among the action sites, mainly due to the fact that the four action sites have different target legumes.

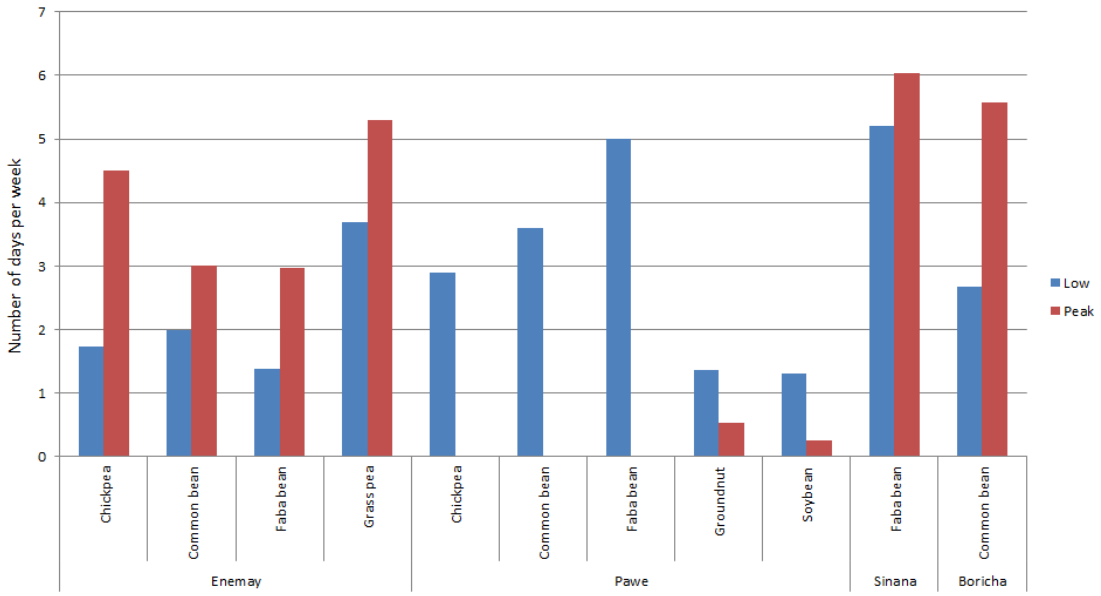


Figure 2.8: Consumed leguminous food items in households in action sites of Ethiopia (number of days per week).

Figure 2.8 shows that, overall in a normal year, food items mainly come from the own farm. The pattern shown is related to the climate seasonality in Ethiopia. During May, June, July, August and September approximately 25% of the households indicated the majority of the food comes from sources other than their own farm.

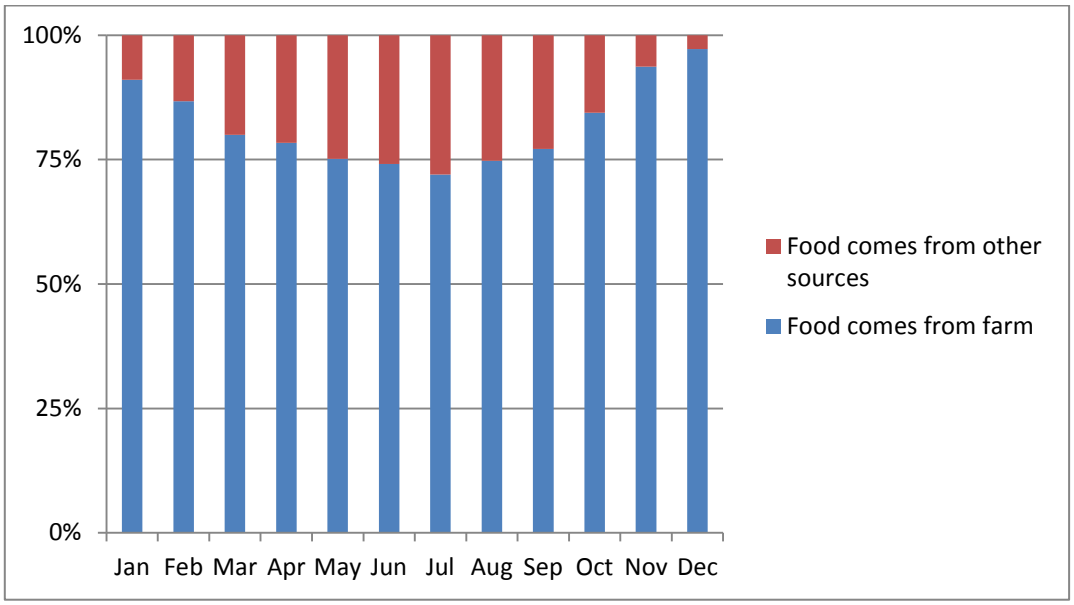


Figure 2.9: Main source of food per month in Ethiopia (% of households).

However, there are differences among the four action sites (see Figure 2.9). In Enemay and Sinana, the consumed food items mainly came from the farm. Households in Pawe consumed food that mainly came from the own farm, but this was less often the case for the months August, September and October. Households in Boricha consumed the least food items that mainly came from their own farm, on average less than 60%. Households in this action site struggled the most to find sufficient food to feed everyone in the household (Figure 2.10). Figure 2.10 also shows that in August, September and October 40-50% of the households in the Enemay and Pawe indicated that they struggled to find sufficient food. This is remarkable for Enemay, as they also indicated that they obtain nearly all of their food from their own farm in the same period.

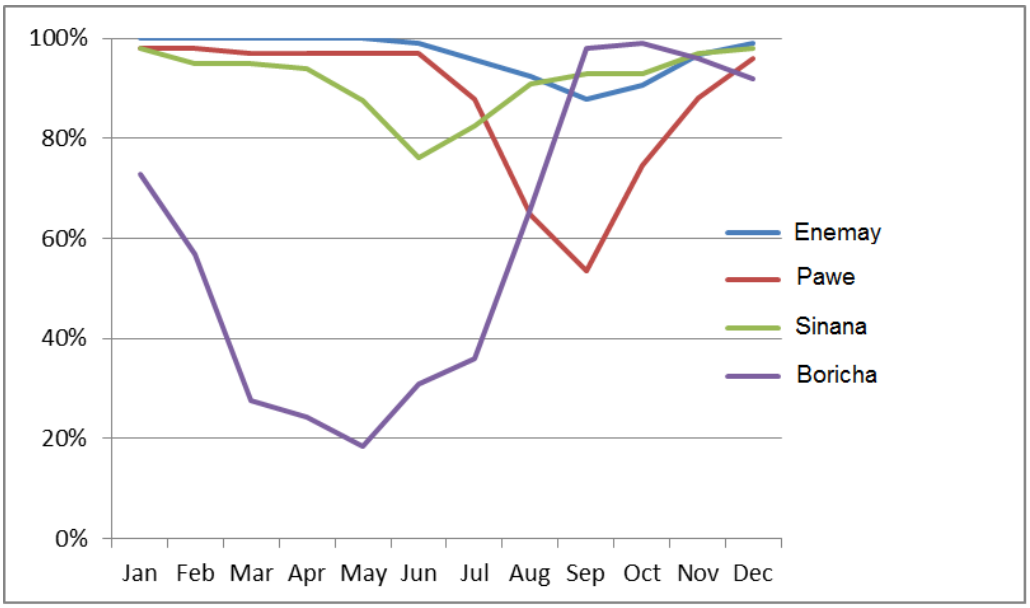


Figure 2.10: Households consuming food primarily from their own farm per month per action site in Ethiopia (% of households).

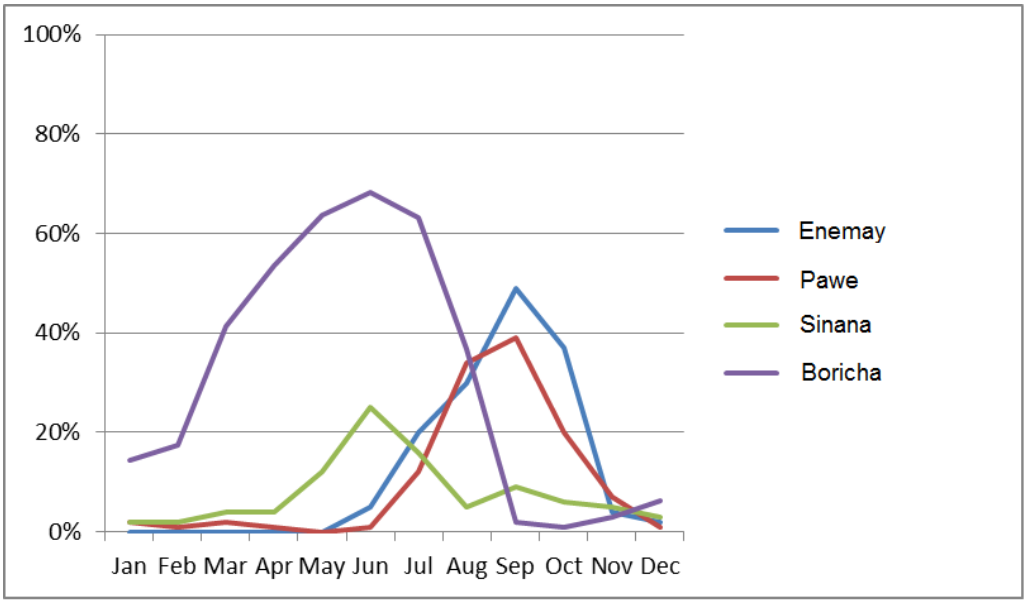


Figure 2.11: Households struggling to find sufficient food to feed everyone in the household per month per action site in Ethiopia (% of households).

2.10 Information

The interviewed farmers indicated they wanted to learn more about agronomic practices or management, pest and diseases and variety/seed selection (data not shown).

Overall, Ethiopian farmers mentioned pest and diseases (58%), lack of improved seed varieties (25%) droughts (unreliable rainfall) (13%), excessive rainfall (13%) and weeds/high costs weeding (8%) to be the Top 5 key challenges in legume cultivation (Table 2.20).

Farmers from Enemay, as compared to farmers from the other action sites, mentioned pests and diseases more often as a key challenge. Lack of improved seeds or varieties were relatively more often mentioned by farmers in Pawe and Boricha. Water-related challenges (drought, unreliable or excessive rainfall) were most often mentioned by households in Boricha.

Table 2.20: Top 5 key challenges that farmers face in legume cultivation per action site and in Ethiopia (%).

Top 5 key challenges	Enemay	Pawe	Sinana	Boricha	Ethiopia
	n=100	n=100	n=100	n=100	n=400
Pests/ diseases	98%	35%	75%	24%	58%
Lack of improved seed/ varieties; poor quality of seed	0%	42%	9%	48%	25%
Drought/ unreliable rainfall	9%	5%	1%	37%	13%
Excessive rainfall	4%	11%	13%	23%	13%
Weeds/ high costs weeding	0%	16%	9%	7%	8%

Figure 2.11 shows the average rank of importance of information sources. Lower ranks are considered to be more important sources of information. Data indicates that government extension agents, local traders and fellow farmers were the main sources of information on legumes. Mobile phones, television and radio were less often considered as main source of information. The farmers mainly sought information about agronomy (planting time, spacing, disease and pest control) (30%), inputs (seed, varieties, fertilisers, inoculants) (30%) and marketing (where markets are, prices, quality required) (19%) (data not shown). Farmers in Pawe also looked for information related to health and industrial use.

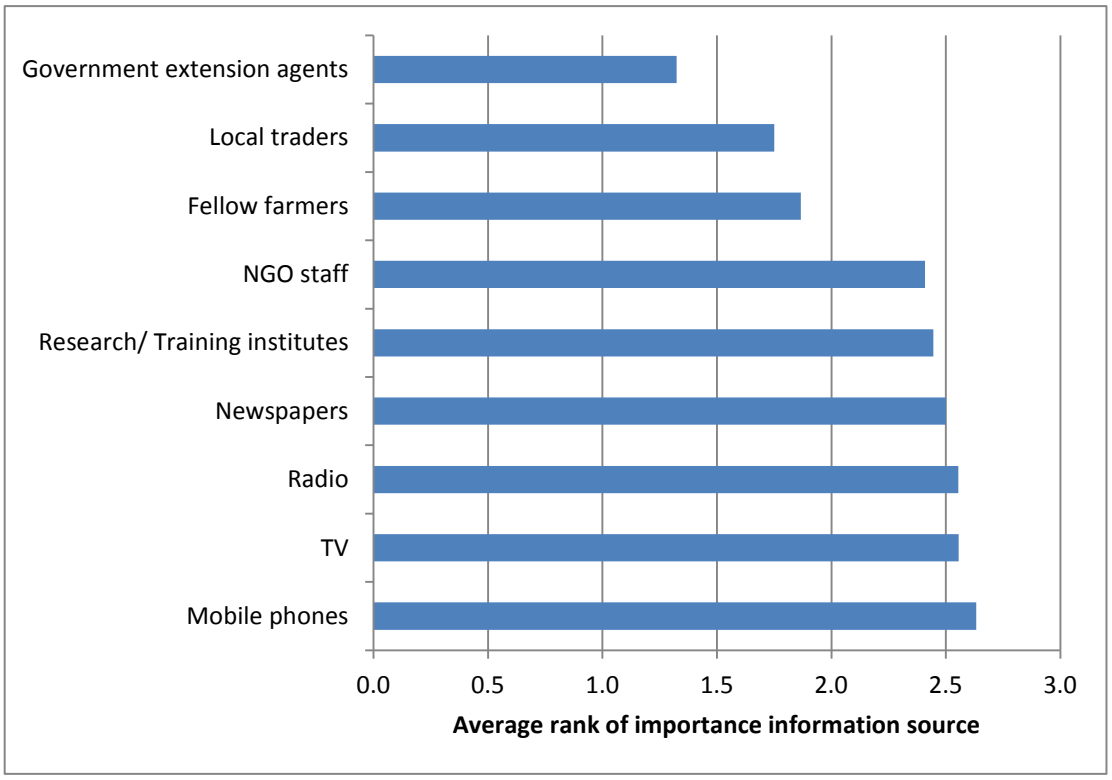


Figure 2.12: The average rank of importance of information sources in Ethiopia.

2.11 Market access

Data with regard to market access was only collected for Boricha. 42% Of the farmers in Boricha indicated they sold common bean directly to the local market.

2.12 Household assets

Many households mentioned furniture (56%), electronics (e.g. radio, television and mobile phone) (31%) or their house (7%) as their most valuable asset (Table 2.21).

Table 2.21: Household assets and services in Ethiopia (% of households).

Type of asset or service	% of households
Furniture	56%
Electronics	31%
Housing	7%
Transport	4%
Farm implements	2%

3 Tanzania

The baseline survey in Tanzania was first carried out among 398 households in the northern zone in September 2013. In March/ April 2014, a second survey was carried out among in total 800 households in the northern, central, southern and southern highland zones. Note that due to oversampling in the northern zone, the means at country level are biased. The two surveys slightly differed. In general, the first survey contained fewer questions (Appendix II).

3.1 Sites

Data from 1198 households was used in the analysis of the baseline survey conducted in Tanzania. The households were located in the action areas of Kongwa (central zone), Nanyumbu (southern zone), Mafinga, Mbozi, Ludewa and Namtumbo (southern highlands) and Kiteto, Hai, Meru, Lushoto and Moshi rural (northern zone) (Figure 3.1).

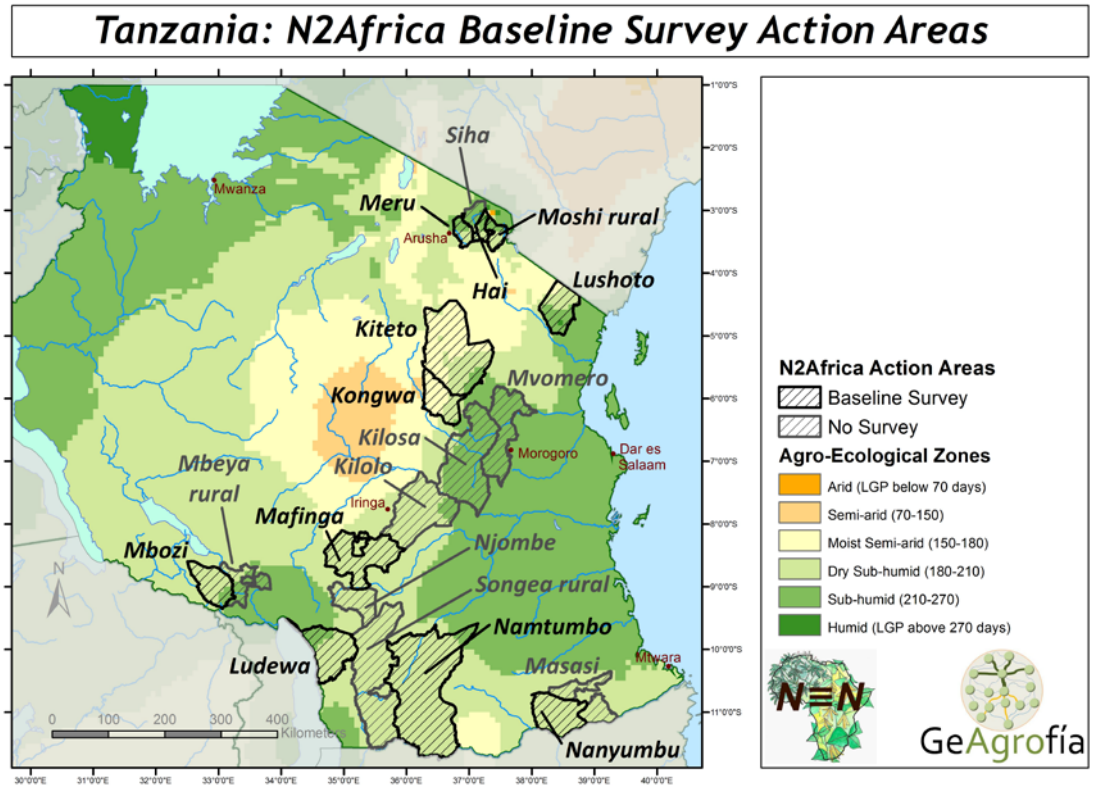


Figure 3.1: N2Africa action areas and agro-ecological zones in Tanzania in 2014.

Table 3.1 shows the distribution of interviewed households over the four zones in Tanzania. In the central zone 130, in the southern zone 200 and southern highlands 400 households were interviewed. In the northern zone relatively more (468) households participated. In total, approximately 60% of the respondents were male. Note that gender data collected is incomplete. Consequently, the number of female and male respondents are smaller than the reported number of households interviewed.

Table 3.1: Distribution of interviewed households and gender respondents per zone in Tanzania.

Zones	Number of households interviewed	Number of female and male respondents	
		Female	Male
	(n=1198)	(n=355)	(n=524)
Central	130	38	54
Northern	468	219	247
Southern	200	48	114
Southern highlands	400	50	109

The action sites in the northern zone are situated in a more humid adoption domain with a high population density and good market access (Farrow, 2014c). The action sites in the central zone have a dry climate, with poor market access and a low population density. The climate in the southern highlands is relatively dry. The zone has a low population density (below 100 persons/km2) and, although the access to markets differs within the zone, the market access is generally good (Farrow, 2014c). Lastly, market access in the southern zone is poor and the population density is low. The southern zone has one growing season with a duration of 3-4.5 months (Farrow, 2014c).

The elevation in the central zone was approximately 1,120 meters above sea level, and in the northern zone it varied between 900 and 1,500 meters above sea level. Most households in the southern zone were situated at an elevation between 200 and 400 meters above sea level. Elevation of the households in the southern highlands varied between approximately 815 and 2,000 meters above sea level.

In Tanzania, the average length of the growing period is 180 days. In the action areas the length of the growing period (LGP) ranges from 150 to 225 days (Farrow, 2014c). The characteristics of the growing seasons are different between the zones, as the northern zone is characterised by bimodal rainfall, while the other zones experience just one growing season (Farrow, 2014c). In the central zone, there is for example, one growing season with a duration of 2-2.5 months.

3.2 Household characteristics

On average 4.4 persons lived in a household (Table 3.2). Children make up a large part of the rural population as 45 % were younger than 17 years old.

On average, 40% of the farmers were female. Although this percentage was slightly lower in the southern zone (29%) and southern highlands (31%). Most of the household heads (84%) were male. In the southern highlands, this was even higher as 93% of the household heads were male.

Table 3.3 shows that he highest education levels completed within male headed households were primary (59%) or secondary school (31%) education. This is comparable to the highest education level of female headed households. In the southern zone, the education of household heads is generally lower, as compared to the other three zones (Table 3.4).

Table 3.2: Average adult equivalent and sex of household head per zone in Tanzania.

	Central	Northern	Southern	Southern highlands	Tanzania
	(n=92)	(n=467	(n=162)	(n=159)	(n=879)
Average hh size (adult equivalent)	4.8	4.7	4.0	4.1	4.4
Sex of hh head					
F	21%	19%	15%	7%	16%
M	79%	81%	85%	93%	84%

Table 3.3: Highest education level completed within male and female headed households in Tanzania (% of household heads).

Education level	Female headed household (n=144)	Male headed household (n=735)
Primary	58%	59%
Secondary	30%	32%

Table 3.4: Highest education level of household heads per zone in Tanzania (% of household heads).

Education level	Central (n=92)	Northern (n=466)	Southern (n=162)	Southern highlands (n=159)	Tanzania (n=879)
Primary	54%	50%	85%	62%	59%
Secondary	32%	39%	9%	32%	31%

3.3 Occupations and source of household income

Although the majority of households received off-farm income, crop farming (92%) was the most important source of income for households (data not shown). The majority of the households in Tanzania received income from multiple sources, crop and livestock farming being the most important ones (see Figure 3.2). The role of trade, remittances and salaried jobs appeared to be rather limited as a source of income. Some differences in sources of income could be observed between the southern zone and the other three zones. In the southern zone relatively more households relied on crop farming and relatively fewer on livestock farming. As compared with other zones, households situated in the central zone depended more on income generated from casual labour and other businesses.

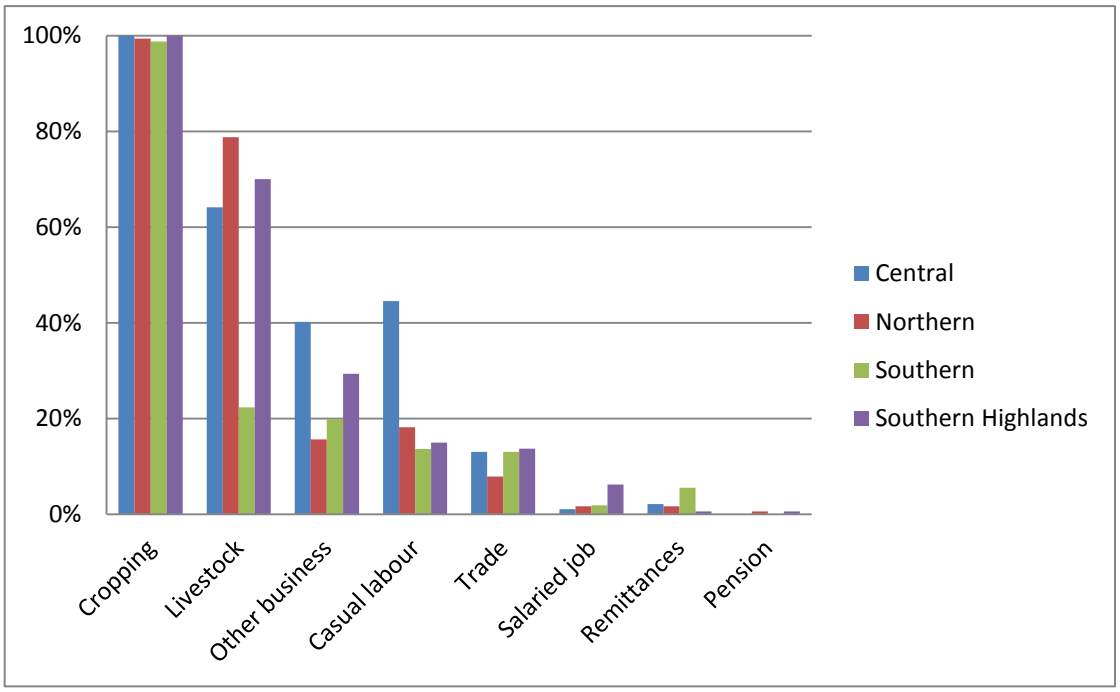


Figure 3.2: Income sources for households in each zone in Tanzania (% of households).

Figure 3.3. shows that the households which listed cropping as an income source, indicated they received most of their total income from cropping activities. Total household income was in most cases composed of multiple income sources. However, income sources other than cropping were only a small fraction of the total household income. This holds pattern for all four Tanzanian zones.

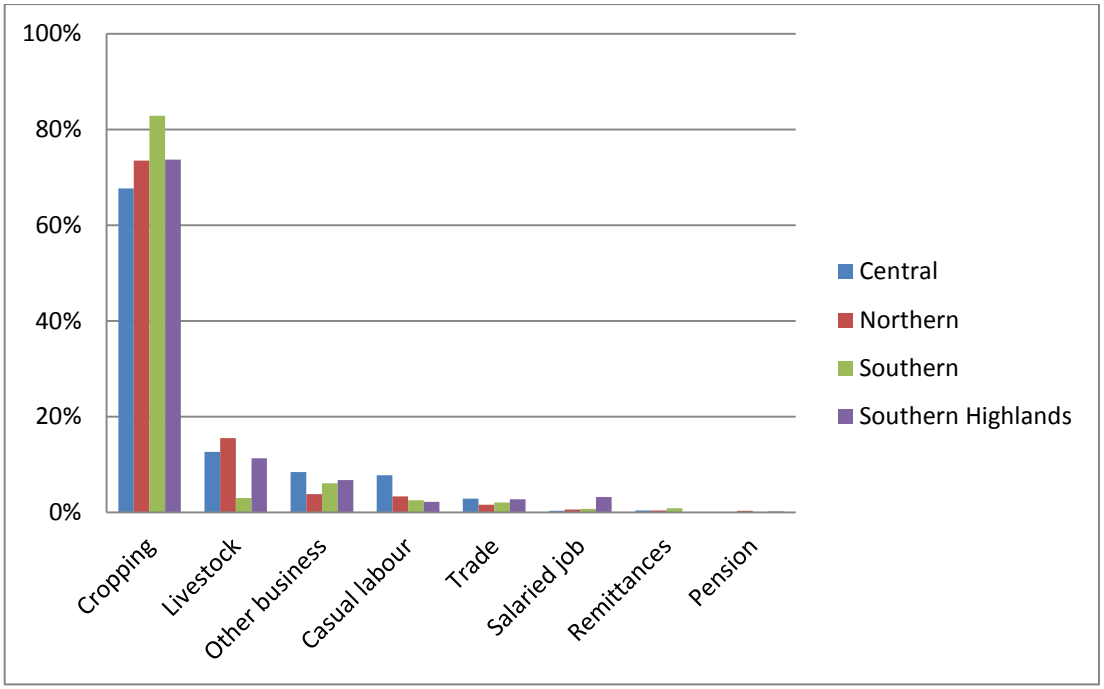


Figure 3.3: The average proportion of income received per income source in Tanzania (% of total income).

3.4 Livestock ownership

The percentage of households owning livestock is unevenly spread across the country. The median Tropical Livestock Unit (TLU) per farm is lowest in the southern zone (Table 3.4). This is the result of households in the southern zone mainly keeping poultry as their livestock.

Furthermore, 50% of the households in the central and northern zone own 1.6 TLU or more livestock (Table 3.5). The percentage of households owning cattle and goat/sheep is higher in the northern zone, as compared to the other zones (Table 3.6). On average, 87% of the households in Tanzania keep poultry, with little variability among the four zones.

Table 3.5: Mean and medium TLU per farm per zone in Tanzania.

Tropical Livestock Unit	Central (n=71)	Northern (n=433)	Southern (n=72)	Southern highlands (n=146)	Tanzania (n=722)
Mean	5.29	3.49	0.57	1.96	2.83
Median	1.65	1.61	0.10	1.25	1.15

Table 3.6: Households owning livestock per type and per zone in Tanzania (% of households).

Livestock type	Central (n=71)	Northern (n=433)	Southern (n=72)	Southern highlands (n=146)	Tanzania (n=722)
Cattle	46%	64%	7%	46%	53%
Donkey	3%	1%	0%	0%	1%
Goat/Sheep	58%	76%	29%	61%	66%
Pig	23%	9%	6%	38%	16%
Poultry	86%	86%	83%	92%	87%

Table 3.7 indicates that the average number of livestock owned by households is the largestin the central zone. Households in the central zone own on average more cattle and goat/sheep per farm, as compared to the other zones. This is probably related to the zonal agro-ecological characteristics (e.g. dry, low population density and poor market access), which provide favourable conditions for rearing livestock.

Table 3.7: Type and average number of livestock owned by households per zone in Tanzania.

Livestock type	Central (n=71)	Northern (n=433)	Southern (n=72)	Southern highlands (n=146)	Tanzania (n=722)
Cattle	9	5	3	3	5
Donkey	3	3			3
Goat/Sheep	13	8	8	5	9
Pig	4	4	7	3	4
Poultry	11	15	8	12	12

Concentrates, grazing, green forage and crop residues all contribute to the diet of the ruminant livestock. The average availability of feed for ruminant livestock varied over the previous year. Figure 3.4 shows the average availability of feed, ranging from excess of feed availability (10), to adequate feed availability (5) to no feed availability (0). The average availability of feed is highest in the southern highlands. In the southern zone, the average feed availability is during the whole year relatively low. This is related to zonal differences in crop production patterns, which result in a lower biomass of crop residues (Figure 3.5). During July, August, September and October the availability of green forage decreases and ruminant livestock is being fed through grazing, crop residues and to a lesser extent by using concentrates. In general, the feed availability is lowest after the dry season and before the first rains in October and November.

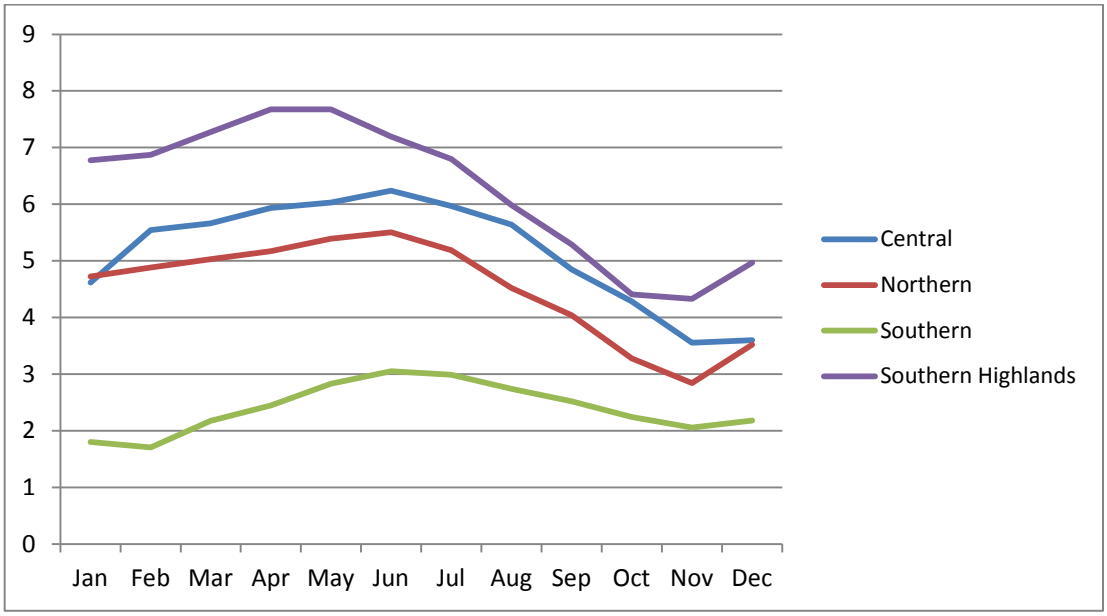


Figure 3.4: Average feed availability score per zone per month in Tanzania.

Figure 3.5 shows the monthly proportion of nutrition derived from different feed sources for ruminant livestock. Overall, grazing is the most important feed source for livestock. In June, July, August and September the diet of cattle and goats/sheep slightly changes, as 20-30 % of the nutrition is derived from crop residues. Generally, leguminous crop residues are a limited part of the total diet.

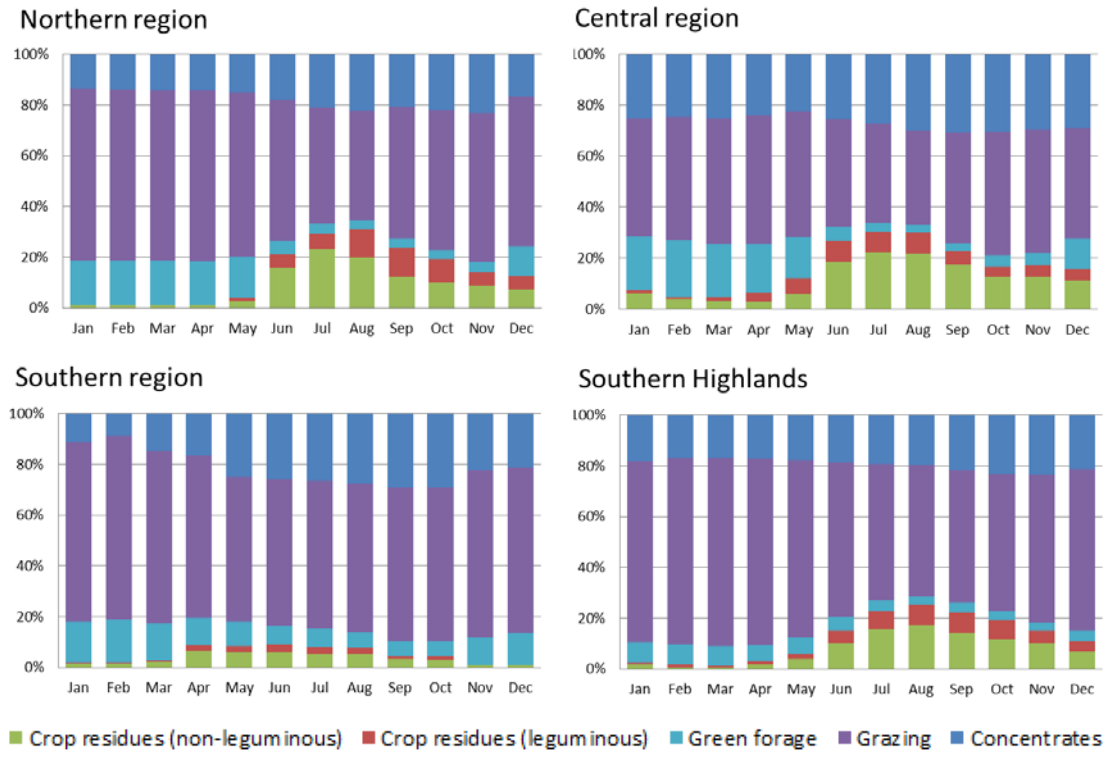


Figure 3.5: Proportion of nutrition derived from different feed sources for ruminant livestock per month and zone in Tanzania (%).

3.5 Labour

14% of the households indicated that farming activities related to land preparation were delayed, because they first had to work on others people's fields (Table 3.8). 18% of the households mentioned that weeding was delayed, because they had to work on others people's fields first. 30% of the households indicated they could not hire enough people to weed their own fields. Weeding was most delayed as compared to other farming activities (land preparation, sowing and harvest, respectively). Farming activities related to harvest were least delayed. This is probably related to the fact that consumption patterns show that most consumed food items come from the farm (Figure 3.9).

Table 3.8: Households indicating farming activities were delayed in Tanzania (% of households).

Farming activity	Delay because farmer works on other people's fields		Delay because farmer is not able to hire labour	
Land preparation	n=409	14%	n=409	21%
Sowing	n=414	12%	n=410	16%
Weeding	n=411	18%	n=412	30%
Harvest	n=411	7%	n=409	10%

3.6 Land holding and land use

The average amount of land available per farm differed among the four zones. The average farm size was largest in the central zone (6.86 ha) (Table 3.9). In this zone, 50% of the households owned at least 4,65 ha. In the other zones the farm sizes were considerably smaller: the average in the northern zone was 2.18 ha, in the southern zone 0.89 ha and in the southern highlands 2.92 ha. In the southern zone, 50% of the households owned less than 0.69 ha. Farms in this zone had a maximum size of 3.88 ha, which is relatively small as compared to the other three zones. On average each farm consisted of 1.9 fields. The field sizes varied across the four zones. The average field sizes are the smallest in the southern highlands (0.78 ha per field). In the central zone the average fields were larger, on average 2.5 ha (data not shown).

Table 3.9: Farm size characteristics per zone in Tanzania.

Farm size	Central (n=92)	Northern (n=466)	Southern (n=162)	Southern highlands (n=159)	Tanzania (n=879)
Mean (ha)	6.86	2.18	0.89	2.92	2.57
Median (ha)	4.65	1.21	0.69	2.43	2.24
Maximum (ha)	79.42	53.82	3.88	20.23	79.42
Average number of fields per farm	2.98	1.95	1.48	2.99	2.16

During the current or most recent season, maize, bean, groundnut and sunflower were the four most commonly used crops in Tanzania (Figure 3.6). Households in the central zone (n=92) grew relatively more sunflower, cowpea, Bambara groundnut and sorghum as compared to the other three zones. Households in the southern zone (n=160) cultivated relatively more vegetables, in combination with maize and groundnut. In this zone, few farmers cultivated bean, cowpea or soyabean. Up to 80% of the households in the northern zone (n=465) and southern highlands (n=160) cultivated common bean. Almost all households in these two zones cultivated maize.

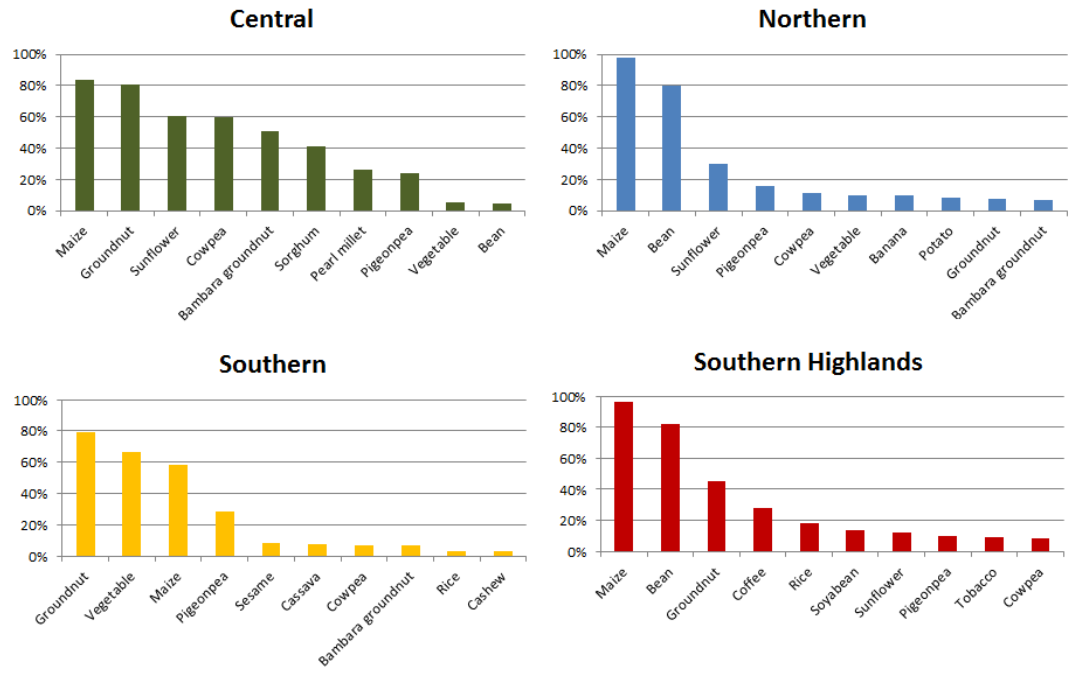


Figure 3.6: Use of crops among interviewed households per zone in Tanzania (% of households).

The area planted with crops was usually small (see Table 3.10). Data with regard to relative share shows that crops are being intercropped. Consequently, the mean field coverage per crop is rather low. Maize and bean seem to be the most important crops, with a mean walking distance that ranges from 25 to 30 minutes from the homestead. In general, cowpea is cultivated in larger fields with a lower average portion of field coverage. Note that the data related to cowpea and pigeonpea is based on a small sample.

Table 3.10: Mean field size (ha), field coverage (ha) and walking distance (minutes) per crop in Tanzania.

Crop type	Number of fields	Average field size (ha)	Mean field coverage (ha)	Mean walking distance (minutes)
Maize	235	0.61	0.37	30
Bean	163	0.81	0.31	25
Groundnut	88	0.61	0.24	20
Sunflower	23	0.61	0.17	30
Pigeonpea	18	0.81	0.19	43
Cowpea	15	1.62	0.24	45
Soyabean	23	0.81	0.23	30

Most fields are located at a walking time of 20 to 45 minutes from the homestead. Overall in Tanzania, 50% of the fields are situated at a walking distance of maximum 30 minutes from the homestead (Table 3.11). Fields in the northern zone are relatively centred around the homestead with 50% of the fields located within a walking distance of 15 minutes.

Table 3.11: Average and mean walking distance to fields per zone in Tanzania (minutes).

Zone	Sample size (n)	Average walking distance to fields (min)	Median walking distance to fields (min)
Central	274	42	30
Northern	868	30	15
Southern	232	56	40
Southern highlands	478	41	30
Tanzania	**1852**	**38**	**30**

Most households indicated that they did not leave land as fallow. On average 21 % of the households left land as fallow (see Table 3.12). However, it is not clear for how long.

Table 3.12: Households that leave land as fallow per zone in Tanzania (% of households).

Zone	Number of households (n)	No land left as fallow	Land left as fellow
Central	92	89%	11%
Northern	467	80%	20%
Southern	161	81%	19%
Southern highlands	160	71%	29%
Tanzania	**880**	**79%**	**21%**

3.7 Legume cultivation and use

The greatest part of the crop harvest was used for sale (48%) or home consumption (37%) (Table 3.13). Only a very small amount of crops was used as payment for hired labour (on average 1 %). On average 14% of the crop harvest was used to save seed for planting in the next growing season.

In the central zone, more than half of the crop harvest was used for consumption (53%) and nearly one third was used for sale (31%). Particularly the harvest of Bambara groundnut and cowpea were consumed. Half of the harvest of groundnut (46%) and pigeonpea (48%) was sold.

In the northern zone, crop harvest was mainly sold (42%) or consumed by the households (42%). Just like households in the central zone, households in the northern zone particularly consumed the harvest of Bambara groundnut (68%) and cowpea (68%).

Households in the southern zone indicated that most of the crop harvest was sold (64%) and (on average) 23% of the crop harvest was consumed. Soyabean and groundnut were mainly cultivated to be sold (79%, 63%, respectively). On the other hand, more than half of the cowpea harvest was used for home consumption (66%).

In the southern highlands, most of the crop harvest was sold (56%). Households particularly sold soyabean (94%), pigeonpea (72%) and cowpea (61%). Only one quarter of the crop harvest was used for home consumption (on average 27%).

Table 3.13: Relative crop harvest use per crop per zone in Tanzania (%).

Crop type per zone	Number of households (n)	Average of % Sale	Average of % Consumption	Average of % Payment/ food hired labour	Average of % Seed for planting
Central	**202**	**31 %**	**53%**	**1%**	**15%**
Bambara groundnut	44	17 %	66%	0%	16%
Cowpea	52	13%	73%	0%	14%
Groundnut	75	46%	37%	1%	16%
Pigeonpea	23	48%	37%	1%	14%
Northern	**612**	**42%**	**42%**	**1%**	**14%**
Bambara groundnut	34	16%	68%	0%	16%
Common bean	359	46%	40%	2%	13%
Cowpea	54	18%	68%	0%	14%
Groundnut	33	39%	44%	0%	17%
Pigeonpea	70	55%	31%	1%	14%
Soyabean	49	38%	41%	0%	21%
Southern	**290**	**64%**	**23%**	**2%**	**11%**
Bambara groundnut	11	49%	40%	5%	6%
Cowpea	10	26%	66%	0%	8%
Groundnut	128	63%	19%	3%	14%
Pigeonpea	44	48%	42%	2%	8%
Soyabean	93	79%	12%	1%	9%
Southern highlands	**265**	**56%**	**27%**	**1%**	**16%**
Common bean	132	48%	33%	1%	18%
Cowpea	16	61%	31%	0%	9%
Groundnut	77	55%	24%	1%	20%
Pigeonpea	18	72%	22%	0%	6%
Soyabean	22	94%	2%	0%	4%
Tanzania	**1369**	**48%**	**37%**	**1%**	**14%**

3.7.1 Use of crop residues and fertilisers

In Tanzania, most of the households used the crop residues for mulching (61%) (Table 3.14). On average, one third of the households used their crop residues as livestock feed and only a few households that used crop residues sold them (3%). In the central zone, 49% of the households that use crop residues fed it to their livestock and 67% of the households indicated they used it as mulch. In the northern zone, 71% of the households that used their crop residues, used it to mulch their fields. The households in the southern zone indicated that they mainly used the crop residues to either mulch their fields or to burn it. In this zone, few households that used crop residues, fed it to their livestock (6%). In the southern highlands, households using crop residues have indicated they used it as livestock feed (44%) or as mulch (45%).

On average, nearly a third of the crop residues in Tanzania were fed to livestock (31%), more than half of the crop residues (61%) were mulched, 22% was burned and only 3% of the crop residues were sold.

Table 3.14: Households that use of crop residues per usage type and zone in Tanzania (%).

Zone	Number of households (n)	Residues fed to livestock	Residues mulched	Residues burned	Residues sold	Residues other
Central	91	49%	67%	5%	4%	11%
Northern	70	33%	71%	3%	9%	9%
Southern	161	6%	68%	37%	1%	1%
Southern highlands	160	44%	45%	25%	2%	3%
Tanzania	**482**	**31%**	**61%**	**22%**	**3%**	**4%**

In Tanzania, 64% of the households (n=877) indicated that they used fertilisers. In total, 60% of the fields were not receiving any mineral fertiliser. In case households used mineral fertilisers, urea was most commonly used (10%), often in combination with other fertilisers (16%). In total, 17% of the households used DAP (in most cases in combination with other types of fertilisers).

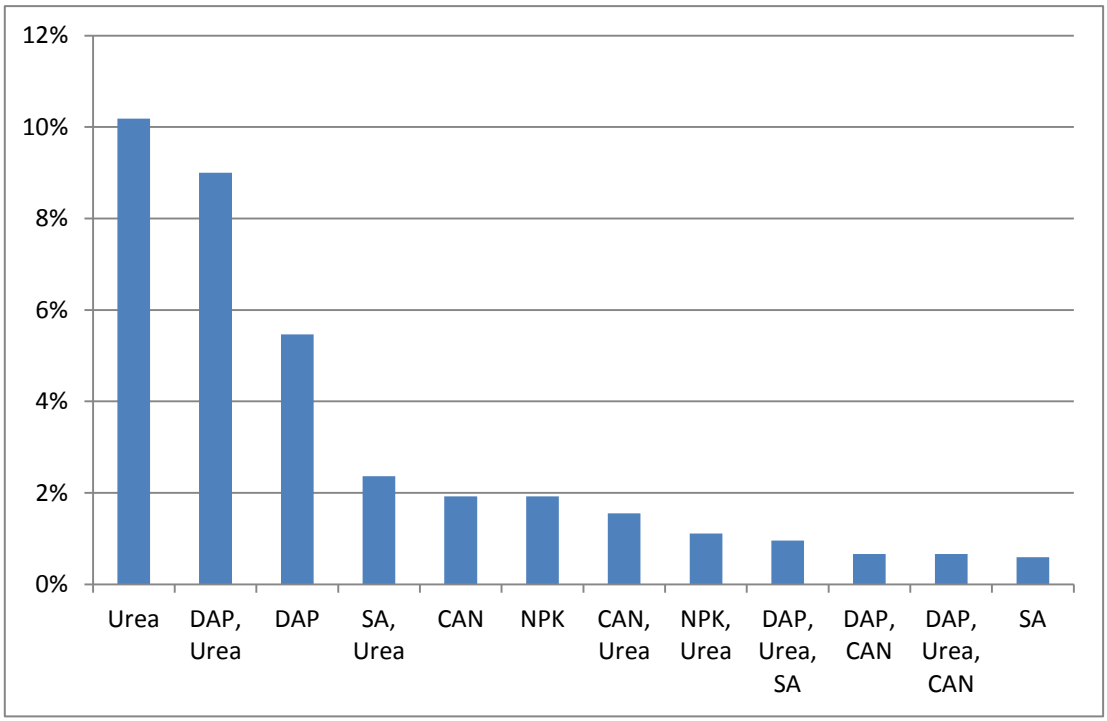


Figure 3.7: Use of fertiliser among interviewed households in Tanzania (% of fields).

3.7.2 Labour saving tools

On average, only one third of the Tanzanian households indicated they used labour saving tools (Table 3.15). Relatively few households (10%) in the southern zone used labour saving tools. More farmers in the northern and central zone indicated they used labour saving tools, as compared with farmers in the southern zone and southern highlands (n=1355). Tools were mostly used by men (89%) for ploughing (contracted services using tractor and draught animals), transport (ox-plough) and spraying (herbicides). The tractor was mainly used by farmers in the central and northern zone. Draught animals and ox-ploughs were mainly used in the southern highlands (data not shown).

Table 3.15: Use of labour saving tools per zone in Tanzania (%).

Zone	Number of households (n)	No use of labour saving tools	Use of labour saving tools
Central	132	50%	50%
Northern	68	40%	60%
Southern	200	90%	10%
Southern highlands	400	65%	35%
Tanzania	**800**	**67%**	**33%**

3.7.3 General production constraints

Table 3.16 shows the most important production constraints of households in Tanzania. Droughts, diseases, pests, unreliable or little rainfall and limited capital are most often mentioned by farmers. There are few differences between zones when it comes to dealing with droughts. However, relatively more households in the northern zone indicated they suffered from droughts. Constraints, such as low soil fertility, destruction by animals and limited labour supply of knowledge were relatively more often mentioned by households in the northern zone.

Table 3.16: Production constraints per zone in Tanzania (% of households).

Production constraints	Central (n=161)	Northern (n=398)	Southern (n=161)	Southern highlands (n=160)	Tanzania (n=880)
Drought	42%	14%	49%	41%	30%
Diseases	28%	30%	31%	25%	29%
Pests	22%	26%	20%	19%	23%
Unreliable or little rainfall	22%	21%	22%	24%	22%
Limited capital	20%	24%	19%	19%	21%
Lack of inputs	17%	14%	15%	14%	15%
Low soil fertility	2%	10%	4%	4%	6%
Destruction by animals	1%	8%	2%	2%	5%
Limited labour supply or knowledge	2%	4%	1%	2%	3%

3.8 Control over land use and harvest

Most fields were managed by both husband and wife (Table 3.17). The same accounts for the decisions with regard to sale of harvested crops. Except for the southern zone, there are hardly zonal differences with regard to control over land use (Table 3.18). In the southern zone most fields are managed by both husband and wife (81%).

Also the harvest sale was in most households (59%) decided by both husband and wife. The data showed that women had more frequent control over the use and harvest of fields when they cultivated cowpea, pearl millet and pea. Coffee, sesame, soyabean and rice were more often cultivated by men (data not shown).

Table 3.17: Fields managed and harvest sale decided by household members in Tanzania (% of fields).

Household member	Fields managed by:		Harvest sale decided by:	
	Number of fields (n)	%	Number of fields (n)	%
Both husband and wife	292	62%	312	59%
Husband	92	18%	80	18%
Wife	89	17%	83	19%

Table 3.18: Control over land use and harvest by household member per zone in Tanzania (% of fields).

Zone	Both husband and wife	Husband	Wife	Number of fields (n)
Central	62%	19%	19%	267
Northern	55%	21%	24%	857
Southern	81%	9%	9%	234
Southern Highlands	62%	19%	19%	473
Tanzania	**61%**	**19%**	**20%**	**1831**

3.9 Nutrition

Table 3.19 shows legumes were primarily consumed (except for common bean) as a side dish (74%). Common bean, cowpea and groundnut are the most often mentioned legumes. Households mainly consume the legume grains, as compared to the legume leaves. Households only consume the leaves of common bean and cowpea. Particularly cowpea is preferred for its leaves. Table 3.17 indicates that households use the cowpea leaves (as compared to the cowpea grains) more often as main or side dish. Legume leaves of the common bean are often used as side dish.

Table 3.19: Consumed grain legumes and legume leaves per type of dish in Tanzania (%).

Legumes	Main dish			Side dish		
	Legume grain	Legume leaves	Sample size	Legume grain	Legume leaves	Sample size
Bambara groundnut	100%	0%	70	100%	0%	53
Chickpea	100%	0%	2	100%	0%	3
Common bean	100%	0%	343	54%	46%	362
Cowpea	27%	73%	22	40%	60%	459
Groundnut	100%	0%	31	100%	0%	322
Pigeonpea	100%	0%	18	97%	3%	165
Soyabean	100%	0%	21	100%	0%	88
Grand total (n)			**507**			**1452**
Grand total (%)			**26%**			**74%**

Figure 3.8 shows the zonal consumption patterns of legumes in Tanzania. Almost all households indicated they consumed leguminous food items on a weekly basis, both in low and peak season. Households consumed leguminous food items more often during the peak season, as compared to the low season. Zonal differences are related to the consumption of chickpea and soyabean. Households in the southern zone more often consumed groundnut and pigeonpea (more than 5 days per week). Soyabean is more often consumed by households in the southern highlands (5 times per week). The zonal differences are highly related to zonal differences in crop production, as households mainly consume what they produce (Table 3.12).

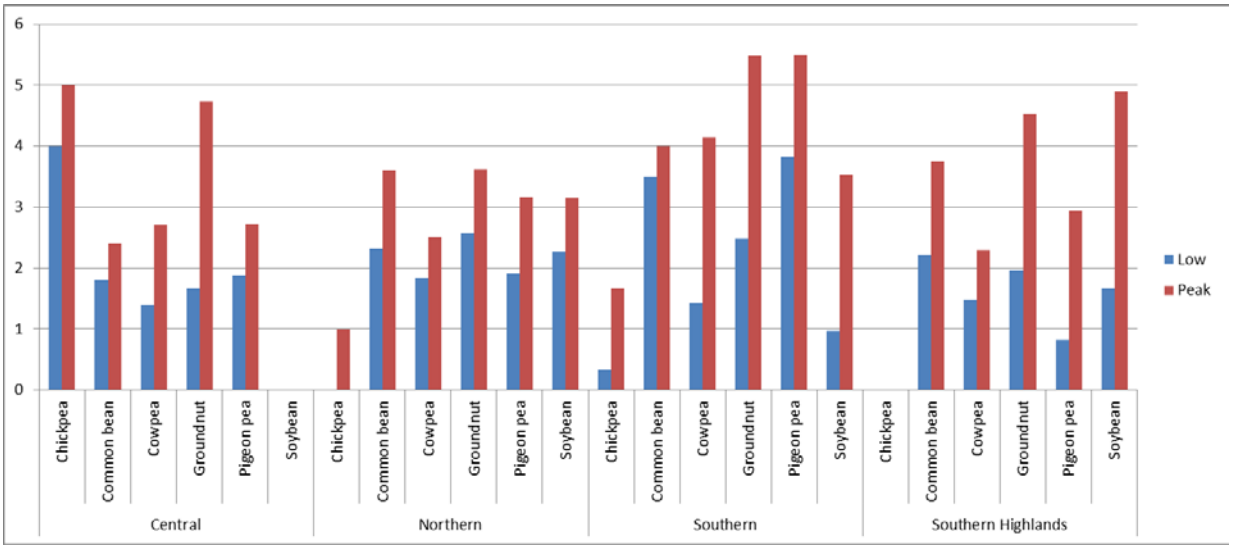


Figure 3.8: Consumed leguminous food items in household nutrition in zones of Tanzania (number of days per week).

Figure 3.9 shows that, overall in a normal year, food items mainly came from the own farm. The pattern shown is related to the climate seasonality in Tanzania. During January, February and March nearly 50% of the food items came from other sources.

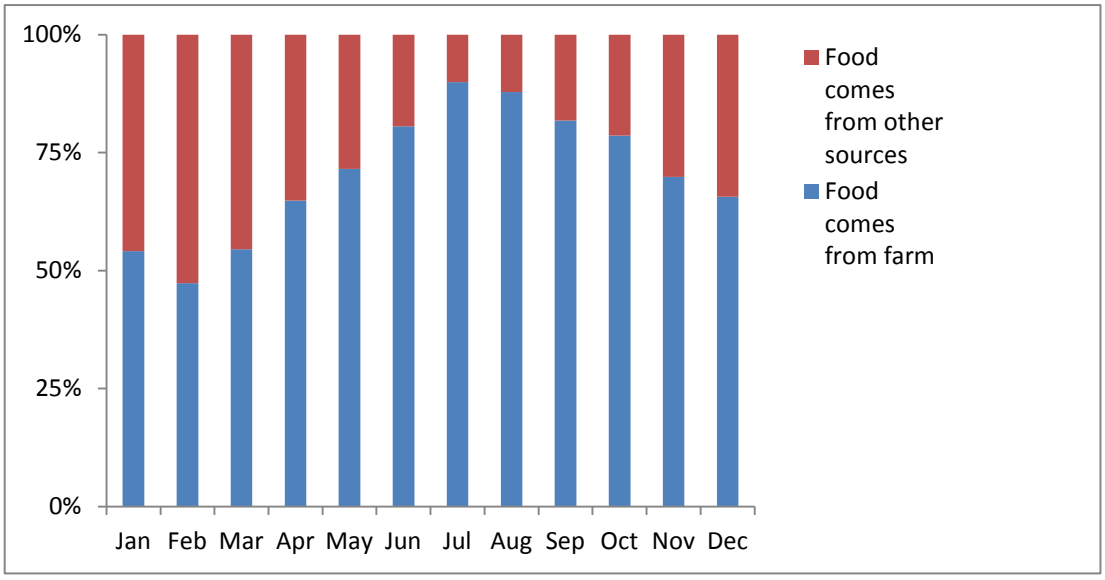


Figure 3.9: Main source of food per month in Tanzania (% of households).

However, there are zonal differences (see Figure 3.10). In the southern highlands, the consumed food items mainly came from the farm. In February and March, less than 40% consumed food items came from the farm in the central and southern zone. Figure 3.10 also shows that households in the southern zone started consuming food items that nearly all (97%) came from their own farm in April, followed by households in the central zone and southern highlands in May. Households in the northern zone consumed the least food items that mainly came from their farm, on average less than 70%.

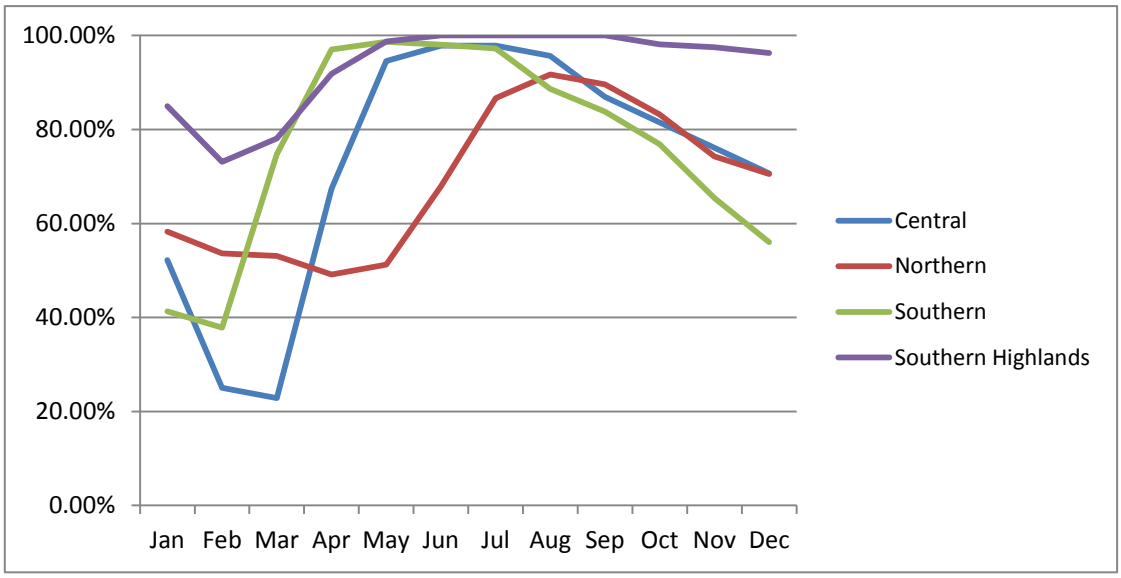


Figure 3.10: Food consumed that mainly comes from own farm per month and zone in Tanzania (% of households).

From February to April, households in the central and southern zone struggled the most to find sufficient food to feed everyone in the household (Figure 3.11). Figure 3.11 also shows that in January and February, more than 60% of the households in the central and southern zone indicated that they struggled to find sufficient food.

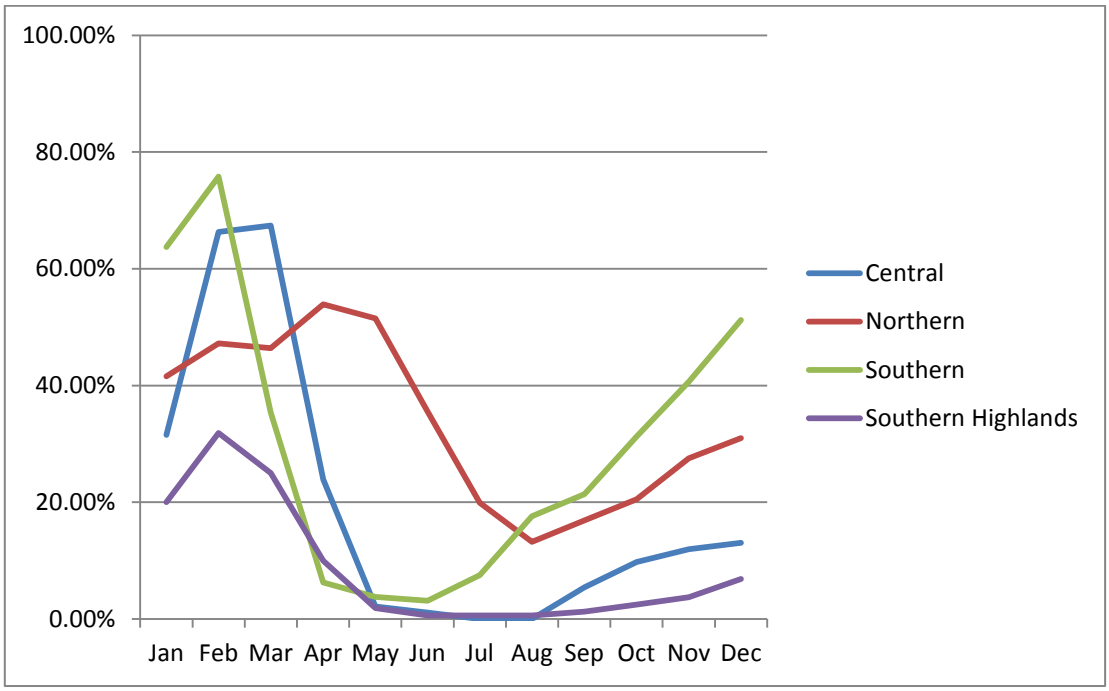


Figure 3.11: Households struggling to find sufficient food to feed everyone in the household per month per zone in Tanzania (% of households).

3.10 Information

The interviewed farmers indicated they wanted to learn more about agronomic practices or management, pest and diseases and marketing concerning legumes. Furthermore, they indicated that they wanted to learn more about variety/seed selection.

Overall, Tanzanian farmers mentioned pest and diseases (40%), lack of improved seed varieties (13%) no access to markets (12%), low selling prices (11%) and droughts (unreliable rainfall) (10%) to be the Top 5 key challenges in legume cultivation (Table 3.20). Furthermore, table 3.18 shows that farmers from the southern zone, as compared to farmers from the other zones, mentioned low selling prices more often as a key challenge. Pests/diseases were relatively more often mentioned by farmers in the central zone and southern highlands. No market access was most often mentioned as key challenge by households in the central and northern zone.

Table 3.20: Top 5 key challenges that farmers face in legume cultivation per zone and in Tanzania (% of households).

Top 5 key challenges	Central	Northern	Southern	Southern Highlands	Tanzania
	(n=132)	(n=68)	(n=200)	(n=400)	(n=800)
Pests/ diseases	57%	35%	24%	43%	40%
Lack of improved seed varieties	22%	22%	17%	7%	13%
No (access to) market	30%	35%	6%	3%	11%
Low selling price	3%	4%	30%	5%	11%
Drought/ unreliable rainfall	11%	9%	10%	11%	10%

Figure 3.12 shows the average rank of importance of information sources. Lower ranks are considered to be more important sources of information. Data indicates that farmer groups, government extension agents and fellow farmers were the main sources of information on legumes. The agricultural show and mobile phones were less often considered as main source of information. The farmers mainly sought information about agronomy (planting time, spacing, disease and pest control) (32%), inputs (seed, varieties, fertilisers, inoculants) (32%) and marketing (where markets are, prices, quality required) (22%) (data not shown).

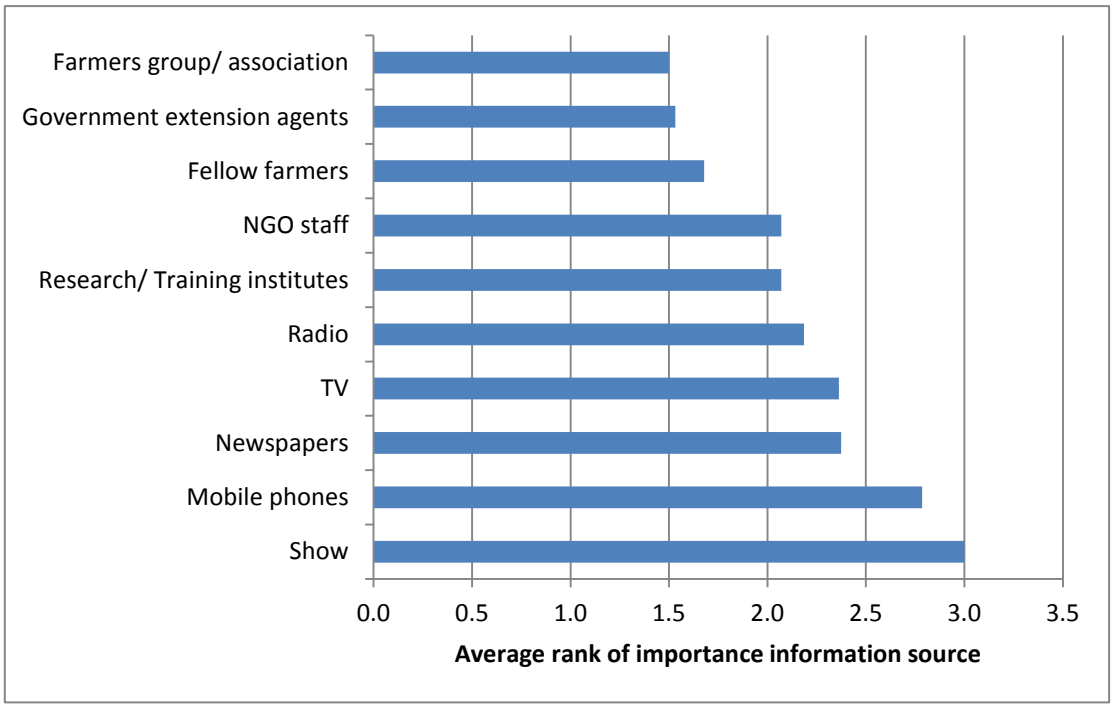


Figure 3.12: The average rank of importance of information sources in Tanzania.

3.11 Market access

Data with regard to market access is not shown. Only a very limited number of households answered the questions related to market access (3%). Therefore, it was not valid to analyse the data.

3.12 Household assets

Many households mentioned their bicycle (22%), radio (13%), house (12%), land (11%) or mobile phone (8%) as their most valuable asset. In general, transport (e.g. bicycle, motor cycle and tractor) (28%), electronics (e.g. radio, television and mobile phone) (24%) and housing/land (24%) were most often mentioned as a valuable type of asset (Table 3.21).

Table 3.21: Household assets and services in Tanzania (% of households).

Type of asset or service	% of households
Transport	28%
Electronics	24%
Housing/land	24%
Furniture	16%
Farm implements	4%
Livestock	3%
Business	1%

4 Uganda

4.1 Sites

Figure 4.1 shows the N2Africa action areas for 2014 in Uganda. The actions sites are clustered into a northern region, eastern region, eastern highlands and southwestern region. The characterisation of these different regions focuses on three factors affecting adoption that show variation across the country: (1) Biophysical relevance of technology; (2) Land availability, quality or tenure; and, (3) Output market for agricultural (legume) products. The action site Kapchorwa is clustered into the eastern highland region and Kibuku and Pallisa are clustered into the eastern region. Kole and Oyam are combined into the northern region. The southwestern region is represented by the action sites Kabale and Kanungu.

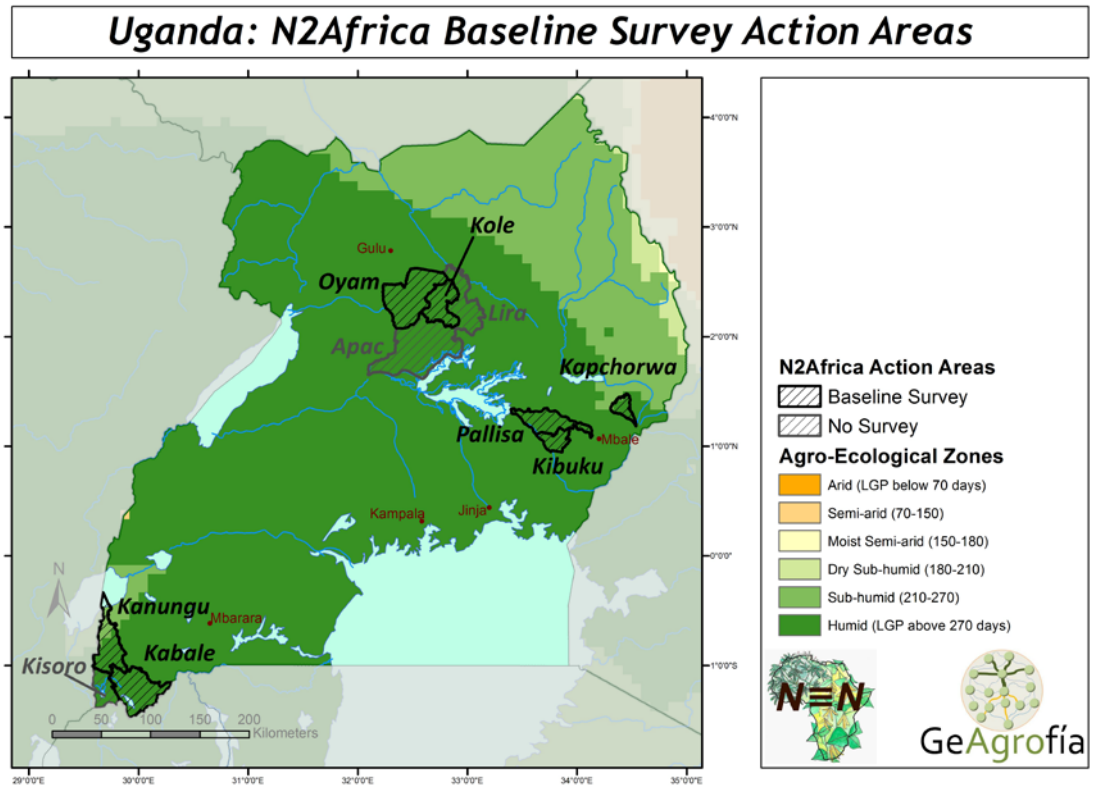


Figure 4.1: Action areas and agro-ecological zones in Uganda in 2014.

The length of the growing period in the target areas varies from 255 days in the northern and eastern regions to 365 days in the southwestern highlands (Farrow, 2014d). All regions experience two growing seasons. The average temperature in the eastern and northern lowlands is 23°C. Both regions are among the warmest areas in Uganda. Kapchorwa in the eastern highlands has significant temperature gradients according to elevation, the average annual temperature ranges from 8-23ºC. Kanungu and Kabale in the southwestern region are among of the coolest action sites (Farrow, 2014d).

The elevation of the homesteads varied between 1,050 and 2,000 meters above sea level. Most households in the northern region were situated in a low-elevation area, at an elevation between 1,000 and 1,100 meters above sea level. The elevation in Kabale and Kanunga in the high-elevation area of the southwestern region varied between 1,750 and 2,000 meters above sea level. The households in the eastern region were situated showed greater variation and can be split in a mid- and high-elevation area. The mid-elevation area in Pallisa and Kibuku was

approximately 1072 meters above sea level. In the high-elevation area in Kapchorwa the elevation varied between approximately 1,650 and 1,950 meters above sea level. Mid-elevation and high-elevation areas (above 1,500 metres) receive substantially greater rainfall than do the lowlands (FAO, 2016).

The coolest target district is Kabale, although this districts has significant temperature gradients according to elevation. Likewise in Kapchorwa, although the cooler areas of this district are primarily forest. The eastern and northern lowlands are among the warmest areas in Uganda with an average temperature of 23°C (Farrow, 2014d). Temperatures in the eastern lowlands are slightly higher during the wettest quarter of the year than in the northern region.

Most of the districts in the regions are characterised by a single agro-ecological zone. Action sites in the southern region are generally characterised as cool, with a generally poor market access and a high population density. The northern action sites as re classified as warm, good market access and low density of the population. The eastern region is divided in two adoption domains; Pallisa and Kibuku being characterised as warm areas, with good market access and a high population density. Kapchorwa on the other hand is generally cooler and with good market access. The population density in this region is generally low.

Table 4.1 shows the distribution of interviewed households over the four regions in Uganda. In each region 100 households were interviewed. In total, 54% of the Ugandan respondents were male.

Table 4.1: Distribution of interviewed households and gender respondents per region in Uganda.

Regions	Number of households interviewed	Gender respondents (%)	
		Female	Male
	(n=400)	(n=184)	(n=216)
Eastern	100	49%	51%
Eastern highlands	100	47%	53%
Northern	100	30%	70%
Southwestern	100	58%	42%

4.2 Household characteristics

On average, the Ugandan households consisted of 6.8 persons, nearly 51% being younger than 16 years old. The average household size in the southwestern highlands was slightly smaller as compared to the other three regions (Table 4.2). This is mainly due to the smaller amount of people younger than 35 years or older than 60 years (on average per household). Most households (85%) were headed by men. The average size of households in the eastern region was higher; the households consisted of more children between the age of 0-16 years and slightly more men and women between the age of 16 and 35 years.

The highest education levels completed within male headed households were primary (42%) or secondary school (40%) education. The highest education of female headed households was comparable with male headed households (Table 4.3).

Table 4.2: Average adult equivalent and sex of household head per region in Uganda.

	Eastern	Eastern highlands	Northern	South-western	Uganda
	(n=100)	(n=100)	(n=100)	(n=100)	(n=400)
Average hh size (adult equivalent)	6.1	5.2	4.4	4.2	5.0
Sex of hh head					
F	13%	18%	18%	12%	15%
M	87%	82%	82%	88%	85%

Table 4.3: Highest education level completed within male and female headed households in Uganda (% of household heads).

Education level	Female headed household	Male headed household
	(n=60)	(n=338)
Primary	47%	42%
Secondary	35%	40%

Table 4.4 shows that most heads of the households in Uganda had received primary (43%) or secondary school (39%) education. In the southwestern region fewer people received an education (data not shown). The highest education level of household heads was generally higher in the eastern highlands.

Table 4.4: Highest education level of household heads per region in Uganda (% of households).

Education level	Eastern	Eastern highlands	Northern	South-western	Uganda
	(n=100)	(n=100)	(n=99)	(n=99)	(n=398)
Primary	33%	29%	56%	55%	43%
Secondary	41%	53%	34%	29%	39%

4.3 Occupations and source of household income

Cropping activities were the main source of cash income for 85% of the households. Similarly, only 5% of the households indicated their main income came from other businesses, 4% came from livestock farming and 3% of the main income was related to a salaried job (data not shown).

Figure 4.2 shows the different income sources per household. The figure shows that the total income per household is related to different income sources. Nearly all households in Uganda received income related to agricultural practices, namely crop and livestock farming. 17% of the interviewed farmers indicated that their total income was related to only crop farming. The total income was only for a small part related to off-farm income, such as casual labour, other businesses and remittances, amongst others. Note that in the southwestern region households indicated their income was not related to pension.

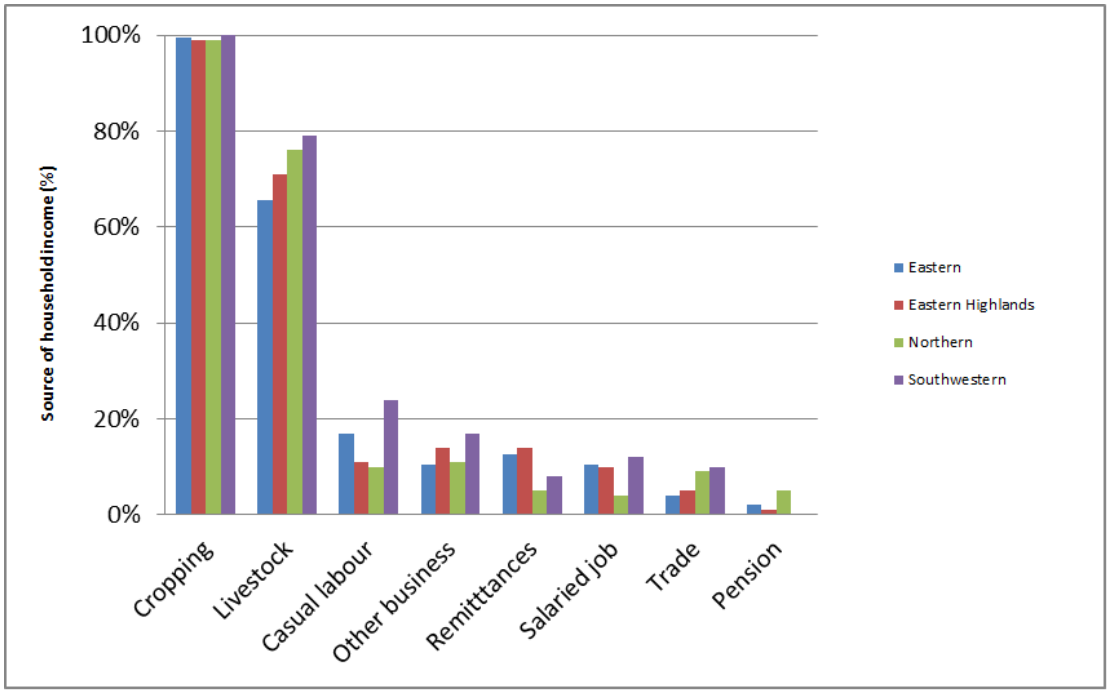


Figure 4.2: Income sources for households in each region in Uganda (% of households).

Figure 4.3 reports the different income sources that contribute to the total household income. It shows that the vast majority of the households indicated they received most of their total income from cropping activities and a salaried job, on average. Total household income was composed of multiple income sources. In general, there are few regional differences.

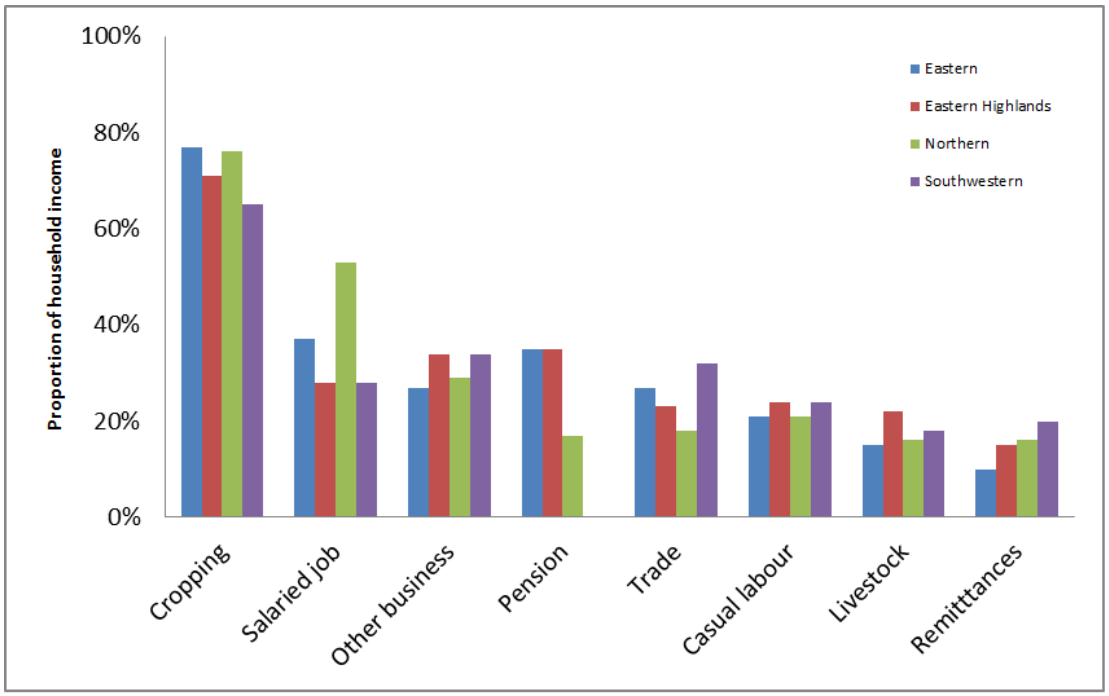


Figure 4.3: The average proportion of income received per income source in Uganda (% of total income).

4.4 Livestock ownership

The percentage of households owning livestock is not evenly spread across the country. The median Tropical Livestock Unit (TLU) per farm is lowest in the southwestern region (Table 4.5). This is probably related to particular farm characteristics in this region: few farms owning cattle (Table 4.6). Furthermore, 50% of the households in the eastern, eastern highlands and northern region owned at least 1.6 TLU.

Table 4.5: Mean and median TLU per farm per region in Uganda.

Tropical Livestock Unit	Eastern	Eastern highlands	Northern	Southwestern	Uganda
	(n=84)	(n=91)	(n=94)	(n=76)	(n=345)
Mean	2.3	2.6	2.2	1.2	2.1
Median	1.6	1.7	1.6	0.8	1.5

Table 4.6 shows the type of livestock owned by households in three studied Ugandan regions. Goat/sheep and poultry are the most commonly owned type of livestock. The percentage of households owning cattle is higher in the eastern, eastern highlands and northern region, as compared to the southwestern region (Table 4.6). Households in the southwestern highlands own relatively more pigs. However, Table 4.7 shows that the average number of pigs per household in the southwestern region is one, as compared to eastern region (5 pigs), eastern highlands (2 pigs) and northern region (2 pigs). The average number of poultry per farm in the southwestern region is also lower. In this region many farms own only one pig and 4 chickens, on average. Interestingly, farms in the eastern highlands own on average a large number of rabbits.

Table 4.6: Households owning livestock per type and per region in Uganda (%).

Livestock type	Eastern	Eastern highlands	Northern	South-western	Uganda
	(n=84)	(n=91)	(n=94)	(n=76)	(n=345)
Cattle	64%	71%	71%	36%	66%
Goat/Sheep	65%	61%	71%	88%	75%
Pig	13%	2%	26%	62%	25%
Poultry	55%	82%	77%	68%	75%
Rabbit	1%	1%	0%	1%	1%

Table 4.7: Type and average number of livestock owned by households per region in Uganda.

Livestock type	Eastern (n=84)	Eastern highlands (n=91)	Northern (n=94)	South-western (n=76)	Uganda (n=345)
Cattle	3	4	2	2	3
Goat/Sheep	4	4	4	4	4
Pig	5	2	2	1	3
Poultry	15	10	11	4	10
Rabbit	2	30	0	3	12

The average availability of feed for ruminant livestock varied over the year. Figure 4.4 shows the average availability of feed, ranging from 'excess of feed availability' (10), to 'adequate feed availability' (5) to 'no feed availability' (0). The average availability of feed per year is the highest in the eastern highlands and northern region. In these two regions the average feed availability per year is adequate from April to November. However, households in the southwestern highlands indicated that there was not enough livestock feed available during the whole year. This is probably related to the on average smaller farm sizes in the south west (Table 4.9).

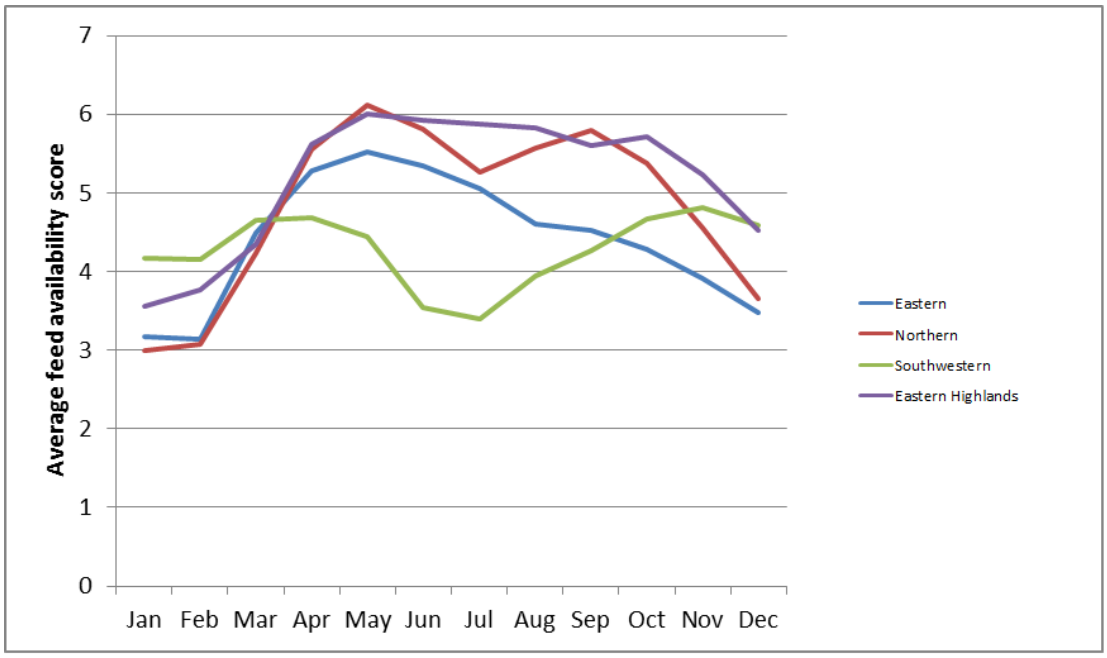


Figure 4.4: Average feed availability score per region per month in Uganda.

Figure 4.5 shows the monthly proportion of nutrition derived from different feed sources for ruminant livestock. Overall, grazing is the most important feed source for livestock. Additionally, households in the southwestern region indicated they used other feed sources (cassava or banana peelings) to feed their livestock. In the northern region, a small proportion of farmers uses other feed sources. This category refers to growing some legume shrubs and pastures, cutting green fodder, providing grain legume residues and concentrates and feeding it to livestock. Grazing of fields after harvests is the common practice in this region. Generally, crop residues both leguminous and non-leguminous are to a very limited extent part of the total diet (on average less than 5%).

Figure 4.5: Proportion of nutrition derived from different feed sources for ruminant livestock per month and region in Uganda (%).

4.5 Labour

In Uganda, more than one third of households indicated that farming activities were delayed, because the farmer was not able to hire labour. Relatively fewer farmers (approximately 20%) indicated farming activities were delayed because they had to work on other people's fields (Table 4.8). In general, sowing was least delayed (15%, 21%, respectively). Farming activities related to land preparation and weeding were most often delayed.

Table 4.8: Households indicating farming activities got delayed in Uganda (% of households).

Farming activity	Delay because farmer works on other people's fields		Delay because farmer is not able to hire labour	
Land preparation	n=318	21%	n=257	36%
Sowing	n=340	15%	n=316	21%
Weeding	n=315	21%	n=253	37%
Harvest	n=325	19%	n=257	36%

4.6 Land holding and land use

The average farm size was largest in the northern region (2.7 ha) (Table 4.9). In this region, 50% of the households owned at least 1.6 ha. In the other regions the farm sizes were considerably smaller: the average in the eastern region was 1.5 ha, in the eastern highlands 1.2 ha and in the southwestern highlands 0.9 ha. In the southwestern region, 50% of the farmers owned less than 0.6 ha. Farms in this region had a maximum size of 8.5 ha, which is relatively small as compared to the other three regions.

On average each farm consisted of 2 fields. The field sizes varied across the regions. The average field sizes are the smallest in the southwestern region (0.38 ha per field). In the eastern region the average fields were larger, on average 0.8 ha. Fields in the northern region were on average 1.34 ha (data not shown).

Table 4.9: Farm size characteristics per region in Uganda.

Farm size	Eastern	Eastern highlands	Northern	South-western	Uganda
	(n=99)	(n=89)	(n=98)	(n=100)	(n=386)
Mean (ha)	1.5	1.2	2.7	0.9	1.6
Median (ha)	1.2	0.8	1.6	0.6	1.0
Maximum (ha)	8.1	14.2	34.8	9.7	34.8

At the time of the interviews held, Ugandan farmers mostly cultivated common bean, maize, cassava, banana, sunflower and soyabean (data not shown). However, the data shows that there are some regional differences with regard to use of crops among interviewed (Figure 4.6). Households in the northern region (n=98) particularly grew sunflower (29%), sesame (28%), and soyabean (24%). Households in the eastern region (n=99) mostly cultivated cassava (19%), cotton (30%) and groundnut (24%). In the eastern highlands, farmers (n=98) produced common bean (69%), banana (26%) and cotton (19%). Farmers in the southwestern region (n=100) cultivated relatively to the other three regions more common bean, banana, sweet potato, millet, potato and sorghum.

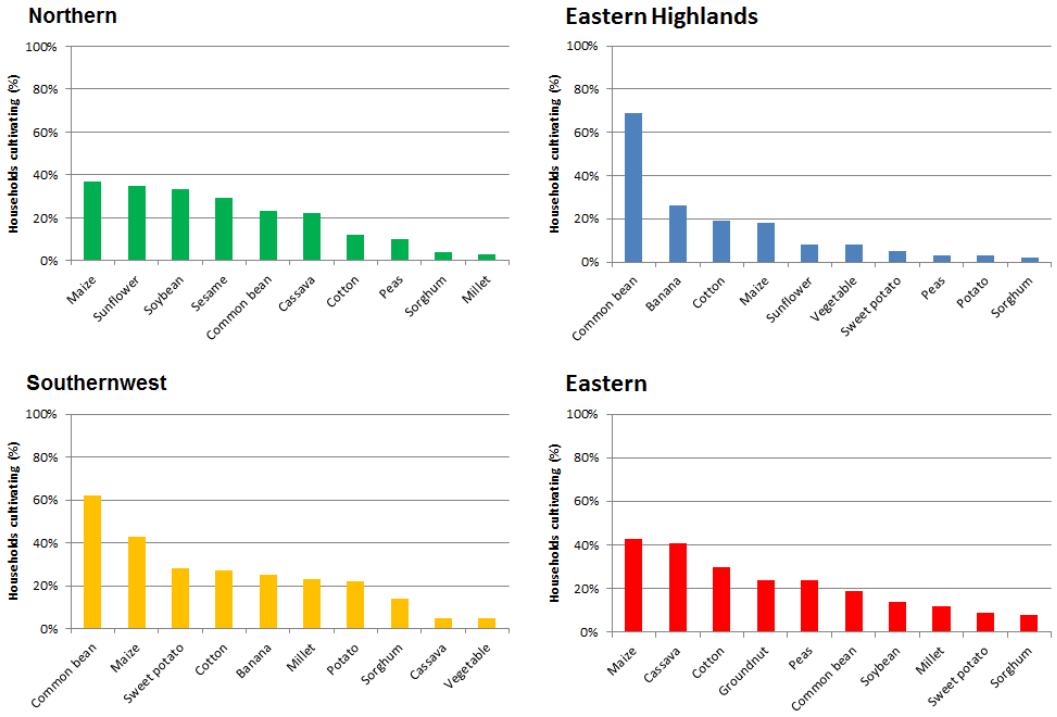


Figure 4.6: Use of crops among interviewed households in Uganda (% of households).

The average field size in Uganda is 0.81 ha, with fields size ranging from 0.38 ha (southwestern region) to 1.34 ha (northern region). The average field sizes planted with crops were usually smaller than 1 ha (Table 4.10). Common bean, maize and cassava seem to be the most important crops, with a mean walking distance that ranges from 14 to 20 minutes from the homestead. Sunflower, cassava and soyabean were cultivated on larger plot sizes. The latter three crops are considered as low-land crops, where there is more land available.

Table 4.10: Mean field size (ha) and walking distance (minutes) per crop in Uganda.

Crop type	Number of fields	Average field size (ha)	Mean walking distance (minutes)
Maize	160	0.58	18
Common bean	234	0.69	20
Groundnut	28	0.86	6
Sunflower	57	1.59	21
Cassava	81	0.97	14
Soyabean	55	1.00	16

Half of the fields are located within a ten minute walk from the homestead. Overall in Uganda, the fields are situated at a walking distance of 20 minutes from the homestead (Table 4.11). However, fields in the eastern region tend to be centred around the homestead, with 50% of the fields located within a walking distance of a few minutes.

Table 4.11: Average and mean walking distance to fields in Uganda (minutes).

Region	Sample size (n)	Average walking distance to fields (min)	Median walking distance to fields (min)
Eastern	159	13	3
Eastern highlands	167	23	10
Northern	196	19	10
Southwestern	228	21	10
Uganda	**750**	**19**	**8**

Most households indicated that they did not leave land as fallow. On average 27% of the households left land as fallow (see Table 4.12). However, it is not clear for how long the field were fallowed.

Table 4.12: Households that leave land as fallow per region in Uganda (%).

Region	Number of households (n)	No land left as fallow	Land left as fellow
Eastern	100	86%	14%
Eastern highlands	99	75%	25%
Northern	98	72%	28%
Southwestern	95	60%	40%
Uganda	**392**	**73%**	**27%**

4.7 Legume cultivation and use

In Uganda, half of the crop harvest is used for sale (51%) and one third is used for home consumption (33%) (Table 4.13). Only a very limited amount of crops were used as payment for hired labour (on average 1%). On average, 15% of the crop harvest was used to save seed for planting in the next growing season. There are few regional differences. Most of them are related to the small sample sizes of some crops. The main regional difference is that farmers in the northern region primarily sold their soyabean harvest (85%).

Table 4.13: Relative crop harvest use per crop per region in Uganda (%).

Crop type per region	Number of households (n)	Average of % Sale	Average of % Consumption	Average of % Payment/ food hired labour	Average of % Seed for planting
Eastern	**105**	**54%**	**27%**	**0%**	**18%**
Groundnut	27	55%	25%	1%	19%
Common bean	15	58%	24%	0%	18%
Peas	39	44%	34%	0%	21%
Soyabean	24	67%	20%	0%	13%
Eastern highlands	**85**	**46%**	**38%**	**1%**	**15%**
Common bean	83	47%	37%	1%	14%
Peas	2	0%	73%	0%	27%
Northern	**93**	**57%**	**31%**	**1%**	**11%**
Groundnut	3	22%	64%	0%	14%
Soyabean	40	85%	1%	0%	14%
Common bean	38	38%	51%	2%	10%
Peas	12	31%	61%	0%	8%
Southwestern	92	**46%**	**38%**	**2%**	**14%**
Groundnut	1	0%	100%	0%	0%
Common bean	90	46%	37%	2%	15%
Peas	1	50%	50%	0%	0%
Uganda	**375**	**51%**	**33%**	**1%**	**15%**

However, Figure 4.7 shows that the legume use differs among the different action sites. Households in Kole used on average 63% of their crop harvest for sale, a small proportion (25%) was used for consumption. Households in Kanungu used 36% of their crop harvest for sale and mainly uses their crop harvest for consumption (45%). Households in all action sites used 10-19% of the crop harvest to save seed for the next growing season. Households in Kanunga, Kibuku and Pallissa used relatively a larger percentage (18-19%) of the crop harvest to save seed.

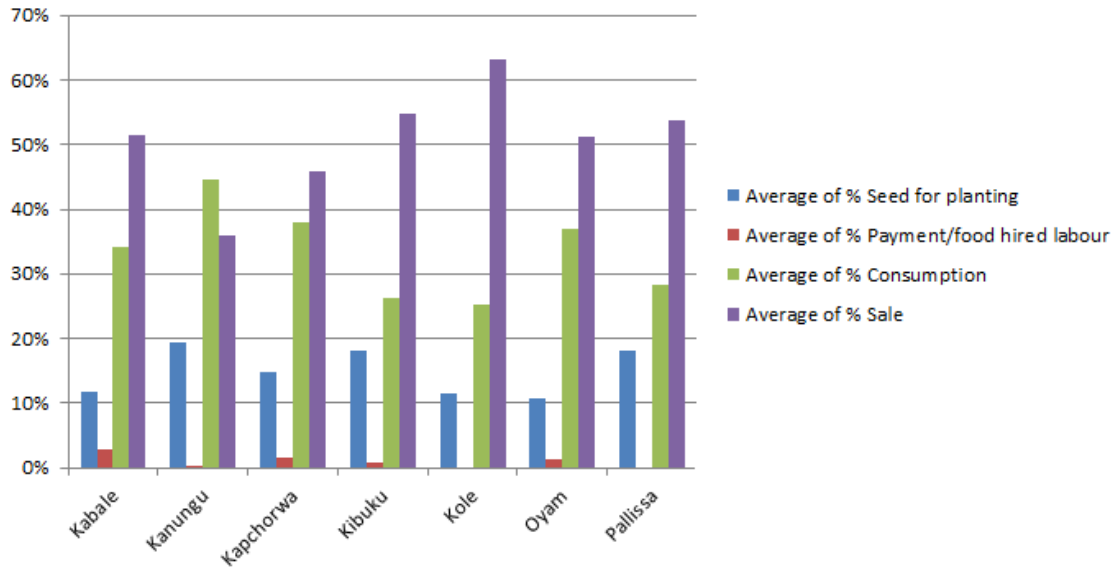


Figure 4.7: Crop harvest use per action site in Uganda (average % of households).

4.7.1 Use of crop residues and fertilisers

Ugandan farmers that used crop residues mainly used it to mulch their fields (70%). Only a few households that used crop residues, used the crop residues to feed their livestock (5%) (Table 4.14). This was also indicated by Figure 4.5. On average, one fifth of the households that used their crop residues, used it for burning (21%) and hardly any household that used crop residues sold them (1%).

Households in the eastern region indicated that they used nearly all of the crop residues to mulch their fields. A large proportion of farmers in the northern region that used crop residues (60%) indicated they also burnt crop residues. This was mainly due to the burning of bush bean and soyabean residues.

Table 4.14: Households that use of crop residues per usage type and region in Uganda (%).

Region	Number of households (n)	Residues fed to livestock	Residues mulched	Residues burned	Residues sold	Residues other
Eastern	99	4%	93%	3%	0%	0%
Eastern highlands	96	11%	88%	1%	0%	0%
Northern	100	5%	30%	60%	2%	1%
South-western	100	1%	73%	14%	0%	12%
Uganda	**395**	**5%**	**70%**	**21%**	**1%**	**3%**

In Uganda (n=750), 90% of the fields did not receive any mineral fertiliser. In case households used mineral fertilisers, DAP was most commonly used (39%) (Figure 4.8).

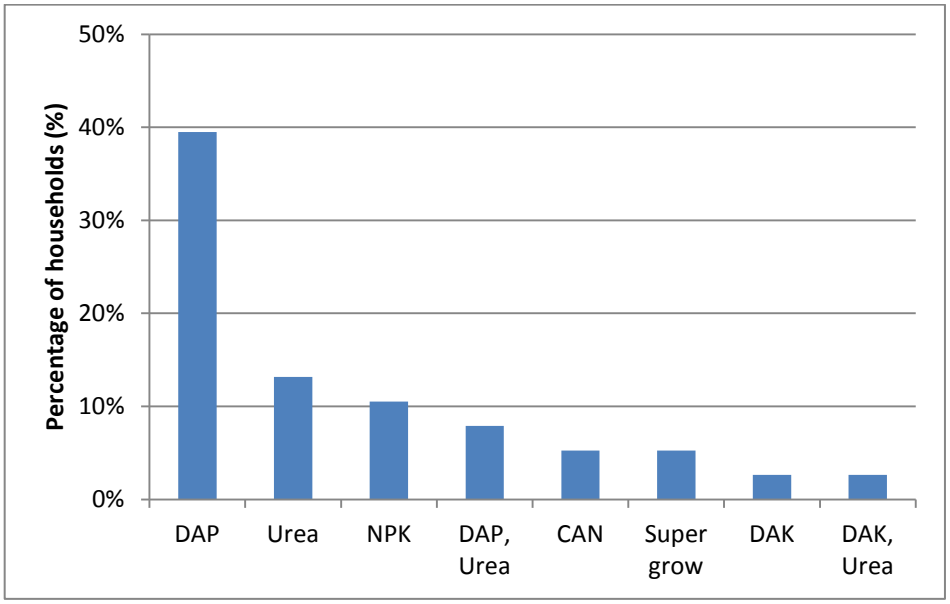


Figure 4.8: Use of mineral fertiliser among interviewed households in Uganda (% of households).

4.7.2 Labour saving tools

On average, nearly 60% of the Ugandan households indicated they used labour saving tools (Table 4.15). A large proportion of farmers in the southwestern highlands (75%) did not use any labour saving tools. This is probably related to the relatively smaller plot sizes in the southwestern region. Tools were mostly used by men (81%) for ploughing (ox-plough) and spraying (spraying pump) (data not shown).

Table 4.15: Use of labour saving tools per region in Uganda (% of households).

Region	Number of households (n)	No use of labour saving tools	Use of labour saving tools
Eastern	100	11%	89%
Eastern highlands	100	37%	63%
Northern	100	42%	58%
Southwestern	100	75%	25%
Uganda	**400**	**41%**	**59%**

4.7.3 General production constraints

Table 4.16 shows the most important production constraints as perceived by the Ugandan households. Pests, diseases, inadequate capital and droughts were most often mentioned by farmers. There were differences among the four regions. It seems that farmers in the eastern region suffered relatively more from droughts than farmers in the eastern highlands, northern or southwestern region. Farmers in the southwestern region suffered mainly from pests, diseases and inadequate capital. Interestingly, low soil fertility was hardly considered to be a production constraint by farmers in the northern region. Households in the northern region indicated that the production level was limited due to pests and diseases.

Table 4.16: Production constraints per region in Uganda (% of households).

Production constraints	Eastern (n=100)	Eastern highlands (n=100)	Northern (n=100)	South-western (n=100)	Uganda (n=400)
Pests	79%	66%	81%	68%	74%
Diseases	46%	47%	62%	34%	47%
Inadequate capital	36%	48%	30%	38%	38%
Drought	60%	18%	38%	19%	34%
Inadequate labour/knowledge	31%	33%	26%	24%	29%
Lack of inputs (fertiliser, quality seed, pesticides, tools)	16%	17%	22%	22%	19%
Low soil fertility	20%	19%	5%	27%	18%
Heavy rains	3%	21%	13%	19%	14%
Poor road infrastructure	2%	5%	19%	11%	9%

4.8 Control over land use and harvest

Most fields were managed by both husband and wife (Table 4.17). Also the harvest sale was in most households (61%) decided by both husband and wife. Fields managed by women were mainly used for common bean and maize (data not shown).

Table 4.17: Fields managed and harvest sale decided by household members in Uganda (% of fields).

Household member	Fields managed by:		Harvest sale decided by:	
	Number of fields (n)	%	Number of fields (n)	%
Both husband and wife	329	47%	429	61%
Husband	149	21%	134	19%
Wife	224	32%	142	20%

Table 4.18 shows regional differences with regard to control over land use. Nearly 50% of the fields in the southwestern highlands were managed by women and only 7% of the fields were solely managed by men. In this region decisions with regard to harvest sale were mainly made by the husband and wife together (68%) or by the wife (29%) (data not shown). On the other hand, 42% of fields in the northern region were managed by men.

Table 4.18: Field managed by household member per region in Uganda (% of fields).

Region	Both husband and wife	Husband	Wife	Number of fields (n)
Eastern	55%	23%	22%	150
Eastern highlands	53%	16%	32%	148
Northern	36%	42%	23%	183
Southwestern	47%	7%	46%	221
Uganda	**47%**	**21%**	**32%**	**702**

4.9 Nutrition

Table 4.19 shows that legumes were mainly consumed as a main dish (87%). Households primarily consumed the legume grains, as compared to the legume leaves. The leaves of the bush bean and climbing bean were used as a side dish. However, note the small sample size.

Table 4.19: Consumed grain legumes and legume leaves per type of dish in Uganda (%).

Legumes	Main dish			Side dish		
	Legume grain	Legume leaves	Sample size	Legume grain	Legume leaves	Sample size
Bush bean	95%	5%	37	25%	75%	4
Climbing bean	85%	15%	27	0%	100%	7
Groundnut	100%	0%	65	100%	0%	1
Other (Peas)	100%	0%	48	100%	0%	1
Soyabean	100%	0%	14	100%	0%	16
Grand total (n)	**185**	**6**	**191**	**19**	**10**	**29**
Grand total (%)	**97%**	**3%**	**100%**	**66%**	**34%**	**100%**

Figure 4.9 shows the regional consumption patterns of legumes in Uganda. Almost all households indicated they consumed leguminous food items on a weekly basis, both in low and peak season. The data indicates that common bean, groundnut, peas and soyabean were consumed in all regions. Pigeonpea was only consumed by households in the northern region.

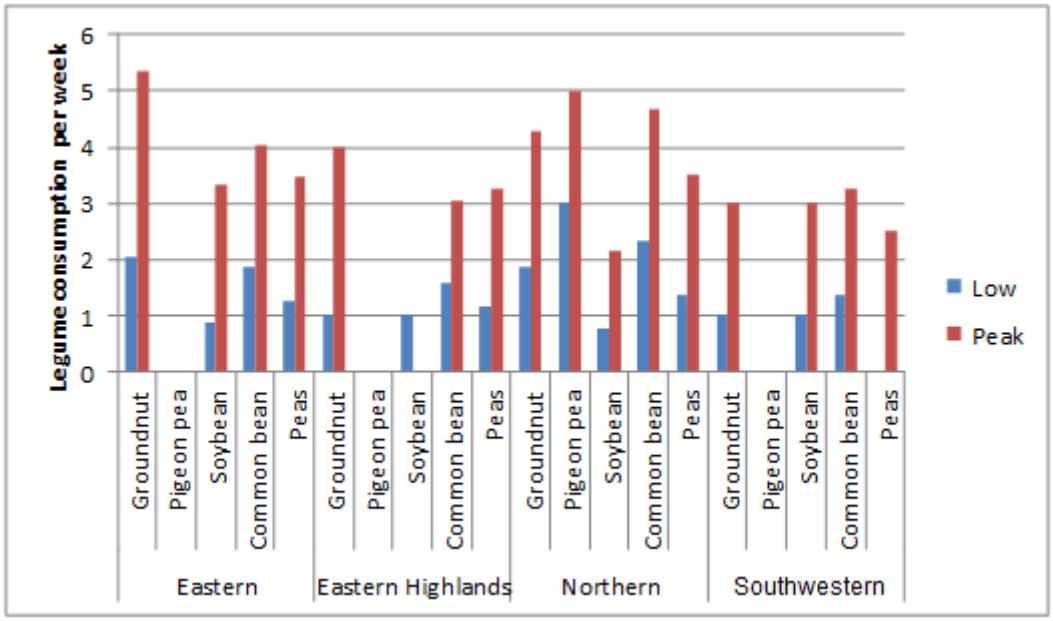


Figure 4.9: Consumed leguminous food items in household nutrition in regions of Uganda (number of days per week).

The consumed food items are mainly produced on farm (see Figure 4.10). However, during May to June 40%-60% of the food items come from other sources.

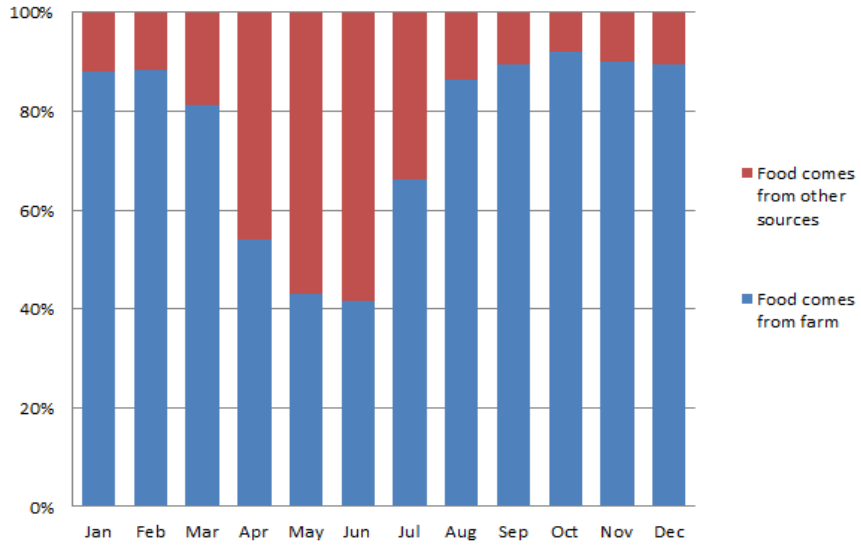


Figure 4.10: Main source of food per month in Uganda (% of households).

However, there are regional differences (see Figure 4.11). Households in the southwestern region consumed food items mainly come from the farm. Households in the northern and eastern region indicated that (from April to July) less than 60% of the food items came from the farm. During these 'hungry' months half of the interviewed households struggled to find sufficient food to feed everyone in the household (Figure 4.12). As coping strategy, farmers sometimes use a small, early maturing bean that matures during this 'hungry period'.

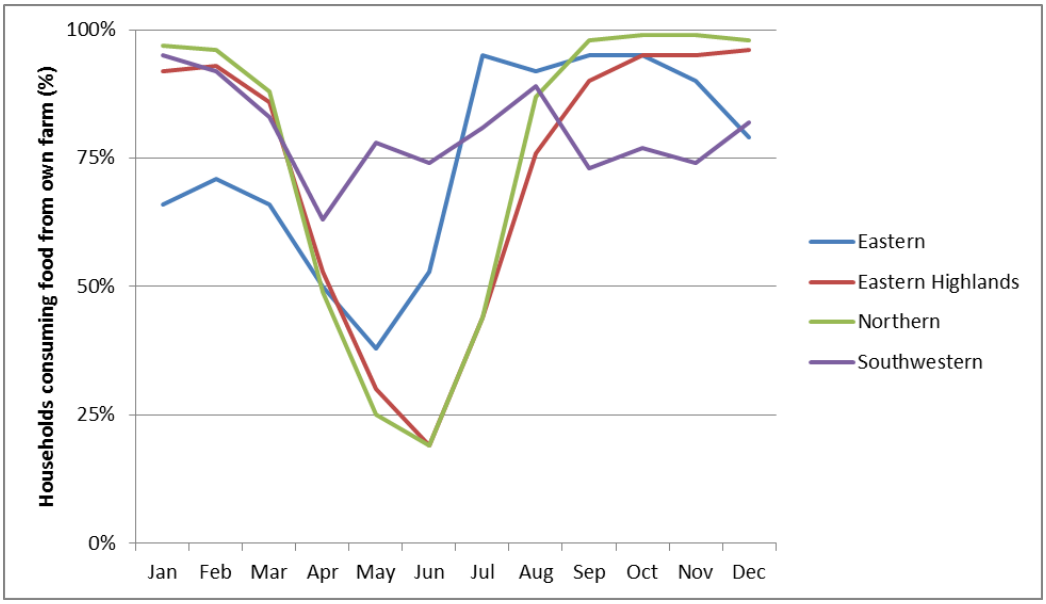


Figure 4.11: Households consuming food primarily from their own farm per month and region in Uganda (% of households).

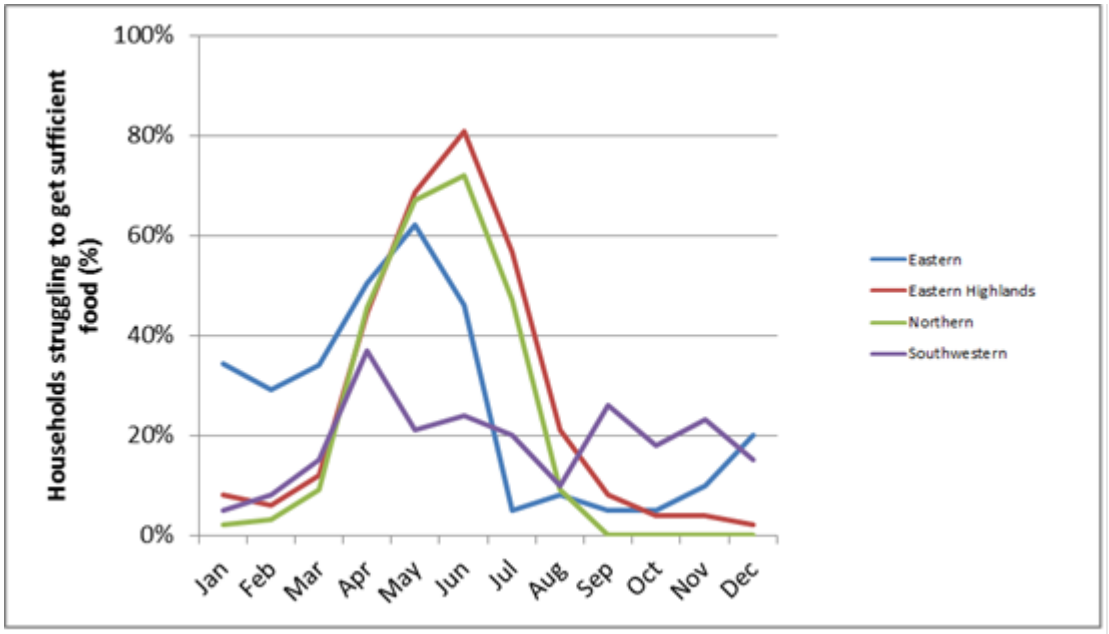


Figure 4.12: Households struggling to find sufficient food to feed everyone in the household per month per region in Uganda (%).

4.10 Information

The interviewed farmers indicated they wanted to learn more about controlling pests and diseases, planting methods and accessing markets (data not shown). Overall, Ugandan farmers mentioned pests and diseases (79%), droughts (32%), lack of capital (24%), poor soil fertility (18%) and lack of inputs (16%) to be the Top 5 key challenges in legume cultivation (Table 4.20). Farmers from the eastern highlands and southwestern region, as compared to farmers from the other two regions, mentioned soil fertility more often as a key challenge. In general, the soils in the eastern and southwestern highlands are intensively cultivated and require fertiliser. Relatively fewer farmers from the southwestern and eastern highlands mentioned droughts as a key challenge, as generally in these regions water is not a limiting production factor. Farmers in the northern region did not suffer from lack of inputs, as opposed to farmers in the southwestern region.

Table 4.20: Top 5 key challenges that farmers face in legume cultivation per region and in Uganda (% of households).

Top 5 key challenges	Eastern	Eastern highlands	Northern	South-western	Uganda
	(n=100)	(n=100)	(n=100)	(n=100)	(n=400)
Pests/ diseases	82%	80%	71%	81%	79%
Drought/ unreliable rainfall	57%	20%	33%	17%	32%
Lack of capital	27%	22%	20%	25%	24%
Poor soil fertility	10%	29%	7%	27%	18%
Lack of inputs	9%	15%	0%	39%	16%

Figure 4.13 shows the average rank of importance of information sources. Lower ranks are considered to be more important sources of information. Data indicates that parents and fellow farmers were the main sources of information on legumes. However, the differences between the different information sources are small, indicating multiple sources are used to gather information. The market area and newspapers were least considered as main source of information. The farmers mainly sought information about agronomy (planting time, spacing, disease and pest control) (35%) and inputs (seed, varieties, fertilisers, inoculants) (33%) (data not shown). Farmers in the northern region looked relatively more often for information with regard to marketing (where markets are, prices, quality required), as compared to farmers from the other two regions.

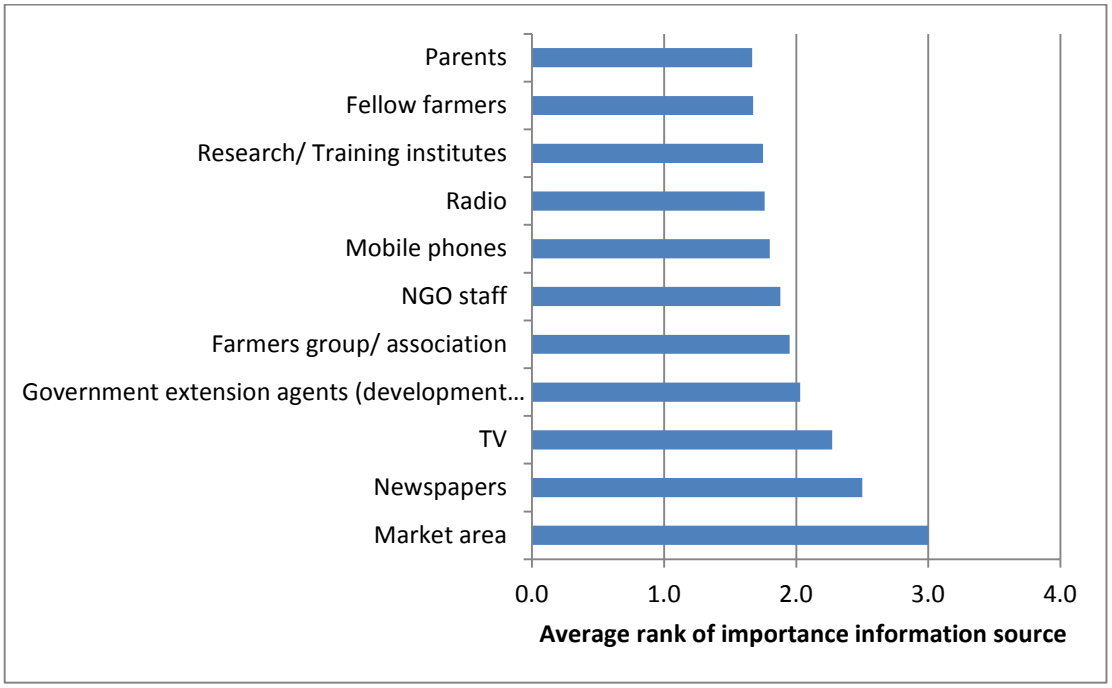


Figure 4.13: The average rank of importance of information sources in Uganda.

4.11 Market access

Only 3% of the interviewed households (n=400) indicated they were involved in collective marketing. Farmers collected the produce together and sold it as a group to middle men, stores, local market, among others. The other farmers (97%) were not involved in any marketing activities.

4.12 **Household assets**

Many households mentioned electronics (e.g. radio, television and mobile phone) (48%), furniture (26%) or transport (e.g. bicycle, motorcycle, car) (20%) as their most valuable asset (Table 4.21).

Table 4.21: Household assets and services in Uganda (% of households).

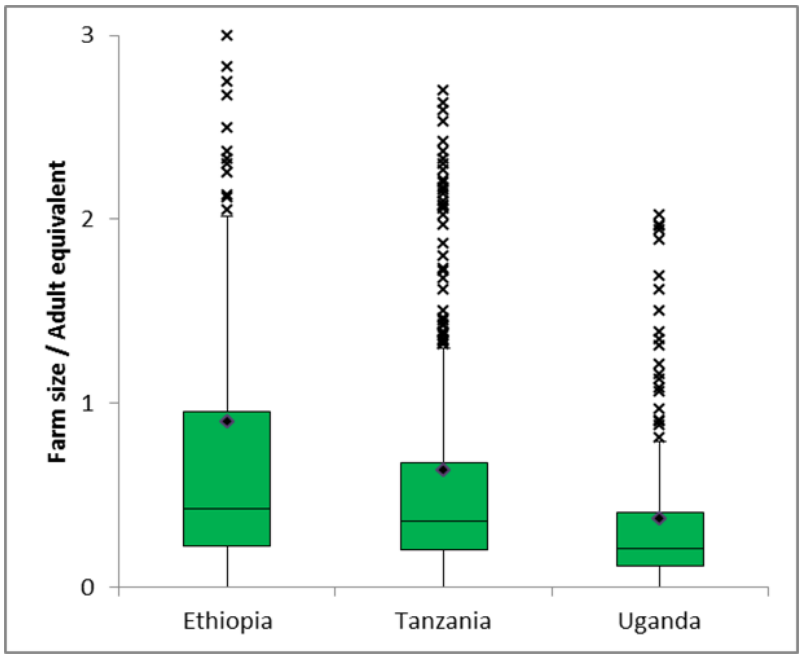
Type of asset or service	% of households
Electronics	48%
Furniture	26%
Transport	20%
Farm implements	2%
Clothing	2%
Livestock	1%

5 Some comparisons among Ethiopia, Tanzania and Uganda

5.1 Household and gender differences

In most countries, men were more frequently engaged in the survey than women. The differences in participation in the survey between women and men is especially large in Ethiopia where very few women were reported to be involved (13%).

Boxplot 5.1 shows the differences among the three countries with regard to the farm size per adult equivalent. In Ethiopia, the land area per household member varies more as compared to Tanzania and Uganda, although the medians were comparable. The amount of land area per household member was generally low (less than 1 ha). The Ethiopian adult equivalent was slightly lower as compared to Tanzania and Uganda. This is related to the smaller number of children 0-16 years, women over 60 years old and men over 60 years old, reported by the Ethiopian households.



Boxplot 5.1: Farm size per adult equivalent in Ethiopia, Tanzania and Uganda.

The difference in education level (primary and secondary level) between male and female headed households is small or even entirely absent (Table 5.1). However, the proportion of female headed households with no (or informal) education is relatively larger in all three countries, as compared to the male headed households.

Table 5.1: Highest education level in male and female headed households in Ethiopia, Tanzania, Uganda.

Country	Education level	Female headed household		Male headed household	
Ethiopia	Primary	n=33	42%	n=367	46%
Tanzania		n=144	58%	n=735	59%
Uganda		n=60	47%	n=338	42%
Ethiopia	Secondary	n=33	45%	n=367	33%
Tanzania		n=144	30%	n=735	32%
Uganda		n=60	35%	n=338	40%

In all three countries, joint household decision making on the crop to grow (the use of the land) and legume harvest is most common. In Ethiopia and Tanzania, most fields are being managed by both husband and wife (Table 5.2). However, it is notable that Ethiopian women's control over land and legume harvest was restricted. In Uganda a larger proportion of women was involved in managing the fields, as compared with men.

Table 5.2: Control over land use and crop harvest by household members (% of fields).

Control over	Wife	Husband	Both	Number of fields
Use of land				
Ethiopia	3%	37%	60%	1497
Tanzania	17%	18%	62%	473
Uganda	32%	21%	47%	702
Harvest all crops				
Ethiopia	4%	25%	71%	1489
Tanzania	19%	18%	59%	475
Uganda	20%	19%	61%	705

5.2 Livestock ownership

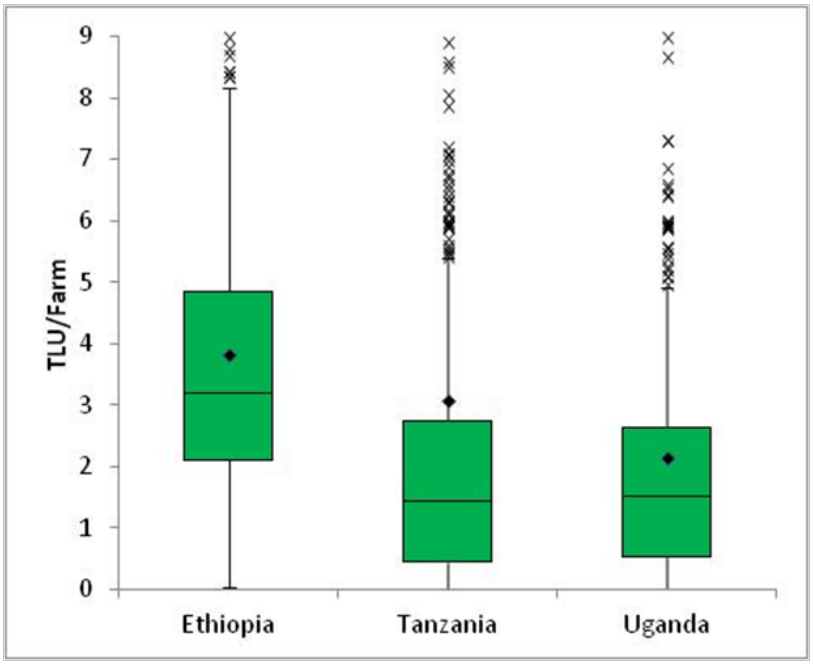
Table 5.3 presents the percentages of households owning and/or taking care of livestock. Clearly, livestock ownership differs between the three countries. Chickens were widely kept by households in all surveyed areas. Cattle and donkeys are particularly important in Ethiopia. Nearly all the interviewed Ethiopian households indicated they owned cattle. Large numbers of smaller ruminants such as goats and sheep could be found in Tanzania and Uganda. In general, ruminants are being fed by natural grazing and forage crops. In Ethiopia the proportion of non-leguminous crop residues fed to ruminants is considerably higher, as compared to Tanzania and Uganda. The use of agro-industrial concentrates is relatively higher in Tanzania, as compared to Ethiopia and Uganda. Differences in livestock keeping between Ethiopia, Tanzania and Uganda appear to be associated more with cultural practices and agricultural development pathways more than with agro-ecology.

In general, crop farming is the most important main source of household income for the farmers interviewed. However, most households in the three countries indicated that they also received income from livestock farming. Off-farm sources of income were reported to be only a small fraction of the total household income.

Table 5.3: Interviewed households owning or taking care of a type of livestock (% of households).

Livestock type	Ethiopia (n=389)	Tanzania (n=722)	Uganda (n=345)
Cattle	96%	53%	66%
Donkey	40%	1%	0%
Goat/Sheep	47%	66%	75%
Horse/Ox/Mule	17%	0%	0%
Pig	0%	16%	25%
Poultry	52%	87%	75%
Rabbit	0%	0%	1%

Boxplot 5.2 shows the Tropical Livestock Unit (TLU) per farm in Ethiopia, Tanzania and Uganda. The Ethiopian TLU per farm is highest in Ethiopia (3.13) as compared with Tanzania and Uganda. This is probably related to the large number of Ethiopian households owning 2.1 cattle (96%). The TLU in Tanzania is the lowest (1.15), as the interviewed households reported that they mainly owned chickens; 87% of the farmers owned on average 12 chickens. In Uganda, goat/sheep and poultry are the most commonly owned type of livestock (75% of the households). The Ugandan farmers owned on average 12 chickens and 4 goat/sheep per farm.



Boxplot 5.2: TLU per farm in Ethiopia, Tanzania, Uganda.

5.3 Crop cultivation

As compared to Ethiopian and Ugandan households, maize and leguminous crops play a more important role in Tanzanian farming systems (Table 5.4 and Table 5.6). The main legume crops (bush bean, groundnut and soyabean) promoted by N2Africa are also those most commonly grown across the project areas. Fewer farmers cultivated climbing bean, faba bean, chickpea or cowpea. Soyabean is also cultivated by farmers in all three countries, but generally by fewer farmers and in particular regions (Ethiopia: Pawe, Tanzania: Southern Highlands, Uganda: northern and eastern region). Groundnut is widely grown in Tanzania and Pawe, Ethiopia. Yields of the targeted legume crops are poor across the mandate areas of the project and can be increased through judicious use of inputs.

Table 5.4: Cultivation of legume crops (% of households).

Legume crop	Ethiopia (n=400)	Tanzania (n=877)	Uganda (n=387)
Bambara groundnut	-	10%	-
Bush bean	23%	58%	31%
Climbing bean	-	-	13%
Cowpea	-	15%	-
Chickpea	10%	-	-
Faba bean	27%	-	-
Groundnut	19%	35%	4%
Pigeonpea	-	18%	-
Grass pea	20%	-	-
Soyabean	23%	3%	9%

Most fields (80%-90%) in Ethiopia, Tanzania and Uganda did not receive organic inputs. The same is true for the application of mineral fertiliser. Most of the fields in Ethiopia, Tanzania and Uganda did not receive any mineral fertiliser (Table 5.5). In case households used mineral fertiliser, DAP and/or urea were most commonly used. The Ethiopian fields received relatively more mineral fertiliser (DAP) as compared to fields in Uganda and Tanzania.

The current use of inoculants by smallholders in the target areas was very low. The use was limited two farmers in Tanzania, six farmers in Uganda and zero farmers in Ethiopia. Based on N2Africa experiences so far, this is likely to result from unavailability of the inoculants in the rural areas, i.e. close enough to smallholder farmers, and depending on the country, a lack of knowledge by smallholder farmers on the beneficial effects of inoculants.

Table 5.5: Use of mineral fertiliser (% of fields receiving mineral fertiliser).

Legume crop	Ethiopia (n=1673)	Tanzania (n=877)	Uganda (n=750)
DAP	16%	5%	4%
Urea	6%	10%	1%
NPK	-	2%	1%
DAP/Urea	23%	9%	1%
CAN	-	2%	1%

Maize is the only non-legume crop that was widely grown across action sites (Table 5.6). Other crops cultivated were more specific for particular agro-ecological zones. For instance, teff, barley, enset and wheat were primarily grown in the project areas in Ethiopia, pigeonpea and sunflower were often cultivated in Tanzania, and cassava was mainly cultivated in Uganda.

Table 5.6: Cultivation of non-legume crops by interviewed households (%).

Crop	Ethiopia (n=400)	Tanzania (n=877)	Uganda (n=387)
Banana	2%	6%	12%
Barley	21%	-	-
Cassava	-	4%	15%
Enset	20%	-	-
Finger millet	18%	2%	7%
Maize	47%	89%	23%
Potato	3%	5%	6%
Sesame	8%	3%	8%
Sunflower	-	25%	9%
Sorghum	7%	5%	6%
Teff	27%	-	-
Wheat	35%	-	-

5.4 Use of legume products

The use of legume haulms has a major impact on the rotational benefits of biological nitrogen fixation for subsequent crops. In case legume residues are burned in the field or left in the field during the dry season with freely grazing animals, a great deal of the nitrogen in the legume residues is likely to be lost for subsequent crops. In case legume residues are used for mulching or for animal feeding, the carry-over of nitrogen and other nutrients could be much larger if the residues, as well as the animal manure produced from the residues, are handled with care and nutrient losses are kept to a minimum.

In Ethiopia with its relatively high densities of ruminants, farmers indicated that, if they used the crop residues, they used it to feed their livestock (Table 5.7). Farmers in Tanzania and Uganda were more likely to use their crop residues as mulch for their fields. Hardly any farmer sold legume residues.

Table 5.7: Households that use of crop residues per usage type and country.

Use of crop residues	Ethiopia (n=400)	Tanzania (n=482)	Uganda (n=302)
Fed to livestock	92%	31%	5%
Mulched	34%	61%	70%
Burned	28%	22%	21%
Sold	4%	3%	1%
Other	1%	4%	1%

Most of the legume harvest was sold (Table 5.8). Particularly, a large part of the soyabean produce, being a commercial legume crop, was sold. The percentage harvest saved for seed is surprisingly similar between the three countries; ranging from 14% to 19%. Another similarity between the countries is that hardly any crop harvest (1%-3%) was use as payment/food for hired labour.

Table 5.8: The average % of crop harvest sold per country.

Average % of crop harvest sold	Ethiopia (n=503)	Tanzania (n=1369)	Uganda (n=375)
Bush bean	38%	46%	44%
Climbing bean	-	-	49%
Groundnut	62%	54%	51%
Other (Peas)	45%	-	53%
Soyabean	71%	69%	77%
Faba bean	44%	-	-

6 Lessons learned

The baseline questionnaire provided us with a rich database of information on a range of topics that will help us assess impact towards the end of the project. Important information derived from the baseline survey includes data on production orientation of the farmers (crops and livestock farming, on-farm and off-farm income generation), crops grown by farmers, as well as the management of these crops, sale of legume products, the importance of livestock in the farming system, and certain gender disparities. Especially data on the cultivation of different legume types and the use of mineral fertilisers, inoculants and/or organic inputs in legumes are relevant to assess the appropriateness of the technologies promoted by N2Africa.

The main reason to collect data on household assets was to facilitate the categorisation of farmers based on resource endowment. In the analyses for the current report, we did not yet look into correlations between a large number of variables.

The sampling was done randomly. As we aimed to establish a baseline that allows us to compare before and after intervention, the study did not have a control.

In analysing data, we found that certain data items only played a minor role in the analysis. In retrospective, the collection of some of these data items could have been omitted, or asked and/or processed differently. Below follows a list of data items that could have been omitted or asked differently.

1. Figures on landholdings should be treated with care, as farmers were often unable to give accurate estimations of field and farm sizes. Farmers were also unable to estimate amounts of inputs used in crops. Therefore, it was not useful to calculate input use per hectare. The same was true for yield estimates.

2. Data with regard to education levels and income could not be analysed in relation to gender, as only the gender of the household head was known. For example, it was not clear whether the highest education level completed within the household was related to that particular household head or to other household members. This is also applicable on the collected income data. As most of the households consisted of different family members (ages and gender), it was not clear who was actually responsible for that particular income source.

3. Mineral fertiliser use and the application of organic inputs could not be related to particular crops, since farmers indicated they grew multiple kinds of crops per field. Table F1 (column 4) of the questionnaire needs to be adjusted to overcome this issue (fill in one crop per field per row).

4. Data on market access was difficult to analyse. This was mainly due to the small sample sizes. Only a few farmers answered the questions. Farmers were asked to specify the marketing system. However, the marketing system was not defined, and therefore it was difficult to understand what was meant with a the marketing system. As it was, the questionnaire did not provide sufficient information to gain meaningful insights.

5. The baseline questionnaire contained a section on household assets which we hope would tell us something about the wealth status of households. While information on household assets has been used to identify farm types, in retrospect we doubt whether this limited use justifies the large number of household assets used in the questionnaire.

Other data items in the baseline survey were found to be useful:

1. The questionnaire contained questions about livestock ownership and availability of feed for ruminants. This data gave an outstanding overview of the different regional patterns.

2. The Baseline questionnaire contained a section on nutrition. We included some questions on the monthly food struggle, food sources, the frequency of legume consumption and the type of dish in the questionnaire. We hope this will give some impression of nutrition and legume consumption and will allow us to observe some change over time – if any. Note that no questions were asked about the amount of food consumed.

Detailed, follow-up studies on a limited number of farms could provide additional information on field sizes, input use and yield, livestock numbers, the main household expenditures and income sources, and access to input and output markets, though. The detailed farm characterisations are in that sense important, as they make up for some of the weaknesses in the baseline study. Given that the baseline survey was a rapid household survey, some of these weaknesses were inevitable.

7 References

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Farrow, A. (2014c). Managing factors that affect the adoption of grain legumes in Tanzania in the N2Africa project, www.N2Africa.org, 69 pp.

Farrow, A. (2014d). Managing factors that affect the adoption of grain legumes in Uganda in the N2Africa project, www.N2Africa.org, 48 pp.

Appendix I: Baseline questionnaire - Northern Tanzania

Name of the interviewer:_____

Date of interview: _____/_____/2013

Country: _____ Sector / State:_____

Action site (District/Division/Ward): _____

Village: _____

GPS coordinates homestead (decimal degrees) North/South: _____

East/West: _____ Elevation:

_____(meter)

Wealth category of the household:_____

Introduction

Introduce yourself and the N2Africa project. Explain the purpose of the survey and assure the interviewee of the confidentiality. Please check if the farmer has any questions at this time.

Part A: General information

A.1. Name of the respondent: _____

A.2. Sex of respondent: Male ___ /Female ___ Age: _____

A.3. Is respondent head of the household: Yes ___ / No ___

A.4. If no, head of household is Male ___ /Female ___ and Age _____ years

A.5. Members of the household

Total number of people in the household:_____

Age	No. of all children	
0 – 16 years		
	No. of females	No. of males
17 – 35 years		
35-60 years		
Over 60 years		

A.6. What is the highest schooling level completed by a person in the household (tick)?

1. Primary: _____ 2. Secondary:_____
3. Post-secondary: _____ 4. Tertiary (College / University:_____
5. Informal / other:_____ 6. None:_____

B. Income

B.1. Importance of agriculture in the household

	What are the main sources of cash income in the household? (please tick)	Estimated proportion of total income (in %, make sure the total equals 100%)
Cropping		
Livestock		
Casual labour		
Trade		
Other business		
Salaried job		
Pension		
Remittances		
Other_____		

C. Livestock

C.1. Number of valuable livestock species owned of by the household

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

Pigs (no.):_____ Chicken (no) _____

Other valuable livestock, type: _____ no: _____

type: _____ no: _____

D. Labour

D.1. Do you hire labour from outside the household to work in your fields?

Yes___/No____

D.2. Do you or your household members work on other people's fields for food or cash (as hired labour)? Yes___/No____

E. Land use

E.1. Draw a sketch map of the farm indicating the fields (will help to establish if it is with consolidated or fragmented parcels of land)

E.2. Total amount of arable land available for cropping, including fallow land:

_____ha or _____acres

E.3. Do you leave land fallow during the cropping season?
1) Yes:____ 2) No:_____
If yes, how long is a field typically left fallow between crops (seasons): _____

E.4. What are the cropping sequences on the fields of your farm? (refer to the sketch map drawn with the farmer for the fields).

Field no (add as many rows as there are fields on the farm)	Season			
	2012A	2012B	2013A	2013B
1				
2				
3				
4				
5				
6				
7				

F. Crop production

Please fill the table below for the main arable crops grown on the farm (exclude small vegetable gardens etc.)

Field	Size (indicate ha, ac or m^2)	Distance of this field from the homestead (walking distance in minutes)	Crop(s) grown (if intercropped, mention all crops and indicate relative shares, e.g. 80% maize / 20% beans)	Indicate variety/ies (ensure variety names for all legumes are noted).	Mineral fertiliser applied? (If yes, specify type)	Organic inputs applied? (Tick if yes)	Inoculant applied? (Tick if yes)	Total harvest from this field (give unit, e.g. in kg or 50 kg bags)	Who manages this field (husband, wife, both husband and wife, other (please specify))	Who decides about the harvest/ sales of the crop from this plot? (husband, wife, both (please specify))
1										
2										
3										

Field	Size (indicate ha, ac or m^2)	Distance of this field from the homestead (walking distance in minutes)	Crop(s) grown (if intercropped, mention all crops and indicate relative shares, e.g. 80% maize / 20% beans)	Indicate variety/ies (ensure variety names for all legumes are noted).	Mineral fertiliser applied? (If yes, specify type)	Organic inputs applied? (Tick if yes)	Inoculant applied? (Tick if yes)	Total harvest from this field (give unit, e.g. in kg or 50 kg bags)	Who manages this field (husband, wife, both husband and wife, other (please specify))	Who decides about the harvest/ sales of the crop from this plot? (husband, wife, both (please specify))
4										
5										
6										

G. Legume Utilisation

G.1. Use of legume grain

Indicate for each crop the total production from last season for the entire farm and the amounts for sale, kept in the household for food, for payment / food of hired labour, and the amount kept for seed. The table refers to the division of crop production directly after harvest. Make sure that the sum of the different amounts equals total production.

Legume crop	Total production at the farm Indicate units, e.g. kg, 50 kg bags. Total production should correspond with the yields given in section F.	Amount for sale	Amount for food in the household	Amount used as payment / food for hired labour	Amount kept as seed / planting material

G.2. Use of legume haulms

How do you use legume haulms (e.g. as feed for own livestock, sale to other people, incorporation in the soil at planting, burned in the field, etc.)

Type of legume	How are the haulms used?
1	
2	
3	
4	
5	

H. Production constraints

H.1 What do you consider to be the major production constraints for your farm?

_____

_____

_____

_____

_____

H.2 What are the three key challenges that you face in obtaining the inputs you use for legume production

A) Seed
   1.....
   2.....
   3.....

B) Mineral fertilisers
   1.....
   2.....
   3.....

C) Organic fertilisers
   1.....
   2.....
   3.....

D) Inoculants
   1.....
   2.....
   3.....

E) Pesticides
   1.....
   2.....
   3.....

H.3 How have you overcome each of the challenges above?

A) Seed

1.....
2.....
3.....

B) Mineral fertilisers

1.....
2.....
3.....

C) Organic fertilisers

1.....
2.....
3.....

D) Inoculants

1.....
2.....
3.....

E) Pesticides

1.....
2.....
3.....

J. Nutrition

J.1. In a normal year (not a drought year for instance), which months of the year do you struggle to find sufficient food to feed everyone in the household?

Tick the box(es).

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

J.2. In a normal year, which months does the food consumed in the household **mainly** comes from your own farm and which months mainly from other sources?

Tick the box(es).

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Tick the months when food comes from the farm												
Tick the months when food comes from other sources												

J.3. How often do you eat grain legumes and legume leaves in your household? (which kinds, number of times per week, main or side dish)

	Which grain legume?	Number of times per week		How eaten? Main or side dish?
		Peak season	Low season	
1.				
2.				
3.				
4.				
	Which legume leaves?			
1.				
2.				

K. Information access

K1. What is the main source of information that you use for production of legumes

1. Fellow Farmers
2. Ministry of Agriculture
3. Research/Training Institutes
4. NGOs
5. Extension staff
6. Mobile phone

K2. What are the main sources of information on legumes (Tick and indicate priority)

1. Government extension agents
2. NGO staff
3. Farmers
4. Radio,
5. TV
6. Newspapers
7. Mobile phones

K.3. What kind of information do you normally seek?

1. Inputs (seed, varieties, fertilisers, inoculants)
2. Agronomy (planting time, spacing, disease and pest control)
3. Post-harvest handling and processing (storage, product value addition)
4. Marketing (where markets are, prices, quality required)

K.4 How do you rate the quality of the information that you obtain

1. Very good
2. Good
3. Fair
4. Poor

Do you have any questions / comments for us?

_____

_____

_____

_____

_____

Thank you for your time and cooperation.

Appendix II: Baseline questionnaire - Southern Tanzania, Ethiopia and Uganda

Name of the interviewer: _____

Date of interview: _____/_____/2013

Country: _____ Region: _____

District: _____ Village: _____

GPS coordinates homestead (decimal degrees): North/South: _____

East/West: _____ Elevation:

_____(meter)

Introduction

Introduce yourself and the N2Africa project. Explain the purpose of the survey and assure the interviewee of the confidentiality. Please check if the farmer has any questions at this time.

Part A: General information

A.1. Name of the respondent: _____

A.2. Sex of respondent: Male ___ /Female ___ Age: _____

A.3. Is respondent head of the household: Yes ___ / No ___

A.4. If no, head of household is Male ___ /Female ___ and Age _____ years

A.5. Members of the household

Total number of people in the household: _____

Age	No. of all children	
0 – 16 years		
	No. of females	No. of males
17 – 35 years		
35-60 years		
Over 60 years		

A.6. What is the highest schooling level completed within the household (tick)?

1. Primary: _____ 2. Secondary:_____
3. Post-secondary: _____ 4. University:_____
5. Informal / other:_____ 6. None:_____

B. Income

B.1. Importance of agriculture in the household

	What are the main sources of ***cash*** income in the household? (please tick)	General estimate of proportion of total income (in %, make sure the total equals 100%)
Cropping		
Livestock		
Casual labour		
Trade		
Other business		
Salaried job		
Pension		
Remittances		
Other_____		
Other….		

B.2. What are the three most valuable goods or assets in your household?

1._____
2._____
3._____

C. Livestock

C.1. Number of valuable livestock species owned of by the household

Local Dairy cows (no.):_____ Improved Dairy cows (no.):_____

Draught cattle (no.):_____ Fattening cattle (no.):_____

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

Pigs (no.):_____ Chicken (no) _____

Other valuable livestock, type: _____ no: _____

type: _____ no: _____

C.2. How did the availability of feed for ruminant livestock vary over the previous year? *(on a scale of 0-10, where 10 = excess feed available, 5= adequate feed available and 0=no feed available)*

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Feed availability (score 0-10)												

C.3. How much did the various feeds contribute to the diet of the animals (ruminant livestock) throughout the previous year? Proportion of nutrition derived from different sources. The different sources **must add to 10**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Crop residues (e.g.rice straw, maize stover)												
Legume crop residues from legume crops Specify legumes: _____												
Green forage (e.g. roadside weeds, cut fodder crops)												
Grazing												
Concentrates (e.g. Wheat bran, grains, oilseed cakes)												
Other – Specify												
Other – Specify												
Must add to 10	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*

C.4. Was the previous year a:

Good year_____; Average year_____; Bad year_____

D. Labour

D.1. Last year (season 2013 A and B), did you hire labour from outside the household to work in your fields? Yes___/No____

D.2. Did you or your household members work on other people's fields for food or cash (as hired labour)? Yes___/No____

D.3. Was there any period in the year when activities on your own fields are delayed because:

	1. You and/or your family members had to work on other people's fields first? (Tick activity which is delayed)	2. You could not hire enough people to work on your fields? (Tick activity which is delayed)
Land preparation		
Sowing		
Weeding		
Harvest		
Other		

E. Land use

E.1. Draw a sketch map of the farm indicating the fields:

E.2. Total amount of arable land available for cropping, including fallow land:

_____ha or _____acre

E.3. Did you leave any land fallow during the previous cropping season (2013 A and 2013 B)? 1) Yes:____ 2) No:_____ --> if no, go to E.4.

If yes, how long is a field typically left fallow between crops (seasons): _____

E.4. What are the two most common crop rotation sequences on your farm? (Refer to the sketch map drawn with the farmer for the field no.)

Field no	Season		
	2011-2012	2012-2013	2013-2014

F. Crop production

F.1. Please fill the table below for the main arable crops grown on the farm in the current or most recent season (exclude small vegetable gardens)

Field	Size (indicate ha, acre or m^2)	Distance of this field from the homestead (walking distance in minutes)	Crop(s) grown (if intercropped, mention all crops and indicate relative shares, e.g. 80% maize / 20% beans)	Indicate variety/ies (ensure variety names for all legumes are noted).	Mineral fertiliser applied? (If yes, specify type)	Organic inputs applied (e.g. compost/ manure)? (Tick if yes)	Inoculant applied? (Tick if yes)	Total harvest from this field (give unit, e.g. in kg)	Who manages this field (husband, wife, both husband and wife, other (please specify))	Who decides about the harvest/ sales of the crop from this plot? (husband, wife, both, other (please specify))
1										
2										
3										

Field	Size (indicate ha, acre or m^2)	Distance of this field from the homestead (walking distance in minutes)	Crop(s) grown (if intercropped, mention all crops and indicate relative shares, e.g. 80% maize / 20% beans)	Indicate variety/ies (ensure variety names for all legumes are noted).	Mineral fertiliser applied? (If yes, specify type)	Organic inputs applied (e.g. compost/ manure)? (Tick if yes)	Inoculant applied? (Tick if yes)	Total harvest from this field (give unit, e.g. in kg)	Who manages this field (husband, wife, both husband and wife, other (please specify))	Who decides about the harvest/ sales of the crop from this plot? (husband, wife, both, other (please specify))
4										
5										
6										

Field	Size (indicate ha, acre or m^2)	Distance of this field from the homestead (walking distance in minutes)	Crop(s) grown (if intercropped, mention all crops and indicate relative shares, e.g. 80% maize / 20% beans)	Indicate variety/ies (ensure variety names for all legumes are noted).	Mineral fertiliser applied? (If yes, specify type)	Organic inputs applied (e.g. compost/ manure)? (Tick if yes)	Inoculant applied? (Tick if yes)	Total harvest from this field (give unit, e.g. in kg)	Who manages this field (husband, wife, both husband and wife, other (please specify))	Who decides about the harvest/ sales of the crop from this plot? (husband, wife, both, other (please specify))
7										
8										
9										

F.2. What do you consider to be the major production constraints for your farm?

_____

_____

_____

_____

_____

G. Legume utilisation

G.1. Use of ***legume grain***

Indicate for each crop the total production from last season for the entire farm and the amounts for sale, kept in the household for food, for payment/food of hired labour, and the amount kept for seed. The table refers to the division of crop production directly after harvest. *Make sure that the sum of the different amounts equals total production as mentioned in part F.*

Legume crop	Total production at the farm Indicate units, e.g. kg, 50 kg bags. Total production should correspond with the yields given in section F.	Amount for sale	Amount for food in the household	Amount used as payment / food for hired labour	Amount kept as seed	Amount given away as gifts, for funerals, church, etc.

G.2. Do you process legume grains before selling them (e.g. into soyabean cakes, soy milk, groundnut paste, peanut butter, etc.)?

Yes:_____ No:_____

If yes, which legume(s) and how do you process the grain?

_____

_____

_____

_____

G.3. Are you involved in the collective marketing of legumes?

Yes:_____ No:_____

If yes, which legume(s) and explain the marketing system?

_____

_____

_____

_____

G.4. Use of ***crop residues***
How do you use crop residues? Give the percentage used to feed livestock, mulched, burnt, etc. Make sure the total equals 100%.

Residue type	Crop (e.g. maize, soyabean)	Fed to livestock	Mulched (left in field)	Burnt	Sold	Other, specify:
Main cereal						
Main legume						
Next most important legume						
Next most important legume						

H. Use of labour saving tools in legume cultivation

H.1. Do you use any labour-saving technologies or tools in the cultivation of legumes (e.g. tractor, herbicide, processing machine, etc.)?

Yes_____ No_____

If yes, which tool(s) do you use?

Specify tool	Specify activity where the tool is used for (e.g. ploughing, planting, processing)	Tool(s) used by men, women, both?

I. Information access

I.1. What are your main sources of information on legumes (Rank the three most important sources of information)

8. Government extension agents (Development agents/district experts)_____
9. Research/Training Institutes _____
10. NGO staff _____
11. Farmers group /Association _____
12. Fellow farmers _____
13. Radio _____
14. TV _____
15. Newspapers _____
16. Mobile phones _____

10. Other, specify_____ _____

I.2. What kind of information on legumes do you normally seek (tick)?

5. Inputs (seed, varieties, fertilisers, inoculants)_____
6. Agronomy (planting time, spacing, disease and pest control)_____
7. Post-harvest handling and processing (storage, product value addition)___
8. Marketing (where markets are, prices, quality required)_____
9. Other, specify_____

I.3. What would you like to learn more concerning legumes?

_____
_____
_____
_____
_____

I.4. What are the key challenges that you face in legume cultivation?

_____
_____
_____
_____
_____
_____

J. Nutrition

J.1. In a normal year (not a drought year for instance), are there any months in which you struggle to find sufficient food to feed everyone in the household?

Y____/ N_____ --> If no, go to J.2.

If yes, in which months of the year do you struggle to find sufficient food? Tick the box(es).

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

J.2. In a normal year, which months does the food consumed in the household **mainly** comes from your own farm and which months mainly from other sources? Tick the box(es).

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Tick the months when food comes from your own farm												
Tick the months when food comes from other sources												

J.3. Do you eat grain legumes and/or legume leaves in your household?

Y_____/ N_____ --> If no, end of survey.

If yes, how often do you eat grain legumes and legume leaves in your household? (which kinds, number of days per week, main or side dish (e.g. as snack))

	Which grain legume?	Number of days per week		How eaten? Main or side dish?
		Peak season	Low season	
1.				
2.				
3.				
4.				
	Which legume leaves?			
1.				
2.				

Do you have any questions / comments for us?

_____

_____

_____

_____

Thank you for your time and cooperation

Appendix III: Comparions Baseline questionnaires

Table 0.1: Differences between the two baseline questionnaires.

Category	Baseline questionnaire Northern Tanzania	Baseline questionnaire Southern Tanzania, Ethiopia and Uganda
General information	Wealth category of the household	What are the three most valuable goods or assets in your household?
	Highest schooling level competed by a person in the household	Highest schooling level competed within the household
Livestock	One category of cattle	Four categories of cattle
	Missing	C.2 How did the availability of feed vary in the previous year?
	Missing	C.3 Contribution of feeds to the diet of animals
	Missing	C.4 Was the previous year good/average/bad?
Labour	Missing	D.3 Was there any period in the year when activities on your own fields are delayed?
Production	Missing	F.2 What do you consider to be the major production constraints for your farm?
Legume utilisation	Missing	G.2 Do you process legume grains before selling them?
	Missing	G.3 Are you involved in the collective marketing of legumes?
Production constraints	H.1 What do you consider the major production constraints for your farm?	Missing
	H.2 What are the three key challenges that you face in obtaining the inputs you use for legume production?	Missing
	H.3 How have you overcome each of the challenges above?	Missing
Labour saving tools	Missing	H.1 Do you use any labour-saving technologies or tools in the cultivation of legumes?
Information access	K.1 What is the main source of information that you use for production of legumes?	Missing
	K.4 How do you rate the quality of the information that you obtain?	Missing
	Missing	I.3 What would you like to learn more concerning legumes?
	Missing	I.4 What are the key challenges that you face in legume cultivation?

Appendix IV: Tropical Livestock Unit

Calculations Tropical Livestock Unit (TLU): SUM(Number of livestock per type * relative weight)

Table 0.2: Relative weight per livestock

Livestock type	Relative weight
Cattle	0.7
Donkey	0.5
Goat/Sheep	0.1
Horse/Ox/Mule	0.8
Pig	0.2
Poultry	0.01
Rabbit	0.01

List of project reports

1. N2Africa Steering Committee Terms of Reference
2. Policy on advanced training grants
3. Rhizobia Strain Isolation and Characterisation Protocol
4. Detailed country-by-country access plan for P and other agro-minerals
5. Workshop Report: Training of Master Trainers on Legume and Inoculant Technologies (Kisumu Hotel, Kisumu, Kenya-24-28 May 2010)
6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis
7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan
8. General approaches and country specific dissemination plans
9. Selected soyabeans, common beans, cowpeas and groundnuts varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launch and workshop report
11. Advancing technical skills in rhizobiology: training report
12. Characterisation of the impact zones and mandate areas in the N2Africa project
13. Production and use of rhizobial inoculants in Africa
18. Adaptive research in N2Africa impact zones: Principles, guidelines and implemented research campaigns
19. Quality assurance (QA) protocols based on African capacities and international existing standards developed
20. Collection and maintenance of elite rhizobial strains
21. MSc and PhD status report
22. Production of seed for local distribution by farming communities engaged in the project
23. A report documenting the involvement of women in at least 50% of all farmer-related activities
24. Participatory development of indicators for monitoring and evaluating progress with project activities and their impact
25. Suitable multi-purpose forage and tree legumes for intensive smallholder meat and dairy industries in East and Central Africa N2Africa mandate areas
26. A revised manual for rhizobium methods and standard protocols available on the project website
27. Update on Inoculant production by cooperating laboratories
28. Legume Seed Acquired for Dissemination in the Project Impact Zones
29. Advanced technical skills in rhizobiology: East and Central African, West African and South African Hub
30. Memoranda of Understanding are formalized with key partners along the legume value chains in the impact zones
31. Existing rhizobiology laboratories upgraded
32. N2Africa Baseline report
33. N2Africa Annual country reports 2011
34. Facilitating large-scale dissemination of Biological Nitrogen Fixation

35. Dissemination tools produced
36. Linking legume farmers to markets
37. The role of AGRA and other partners in the project defined and co-funding/financing options for scale-up of inoculum (banks, AGRA, industry) identified
38. Progress Towards Achieving the Vision of Success of N2Africa
39. Quantifying the impact of the N2Africa project on Biological Nitrogen Fixation
40. Training agro-dealers in accessing, managing and distributing information on inoculant use
41. Opportunities for N2Africa in Ethiopia
42. N2Africa Project Progress Report Month 30
43. Review & Planning meeting Zimbabwe
44. Howard G. Buffett Foundation – N2Africa June 2012 Interim Report
45. Number of Extension Events Organized per Season per Country
46. N2Africa narrative reports Month 30
47. Background information on agronomy, farming systems and ongoing projects on grain legumes in Uganda
48. Opportunities for N2Africa in Tanzania
49. Background information on agronomy, farming systems and ongoing projects on grain legumes in Ethiopia
50. Special Events on the Role of Legumes in Household Nutrition and Value-Added Processing
51. Value chain analyses of grain legumes in N2Africa: Kenya, Rwanda, eastern DRC, Ghana, Nigeria, Mozambique, Malawi and Zimbabwe
52. Background information on agronomy, farming systems and ongoing projects on grain legumes in Tanzania
53. Nutritional benefits of legume consumption at household level in rural sub-Saharan Africa: Literature study
54. N2Africa Project Progress Report Month 42
55. Market Analysis of Inoculant Production and Use
56. Identified soyabean, common bean, cowpea and groundnut varieties with high Biological Nitrogen Fixation potential identified in N2Africa impact zones
57. A N2Africa universal logo representing inoculant quality assurance
58. M&E Workstream report
59. Improving legume inoculants and developing strategic alliances for their advancement
60. Rhizobium collection, testing and the identification of candidate elite strains
61. Evaluation of the progress made towards achieving the Vision of Success in N2Africa
62. Policy recommendation related to inoculant regulation and cross border trade
63. Satellite sites and activities in the impact zones of the N2Africa project
64. Linking communities to legume processing initiatives
65. Special events on the role of legumes in household nutrition and value-added processing
66. Media Events in the N2Africa project
67. Launch N2Africa Phase II – Report Uganda

68. Review of conditioning factors and constraints to legume adoption and their management in Phase II of N2Africa
69. Report on the milestones in the Supplementary N2Africa grant
70. N2Africa Phase II Launch in Tanzania
71. N2Africa Phase II 6 months report
72. Involvement of women in at least 50% of all farmer related activities
73. N2Africa Final Report of the First Phase: 2009-2013
74. Managing factors that affect the adoption of grain legumes in Uganda in the N2Africa project
75. Managing factors that affect the adoption of grain legumes in Ethiopia in the N2Africa project
76. Managing factors that affect the adoption of grain legumes in Tanzania in the N2Africa project
77. N2Africa Action Areas in Ethiopia, Ghana, Nigeria, Tanzania and Uganda in 2014
78. N2Africa Annual report Phase II Year 1
79. N2Africa: Taking Stock and Moving Forward. Workshop report
80. N2Africa Kenya Country Report 2015
81. N2Africa Annual Report 2015
82. Value Chain Analysis of Grain Legumes in Borno State, Nigeria
83. Baseline report Borno State
84. N2Africa Annual Report 2015 DR Congo
85. N2Africa Annual Report 2015 Rwanda
86. N2Africa Annual Report 2015 Malawi
87. Contract Sprayer in Borno State, Nigeria
88. N2Africa Baseline Report II Ethiopia, Tanzania, Uganda, version 2.1

8 Partners involved in the N2Africa project

A2N

Bayero University Kano (BUK)

Caritas Rwanda

Diobass

Eglise Presbyterienne Rwanda

Ethiopian Institute of Agricultural Research

Kwame Nkrumah University of science and Technology

MIRCEN
University of Nairobi MIRCEN

Resource Projects-Kenya

Sasakawa Global; 2000

Université Catholique de Bukavu

University of Zimbabwe

Urbanet