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Integrated *Striga* Management in Africa

Constraints and Opportunities of Maize Production in Western Kenya

A Baseline Assessment of *Striga* extent, Severity, and Control Technologies

Joseph Ndwiga, Jimmy Pittchar, Peter Musyoka, Dickens Nyagol, George Marechera, Gospel Omanya, and Mel Oluoch

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AFRICAN AGRICULTURAL TECHNOLOGY FOUNDATION
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African Insect Science for Food and Health

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- The International Institute of Tropical Agriculture (IITA)
- The African Agricultural Technology Foundation (AATF)

Executive summary

This report presents results of a baseline study on the constraints and opportunities of maize production in the Western Region of Kenya. The aim of the study was to provide baseline information that would set the basis for measuring progress and impact of the project on the livelihoods of the target population. Its objective was to determine the current status of livelihoods within the project areas by looking at various indicators of livelihoods such as household demographics; access to land, input use, and crop production; decision-making process in farming; *Striga* and *Striga* control technologies; vulnerability; capital assets; and livelihood strategies and outcomes, and explore opportunities and constraints affecting maize production in the project areas.
One thousand two hundred (1200) households randomly selected from 12 districts were interviewed using a structured questionnaire. Data from the study was analyzed using descriptive statistics and multiple regression.

The study found out that high proportions of households are male-headed households with the proportion of female-headed households in Nyanza being higher than in the Western region. The average age of household head was 49 years with average formal schooling of eight years and household size of six. About 60% of household heads work full-time on the farm. Household land holdings are small and mostly used for the production of annual crops especially maize. Household members over 60 years of age are the ones working mostly full time on the farm. More women than men belong to and participate in the leadership of social groups. In addition most household members belong to women groups, development committees, and credit and savings groups.

The main source of funding for farming aspects among the households is proceeds from sale of farm produce which include maize. All key farming related decisions in the households are made by both the household head and the spouse except the decision on the acreage of land to plant. Input use levels are low and vary inter-province.

Striga is ranked as the number one production constraint in maize production and is severe among 50% of households sampled. In terms of severity, *Striga* currently claims over 40% of the households' maize crop. Over 80% of the households use the uprooting method to control *Striga* in their farms. About 50% of the households use organic and inorganic fertilizers. The use of control technologies like Imazapyr-resistant (IR) maize is less than 5% among farmers. The main reasons for non-adoption of *Striga* control measures among the households is inadequate information on the technologies and their high costs. The model on determinants of maize production showed that the level of usage of organic fertilizer influences maize production level.

The level of investment in maize production among households is determined by the type of variety being grown and whether intercropped. Most households' farm produce ends up in the local market in the hands of local consumers and traders where produce prices are low leading to low returns by farmers. Since the main source of funding for farming operations is proceeds from sales of produce, the low returns are not supporting farmers' efforts to re-invest in maize production and production management including *Striga* control. The level of access to formal financial capital and human capital with regards to *Striga* control is very low. The households are food self-sufficient for less than six months in a year.

The study identified ways to improve the adoption of *Striga* control technologies. This included making information on innovations available to maize producing farmers since they are literate enough to read and adopt the innovation to improve their production. This should be done through enhancing partnerships and collaboration with other partners and strengthening farmer-to-farmer extension on *Striga* management which is gaining ground in the study area. Given the fact that most of farmers are full-time farm workers, they need to be encouraged by providing necessary assistance such as adequate training, appropriate technologies for production, and a good marketing system for their production. Other help includes giving financial assistance to maize farmers to acquire farms inputs like maize seeds, fertilizer, agrochemicals, and other materials for farming activities through enhancing linkages between farmers' groups and financial institutions.

Government should create marketing information centers in order to inform maize farmers on prevailing maize prices in the market. Financial institutions such as agricultural and community banks should be established in the study area with simple procedures for securing loans. The relevant government agencies should mobilize the maize farmers to form themselves into formidable groups so that they can derive maximum benefit of economies of scale both in input purchasing as well as produce marketing. This will also ensure that other actors working or willing to work with the farmers to enhance *Striga* management find a suitable platform through which to link up with the farmers and other players.

Acronyms and abbreviations

AATF	African Agricultural Technology Foundation
ASK	Agricultural Society of Kenya
FBO	farmer-based organizations
FTC	Farmer Training Centre
GPS	Global Positioning System
Ha	hectare
icipe	International Centre of Insect Physiology and Ecology
IR	Imazapyr-resistant maize
ISMA	Integrated *Striga* Management in Africa
NGOs	nongovernmental organizations
OPV	open-pollinated variety

Introduction

Background

Western Kenya (the Lake region) is a major maize-producing region of the country. Maize is a main staple crop and a source of income and employment for millions of farming families in the region. However, maize production is threatened by a series of production constraints that hamper not only the livelihoods of the farming population but also the meeting of the government objectives for agricultural sector transformation.

The problem of *Striga hermonthica* was in existence as early as 1936 in the fields of farmers within Lake Victoria Basin, western Kenya (Watt 1936; Khan et al. 2006). *Striga* attaches itself to the maize or sorghum roots from which it draws its moisture and nutrient requirements, inhibiting plant growth, reducing yields, and in extreme cases, causing plant death. The annual *Striga* damage in sub-Saharan Africa (SSA) is estimated at US$1 billion and affects the livelihoods of more than 100 million people. Fifteen countries of eastern, southern, and western Africa account for 95% of the continent's *Striga*-infested fields. Farmers and various organizations using both traditional and conventional efforts have tried to control *Striga* infestation in the region but results have not been promising until recently.

In a bid to contribute to nourishing livelihoods of poor farm families in Africa, the International Wheat and Maize Center (CIMMYT) developed a hybrid maize—Imazapyr-resistant (IR) maize locally referred to as *Ua Kayongo*—to control *Striga*. The African Agricultural Technology Foundation (AATF) is facilitating the deployment of IR maize technology. The use of IR maize technology to control *Striga* is being promoted to increase maize yields by between 38 and 82% more than those currently obtained from traditional maize varieties. In Kenya, it is estimated that when adopted, the proposed technology will lead to an extra 62,000 tons (t) of maize in Western Province alone.

The objective of the Integrated *Striga* Management in Africa (ISMA) project is to enable smallholder farmers in SSA to have access to appropriate *Striga* management technologies such as seed of Imazapyr-resistant (IR) maize, *Striga*-tolerant varieties, suppression and trap cropping management systems, and soil fertility management.

The project covers 12 districts in Kenya: Kisumu, Rachuonyo, Migori, Homa Bay, Bondo, Nyando, and Siaya in Nyanza Province and Butere, Mumias, Teso, Busia, and Vihiga in Western Province where *Striga* is a major threat to food security for millions of small-scale farmers.

The project has adopted a results-based implementation approach that entails setting baselines for various project objectives in order to enable the assessment of the project impacts at the end of the project implementation period. Hence prior to the large-scale implementation of interventions, a baseline study was commissioned by AATF and *icipe*.

Aims and objectives of the study

The aim of the study was to provide baseline information that would set the basis for measuring progress and impact of the project on the livelihoods of the target population. Its objective was to determine the current status of livelihoods within the project areas by looking at various indicators of livelihoods such as household demographics; access to land, input use, and crop production; decision-making process in farming; *Striga* and *Striga* control technologies; vulnerability; capital assets; and livelihood strategies and outcomes, and in addition explore opportunities and constraints affecting maize production in the project areas.

Scope of the study

The baseline survey was conducted in twelve districts in Western Kenya which are of interest to the ISMA project to provide baseline information for various project objectives in order to enable the assessment of the project impacts at the end of the project implementation period. The reference period was the 2011 production year.

Methodology

Study area

The baseline study was carried out in 12 larger districts of Nyanza and Western provinces of Kenya. These included Kisumu, Rachuonyo, Migori, Homa Bay, Bondo, Nyando, and Siaya in Nyanza Province and Butere, Mumias, Teso, Busia, and Vihiga in Western Province where maize is an important staple food and *Striga* is a major threat to food security for millions of small-scale farmers. Nyanza Province occupies a total area of 16,182 km^2 and a population of 5,442,711 as per the 2009 census or a population density of 336 persons/km^2, against 66 persons/km^2 for the country as a whole (Republic of Kenya 2009). Western province has a population of 4,334,282 and a density of 515 persons/km^2 on a total area of 8400km^2. These two provinces have the second highest population density after Nairobi Province. There were about 968,014 households in Nyanza in 1999 and 701,323 in Western province (VM Manyong et al. 2008) (Table 1).

Sampling procedure

The sampling unit was the farm household. A total of 1200 households were randomly sampled in 12 districts. A random sample of 100 farm households was drawn from each district. Random numbers were generated using Research Randomizer software (www.randomizer.org) and used to select a random sample of 50 GPS points from each geographical/administrative district map, excluding unfarmed areas, e.g., water masses, mountains, and forested areas. A table of GPS coordinates was generated for each district. The sampled GPS points were used to interview two households within a 200-m radius from the reference GPS coordinate. This ensured inclusion of at least 50 villages in each district in the survey.

Data collection and analysis

Data was collected in by means of structured questionnaires administered with the assistance of trained enumerators (four covering each of the 12 project districts in Western Kenya). Themes included in the questionnaire were related to household demographics; access to land, input use and crop production; decision-making process in farming; *Striga* and *Striga* control technologies; vulnerability; capital assets; and livelihood strategies and outcomes.

For enumeration purposes, young college graduates from within the localities (districts) were recruited and trained for three days on enumeration skills and use of GPS handsets to record coordinates in each household. Before the actual data collection, the instrument was pre-tested and adjusted to ensure that it yielded the required information during the survey. The pre-test was done in an area outside those sampled for actual data collection. For quality control, the field exercise was coordinated and supervised by a team comprising AATF and *icipe* staff.

Data was analyzed using SPSS statistical software and descriptive statistics were used for the analysis of socioeconomic characteristics of the farmers, identification of the resources used in maize production, and identification of maize production constraints. Multiple regression was used for the analysis of the effect of production inputs in maize output.

Table 1. Areas and population statistics of the study area.

Province/Country	Capital	Area (sq.km)	Population (24/08/2009 census)	Population density
Nyanza	Kisumu	16,182	5,442,711	336.3435
Western	Kakamega	8400	4,334,282	515.986
Total for Kenya		581,834	38,610,097	66.3593

Model specification

Multiple linear regression

An econometric model was used to analyze the effect of production input on maize output. Production of maize was explicitly expressed as a function of the inputs. The econometric model is explicitly specified as follows:

$Y = \beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\beta5X5+\mu$ (1) Where Y

= maize output in kilograms

$\beta0$ = constant factor

X1 = land under cultivation

X2 = total number of labor used in man-hours

X3 = quantity of maize planted in kilograms

X4 = quantity of fertilizer in kilograms

X5 = quantity of agrochemicals used in litres

Bi = estimates of the coefficients with (i = 1, 2…5)

μ = an error term measuring variation in maize output unaccounted for by independent variable.

The estimates of the coefficient βi were estimated for the effect of the variable on changes in maize output. A positive βi was found for variables associated with the increased maize output and negative βi (i = 1, 2…5) was found when a variable is associated with the decrease in maize output.

Outline of the report

This report presents empirical results from preliminary analyses for both Western and Nyanza provinces. Chapter 1 gives an introduction to the study. Chapter 2 describes the methodology, and Chapter 3 presents the results of the study. Conclusion and recommendations are addressed in Chapter 4. Significant differences observed in any of the profiles or segments across the study regions are highlighted.

Teacher Philip Ochieng at his IR maize farm in Kisumu District.

Results

Socioeconomic characteristics of households

Demographic and socioeconomic characteristics of households

Analysis of the households' socioeconomic profile presented in Table 2 indicates that 80.5% of the sampled households are male headed. By province the proportion is higher in Western with Teso district leading at 93.9% and lower in Nyanza with Bondo being the lowest at 52.5%. Inter-province differences in household headship further shows that more female-headed households were found in Nyanza Province (31.7%) than in Western Province (18.2%). This can be explained possibly by the higher mobility of men in Nyanza than those in Western and the high incidence of HIV/AIDs in Nyanza compared to Western.

The average age of heads of households from both provinces was 49 years. The inter-province difference in average age of households indicates that heads in Nyanza are slightly older at about 50 year compared to those in Western at about 48 years.

The average number of years of schooling of heads of households in both provinces was about eight years. However, those in Western have a higher average number of years of schooling with Teso district leading at 10. At this level of education, most heads of households could read and write in Kiswahili, which is an essential attribute for adoption of technologies.

About 60% of household heads work full time on the farm. There was no clear inter-provincial difference on the percentage of heads working full time on the farm. However aggregated by district, Nyando (34.4%), Mumias (41.2%), and Kisumu (46.5%) had the lowest proportion of household heads working full time on the farm.

The average household size is six with no difference across the provinces. Although the average household size is the same across the regions, the lowest average of 5 is recorded in Homabay, Butere, Bondo, and Nyando while the highest of 7 is recorded in Siaya.

Social capital

Social group membership

Participation in social groups is important as it enhances household's social capital and eventual access to other factors of production like improved technologies. The analysis of results indicate that about 50% of the sample respondents are members of social groups. A higher proportion of respondents in Nyanza (54%) are members of social groups as compared to those in Western (43%).

According to the sampled respondents (Table 3), more women are participating in social groups than men in both Nyanza and Western. Even though more women participate in social groups in Nyanza than in Western the level of participation of men is the same in the two areas. In terms of leadership, there is equal level of participation by women in the two regions. However, more men participate in leadership in Western than Nyanza.

Table 2. Socioeconomic characteristics of the sampled households.

	All	Nyanza	Western
Male household head (%)	80.5	68.3	81.8
Age of the household head (years)	49.3	50.37	47.8
Years of schooling of household head	8.4	8.16	8.67
Household head working full time on the farm (%)	62.7	62	63.3
Household size (number)	6	6	6

n = number of respondents

Striga weed uprooted and thrown on roadside. This is one of the traditional ways of *Striga* control which though not recommended is still being practiced in Butula District.

Table 3. Level of involvement in social groups.

	Number of women compared to men			Number of men compared to women		
	All	Nyanza	Western	All	Nyanza	Western
Membership	22	24	19	3	3	3
Leadership	3	3	3	2	1	2

Table 4. Level of household members' participation in associations/groups and years of involvement.

	All			Nyanza			Western		
Association/ group type	n	%	Years	n	%	Years	n	%	Years
Community development	185	29.9	5.8	142	28.8	5.6	43	34.1	6.6
Cooperative	27	4.4	7	22	4.5	5.4	5	4	15.7
Religious group	50	8.1	8.6	47	9.5	8.5	3	2.4	10
Credit and savings group	124	20	3.5	108	21.9	3.7	16	12.7	2.5
Men's group	22	3.6	4	19	3.9	3.8	3	2.4	7
Women's group	188	30.4	4.6	134	27.2	4.7	54	42.9	4.5
AIDS group	7	1.1	3.9	7	1.4	3.9	0	0	-
Others (specify)	16	2.6	5.5	14	2.8	6	2	1.6	3

n = number of respondents

Household members' participation in associations/groups and years of involvement

The results from the analysis of the level of household members' participation in social associations/ groups presented in Table 4 shows that most sample respondents belong to women groups, community development groups, and credit and savings groups in that order. By region, a higher proportion of respondents in Western belong to women groups and community development groups than in Nyanza. However, a higher proportion of sample respondents in Nyanza belonged to credit and savings groups.

Productive resource endowment and decision-making process in farming

Main source of funding

Funding is an important aspect in farming that determines the extent to which farm operations can be undertaken. According to the study results (Figure 1), the main sources of funding for farm operations in the entire region were proceeds from sale of farm produce, income from business, income from off-farm employment, and remittances, in that order. Most of the sampled households in Western unlike Nyanza fund their farm operations using proceeds from sale of farm produce with Butere having the highest proportion of households (59%) relying on this source and Kisumu the least (24%). A higher proportion of sampled households in Nyanza fund farm operations with income from business than in Western. However, by district, Teso has a majority of households (40%) funding farming aspects from business while Butere (11%) and Mumias (11%) have the least. Western has the highest proportion of households funding farm operations from off-farm employment. By district Mumias (42%), Siaya (29%), and Busia (29%) have the highest proportion of funding from off-farm employment while Bondo has the lowest (9%). With regards to funding farm activities from remittances, a higher proportion of sampled respondents from Nyanza rather than Western use this source with Rachuonyo (24%) leading and Homabay (3%), Butere (5%), and Mumias (5%) with the least.

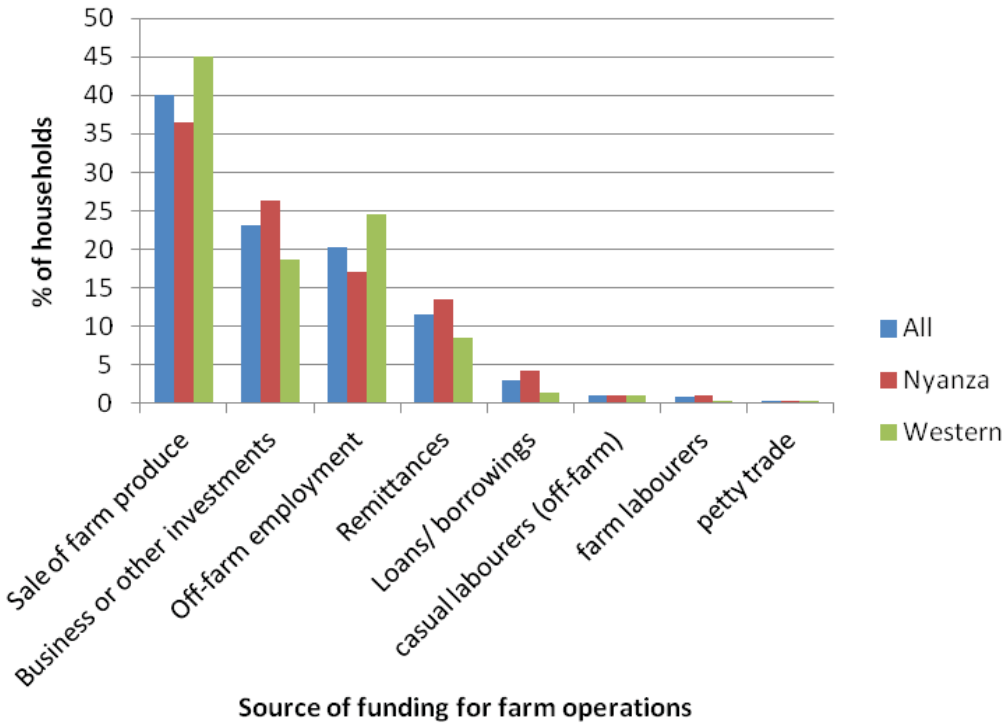

Figure 1. Main source of funding for farm operations (% of respondents).

Land tenure and use

The analysis of results (Table 5) shows that sample respondents in Nyanza, on average, own larger plots of land (2.5 ha) than those in Western (1.4 ha). In addition, respondents in Western rent more land (0.4 ha) for use than in those in Nyanza (0.2 ha). Borrowing land for use is also shown among respondents of Nyanza where respondents acquire up to 0.1 ha for use in the production of annual crops which is not prevalent in Western.

Respondents from Nyanza put a higher proportion of their owned land under annual crop production (1.6 ha) than those from Western (0.9 ha). However, an equal proportion of land is put under perennial crops in Western (0.3 ha) and Nyanza (0.3 ha). Respondents from Nyanza use more land for grazing (0.2 ha), fallow (0.2 ha),

Table 5. Land tenure and use information.

Land tenure	Size (ha)			Annual crops			Perennial crops			Grazing			Fallow			Rented out		
	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE
Land owned	2	2.5	1.4	1.3	1.6	0.9	0.3	0.3	0.3	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0
Rented Land	0.3	0.2	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0
Borrowed	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Land	2.4	2.8	1.8	1.5	1.8	1	0.4	0.4	0.4	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0

NY = Nyanza, WE = Western.

and renting out (0.1 ha) unlike Western respondents who use 0.1 ha for grazing, 0.1 ha on fallow, and 0 ha of land for renting out. About 0.1 ha of rented land is put under annual and perennial crops in both Nyanza and Western.

Household workforce

The household workforce is very crucial in ensuring that farm operations are sustainably undertaken. Results presented in Table 6 reveal that out of an average household size of six in Nyanza and Western, an average of four members form the household workforce. In Nyanza and Western two household members (male and female) in the over 60-year age category work full time on the farm. One household member in the 18-40 category works part time on the farm in Western Province. The results therefore indicate that the household workforce in Nyanza is mostly dominated by the elderly whereas in Western an average of one member works part time on the farm. This may be attributed to the fact that there is a high exodus of younger household members to urban areas in search of off-farm employment.

Ms. Mebo inspecting one of the IR maize cobs in her farm, Kiboswa, Nandi South District.

Table 6. Distribution of household's workforce.

Age category	Total in household			Number working fulltime on the farm			Number working part time on the farm			Number working off farm			Number of able bodied not doing anything			Number of disabled members		
	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE
0–6 years (male)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0–6 years (female)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7–12 years (male)	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7–12 years(female)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13–17 years (male)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13–17 years(female)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18–40 years (male)	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
18–40 years(female)	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41–60 years (male)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41–60 years(female)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Over 60 years (male)	0.2	0.2	1	0.2	0.3	0.1	0	0	0	0	0	0	0	0	0	0	0	0
Over 60 years (female)	0.1	0.2	0.1	0.3	0.4	0.1	0	0	0	0	0	0	0	0	0	0	0	0
Total	3.3	4.4	4.1	0.5	0.6	0.2	1	0	1	0	0	0	0	0	0	0	0	0

Productive assets owned

As depicted in Table 7, analysis of the productive assets shows that there is no variation in the quantities of key productive assets owned by the respondent households in Nyanza and Western. Whereas donkeys are a key productive asset in Nyanza, respondent households in Western don't keep them for production purposes. Most households in both regions perceive most of their productive assets to be working properly (above 65%). The value of the most key productive assets (like irrigation pumps, sprayers work bulls, ox ploughs, and ox carts) kept by respondents in Nyanza is higher than those of Western.

Households decision-making process in farming

The decisions made by the household members are very crucial with regards to the level of success that can be achieved in farming. Results presented in Table 8 indicate that, in both Nyanza and Western, while most decisions (on crops to plant, variety to grow, planting new crops, purchase of farm inputs/household assets, food security coping mechanisms, farm operations, and new agricultural technologies to use) are made jointly by head of household and spouse, the decision on acreage to plant is made by household head alone. The results also show that in most households in Western, more decisions on farming aspects are made jointly by the head and the spouse than in Nyanza.

Table 7. Productive assets owned, status, and value.

Functioning asset	Details	All	Nyanza	Western
Hand hoe	Number owned	3.5	3.8	3.2
	Most working properly (%)	80.10	75.3	87.1
	Total value (Kshs)	1046.3	1135.2	923
Machete (cutlass)	Number owned	1.6	1.6	1.5
	Most working properly (%)	81.50	78.1	86.4
	Total value (Kshs)	397	358.4	327.1
Axe	Number owned	1.1	1.1	1.1
	Most working properly (%)	83.2	79.9	88.4
	Total value (Kshs)	408.6	430.6	376.8
Shovel	Number owned	1.2	1.3	1.5
	Most working properly (%)	80.5	78.1	86.5
	Total value (Kshs)	476.9	513.1	392.6
Ox plough	Number owned	1.1	1.1	1
	Most working properly (%)	83.2	83	85
	Total value (Kshs)	6079.5	6271.5	4573.7
Ox cart	Number owned	1.1	1.1	1
	Most working properly (%)	83.3	83.3	0.0
	Total value (Kshs)	5494.4	6091.7	716.7
Wheelbarrow	Number owned	1.1	1.1	1.1
	Most working properly (%)	72.7	69.3	79.8
	Total value (Kshs)	3289	3442.7	2988.6
Work bull	Number owned	3.1	3.2	2.4
	Most working properly (%)	87.5	87.5	87.5
	Total value (Kshs)	54,918.8	56,487.1	42,111.1
Donkey	Number owned	1.8	1.8	––
	Most working properly (%)	89.5	89.5	–
	Total value (Kshs)	12,487	13,031.8	–
Sprayer	Number owned	1.1	1.2	1.1
	Most working properly (%)	77.4	79.1	75.6
	Total value (Kshs)	2680.2	3667	1756.4
Irrigation pump	Number owned	1	1.0	1.0
	Most working properly (%)	66.7	63.6	75
	Total value (Kshs)	9475	11,909.1	4120

Table 8. Household decision-making process in farming (% of respondents).

	Crops to plant		Acreage to plant		Variety to grow		Planting new crop		Purchase of farm inputs/ household assets		Food security coping mechanisms		Farm operations		New agricultural technology to use	
	NY	WE	NY	WE	NY	WE	NY	WE	NY	WE	NY	WE	NY	WE	NY	WE
Head alone	39.7	25.6	43.0	26.2	38.8	23.8	38.4	23.4	40.7	28.6	38.5	24.6	38.8	24.8	39.3	24.0
Spouse alone	17.2	14.0	15.6	14.0	17.2	13.8	16.8	14.6	15.5	14.6	15.5	13.8	16.2	13.8	14.5	13.4
Jointly (head and spouse)	41.8	59.8	40.0	59.2	42.6	61.8	43.4	61.4	42.4	56.0	44.4	61.0	43.6	60.8	44.7	61.6
Children	1.3	0.6	1.4	0.6	1.4	0.6	1.4	0.6	1.4	0.8	1.6	0.6	1.4	0.6	1.6	1.0

NY = Nyanza, WE = Western

Crop production and marketing

Land allocation and inputs in relation to maize during the long rainy season of 2011

The amount of land allocated to an enterprise has a lot of influence on the level of output that can be achieved in any given season. Results presented in Table 9 show the average amount of land that was allocated to various maize crop varieties by the sample respondents in both Nyanza and Western. More land was allocated to local maize (both sole and intercropped) and hybrid maize (sole and intercropped) in Nyanza than in Western. However, more land was allocated to the production of improved OPV maize (both sole and intercropped) in Western than Nyanza.

Striga infestation rates

According to the analysis of results presented in Table 10, local maize (sole and intercropped) planted by respondents in Nyanza and Western was severely infested by *Striga*. Whereas the hybrid maize intercrop in both regions was severely infested, the extent of infestation on hybrid maize planted as a sole stand was more severe in Western than Nyanza. The extent of infestation on improved OPV maize (sole and intercrop) was more severe in Nyanza than in Western.

Ms. Otiende admires a maize cob in her farm in Kisumu District.

Table 9. Land allocation (ha).

Crop enterprise	Land allocation	All	NY	WE
Local maize, sole	*N*	222.0	168.0	54.0
	Ha	1.6	1.8	1
Hybrid maize, sole	*N*	138	94	4
	Ha	1.4	1.6	1
Improved OPV maize, sole	*N*	26.0	7.0	19.0
	Ha	1.2	1	1.3
Local maize, intercropped	*N*	444	295	149
	Ha	1.6	1.7	1.2
Hybrid maize, intercropped	*N*	376	174	202
	Ha	1.2	1.5	1
Improved OPV maize, intercropped	*N*	43	1	42
	Ha	1.2	1	1.2

N = number of respondents; NY = Nyanza; WE = Western

Table 10. Extent of *Striga* infestation.

Crop enterprise	Extent of Striga infestation (% of respondents)								
	Not infested			Mild			Severe		
	All	NY	WE	All	NY	WE	All	NY	WE
Local maize, sole	10.3	8.8	14.8	37.5	38.2	35.2	52.2	52.9	50.0
Hybrid maize, sole	18.7	16.7	23.3	38.1	33.3	48.8	43.2	50.0	27.9
Improved OPV maize, sole	25.9	0.0	35.0	44.4	42.9	45.0	29.6	57.1	20.0
Local maize, intercropped	8.70	7.30	11.30	46.70	45.70	48.70	44.70	47.00	40.00
Hybrid maize, intercropped	10.2	8.4	11.7	44.3	43.8	44.7	45.6	47.8	43.7
Improved OPV maize, intercropped	25.60	0.00	26.20	46.50	100.00	45.20	27.90	0.00	28.60

NY = Nyanza; WE = Western

Vitalis Kwena in his IR maize field in Busia District.

Table 11. Distribution of households by maize seed type and cropping pattern (%).

Planted seed type/intercropped with	Cropping pattern	All	Nyanza	Western
Local variety retained	Mono	80.3	83	69.2
Local variety purchased	Mono	10.6	8.8	17.9
Purchased hybrid non-*Striga* resistant	Mono	78.6	73.8	88.1
Purchased hybrid *Striga* resistant	Mono	9.5	11.9	4.8
Purchased non-*Striga* resistant OPV	Mono	70.6	50	81.8
Local variety retained	Mono	17.6	33.3	9.1
Local maize	Intercropping with beans	81.9	82.3	81.10
Hybrid maize	Intercropping with beans	88.6	88.8	84.9
Improved OPV maize	Intercropping with beans	97.6	100	97.6

Maize intercrop and planting seed type

As shown in Table 11, most respondents in the two regions intercropped their local maize, hybrid maize, and improved OPV maize with beans. Very few (9.5%) farmers in both regions grew *Striga* resistant maize varieties. It is also evident from the results that most farmers grew several varieties in their farms. Local varieties which is mainly saved seeds is a common practice in both areas.

Level of input use

As shown in Table 12, overall more hybrid seed maize planted as an intercrop was used by respondents than any other seed variety combination. Organic fertilizer was used more with Improved OPV maize (intercropped) than with any other seed variety combination. Inorganic fertilizer was more popular with hybrid seed maize planted as an intercrop.

Larger volumes of insecticides were more commonly used with hybrid seed maize planted as an intercrop as was the case with herbicides.

Households rating 2011 season above average with regard to rainfall

From the analysis of results presented in Table 13, over 25% of respondents perceived the long rain season of 2011 as above average with regards to rainfall/soil moisture in their farms apart from those who planted local maize intercropped with other crops in Western Province.

Total direct production costs

The cost of production is one of the factors that may determine a farmer's continued involvement in farming activities or not. Table 14 shows that respondents from Western Province who grew hybrid and Improved OPV maize (intercropped) invested more in production compared to their Nyanza counterparts. Respondents growing local maize (sole and intercropped) and hybrid maize (sole) in Nyanza invest more in terms of production cost than respondents from Western.

Table 12. Quantity of input used during long rainy season of 2011.

Seed variety and cropping pattern	Quantity of inputs used																	
	Seed (kg)			Organic fertilizer (kg)			Inorganic fertilizer (kg)			Seed (only for intercrop)			Insecticides (lt/kg)			Herbicides (lt)		
	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE
Local maize, sole	6.6	6.7	6.2	34.5	33.9	35.8	23.6	22.9	24.4	–	–	–	5.2	5	6	6	6	–
Hybrid maize, sole	6.2	6.4	5.6	28.9	36.2	19.4	46.3	69.4	25.7	–	–	–	1.5	1.5	–	–	–	–
Improved OPV maize, sole	6.4	6.4	6.4	27.9	24.7	29	33.1	93.0	29.6	–	–	–	12	12	–	11	11	–
Retained/Local maize, intercropped	7.3	7.3	7.4	70	54.8	91.8	19.1	21.5	16.1	7.1	6.3	8.3	4.5	6	3.4	8.8	8.8	0
Hybrid maize, intercropped	13.1	17.8	9.1	139.9	66.4	187.6	47.3	26.9	60.1	11.2	11.8	10.9	10.2	4.9	12.6	17.2	2.3	32
Improved OPV maize, intercropped	6.2	4.5	6.2	173.5	50	178.9	38.8	75	37.6	7.8	4	7.9	6.8	–	6.8	–	–	–

NY = Nyanza; WE = Western

Table 13. Households rating 2011 season above average with regard to rainfall (%).

Seed variety and cropping pattern	All	Nyanza	Western
Local maize, sole	38.2	38.8	36.4
Hybrid maize, sole	31.3	29.7	34.9
Improved OPV maize, sole	48.1	28.6	55.0
Local maize, intercropped	34.2	39.2	24.1
Hybrid maize intercropped	37.0	34.7	38.8

Table 14. Total direct production costs (Kshs).

Seed variety and cropping pattern	All	Nyanza	Western
Local maize, sole	11,903.30	14,311.10	8,403.60
Hybrid maize, sole	11,114.00	12,440.00	8,604.00
Improved OPV maize, sole	14,003.00	10,875.00	14,102.00
Local maize, intercropped	14,013.00	17,724.00	9,626.00
Hybrid maize intercropped	15,755.00	13,792.00	20,168.00

Table 15. Amount of maize harvested (Kg) per acre.

Seed variety and cropping pattern	All	Nyanza	Western
Local maize, sole	226.70	250.6	157.00
Hybrid maize, sole	1,218.00	541.00	2,604.00
Improved OPV maize, sole	401.00	174.00	469.00
Local maize, intercropped	217.00	225.00	200.00
Hybrid maize intercropped	503.00	311.00	661.00
Average maize production (Kg)	513.14	300.32	818.20

Table 16. Quantity of maize sold (Kg).

Seed variety and cropping pattern	All	Nyanza	Western
Local maize, sole	114.00	91.00	221.00
Hybrid maize, sole	2,645.00	195.00	843.80
Improved OPV maize, sole	269.50	–	269.50
Local maize, intercropped	107.00	118.00	95.00
Hybrid maize intercropped	213.40	113.70	291.00

Amount of maize harvested (Kg)

Table 15 shows that maize output for respondents in Western was better than those from Nyanza, except on local maize (sole and intercropped).

Maize marketing during the long rainy season of 2011

The results on marketing aspects presented in Table 16 show that respondents from Western have a higher marketed surplus for most maize produce than those in Nyanza except for those growing local maize (intercropped).

Maize selling price during the long rainy season of 2011

Across the various maize crop varieties and cropping patterns respondents from Nyanza had a better unit price than those in Western during the peak sales month (Table 17).

A limiting constraint to most maize growing respondents in the two areas is the low produce prices, which limits the farmers' willingness to adopt productivity enhancing technologies especially in Nyanza. Results also

showed that technologies not adopted by most respondents due to low produce prices included application of fertilizers and adoption of improved seed varieties.

Proportion of maize grain sold and market place most produce sold

Most respondents in the two areas disposed most of their produce at the local market except for the respondents growing improved OPV maize and Hybrid maize (sole) who disposed most of their produce at the farmgate and to the local consumers, respectively (Table 18).

Total maize output and returns during the long rainy season of 2011

The results presented in Table 15 indicate that respondent households in Western have a higher marketed surplus than those in Nyanza. However, the unit sale price during the peak month of sale is higher for Nyanza respondents than Western. However, for estimation of gross margins, the average unit prices were found to be too low necessitating the correction of unit price to Kshs 2000. On average, most farmers are not breaking even. The inter-province comparison shows that the gross margin for Nyanza respondents is the lowest. The sampled households in both areas are investing more in terms of direct production costs making the net returns dismal. Even though they attract poor produce unit prices during the peak sales month, the higher gross margin for Western respondents is because of higher output per hectare and higher marketed surplus. The lower net revenue for respondents in Nyanza is due to low output per hectare, low marketed surplus, and numerous high direct cost elements (discussed later) even though they attract fairly better produce prices during the peak sales month.

A healthy IR maize crop at Vitalis Kweno Farm, in Busia.

Table 17. Average price per 90-kg bag during peak month (Kshs).

Seed variety and cropping pattern	All	Nyanza	Western
Local maize, sole	286.00	385.00	119.00
Hybrid maize, sole	542.80	799.90	323.20
Improved OPV maize, sole	2,526.50	1,627.00	360.00
Local maize, intercropped	604.00	608.00	591.00
Hybrid maize intercropped	499.50	–	499.50

Table 18. Market place where most grain was sold and proportion.

	Market place where most grain was sold and proportion		
Seed variety and cropping pattern	Local market	Local consumers	Farmgate
Local maize, sole	65.90%		–
Hybrid maize, sole	–	47.10%	–
Improved OPV maize, sole	–	–	50.00%
Local maize, intercropped	70.80%	–	–
Hybrid maize intercropped	50.00%	–	–

Production of other crop enterprises

The level of production of other crop enterprises greatly determines the level of resources that can be allocated for the production of maize. The results presented in Table 16 indicate that sample respondents in Nyanza obtain higher productivity per hectare of land planted with other crops than respondents from Western. This may likely determine the amount of land respondents in both regions allocate to the production of maize.

Access and control over resources

Gender access to resources

As depicted in the analysis of results shown in Table 17 and according to a high proportion of sampled respondents, women have equal access with men to natural, human, financial, physical, and social capital. In Nyanza a high proportion of sampled respondents indicate that women have less access than men compared with the proportion in Western. On the other hand, a high proportion of respondents in Western indicate that women have equal access to resources compared with the proportion in Nyanza.

Gender involvement in activities and practices

A higher proportion of respondents in both regions indicated that there was equal involvement of men and women in all farm activities and practices (Table 18). However, the proportion of respondents in Western was higher compared with those in Nyanza.

Striga extent, severity, and control technologies

Main production constraints

The results presented in Table 19 show that the key production constraints in order of importance to the sampled respondents were *Striga* menace, other weeds, termites, storage insects, lack of fertilizers, stemborer, low and erratic rainfall, lack of herbicide, and lack of pesticides. While other weeds and low and erratic rainfall constraints were felt more by the respondents of Nyanza, stemborer, lack of fertilizer, lack of herbicides, and lack of pesticides were felt more by the respondents of Western.

Table 19. Net returns from maize production.

	All	Nyanza	Western
Average maize sales (kg)	187.95	129.43	398.60
Number of bags (90 kg) harvested	2.09	1.44	4.43
Average unit sale price during peak month of sale (Kshs)	596.60	854.98	342.44
(Unit price correction)	2000.00	2000.00	2000.00
Revenue from maize production	4180.00	2880.00	8860.00
Total direct cost (Kshs)	5632.95	5622.11	5647.98
Gross margin (revenue—total direct costs)	(1452.95)	(2742.11)	3212.00

A large and almost equal proportion of respondents in the two regions perceived *Striga* as a highly severe constraint. Though the respondents in both areas perceived the other constraints as severe, more respondents in Western felt that these constraints were severe. A higher proportion of respondents in Nyanza saw the stemborer constraint as severe compared with those in Western.

Sample respondents from Nyanza have experienced the *Striga* menace in their farms for longer (about 14 years) than those from Western (about 10 years).

Extent and severity of the *Striga* problem

As illustrated in the results presented in Table 20, sample respondents from Nyanza allocate more land to maize enterprises than those from Western. A big proportion of respondents' land under maize is currently infested by *Striga*. The level of infestation is higher in Nyanza than Western. Respondents growing local maize (sole and intercropped), hybrid maize (sole and intercropped), and improved OPV maize (sole) in Nyanza have about 50% of their land infested by *Striga*. On the other hand, sample respondents growing improved OPV maize (intercropped) in Western have about 50% of their land infested by *Striga*.

Striga control measures used by the households

Among the sample respondents growing maize in both regions, the *Striga* control measure of choice is uprooting. Over 80% of respondents growing local maize (sole) and hybrid maize (sole and intercropped) uproot *Striga* weed from their farm in both regions (Table 21). More respondents growing improved OPV maize (sole and intercropped) uproot *Striga* from their maize crop in western than in Nyanza. However, more respondents planting local maize (intercropped) in Nyanza uproot *Striga* from their farms.

Awareness of *Striga* control technologies and current use status

Use of farm yard manure

About 50% of respondents in both regions are aware of this technology and are currently using it. Respondents from Western report higher associated maize yield per ha than those in Nyanza (404 to 217). Respondents from Nyanza have been aware of the technology for the last 14 years and have been using it for the last 11 years compared to those in Western who have been aware of it for the last 10 years and used the technology for the last eight years. Above 50% of respondents in Nyanza source information on farmyard manure technology from ASK shows, the Farmer Training Centre (FTC), local NGOs, farmer-based organizations (FBOs), and farmers from within the village. On the other hand, above 50% of respondents using farmyard manure source information from research institutes, government extension workers, mass media, farmers from within the village, and farmers from other villages. Over 50% of respondents in Nyanza received information through demonstration on farmyard manure usage from local NGOs, research institutes, at ASK shows, and FTCs. In contrast, over 50% of respondents from Western received information through demonstrations from mass media, government extension workers, FBOs, research institutes, farmers from within the village, and farmers from outside the village. About 50% of respondents in the two regions perceive it as most effective relative to traditional control methods.

Table 20. Land allocation for other crop enterprises.

Crop	Yield/ha All	Yield/ha Nyanza	Yield/ha Western
	Mean	**Mean**	**Mean**
Sorghum	1.6	1.3	2.7
Yield per hectare obtained	103.1	116.7	66.8
Millet	0.5	0.7	0.3
Yield per hectare obtained	136.8	158.2	109.8
Rice	1.4	1.5	0.1
Yield per hectare obtained	7304.7	7861.2	70
Groundnut	2.1	1.2	3.1
Yield per hectare obtained	107	67.2	152.8
Sweetpotato	10.5	24.1	1.4
Yield per hectare obtained	86.8	108.6	72.9
Soybean	0.4	0.4	0.3
Yield per hectare obtained	65.5	42.8	73.9
Cassava	0.9	1.4	0.6
Yield per hectare obtained	168.6	209.4	143.2
Kale/*sukuma wiki*	0.9	1.3	0.7
Yield per hectare obtained	128.2	55.9	166.7
Cabbage	0.1	0	0.1
Yield per hectare obtained	91	150	76.2
Indigenous/local vegetables			
Yield per hectare obtained	77.6	39.6	91.6
Onion	2.1 (9.4)	2.5 (10.53)	0.3
Yield per hectare obtained	22.1	23.1	18.7
Tomato	4	5	0.3
Yield per hectare obtained	149.6	152.7	140.5
Watermelon	1.1	1.1	–
Yield per hectare obtained	155	155	–
Eggplant	0	–	0
Yield per hectare obtained	1000	–	1000
Cotton	1.1	1.3	0.1
Yield per hectare obtained	187.6	231.1	13.5
Others	2.5	5.1	0.6
Yield per hectare obtained	60,348.7	140,000	468
Overall average output per hectare (Kg)	2097	2786	208.125

Table 21. Level of access to resources by men and women.

Resource	Access to resources by women			Level of access by women as well as men (% of respondents)								
				More than men			Equally with men			Less than men		
	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE
Natural capital (land areas and tenure)	78.2	78.2	78.1	7.9	6.5	9.8	44.5	41	50	47.6	52.7	40.6
Human capital (labor)	11.3	13	9	11	9.1	14	59.2	55	65	29.8	36.3	21.2
Financial capital (cash, credit)	85.5	85.0	86.2	8.1	7.3	9.3	54.9	49.9	61.9	36.9	42.8	28.9
Physical capital (housing quality, consumer durables)	83.2	81.2	85.9	9.7	7.4	13	52.9	45	63	37.4	47.7	23.9
Social capital (social networks and associations)	85.5	84.8	86.5	25.4	24.4	26.7	51.3	46.1	58.4	23.3	29.5	14.9

NY = Nyanza; WE = Western.

Use of hand pulling

About 57% of the respondents in Nyanza are aware of and using the technology currently as compared to about 43% of respondents in Western. The associated maize yield per ha is higher for Nyanza respondents compared to respondents in Western (617 to 484). While respondents in Nyanza have been aware of the technology for 16 years and used it for the last 14 years, those in Western have been aware of it for 11 years and used it for the last nine years. Over 50% of respondents in Nyanza received information on the technology from government extension workers, local NGOs, FBOs, mass media, and farmers within the village. On the other hand, over 60% of respondents from Western received information on hand pulling technology from FTCs, research institutes, and farmers from other villages. For about 50% of the respondents in Nyanza, demonstrations on the technology were conducted by farmers from the village, government extension workers, local NGOs, FBOs, and FTCs. For about 50% of the respondents in Western demonstrations were conducted by FTCs, FBOs, research institutes, and farmers from other villages. About 64% of the respondents in Western perceive the technology as the most effective relative to traditional control methods compared to about 48% of respondents in Nyanza who consider it moderately effective.

Use of inorganic manure

About 57% of the respondents in Nyanza are aware of and currently using the technology compared to about 42% of respondents in Western. The associated maize yield per ha is higher for Western respondents compared to respondents in Nyanza (268 to 490). While respondents in Nyanza have been aware of the technology for about five years and used it for the last three years, those in Western have been aware of it for 12 years and used it for the last 11 years. Over 50% of respondents in Nyanza received information on the technology from FBOs, mass media, FTCs, farmers from other villages, and farmers within the village. On the other hand, over 60% of respondents from Western received information on inorganic fertilizer technology from research institutes, local NGOs, government extension workers, and farmers from other villages. For over 50% of the respondents in Nyanza, demonstrations on the technology were conducted by farmers from the village, local NGOs, and FBOs. For over 50% of the respondents in Western, demonstrations were conducted by research institutes, government extension workers, farmers from the village, and farmers from other villages. About 88% of the respondents in Nyanza perceive the technology as the most effective relative to traditional control methods compared to about 63% of respondents in Western who consider it moderately effective.

The awareness level on other *Striga* control technologies like IR maize is less than 5% and the current use level among respondents who are aware of it is about 20% except for crop rotation with a use level of about 74%. About 50% of respondents who are aware of them have never adopted them.

Reasons for non-adoption of *Striga* control technologies

Table 22 presents the results indicating that the main reason for non-adoption of *Striga* control technologies is lack of adequate information about the technology even though farmers are aware of them; this is followed by the high cost of the technology, non-availability of improved seed (*Striga*-resistant varieties), and fear of technology failure.

Vulnerability, capital assets, and livelihoods

Food self-sufficiency

One of the primary aims of food production is to ensure food self-sufficiency. The results presented in Table 23 reveal that a good proportion of the sampled respondents (34.4%) are food self-sufficient for less than six months in a year. By region the proportion of respondents is higher for Nyanza compared to Western. By region, a higher proportion of sampled respondents (37.5% to Western's 30%) are food self-sufficient.

Table 22. Level of participation by men and women in farm activities and practices.

Activity	Only women involved		Level of involvement of women as well as men (%)												
			Women more than men			Equal involvement			Women less involved			Women not involved			
	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE
Attending field demonstration	4.3	4.0	4.7	31.6	31.6	31.5	42.3	40.3	44.9	16.7	20.4	11.6	5.2	3.6	7.3
Ploughing farmlang	1.9	1.4	2.4	21.1	18.1	25.4	41.3	42.4	39.8	25.9	30.7	19.1	9.8	7.3	13.4
Planting crops	2.0	1.4	2.8	35.4	37.6	32.3	56.9	55.6	58.8	4.9	5.0	4.7	0.8	0.3	1.4
Weeding crops	2.9	2.0	4.3	40.6	45.4	33.9	52.4	49.1	57.0	3.5	3.2	4.1	0.5	0.3	0.8
Harvesting crops	2.3	2.2	2.4	37.7	42.7	30.6	56.4	51.9	62.7	3.2	2.9	3.7	0.4	0.3	0.6
Postharvesting crops	4.9	6.1	3.2	41.7	48.3	32.5	47.6	40.6	57.4	5.2	4.8	5.9	0.6	0.3	1.0
Sale of farm produce	3.9	3.2	4.9	35.6	37.3	33.3	50.0	49.3	51.0	9.4	9.1	9.8	1.1	1.2	1.0
Off-farm activities	2.04	1.16	3.26	17.32	18.78	15.27	44.99	42.07	49.08	31.15	33.62	27.70	4.50	4.37	4.68
Learning improved agricultural technologies	1.90	1.22	2.86	26.70	27.81	25.10	48.70	43.92	55.10	20.30	24.32	14.90	2.40	2.74	2.04
Adaptive trials of improved agricultural technologies	2.11	1.20	3.30	24.82	26.30	22.90	48.68	45.30	53.20	22.11	24.90	18.40	2.28	2.30	2.30
Training other farmers on improved agricultural technologies	2.00	0.60	3.90	23.70	26.40	20.10	45.80	41.90	51.00	24.80	26.40	22.60	3.60	4.60	2.30

NY = Nyanza; WE = Western.

Table 23. Distribution of respondents by main production constraints and level of severity.

Constraint	% of respondents experiencing constraint			Level of severity									Number of years as constraint on the farm		
				Highly severe			Severe			Less severe					
	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE
Striga as a production constraint	93.0	92.9	93.1	46.3	45.3	47.8	36.9	38.4	34.7	16.8	16.3	17.6	12.94	14.29	10.95
Stem borer	36.6	31.1	44.2	31	31.3	30.7	41.2	42.5	39.9	27.8	26.2	29.4			
Termites	44.2	44.0	44.6	29.3	31.8	25.8	48	46.4	50.2	22.8	21.9	24.0			
Storage insects	44.2	44.0	44.6	29.3	31.8	25.8	48	46.4	50.2	22.8	21.9	24.0			
Low and erratic rainfall	36	43.3	25.8	23.3	26.1	16.5	56.1	55.3	57.9	20.6	18.6	25.6			
Water logging (flooding	21.4	24.8	16.6	38.6	39.6	36.2	43.8	40.8	50.0	17.7	19.5	13.8			
Lack of improved seeds	34.9	34.8	35.0	28.1	30.1	25.4	57.5	56.3	59.2	14.3	13.5	15.4			
Lack of fertilizer	42.5	37.0	50.2	29.6	35.0	24.1	53.4	48.4	58.5	17	16.7	17.4			
Lack of herbicide	28.6	25.8	32.6	23.5	28.7	17.8	51.2	48.0	54.8	25.3	23.4	27.4			
Lack of pesticide	28.7	24.2	35.0	23.9	27.7	20.5	49.1	48.4	49.7	27	23.9	29.8			
Other weeds as production constraints	82.0	83.8	79.1	33.3	31.6	36.4	54.4	49.1	63.6	12.2	19.3	0.0			

NY = Nyanza; WE = Western.

Table 24. The extent and severity of *Striga* constraint in maize crop enterprises.

Crop	Area usually under maize			Proportion of land infested by Striga (%)					
				Now			Past two years		
	All	NY	WE	All	NY	WE	All	NY	WE
Local maize, sole	1.6	1.7	1.3	45.6	48.1	39.4	41.8	41.4	42.6
Hybrid maize, sole	1.2	1.5	0.5	48.2	49.8	45.3	44.7	39.9	53.6
Improved OPV maize, sole	1.8	6	1.1	36.6	52.5	33.9	41.1	40.5	41.2
Local maize, intercropped	1.4	1.6	1	50.9	52	48.1	48.2	47.8	49.1
Hybrid maize, intercropped	1.2	1.5	0.5	48.2	49.8	45.3	44.7	39.9	53.6
Improved OPV maize, intercropped	1.1	1.5	0.7	48.6	42.6	54.2	44.4	40.9	47.8

NY = Nyanza; WE = Western.

Access to financial capital

As shown in Table 24, the key financial capital accessed by most households is cash savings at home followed by remittances, informal credit, and cash savings at the bank. There is no major variation in the sampled respondents' level of access of each type of financial capital in the two regions.

Livestock ownership

The results presented in Table 25 show that respondents from Nyanza keep a higher number of most livestock types than respondents from Western. However, it is noted that respondents from Western keep a higher number of livestock like pigeons, rabbits, and donkeys. The unit value of livestock kept by sample respondents in Nyanza is higher than those in Western, leading to a higher total value of livestock owned for respondents from Nyanza.

Access to physical infrastructure/capital

The two regions are variously endowed with physical infrastructure/capital. According to the results presented in Table 26, most respondents in the two areas access water from the lake/stream/river, rainwater, boreholes, wells, and springs. Conspicuously, a higher proportion of respondents in Nyanza rely on borehole water while a higher proportion from Western relies on springs and rainwater.

The majority of respondents (over 80%) in the two regions access pit latrines as a form of toilet. For house lighting and cooking, most (over 90%) use paraffin and firewood. Other infrastructure accessed by most respondents (over 50%) across the regions include health centers, bicycles, mobile phones, own house, corrugated iron roof sheet, and mud and pole wall.

Access to human capital

From the results presented in Table 27, the proportion of sampled households accessing information on various introduced agricultural technologies is very low. The proportions of sample respondents who access information in Western obtain it from government extension workers while those in Nyanza mostly from NGOs/projects. A small percent of households in both areas obtain information from private agents.

Household income

From the results presented in Table 28, a higher proportion of respondents from Western are involved in maize production and have higher revenue from maize per year than respondents from Nyanza. However, a higher proportion from Nyanza perceive maize production as a stable source of income than those from Western. While a higher proportion of respondents from Western are involved in the production of other crops and wage employment, a higher proportion of respondents from Nyanza are involved in livestock keeping. Respondents from Western receive higher revenues from other crops, livestock, and wage employment per year than those from Nyanza. However, a smaller proportion of respondents feel that other crops, livestock keeping, and wage employment is a stable source of income than those from Nyanza.

Table 25. Distribution of respondents by *Striga* control measures.

	Striga control measure used (%)																							
	Uprooting			Burning			Manuring			Crop rotation			Intercropping			Push pull			IR maize			Others		
Crop	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE	All	NY	WE
Local maize, sole	86.5	86.8	85.7	1.6	1.7	1.4	8.6	7.5	11.4	0.8	1.1	0.0	0.4	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.9	0.0
Hybrid maize, sole	85	82	92	1.9	3.1	0	7.8	11	2.6	1	1.5	0	0	0	0	0	0	0	0	0	0	3.9	3.1	5.3
Improved OPV maize, sole	86.7	50.0	92.3	0.0	0.0	0.0	13.3	50.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local maize, intercropped	100	66.7	33.3	100	50	50	100	81.4	100	75	25	100	100	100	0.0	100	0.0	100	0.0	0.0	0.0	100	90.0	10
Hybrid maize, intercropped	85.4	81.5	92.1	1.9	3.1	0.0	7.8	10.8	2.6	1.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	3.1	5.3
Improved OPV maize, intercropped	77.0	65.8	86.7	1.8	3.2	0.6	14.0	19.4	9.4	0.9	1.9	0.0	2.4	4.5	0.6	0.9	1.3	0.6	0.6	1.3	0.0	2.4	2.6	2.2

NY = Nyanza; WE = Western.

Table 26. Distribution of respondent households by reason for non-adoption of technology.

Reason for non-adoption	% of respondents			Rank
	All	NY	WE	
Lack of adequate information about the technology	43.05	41.1	45.0	1
Fear of technology failure	20.95	16.5	25.4	4
High cost of technology	30.55	23.1	38.0	2
Non-availability of improved seed (*Striga*-resistant varieties)	24.3	17.0	31.6	3
Others (e.g., cultural factors)	7.05	6.7	7.4	5

NY = Nyanza; WE = Western.

Table 27. Annual food self-sufficiency.

No. of months	% distribution of households by duration of food self-sufficiency (months)		
	All	Nyanza	Western
None	3.1	4.9	8.4
1–3 months	34.4	37.5	30.0
4–6 months	28.6	30.1	26.6
7–9 months	18.9	15.2	24.2
10–12 months	11.7	12.3	10.8

Table 28. Level of households' financial capital access.

Type of financial capital	% distribution of households by type of financial capital accessed		
	All	Nyanza	Western
Cash savings at the bank	21.3	21.5	21.0
Cash savings at home/pocket	65.5	62.3	70.0
Claim of good debtors	17.3	20.6	12.6
Jewellery	2.3	2.6	2.0
Formal credit	10.9	10.7	11.2
Informal credit	27.9	27.8	28.0
Cash remittances from relatives/friends	37.4	38.4	36.0
Others	11.4	12.8	9.4

Household non-farm income

The results presented in Table 29 show that a higher proportion of respondent's household members are engaged in non-farm income in Nyanza than Western. However, for most non-farm income activities performed, respondent households in Western obtain a higher amount of money per year than those in Nyanza. The proportion of respondent households who perceive these activities as stable source of income is higher in Nyanza than Western. The sample respondents from Western obtain a higher overall non-farm income per year than sampled respondents from Nyanza.

Opportunities and constraints affecting maize production

The analysis of opportunities and constraints affecting maize production in this study was done in two ways; First through assessment of household livelihood assets and second through studying the factors affecting maize production.

Table 29. Average number of livestock kept by households and their value.

	Whole sample		Nyanza		Western	
Livestock	Mean	Valid N	Mean	Valid N	Mean	Valid N
Dairy cattle	2.2		3.2		1.9	
Average price/unit (Ksh)	5106.6	106.0	29,252.2	23.0	23,957.8	83.0
Local cattle	3.8	703.0	4.4	431.0	3	272.0
Average price/unit (Ksh)	14,023	681.0	14,063.8	418.0	13,958.2	263.0
Dairy goats	3.4	33.0	3.6	16.0	3.2	17.0
Average price/unit (Ksh)	11,363.6	33.0	12,275	16.0	10,505.9	17.0
Local goats	3.7	387.0	4	302.0	3	85.0
Average price/unit (Ksh)	3599.9	374.0	3640.6	293.0	3452.8	81.0
Sheep	4.3	269.0	4.7	213.0	2.8	56.0
Average price/unit (Ksh)	3016	260.0	3129.3	205.0	2593.6	55.0
Chicken	10.6	1,002.0	10.8	580.0	10.4	422.0
Average price/unit (Ksh)	395.8	1,002.0	390.9	580.0	402.6	422.0
Rabbits	9.1	17.0	11.9	9.0	5.9	8.0
Average price/unit (Ksh)	658.6	14.0	324.3	7.0	992.9	7.0
Pigeon	7.5	11.0	7.4	9.0	7.5	2.0
Average price/unit (Ksh)	165	10.0	168.8	8.0	150	2.0
Donkeys	1.9	21.0	1.8	20.0	5.0	1.0
Average price/unit (Ksh)	8294.7	19.0	8533.3	18.0	4,000.0	1.0
Horses	8	2.0	6.0	1.0	10.0	1.0
Average price/unit (Ksh)	500.0	1.0	500.0	1.0	–	–
Guinea fowl	1.0	2.0	–	–	1.0	2.0
Average price/unit (Ksh)	3250	2.0	–	–	3250	2.0
Ducks	73.8	57.0	120.7	34.0	4.5	23.0
Average price/unit (Ksh)	671.9	53.0	600	32.0	781.4	21.0
Pigs	2.2	58.0	4.2	8.0	1.8	50.0
Average price/unit (Ksh)	3490.2	57.0	3037.5	8.0	3564.1	49.0
Total value of livestock owned (Ksh)	75,488.5	1122.0	100,000	651.0	40,956.7	471.0

Result of multiple linear regression analysis

Maize output was regressed with the quantity of land, labor, maize seeds planted, fertilizer, and agrochemicals. An econometric model was used to analyze the effect of production input on maize output. Production of maize was explicitly expressed as a function of the inputs. The econometric model is explicitly specified as follows:

$Y= \beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\beta5X5+\mu$ (1) Where Y = maize output in kilograms

$\beta0$ = constant factor

X1 = land under cultivation

X2 = total number man-hours of labor

X3 = quantity of maize planted in kilograms

X4 = quantity of fertilizer in kilograms

X5 = quantity of agrochemicals used in liters

Bi = estimates of the coefficients with (i = 1, 2…5)

μ = an error term measuring variation in maize output unaccounted for by independent variable.

The estimates of the coefficient βi were estimated for the effect of the variable on changes in maize output. A positive βi was found for variables associated with the increased maize output and negative βi (i = 1, 2…5) was found when a variable is associated with the decrease in maize output.

The estimate of the coefficient (βi) for the quantity of inorganic fertilizer used was positive and had a significant coefficient at 1% level of significance. The implication of this result is that any unit increase in the quantity of inorganic fertilizer will increase maize output by the value of their estimated coefficients. This is similar to findings by Godwin et al. (2008). Table 30 shows the details of the model. The result shows that a unit increase in the usage of fertilizer increases maize output.

Integrated *Striga* management demonstration plot in Teso District.

Table 30. Level of access to physical infrastructure.

		% household access distributed by region		
Physical infrastructure/capital	Specific	All	NY	WE
Water supply	Piped	3.9	4.4	3.4
	Public tap	6.45	8.9	4.0
	Borehole	31.55	35.7	27.4
	Well/spring	24.65	19.9	29.4
	Rain water	28.15	25.9	30.4
	Vendor/tanker truck	1.85	2.9	0.8
	River/lake/stream	51.15	52.3	50.0
	Others	1.25	1.7	0.8
Toilet facility	Flush toilet	1.85	2.1	1.6
	Pit latrine	89.6	83.0	96.2
	Bush	8.5	14.6	2.4
	Others	1.05	1.7	0.4
Type of lighting for house	Electricity	4.2	5.6	2.8
	Paraffin or kerosene Lantern	96	94.8	97.2
	Candles	4.5	3.2	5.8
	Torch	5	6.0	4.0
	Firewood	3.35	2.7	4.0
	Solar	2.15	2.7	1.6
	Gas	0.15	0.1	0.2
	Others	0.25	0.3	0.2
Cooking fuel	Firewood	94	93.4	94.6
	Charcoal	28.8	30.4	27.2
	Electricity	0.8	1.0	0.6
	Paraffin or kerosene	3.4	4.0	2.8
	Gas	0.4	0.6	0.2
	Others	0.15	0.1	0.2
Health center/hospital		84.75	87.7	81.8
Own vehicle		4.25	5.3	3.2
Own motorcycle		6.75	8.3	5.2
Own bicycle		45.5	44.4	46.6
Telecommunication (mobile phone, others)		73.25	73.5	73.0
Own house		83.55	80.7	86.4
Renting a house		6.5	7.2	5.8
House roof	Thatched	18.35	12.3	24.4
	Corrugated iron sheets/Aluminum sheets	82.8	86.4	79.2
	Asbestos	0.2	0.4	0.0
	Tiles	0.35	0.7	0.0
	Concrete	0.7	1.0	0.4
	Others	0.05	0.1	0.0
House wall	Thatched	4.2	1.6	6.8
	Mud and poles	79.8	79.2	80.4
	Raw bricks	1.55	1.1	2.0
	Burnt bricks with mud	8.25	8.9	7.6
	Cement blocks	6.35	8.3	4.4
	Stone	0.55	0.7	0.4
	Others	1.15	1.9	0.4

Table 31. Households' access to human capital.

Technology on which advice received	Source	% household access to information on technologies distributed by source			Distributed by number of times/ visits in 2011		
		All	NY	WE	All	NY	WE
Improved maize varieties	Public (Govt. etc)	11.2	9.6	12.8	3	4	2
	NGOs/Projects	8.65	9.5	7.8	2	2	2
	Private agents	2.5	3.6	1.4	2	2	2
Improved cowpea varieties	Public (Govt. etc)	4.2	3.0	5.4	2	2	2
	NGOs/Projects	3.65	3.3	4.0	2	2	2
	Private agents	1.05	2.1	0.0	1	2	-
Control of *Striga*	Public (Govt. etc)	8.1	6.6	9.6	2	2	2
	NGOs/Projects	5.95	7.3	4.6	2	2	2
	Private agents	3.3	4.0	2.6	2.5	3	2
Control of other weeds	Public (Govt. etc)	5.4	4.2	6.6	2	2	2
	NGOs/Projects	4.1	4.0	4.2	2	2	2
	Private agents	2.1	3.0	1.2	2	2	2
Soil fertility management	Public (Govt. etc)	7.6	7.4	7.8	1.5	2	1
	NGOs/Projects	6.45	7.3	5.6	2	2	2
	Private agents	1.8	2.4	1.2	1	1	1
Improved food grain storage	Public (Govt. etc)	4.25	3.3	5.2	1.5	2	1
	NGOs/Projects	3.6	3.6	3.6	2	3	1
	Private agents	1.1	1.4	0.8	0.5	1	-
Collective product marketing	Public (Govt. etc)	3.7	3.0	4.4	2	2	2
	NGOs/Projects	3.5	3.6	3.4	1.5	2	1
	Private agents	0.95	1.1	0.8	1	2	-
Livestock management	Public (Govt. etc)	5.45	5.3	5.6	2	2	2
	NGOs/Projects	4.45	4.7	4.2	5	7	3
	Private agents	1.6	2.0	1.2	3	3	3

Table 32. Household farm income.

Enterprise		All	Nyanza	Western
Maize production	Proportion of households members involved in maize production	44.90%	40.10%	49.50%
	Amount from maize production per year (Ksh)	20,225.5	16,060.5	23,553.8
	Proportion of households reporting production of maize as stable source of income	17.90%	23.1%	13.4%
Other crops production	Proportion of households members involved in production of other crops	37.00%	33.8%	40.9%
	Amount from other crops production per year (Ksh)	27574.2	25749.8	51008.9
	Proportion of households reporting production of other crops as stable source of income	19.70%	26.8%	10.6%
Livestock keeping	Proportion of households members involved in livestock keeping	41.20%	43.2%	38.9%
	Amount from livestock keeping per year (Ksh)	16471.2	11773	22065.8
	Proportion of households reporting livestock keeping as stable source of income	20.30%	27.4%	11.6%
Agricultural wage employment	Proportion of households members involved in agricultural wage employment	24.40%	23.9%	25.0%
	Amount from agricultural wage employment per year (Ksh)	16436.1	12352	20265
	Proportion of households reporting agricultural wage employment as stable source of income	5.90%	8.9%	2.3%
	N	155	75	80
	Total farm income (Ksh)	38779.1	30156.5	48600.7

Table 33. Household non-farm income details.

Source		All	Nyanza	Western
Non-agricultural wage	Proportion of household members involved	26.2	27.9%	24.2%
	Amount obtained per year (Ksh)	45,929.9	44,886.7	47,132.6
	Proportion of households reporting it as stable source of income	24.5	33.6%	12.5%
Petty trade	Proportion of household members involved	29.4	29.6%	29.1%
	Amount obtained per year (Ksh)	32,917.5	32,169.9	33,851.9
	Proportion of households reporting it as stable source of income	18.5	21.7%	14.2%
Handicrafts	Proportion of household members involved	6	8.5%	2.8%
	Amount obtained per year (Ksh)	20,835.4	14,657.5	51725
	Proportion of households reporting it as stable source of income	14.5	14.6%	14.3%
Transport service	Proportion of household members involved	11.3	12.1%	10.5%
	Amount obtained per year (Ksh)	42,879.4	65,377.5	28,364.5
	Proportion of households reporting it as stable source of income	17.2	20.0%	14.3%
Grain mills	Proportion of household members involved	10.3	3.8%	16.1%
	Amount obtained per year (Ksh)	7203.9	20,416.6	3600.4
	Proportion of households reporting it as stable source of income	57.9	30.8%	72.0%
Fishing	Proportion of household members involved	6.2	10.7%	1.0%
	Amount obtained per year (Ksh)	40,493.1	45732	7750
	Proportion of households reporting it as stable source of income	17.9	21.2%	.0%
Hunting and gathering of wild food	Proportion of household members involved	2.4	3.8%	1.0%
	Amount obtained per year (Ksh)	45,000	4,5000	.
	Proportion of households reporting it as stable source of income	0	0	0
Selling fuelwood and charcoal	Proportion of household members involved	15.4	20.1%	9.8%
	Amount obtained per year (Ksh)	15,689.3	18,477.5	8718.75
	Proportion of households reporting it as stable source of income	9.4	10.9%	5.6%
Selling prepared food/drinks	Proportion of household members involved	6.4	6.3%	6.5%
	Amount obtained per year (Ksh)	24,146.7	30,105.7	12,228.6
	Proportion of households reporting it as stable source of income	10.8	13.0%	7.1%
Professional work	Proportion of household members involved	14	14.1%	13.8%
	Amount obtained per year (Ksh)	120,000	134,870	91,640
	Proportion of households reporting it as stable source of income	48.6	58.1%	33.3%
Traditional medicine	Proportion of household members involved	3.3	6.4%	.0%
	Amount obtained per year (Ksh)	6792.3	6792.3	
	Proportion of households reporting it as stable source of income	12.5	15.0%	.0%
Rent income	Proportion of household members involved	6	5.6%	6.3%
	Amount obtained per year (Ksh)	52,078.3	40,046.2	67720
	Proportion of households reporting it as stable source of income	31.4	34.8%	25.0%
Remittances	Proportion of household members involved	29.6	28.7%	30.7%
	Amount obtained per year (Ksh)	18,850	18,598.3	19,140.4
	Proportion of households reporting it as stable source of income	12.6	16.3%	8.3%
Other non-farm income	Proportion of household members involved	30.4	28.9%	33.3%
	Amount obtained per year (Ksh)	57,170.2	67,960	38,129.4
	Proportion of households reporting it as stable source of income	24.5	35.5%	5.6%
Total non-farm Income (Ksh)		50,469.4	52,967.3	47,353.1
Total income (farm and non-farm income) (Ksh)		64,592.5	59,471.5	71,024.7

Table 34. Linear regression results for the determinants of maize production.

Variable	Coefficient	Standard error	t-ratio	P[|T|>t]	Mean of X|
Constant	5.07998	0.58019	8.756***	.0000	
Amount of maize planted	0.000388	0.0004324	0.897	0.3704	–12.1306
Amount of organic fertilizer used	–0.0000221	0.0000858	–0.257	0.7972	–463.853
Amount of inorganic fertilizer used	0.000284	0.0001119	2.532**	0.0118	–447.523
Amount of insecticides used	0.00005905	0.000148	0.397	0.6916	–170.18
Amount of herbicides used	–0.000487	0.000515	–0.945	0.3455	–986.514
Household family labor input	0.000000606	0.0000231	0.026	0.9791	1567.673

Significance levels: * = $P < 0.1$, ** = $P < 0.05$, and *** = $P < 0.01$.

IR seed maize pack.

Conclusion and Recommendations

Conclusion

The study concludes that most maize farmers are relatively literate and have the ability to receive, decode, and understand any relevant information to make innovative decisions on *Striga* control technologies. Land acquisition for maize production in the study area is mainly through inheritance hence most households can make major long-term investment decisions touching on the management of *Striga* on their farms. Most maize farmers are small-scale farmers and are likely to prefer improved *Striga* management measures that do not attract high investment costs. They obtain low output per hectare from their farms as a result of the heavy infestation of *Striga* on a large proportion of their land and the low adoption rate of improved management practices. Most maize farmers used local varieties of maize for their production which is one of the contributing factors to susceptibility and loss to *Striga.* Hence for sustainable management of *Striga*, improved land management practices and use of improved seed varieties are some of the key measures that may help to reduce the high level of *Striga* prevalence among the sampled respondents.

The aim of this study was to produce information necessary for the detection of important constraints to IR maize technology adoption and assess the extent of use of IR maize and other *Striga* control technologies. Structured questionnaires were used for data collection. Data were collected in 12 districts, 32 villages, and 1198 households using a multi-stage random sampling strategy. A random sample of 100 farm households was drawn from each district. The households were identified using GPS coordinates. Data analyses included descriptive statistics and econometric models. The summary of major findings is as follows.

- The proportion of male-headed households was lower among the respondents in Nyanza than Western. Out-migration and other incidences like HIV/AIDs prevalent in Nyanza may be some of the contributory factors to the presence of more female-headed households. Since the social issues surrounding female and male-headed households may be not be the same, there is need to consider targeting strategies that ensure that both kinds of households embrace appropriate *Striga* management practices to ensure that its spread is contained within the communities.
- Household land holdings were found to be small. Annual crops, especially maize, consumed the largest part of household land allocation. It was also found that there is a practice of land borrowing in Nyanza and more of land renting in Western. However, the big question remains on whether there is any connection between land borrowing and *Striga* spread!
- Household members over 60 years of age are the ones working mostly full time on the farm. There is a need to develop targeted interventions so as to ensure that adoption of *Striga* control measures is sustainable. Some of the elderly farmers may not be able to undertake all the necessary *Striga* control operations. Targeting the youth too in the same breath with *Striga*-related messages will enhance the overall benefits accruing from *Striga* management to the households.
- More women than men belong to and participate in the leadership of social groups. In addition most household members belong to women groups, development committees, and credit and savings groups. This shows the kind of influence these groups hold in the communities. There is a need to develop an approach that puts these community institutions at the fore of *Striga* management and this approach should also include financial aspects with regards to facilitating linkages with financial institutions which could offer farmers good products that even enhance investments in *Striga* management technologies.
- The main source of funding for farming among the households is proceeds from sale of farm produce which include maize. This means that with the reduction of produce occasioned by *Striga* infestation, the households will not have enough to sell and re-invest in farming operations. The interventions meant to enhance *Striga* management for enhanced maize output should therefore be linked to marketing interventions to ensure that the farmers get enough revenue from their produce for re-investment to sustain *Striga* management measures being adopted by the households.

- The value of most productive assets including irrigation pumps, sprayers, work bulls, ox ploughs, ox carts, and donkeys is high in Nyanza. This could be linked to the demand for these assets in Nyanza. The average household land size is higher in Nyanza and this may increase demand for their use leading to a rise in value. This therefore calls for an intervention that encourages linkage of the service providers and the farmers to ensure that the households are able to obtain the key productive assets at a reasonable cost to enhance use in the management of *Striga* in their farms.
- All key farming-related decisions in the households are made by both the household head and the spouse except the decision on the acreage of land to plant. Since most productive activities on the farm are performed by various members of the households, should the head of the household fail to make the right decision then such operations may suffer. For example, the household-head's decisions that allocate an uneconomical size of land for the production of maize may lead to the household obtaining negative returns. There is need therefore for interventions to support decision making on the acreage of land to plant in the family.
- Input use levels vary among the households. Since input use and management greatly determines the level of output that can be obtained, there is a need to come up with interventions that support collaboration between the public extension systems and other service providers to ensure that the farmers can afford inputs and use them well both for the management of weeds, including *Striga*, and improved productivity.
- *Striga* is ranked as the number one production constraint among the households. This provides an opportunity for working with the households and the community to find and implement sustainable solutions to the problem. Since *Striga* transcends household boundaries, the approach used should target working with households at the group and community level.
- The level of investment in maize production is determined by the type of variety being grown by the farmer and whether intercropped. As this is very important, there is need to come up with intervention strategies that support the farmers in their production management practices to ensure that the level of investment is good enough to allow for effective management of the weed and enhanced output.

Christine in her IR maize field: she now harvests up to 10 bags from the same piece of land where she could only get 3 bags before, in Bondo District.

- Most household farm produce ends up in the local market in the hands of local consumers and traders where the produce prices are low and the returns obtained by farmers not likely to spur re-investment in maize production and production management including *Striga* control. Interventions that enhance economies of scale and market linkages are suitable and will ensure that the farmers are able to target rewarding markets.

References

Khan, Z.R., J.A. Pickett, L.J. Wadhams, A. Hassanali, and C.A.O. Midega. 2006. Combined control of *Striga hermonthica* and stemborers by maize-*Desmodium* spp. intercrops. Crop Protection *25*: 989–995. http://dx.doi.org/10.1016/j.cropro.2006.01.008

Godwin, A.A, and F.D. Raoul. 2008. Evaluating the constraints and opportunities of maize production in the west region of cameroon for sustainable development. Journal of Sustainable Development in Africa 13(4).

Government of Kenya. Census report 2009. Government Printer.

Manyong, V.M. S.J. Nindi, A.D. Alene, G.D. Odhiambo, G. Omanya, H.D. Mignouna, and M. Bokanga. 2008. Farmer perceptions of imazapyr-resistant (IR) maize technology on the control of *Striga* in western Kenya: An agricultural collaborative study on *Striga* control by the African Agricultural Technology Foundation and the International Institute of Tropical Agriculture. Nairobi, Kenya: African Agricultural Technology Foundation.