

Community based risk spectrum analysis in Uganda

Male and female livelihood risks and barriers to uptake of drought tolerant maize varieties

Working Paper No. 318

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Astrid Mastenbroek
Tatiana Gumucio
Josephine Nakanwagi
Christine Kawuma



RESEARCH PROGRAM ON
**Climate Change,
Agriculture and
Food Security**



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Contact us

CCAFS Program Management Unit, Wageningen University & Research, Lumen building, Droevendaalsesteeg 3a, 6708 PB Wageningen, the Netherlands. Email: ccafs@cgiar.org

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Abstract

Even though drought tolerant maize (DTM) varieties have proven yield stabilization benefits, the adoptions remains low. In this research, we explore the risk spectrum that male and female smallholder farmers face in agriculture and the gendered barriers and drivers to adoption of drought tolerant maize varieties. The study appraises how communities in four district in Uganda are responding to observed changes and managing agricultural risks. The study uses exploratory qualitative research methods including participatory rural appraisal tools and focus group discussions with men's and women's groups separately.

We observed that in Dokolo, but also in Iganga and Masindi districts, households operate in relative isolation, which on the one hand, harnesses them against risks but on the other hand makes them more vulnerable for the negative effects of personal risk, production risks, price risk and general poverty. Secondly, we observed that women can have less agency in comparison to men in that they have less land control and voice in agricultural decision-making processes; consequently, women can be more vulnerable to agricultural risk compared to men, in this respect.

We elicited that many households optimize labor in the portfolio of different income generating activities to spread risk and smooth income and production. In Dokolo, Iganga and Masindi districts, we identified that health risk, production risk, (grain) price risk and financial risk (general poverty) are the most urgent risks that affect households productive choices. Narrowing down to DTM adoption, we noted that motivation (affordability considerations) combined with capability (knowledge on yield performance) constitute the largest barrier to adoption in all districts. In Dokolo we note capacity (knowledge of varieties) and opportunity (access to agro-dealers) as additional barriers. We also observed that due to low(er)ing soil fertility, uptake of hybrid DTM should go together with fertilizer. Lastly we observed that these barriers may be more significant for women than for men. Further research should focus on the interplay of these four findings.

Keywords

Uganda; agriculture; smallholder farmers; risk management; gender; maize; seed.

About the authors

Astrid Mastebroek (coordinating author) is an External PhD candidate at Wageningen University, Development Economics Group. P.O. Box 35, 6700 AA Wageningen, The Netherlands Email: astrid.mastebroek@wur.nl

Tatiana Gumucio is a Postdoctoral Research Scientist at the International Research Institute for Climate and Society (IRI) at Columbia University, New York, USA.

Josephine Nakanwagi is a Zonal Sustainable Land Management Coordinator at Ministry of Agriculture Animal Industry and Fisheries, P.O BOX 102, Entebbe, Kampala.

Christine Kawuma is a Monitoring and Evaluation (M&E) Manager at Integrated Seed Sector Development (ISSD) Plus project, P.O Box 20106, Kampala, Uganda.

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Acronyms

DT	Drought tolerant
DTM	Drought tolerant maize
FAW	Fall army worm
FGD	Focus group discussion
IFAD	International Fund for Agricultural Development
ISSD	Integrated Seed Sector Development
LRA	Lord Resistance Army
NAADS	National Agricultural Advisory Services
NGO	Non-governmental organization
PARM	Platform for Agricultural Risk Management
PRA	Participatory rural appraisal
OPV	Open pollinated variety
OWC	Operation wealth creation
SACCO	Savings and Credit Cooperative Organization
UGX	Ugandan Shilling
VHT	Village Health Team
VSLA	Village Savings and Loans Association
WEAI	Women Empowerment in Agriculture Index
WFP	World Food Program

Introduction

This research project is part of the NWO-WOTRO funded research project “Promoting climate resilient seed varieties: smallholder barriers to adoption and willingness to pay for seed of drought tolerant maize varieties in Uganda (PROMO)”. The research is a collaboration between ISSD Plus project, implemented by Wageningen UR Uganda, Wageningen Development Economics Group, two CCAFS projects (Capacitating African Stakeholders with Climate Advisories and Insurance Development (P1605) and Building a Global Agricultural Insurance Community of Practice: From Evidence to Scale and Sustainability (P1609)), CCAFS Flagship on Climate Services and Safety Nets and the East Africa Regional Program, and Makerere University, College of Agricultural and Environmental Sciences.

Maize is important for diets and incomes of smallholder farmers. Given climate risk to agricultural seasons, drought tolerant maize varieties can play an important role in maintaining production and protecting livelihoods. However, despite the proven benefits uptake of these varieties is slow. Research in Northern Uganda has shown that less than 12% of farmers purchase certified maize seed from formal seed markets, of which 9% are hybrid varieties (Mastenbroek and Ntare, 2016). This despite the fact that the seed has a much higher yield potential and is often more drought tolerant than the varieties traditionally grown by farmers. Farmers rely mostly on home-saved seed and low quality products from local markets. Mastenbroek, Sirutyte, & Sparrow, (forthcoming) conducted a study in Northern Uganda that suggests that price is a major deterrent for adoption of quality assured maize seed and that barriers to increase willingness to pay more exist. Potential barriers for uptake of advanced seed technology could be that farmers lack information to assess benefits of drought tolerant maize, or because of liquidity constraints, or downside risk. Furthermore, Fisher and Carr (2015) study in Eastern Uganda shows that factors related to differential access to productive resources can contribute to men’s greater tendency to adopt drought tolerant maize in comparison to women. Despite this and other research related to gender-based barriers to adopt climate smart agriculture in sub-Saharan Africa (Mutenje et al., 2019), more research on gender differences in potential barriers for uptake of quality assured maize seed in Uganda is necessary.

Recent empirical literature argues that downside risk, for example risk of substantial income loss associated with weather shocks, may deter farmers to invest in production enhancing technology such as certified seed (e.g. Emerick et al., 2016). In this case, bundling of products, such as drought tolerant maize seed and insurance, may be a way to encourage farmers to invest in certified seed. The five major risks in agriculture are identified as production risk, market risk, institutional risk, personal risk and financial risk. Results of a metadata analysis of 3283 papers shows that 66% of these papers only focus on production risks, while 15% looks into the combination of more than one risk (Komarek et al., 2020). However, the risk spectrum faced by farmers involves various climate and macro-economic factors, as well as seed and farming choices, facing a time span from planting until harvest and storage and marketing and could be different for male and female farmers. This spectrum is beyond the scope of a single technology or insurance product, and any strategy to limit agricultural risk would need to focus on designing the best package to address local preferences and contexts.

The objective of this qualitative research activity is to assess the gendered risk spectrum along the maize value chain, identifying gendered drivers and barriers to adoption of high yielding drought tolerant maize varieties. The study will appraise how local communities are responding/adapting to observed changes and risks. The results of this study will feed into a next round of data collection, that focuses on key barriers identified by stakeholders. Using lab-in-field tools, products/messages that have the potential to lift key barriers will be further explored and jointly designed with farmers. Key results of the analysis will provide a gendered overview of identified risks, barriers and drivers for adoption of drought tolerant (DT) maize seed and provide strategic inputs for further research on how to address the these barriers to adoption.

The research on community based gendered risk spectrum analysis for adoption of drought tolerant maize varieties in Uganda used exploratory qualitative research methods, including Participatory Rural Appraisal tools, focus group discussions, and key informant discussions. The participatory rural appraisal tools comprised village resource maps, four cells analysis, seasonal calendars and risk scoring. Gender considerations were integrated throughout the data collection process. This involved extensive engagement with farmers as well as interaction with agricultural officers, agro input dealers, breeders and seed companies.

Research methodology

Conceptual framework

Agriculture is the backbone of the Uganda's economy and the livelihood of many people. However, agriculture is often characterized by high variability of production outcomes, that is, by production risk (Morton, 2007). Agricultural production outputs cannot be predicted with certainty, unlike most non-agricultural enterprises due to external factors such as weather, pests, and diseases (Kansiime and Mastenbroek, 2016). Rainfall variability influenced by large scale inter-seasonal and inter-annual variability resulting in frequent extreme weather events is among the major risk factors affecting agricultural production and food security in Uganda. With only 0.1% of land irrigated, changes in rainfall greatly impact the rain-fed agricultural sector as well as the ability to achieve broader development objectives in Uganda and MDGs (James, 2010). The increased uncertainty of climate effects represents an additional problem to farmers that translates into production risks associated with crop yields.

An extensive literature has been developed on the impacts of climate change and variability on agriculture, with the earliest focusing primarily on the vulnerability of the sector and livelihoods. In general, the degree of vulnerability of the agricultural sector to climate variability and change is contingent on a wide range of local environmental and management factors such as biological conditions, type of crop, extent of knowledge and awareness of expected changes in climate, the extent of support from government and other agencies and the ability of key stakeholders to address climate concerns using appropriate remedial steps (Kurukulasuriya and Rosenthal, 2013). A number of options for managing climate-induced risk in agriculture have been cited in the literature. Diversifying agriculture with crops and varieties that can perform better under various climatic stresses is among the most cited strategies for adapting agriculture to climate variability and change (Di Falco, 2006; Kurukulasuriya and Mendelsohn, 2007; Nzuma et al., 2010).

Crop adaptation requires farmers to make decisions on which crops to grow that are suited to their environments. Seed systems play a crucial role as a basis for crop selection, and subsequently adaptation to climate change (ISSD, 2015). Existing seed systems in Uganda include home saved seed (representing approximately 40% of farmers' seed), community

based seed systems, and commercial seed produced and marketed by international and domestic seed companies. This latter system supplies less than 15% of the smallholder seed requirements, mainly maize (ISSD, 2014).

Apart from the above described production risks, farmers also face substantial market challenges. Maize markets are generally fragmented characterized by (among others) limited infrastructure, limited affordable financing, high levels of land disputes, limited knowledge and skills in marketing, and limited access to market information (Salami et al., 2010).

For this study we build on the notion of the five major agricultural risk (Harwood et al., 1999; Komarek et al., 2020) and work done by the Platform for Agricultural Risk Management (PARM <http://p4arm.org>), and use the following categorization of risks:

- Input risks
- Weather, biological and environmental risks
- Logistical and infrastructural risks
- Market risks
- Health risks
- Public policy and institutional risks

Table 1 provides a description of each of the agricultural risk categories identified by PARM (2015) and Komarek et al. (2020) including one additional category indicated by Siegel and Alwang (1999), ‘social risks and cultural norms’ as we expect barriers to uptake of drought tolerant maize in this sphere as well. Using PRA tools, we narrow down to the maize sub-sector and analyze these risks from the community perspective, rather than a macro-level analysis, which typically relies on secondary data sources.

Table 1. Definition of risk categories in the agricultural sector.

Risk category	Sub category	Description
Production risks – uncertain natural growth processes	Input risks	Access to seed and other inputs, information, management decisions pertaining crops, seed and other inputs, and agronomic practices.
	Weather, biological and environmental related risks	Periodic deficit and/or excess rainfall or temperature, (hail) storms, changes in cropping patterns, crop and livestock pests and diseases, and contamination and degradation of natural resources.

Risk category	Sub category	Description
Market risks – price, costs, market access	Logistical and infrastructural risks	Changes in access (physical or economic) to transport, communication, energy, degraded transport, or energy infrastructure due to physical destruction or lack of maintenance. Delays and disruptions of charges along the value chains.
	Price risks	Fluctuations in prices of inputs and/or outputs due to different causes such as changes in national, regional or international supply and/or demand that impact domestic, regional and/or international markets, changes in demands for quantity and/or quality attributes, changes in food safety and production requirements.
Personal risks – human health and personal relationships	Health risks	Health risks for farming households and farm workers, production failure due to health reasons, such as injury from machinery, diseases, negative human health effects from pesticide use, and disease transmission between livestock and humans.
	Social risks and cultural norms	Risks related to needs for social support, safety nets and welfare services. Social or culturally influenced threats such as intra-household and intra-communal conflicts (e.g. landownership, social norms on labor division, domestic violence).
Financial risks - risks associated with how the farm is financed & additional variability of cash flow	Risks associated to levels of poverty	Risk related to general poverty, generic lack of money in households and/or food insecurity, low levels of cash-flow within semi-subsistent households as production unit making agricultural investment choices.
	Access to credit and other financial products	Risks related to access, costs, collateral and/or grace period of financial products, availability of financial products, and suitability of financial products to the agricultural sector.
Institutional risks – unpredictable changes in policies and regulations	Public policy and institutional risks	Macroeconomic shocks and downturns. Changing or uncertain policies and weak enforcement of those monetary, fiscal/tax, and financial (credit, savings, insurance) policies; unpredictable regulatory and legal measures; trade and market disruptions; uncertainty in land tenure, governance uncertainty; conflicts and political or labor disputes, corruption, weak institutions.

Source: Combination Komarek et al. (2020) and Terms of Reference PARM Risk assessment except for social risks & cultural norms and financial sub-categories, which are our own.

To analyze the risk management strategies of households that will be mentioned by the focus groups we use the asset based approach, in the broadest sense of the word (Devereux, 2001; Hansen et al., 2019; Siegel and Alwang, 1999). Risk management strategies are ‘the set of mechanisms used by households to deal with anticipated or actual losses associated with uncertain events and outcomes. These mechanisms are employed depending on beliefs about the probability of events’ occurrence and anticipated impacts on households welfare’ (Siegel and Alwang, 1999, p3). A rich body of literature in the 1990s and early 2000s document two *ex-ante* risk management strategies and one *ex post* risk management strategy as presented in Table 1. *Ex ante* risk reduction and risk mitigation are planned and aimed at preventing a large impact. They can be income and/or consumption smoothing. *Ex post* coping mechanism are ad hoc, responding to the impact of an events’ occurrence and are consumption smoothing.

Table 1. Description of risk management strategies.

Risk management strategy	Ex-ante action	Ex-post action
Reduction	Invest in measures that lower the probability or impact of a risky event	If risk prevented => no action If risk reduced and event does not occur => no action If risk reduced and event occurs => possible coping to smooth consumption (depends on risk mitigation actions) If risk not reduced and event occurs => coping to smooth consumption
Mitigation	Invest in formal insurance arrangements that provides payoff (or compensation) for realisations of risky events Invest in formal savings or precautionary savings Invest in social capital	If risky event does not occur => no action If risky event occurs => receive payoff (compensation) or sell liquid assets, and possible coping to smooth consumption
Coping	No specific action (i.e. investment) that helps household manage risk	Coping to smooth consumption

Source: Siegel and Alwang, 1999

Gender can significantly influence the concerns and risks perceived by women and men in rural and farming communities, due in part to the gender-specific household roles and responsibilities they carry out. Correspondingly, while it can be possible to identify trends in

underlying reasons, gender differences in risk perceptions can be highly location-specific. Research with smallholder agriculturalists and pastoralists in sub-Saharan Africa suggests that differences in risk perceptions might be influenced by gender roles and responsibilities (Barrett et al., 2001; Cullen et al., 2018; Quinn et al., 2003; Smith et al., 2000). For example, Smith, Barrett and Box's study (2000, 2001) of pastoralists in Kenya and Ethiopia suggests that, although there is some convergence in the sources of risk that women and men cite, men's primary role in livestock production can influence their greater concern for risk related to livestock management. Similarly, women's significant role in food preparation can influence their increased concern for food availability risk. Furthermore, Smith, Barrett & Box (2001) highlight that gender trends can vary according to location. Research (Quinn et al., 2003; Cullen et al., 2018) with agriculturalists and pastoralists in Tanzania and Mali also suggests that gender labor roles can influence risk perceptions, as risk associated with "natural capital" (i.e., land, weather, livestock disease) is perceived higher for men, while those associated with "human capital" (i.e., hunger, access to water, access to medical care) is perceived higher for women.

Some qualitative research exists that focuses on women's role in agriculture and how this may influence their knowledge of farming, risk perceptions, and adaptation strategies (Bee, 2016; Rengalakshmi et al., 2018). While the study does not include men, Bee's (2016) research with rural women in Guanajuato, Mexico, shows that women farmers consider lack of rain to be high risk and high severity in comparison to other types of perceived risks. Furthermore, lack of water is a more significant risk to them than food prices or lack of jobs (although significant, as well) because of the importance they give to being able to produce their own food. Similarly, Rengalakshmi Manjula & Devaraj's (2018) research in Tamil Nadu state in India suggests that women's strategies to recover from extreme weather events may depend on their own labor, and be driven out of a concern for food security and "self-reliance," whereas men may perceive it as an opportunity to enhance the farm production system and income, relying more-so on crops and technologies.

To promote true effectiveness and equity, it is important that programs and initiatives to advance smallholder adoption of drought-tolerant maize understand women's and men's livelihood risk perceptions and their constraints to demand and adopt drought-tolerant maize. Although women play a crucial role in farming and food production, they can often

face significant challenges to adopt agricultural technologies in comparison to men (Meinzen-Dick et al., 2011). Consequently, in this study we will assess gendered roles and responsibilities as they influence risk perceptions concerning maize production and adoption of high yielding, drought tolerant maize varieties.

We also draw from the Women's Empowerment in Agriculture Index (WEAI), a framework that highlights the capacity to make decisions and the resources to act on them as key to empowerment (Kabeer, 1999). Consequently, we critically consider women's and men's i) capacity to participate in decision-making on agricultural production and ii) control over resources necessary to act on those agricultural decisions. Furthermore, we recognize that normative structures surrounding gender can condition women's and men's capacities to act as well as the resources available to them. For this reason, we draw from the Enabling Gender Equality in Agricultural and Environmental Innovation (GENNOVATE) project for our understanding of normative structures surrounding gender. The framework envisions an opportunity structure wherein institutions and gender norms varyingly condition actors' abilities to access and act on available resources and technologies for agriculture and natural resource management. In this way, norms can influence actors' capacities to exercise agency and innovate. At the same time, agency and innovation can cause shifts in the opportunity structure, creating change in gender norms, as well (Badstue et al., 2014).

While we recognize that different groups of women and men can experience challenges to demand and adopt drought tolerant maize due to identifying traits in addition to gender, such as ethnicity, wealth-class, and life-stage (Carr and Thompson, 2014; Fisher and Carr, 2015) for this exploratory study we compare trends between aggregate groups of women and men, due to project-related and other limitations..

Description of tools

To enable us to answer the research questions and produce the expected outputs for the study, we applied exploratory research methods, providing information for the major outputs. To secure maximum engagement of the community members, we used Participatory Rural Appraisal (PRA) tools. PRA places emphasis on empowering communities to assume an active role in analyzing their own living conditions, problems and potentials in order to seek for a change of their situation. The tools used for this research are village

resource maps, holistic timelines, seasonal calendars, four cells analysis, FGDs on maize seed buying behavior and matrix scoring for major risks and concerns.

The **Village Resource Map** tool was used to learn about the community and its resource base. The objective was to learn the villagers' perceptions of what natural resources are found in the community, how they are used, differences of access and control of key resources, and perceived changes in quality of resources over the years.

The **Historic timeline** was used to identify major events in the community and how these events affect livelihoods in the community over time. The historic timeline also provided insights into the frequency of severe climate events that are occurring and how communities cope with them.

A **Seasonal calendar** was used to explore seasonal changes (e.g. gender-specific workload, diseases, income, expenditure, etc.). The objective was to learn about changes in livelihoods over the year and to show the seasonality of agricultural and non-agricultural workload, food availability, human diseases, gender-specific income and expenditure, water, forage, credit and holidays. For the purposes of our study, we used the tool to analyze gender-specific participation in decision-making concerning livelihood tasks carried out over the year.

The **Four cell analysis** tool was used for rapid assessment of farmers' knowledge on local production status of crops or varieties by using the two key variables: production area and households growing the crops or varieties. These variables were organized into four different cells (a) crops or varieties grown by many households on large production areas, (b) crop or varieties grown by many households on small production areas, (c) crops or varieties grown by few households on large production areas, and (d) crops or varieties grown by few households on small production areas. The tool gave us an insight into what crops are commonly grown in the area and what role maize plays in the farming systems. In addition, we used the tool to provide insights into whether there are different gendered perceptions about the importance of various crops.

Focus group discussion on maize seed buying behavior was used to gain an in-depth understanding of why smallholder farmers are not generally buying quality maize seed from agro-dealers and seed companies. The discussion involved probing the underlying reasons

that are usually provided by farmers in surveys (for example, seed is expensive, no access, not enough information). We used the tool to understand how gender influences differences in access to information and subsequent awareness of different varieties, including drought tolerant maize varieties.

Risk ranking and prioritization helped to identify the risks farmers face (inputs risks, weather, biological & environmental risks, logistical & infrastructural risks, market risks, health risks, social risks and cultural norms), taking into consideration that women and men may perceive risks differently, due to the socially-differentiated roles they carry out in their households and communities.

The detailed description of the tools are provided in Appendix 1. The Informed Consent form is provided in Appendix 2.

Description of research districts

Uganda national maize production stands at 2.8 million metric tons per year from an estimated area of 1 million hectares with not much difference in yield between the first and second season at 1.4 million metric tons each season (Uganda Bureau of Statistics, 2016). The Eastern region takes a lion's share in production with 46.9%, followed by the Western region with 21.1%, Central region with 19.1%, and lastly the Northern region with 12.9% (Uganda Bureau of Statistics, 2010).

This study was conducted in Iganga, Masindi and Dokolo districts in Eastern, Western and Northern regions of Uganda respectively. Districts are presented in Figure 1. The districts were purposely selected. The choice of districts was guided by maize production intensity, climate and promotional activities for drought tolerant maize varieties in these regions. Iganga and Masindi districts were selected because there are among the leading maize producers with an annual production of 303,262 and 61,715 metric tons of maize correspondingly. In addition, in these districts seed companies, through other projects, have promoted and marketed DT maize varieties in the recent past. In the northern region, Dokolo district was selected because it is an upcoming maize producer with vast agricultural land and a high potential for technology adoption classified among the middle producers with production of 16,921 tons per annum (Uganda Bureau of Statistics, 2017). Kapchorwa was selected as the control district because of higher uptake of quality seed compared to

other districts. This provides us with a better understanding of why in some areas uptake is high and not in others.

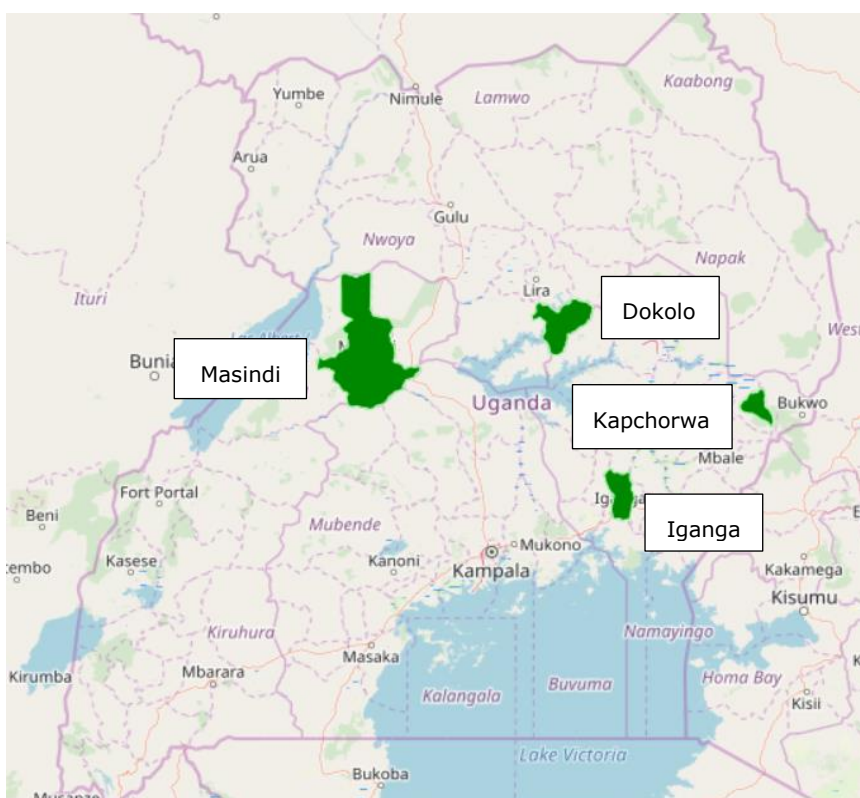


Figure 1. Map of Uganda with districts of interest highlighted. Source: <https://ubos.geo-solutions.it/maps/new?copy=146> (accessed January 2020)

Table 2 provides a brief overview of the agro-ecological characteristics for each of the districts as provided in the livelihood mapping and zoning (Browne and Glaeser, 2010). Two sub-counties were selected from each district and two villages from each sub-county.

Table 2. Overview of agro-ecological characteristics per district.

District	Livelihood zone	Rainfall	Soil fertility	Hazards
Dokolo	Mid-north simsim, maize and cassava	1000 – 1400 mm annually; 2 rainy seasons: mid-March – Mid-June & mid-July – mid- November	Soils are moderately fertile	Prolonged dry spells, crop and livestock epidemics, floods Infrequent (once in 5 - 10 years
Iganga	Southeastern maize, beans, Robusta coffee and cattle	Not available	Not available	Prolonged dry spells, crop diseases, livestock diseases

District	Livelihood zone	Rainfall	Soil fertility	Hazards
Masindi	Bwijanga-Pakanyi sugarcane, maize and cassava	1270 – 1400 mm annually; 2 rainy seasons: May – June & August - November	Soils are relatively fertile	Prolonged dry spells (once every 3 years)
Kapchorwa	Mt Elgon Highland Irish potato and cereal	2000 mm annually	Not available	Flooding, livestock diseases

Source: (Browne and Glaeser, 2010).

Data collection process

After approval of the Ethical Review Board at CCAFS and prior to data collection, we pretested the tool in Mukono with the enumerators. Based on the pre-test we adjusted the data collection process slightly. We conducted the group discussions in April 2019 (see Table 3 for field activity plan). In each district of Dokolo, Iganga and Masindi, two sub-counties were purposely selected based on advice of the district production and marketing agricultural officer. We visited two villages in each sub-country providing a sample of four villages per district for Dokolo, Iganga and Masindi districts and two villages in one sub-country for Kapchorwa as the latter served as a control district. A team of two ISSD Plus project staff and eight enumerators conducted the PRA and key informant interviews. In the villages we organized a men's group and a women's group.

The team approached the sub-county agricultural extension officer and the village local council one (LC1) chairperson in advance to explain the purpose of the research and invite the community to participate. The agricultural extension Officers of respective study sub-counties supported mobilization of the farmers. They also participated in the group discussions as a translator when needed. The selection criteria for participants was explained and the agricultural officer was asked to invite participants. The selection criteria were: 15 couples and 5 female headed household with a male relative to ensure equal stratification in the male and female groups, three – five households with more than 3 acres, three – five households with less than 3 acres, at least 1 leader of a farmer group, at least three farmers younger than 35, at least three farmers older than 55. In total 20 farmers were invited per group of either men or women. However, the actual number of participants that turned up per village varied, in some villages they were less than 40 in others they were forty. A team

of eight enumerators split into two groups; four enumerators per group who then conducted the PRA with men and women separately. One person was the key facilitator and another person the note taker. The exercise was conducted in local language with translations for record keeping purposes. The two ISSD plus project staff participated as either note taker or facilitator. In addition, one team member interviewed key informants while the FGD proceeded. The exercises took about six hours and we provided a snack and a bar of soap for all participants in the groups of men and women as appreciation of availing time.

We recorded the data in three ways. We used flipcharts and other tools to facilitate the discussion and visualize the responses for the communities. We took photos of the visual products developed at the end of each session. These included photos of: a map of the key resources in the community; a figure depicting the main cash and food crops in the village; a calendar of livelihood activity tasks over the year, including household members' roles; a thirty-year timeline of key events that have affected agricultural development in the community; and a table of farmers' perceived livelihood risks, prioritized, along with corresponding coping strategies and solutions. We used enumerator record forms to write down the responses and explanations while the PRAs were conducted.

Table 3. Field activity plan for pre-testing and data collection.

District	Sub-counties	Villages	Date of FGD	Farmer Groups that participated
1. Mukono (Pre-testing)	Nabbale	-Bugere -Nabbale 1	2 nd April, 2019	Mukono family farmers group
2. Iganga	Nawanyingi	-Magogo -Bunyiiro	8 th April, 2019	Magogo Farmers Women Group
	Nambale	-Nambale -Naibiri central	9 th April, 2019	Nambale Agribusiness co-operative enterprise
3. Kapchorwa	Kaserem	-Ngeci -Kubilat	11 th April, 2019	Kaserem area cooperative enterprise

District	Sub-counties	Villages	Date of FGD	Farmer Groups that participated
4. Dokolo	Amwamo	-Adicuny -Alanyi A	13 th April, 2019	
	Kwera	-Akuriluba -Abinyi	15 th April, 2019	
5. Masindi	Pakanyi	-Kibaba -Kihaguzi	17 th April, 2019	- Kisindi modern farmers group - Kukwa-tamazi farmers' co-operative
	Bwijanga	-Bulima -Kyakati	18 th April, 2019	- Bulima maize growers's Association - Kyakati maize growers Association

Findings

Introduction

This chapter describes the main finding for each of the tools that we used. We look at gender differences in responses of men's and women's groups and we look at patterns in districts. We also highlight some of the commonalities and differences between districts. We start with the analysis of the natural resources in the communities using the information gathered with the village resource maps, followed by the historic timeline, major activities throughout the year, labor division and control over resources using the seasonal calendar, main cropping pattern and the role of maize within the cropping pattern using the four cell analysis. We then zoom in on maize varieties and maize seed related issues using the focus group discussions. Lastly we look at the major risks and concerns in the villages that were identified by the men's and women's groups using the risk and concern ranking.

Village natural resources

The resource mapping exercise demonstrated trends concerning women's and men's control over key natural resources in the community. In particular, it showed who participates in decision-making over the resources. It also highlighted a few differences and commonalities between districts concerning changes in quality and availability of resources.

Land

Information from the focus groups across districts showed that while men and women reported that men alone tend to have control over land, with a few women's and men's groups noting that both women and men have land control, men's and women's responses varied concerning who makes decisions on land. **Error! Reference source not found.** demonstrates these trends. The majority of men's groups reported that men alone make land decisions; however, women tended to report that both women and men participate in land decision-making (except in 2 villages in Dokolo and one in Iganga and Masindi each). No groups reported that women alone control land or make decisions on land.

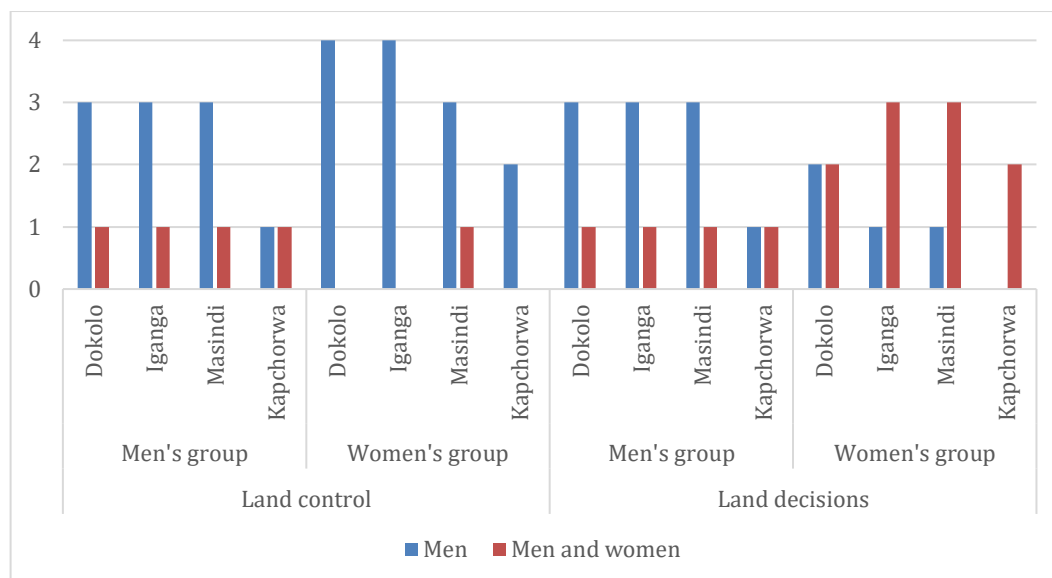


Figure 2. Gendered land control and decision-making, by men's and women's groups.

Both the men's groups and women's groups in three out of four villages in Dokolo mentioned that land has become scarce and has competing purposes, like agriculture, settlements, asset to sell for income and brick making. Except for one women's group, all groups said that the soil fertility has gone down due to bush burning, deforestation, over-cultivation, no crop rotation and population growth. In one village there are conflicts over land boundaries and in another they are existing but rare.

Except for one women's group, all women's and men's groups in Iganga mentioned that land is scarce. All groups mentioned that the soil fertility is low and that this is a change from the past. In Iganga, Striga (a weed) is particularly problematic. Other reasons mentioned were over-cultivation, soil erosion, land fragmentation and drought. Sugarcane cultivation was also mentioned as an issue because other crops do not do well where sugarcane is grown. In one village, the women's group mentioned that they did not have a say over land issues. Concerning land conflicts, in one village both men's and women's groups mentioned no conflicts, in another village both groups mentioned boundary conflicts, while in other villages only one of the two groups mentioned conflicts over land.

In Masindi both men's and women's groups in one village mentioned that land is abundantly available while in the other three villages land is scarce. All women's and men's groups apart from one men's group mentioned soil fertility as low mainly due to over-cultivation and mono cropping. Over use of fertilizer and pollution was also mentioned. Problems and

related conflicts with respect to land are because of lack of land titles/ unclear ownership of land. Another problem frequently mentioned was pests and diseases.

In Kapchorwa, land is a scarce resource and the soils are not fertile due to over-cultivation, soil erosion (mountainous areas) and land fragmentation. Problems mentioned were over-population and that land is lacking for cultivation and is expensive. Conflicts exist over boundaries of land.

The differences in women's and men's control and participation in decision-making for key resources are indicative of the differing roles and responsibilities that women and men carry out for their households and community. The responses that women's and men's groups gave for land uses and most common household income sources also suggest that gender roles can significantly influence the labor activities that women and men carry out. For example, in some groups men reported sourcing materials for construction as a land use while women did not; building construction may be a role carried out more by men than women. Also, men's groups often noted brick-making as a common income source, more frequently than women. This also may be due to a tendency for brick-making to be a labor activity carried out by men more than women. Trends related to labor activities are elaborated upon in the seasonal calendar tool.

Swamps

Responses concerning who controls and has decision-making power over swamps were more diversified. As Figure 2 shows, women's and men's groups noted that, besides individual men and women themselves, the government or community could have control and/or decision-making power over swamps, highlighting the resource's nature as a public good, in some cases. Unlike with land, the responses concerning who is involved in control and decision making over swamps have similar distributions. Women's groups repeated more frequently than men's groups that both women and men control and participate in decision-making over swamps. In contrast, men reported more frequently that men alone or the government controlled and had decision-making power over swamps. In comparison to other districts, women's and men's focus groups from Iganga tended to report most frequently that men controlled and participated in decision-making over swamps. Women's groups in Masindi tended to note most frequently that both women and men were involved

in control and decision-making over swamps. It is interesting to note that while men’s focus groups in Kapchorwa did not note swamps in their resource maps, one women’s group did.

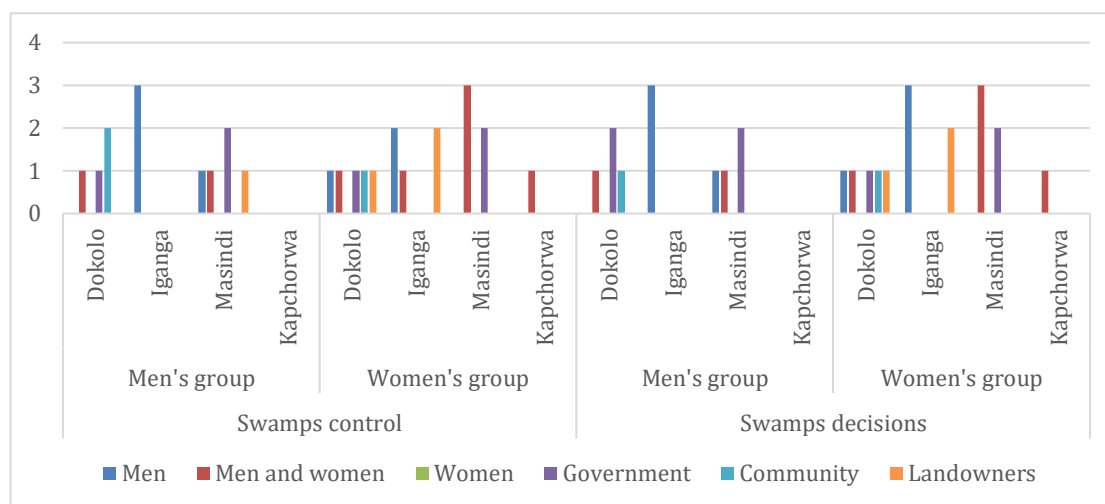


Figure 2. Gendered swamp control and decision-making, by men’s and women’s groups.

Forests, trees and woodlots

Concerning resources related to forests, trees and woodlots, men’s and women’s responses coincided in that they both reported most frequently that men alone tend to control them (Figure 3); however, concerning decision-making on forests/trees/woodlots, women recognized the participation of women more than men. Men’s groups reported most frequently that men alone make decisions on forests/trees/woodlots, while women reported most frequently that men alone or that both women and men make decisions. Men’s groups in Iganga tended to note most frequently, in comparison to other men’s and women’s groups, that men alone are involved in control and decision-making over forests/trees/woodlots. Additionally, women’s groups in Masindi tended to note most frequently that both women and men are involved in control and decision-making over this resource category. Similarly to swamp resources, women’s and men’s groups noted the government, community and landowners as entities that could be involved in control and decision-making over forests/trees/woodlots, as well.

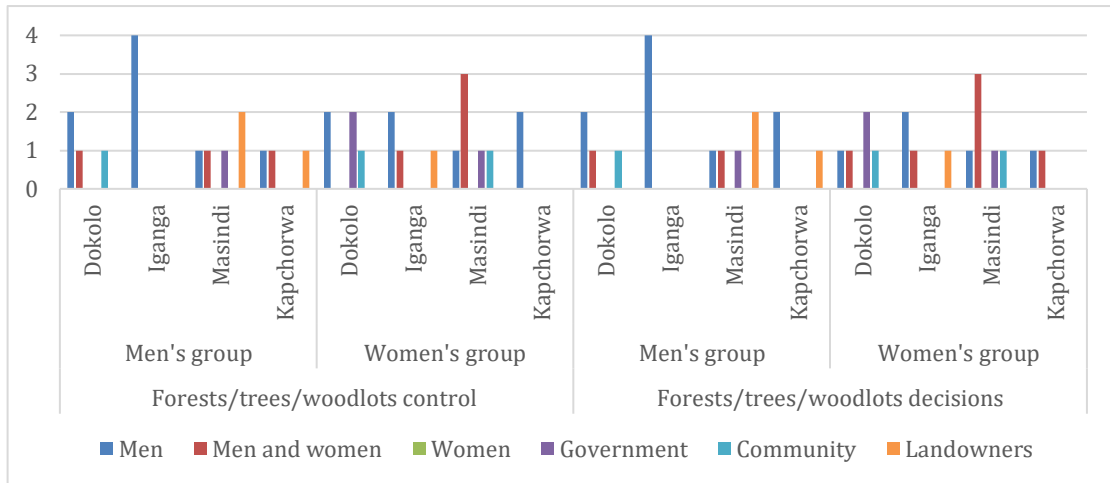


Figure 3. Gendered forests/trees/woodlots control and decision-making, by men's and women's groups.

It is interesting to note that, across the types of resources, women's groups from Masindi tended to consistently report that both women and men control and participate in decision-making over them (see Figure 2 and Figure 3). Men's groups in Iganga tended to report that men alone controlled and participated in decision-making over resources (see Figure 2 and Figure 3).

Water sources

While fewer women's and men's groups discussed water sources as a resource, of those that did, they tended to recognize the local government, in the form of council people or water committee, as responsible for control and decision-making (Figure 4). Water sources included wells, boreholes, lakes, and streams. This also tended to be one of the few resources for which women and men recognized that women alone can have control and decision-making power. Additionally, it is worth noting that none of the villages in Masindi mentioned a water source in their resource mapping, except for one village wherein both groups mentioned a stream.

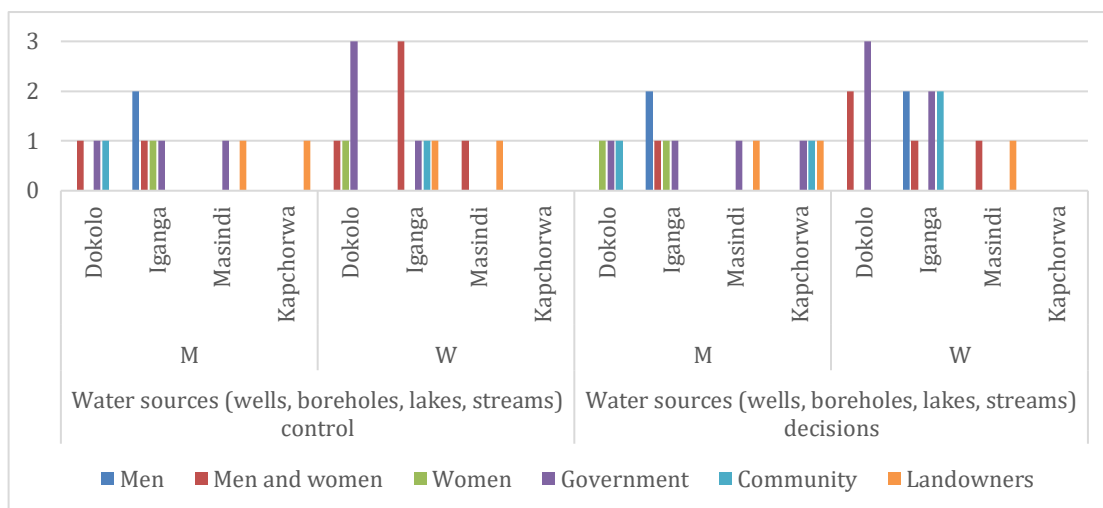


Figure 4. Gendered water source control and decision-making, by men's and women's groups.

Changes in status resources over time and conflict proneness

Most women and men from all villages reported land scarcity. In general, drought was commonly mentioned as affecting entire villages, according to women and men.

In Dokolo district, land, woodlots/forests, and swamps are generally available in the villages and are used for different forms of income generation, for example crop cultivation, animal husbandry, brick making and construction materials for homes such as thatching materials, poles, mud etc. In three villages the men's and women's groups indicated that the resources are scarce and that this is a change from the past due to human interaction (over grazing, population growth, charcoal burning, over cultivation of crops etc) and due to recurring droughts (mainly related to water sources). In two villages women's groups mentioned competition over resources as sources of conflict while men did not. In one village, both groups mentioned some conflicts over resources, while in one village both groups mentioned that there were no conflicts.

In Iganga, land, woodlots/forests, roads and swamps and other water sources are available in the villages and are used for different forms of livelihood activities. Of note is that two men's groups and one women's group mention roads as an important resource for the village to transport people and produce. Also, medicinal plants were mentioned more often than in the other districts. All groups mention a negative change in soil fertility status mainly due to human interactions (over-cultivation, land fragmentation, population growth etc),

recurring droughts (related to land use, water sources and trees) and pests and diseases (related to all resources). Water sources have become dirty and the government has taken up ownership of swamps, reducing access for communities. Conflicts that were mentioned were related to theft, land boundary issues and water source owners renting them out to multiple people.

In Masindi, land, swamps and other water sources, woodlots/forests and rocks/sand were commonly mentioned as resources available in the village. Of note is that a number of public authorities are mentioned as managing these resources, such as National environmental management authority (NEMA) for swamps and Uganda Wildlife Authority (UWA) for woodlots in game reserves. Some villages also mentioned wildlife as a problem. Apart from swamps which are not farmed a lot, most natural resources have gone down in fertility due to over-cultivation, mono cropping (maize), bush burning, deforestation and pollution. Drought was only mentioned in two villages, as was massive sugarcane plantations. Conflicts are mentioned in all villages and all are related to land ownership.

In Kapchorwa, land, streams and woodlots were mentioned as main natural resources. The fertility/productivity is reducing over time mainly due to drought, deforestation and over use. Conflicts mentioned in both villages were over boundaries of the resources between families and also within families.

Historic timelines

The historical timeline inquired as to major historical events experienced in the community, including those related to climate, infrastructural developments, and crop and seed system initiatives. Effects of each event on maize production, food security, women's and men behaviors, and other livelihood related issues were also discussed in the women's and men's focus groups. In this way, it was possible to understand each district's institutional context and begin to assess farmers' mechanisms for coping with change.

Infrastructural development

Major infrastructural developments noted by women and men across districts concerned construction of roads, health centers, schools, and electricity, the latter often noted particularly by women. Men's and women's groups in Dokolo did not mention the development of a health center. Women and men noted a combination of positive and

negative effects of the infrastructural developments. For example positive effects were better access to markets and veterinary services, easier transport of agricultural products and livestock, easier grazing, enhanced food security, the development of businesses and trading centers, access to services including Village and Savings Loan Associations (VSLAs). Men's groups in Iganga noted a trend of women participating in new activities including productive roles due to education and their participation in community meetings. Negative effects noted by women and men across districts included increased theft (in Dokolo in particular, this was related to the LRA war), increased food prices, spread of pests and diseases, crop destruction while opening roads and increased male and female misbehavior, defilement and spread of HIV/AIDS. One women's group in Masindi noted increased domestic violence and school dropouts as a result of the development of electricity in the area. Groups in Dokolo mentioned the LRA war as a major historical event with the peak around 2002. Having health centers nearby helped boost health and energy for crop production (Iganga - men's group).

We note that Dokolo is the least/latest developed, with men's and women's groups mentioning the least positive market developments and access to services, followed by Iganga and Kapchorwa, with Masindi being the most developed (roads, rural electrification, schools, health centers, trading centers with agro-input shops and mills, telecom) creating opportunities for opening up small businesses and boosting income. The effects of the LRA war most likely contributed to infrastructural development starting later compared to other districts and that service delivery was disrupted.

We looked at maize storage as an important infrastructure in the maize value chain. Maize is mainly stored at home. In Dokolo, none of the groups mentioned that (communal) stores are available in the village. Only one women's group mentioned a mill in the village. In Iganga responses were mixed. Two villages have mills, threshers and stores. One village has a thresher and possibilities to rent stores. One village has a mill and possibilities to rent stores. In Masindi stores, processors and mills are generable available, though stores are sometimes owned by middlemen. In Kapchorwa processors, threshers and stores are generally available.

Crop and seed system initiatives

Major crop and seed system initiatives over the last thirty years noted by women and men included those by NAADS, Operation Wealth Creation, and AT Uganda. In Iganga, women in particular noted farmers buying seed from one another, using home saved seed, and selecting a local DTM variety from this, as a key seed system initiative. Those initiatives linked to access to new seed varieties noted a productivity increase in maize, easy access to extension services and better food security as a result (2 men's groups Dokolo, 2 men's groups & 1 women's group Iganga; 1 men's group & 1 women's group Masindi, 1 men's group in Kapchorwa). In terms of extension services Kapchorwa, Iganga and Masindi received more agricultural extension services compared to Dokolo, reported more by men's groups. In one instance, a men's group in Dokolo noted reduced domestic violence as a positive effect of crop and seed systems initiatives by AT Uganda.

Climatic events

Across districts, men's and women's groups tended to note drought and associated times of famine, hailstones, floods, and strong winds as major climatic events occurring over the last thirty years, although timing and frequency of reported events sometimes differed. In particular, women in Masindi were the only groups to note the occurrence of strong winds as a major climatic event and in two villages in Masindi drought was not mentioned. In addition to crops being affected by the weather itself, extreme weather (heat/drought and too much rainfall) also led to an increase in pests and diseases affecting humans, livestock and crop production. Associated with climatic events, women's and men's groups also noted periods of Fall armyworm (FAW) infestation which was very damaging in 2016 till 2018. This has been one of the major recent national historic events, particularly affecting maize cultivation.

Across districts, the effects of climate events were similar with negative impact on food security, health status and societal disruptions. Women's and men's groups across districts tended to note negative effects of the climatic events on production, food security and livelihoods. Maize and other key crops were detrimentally damaged, contributing to increased stress on food security (due to reduced production, reduced income, and reduced ability to store food). Women and men also tended to report that savings and borrowing

became limited as a result, although some groups noted that borrowing to purchase food increased.

The climatic events were also reported to contribute to societal disruption. In particular, domestic violence was noted as an effect frequently by men (four groups) and women (three groups) in Dokolo. A women's group in Dokolo noted that the compounding effects of drought and famine created increased childcare needs and demands on women's meal preparation role; this increased stress on spousal relations in the process, resulting in women getting "beaten" by their husbands. In comparison, in other districts domestic violence was also mentioned as an effect of extreme climatic events, although it was mentioned much less than in Dokolo. In Kapchorwa, it was noted by one women's group, and in Masindi it was noted by one women's group and one men's group. Similarly to the discussion in the women's groups in Dokolo, a women's group in Masindi noted that "men became violent because of lack of food." In Iganga, men's groups reported conflicting observations: one men's group noted increased domestic violence as a result of climatic events. However, another men's group mentioned decreased domestic violence as a result of increased unity between women and men to confront the detrimental impacts of drought and flood together. This was similar to a trend mentioned by a men's group in Dokolo, wherein they highlighted that the LRA war contributed to increased family unity and reduced domestic violence in the process). Despite the positive trend noted, the same men's group in Iganga highlighted that the climatic events resulted in men abandoning their families, suggesting that the extreme events still contributed to intra-familial stress and conflict in some instances. A men's group and a women's group in Masindi also noted male abandonment of homes and out-migration, as a result of climatic events. Furthermore, two women's groups in Dokolo and one men's group in Masindi mentioned increased school drop-outs as a result of climatic events.

Despite the negative effects of climatic events noted, women in Iganga district noted positive coping mechanisms that developed, such as planting cassava as a food security crop, men learning how to store food, using plates instead of trays to serve food, planting early, and women expecting men to obtain money for purchasing posho before returning home from work. Women and men in Kapchorwa also noted the development of new practices to cope with the effects of climatic events, for example, refraining from wasting food and

planting trees. It is noted that the effects of severe negative climate events such as droughts impacted hard on communities.

Climatologically Dokolo and Iganga seem to be more affected by droughts and related pests and diseases compared to Masindi and Kapchorwa, the latter having a more temperate climate due to its highland location. As a result, groups in Masindi tend to mention hailstorms and strong winds rather than droughts. Those villages that are close to swamps are prone to flooding.

Drivers of climatic events and declining soil fertility

Concerning the causes and drivers of climatic events, women and men in Dokolo coincided in reporting deforestation and misuse of wetlands. Men additionally noted global warming, charcoal burning, blasting nearby rock, and bush burning. Both women's and men's focus groups noted that land had either low or no fertility, due to changes related to soil erosion, drought, over cultivation and mono-cropping. Women noted brick-making as an additional cause of land's infertility. Additionally, men alone mentioned bush burning as a cause.

Women and men in Iganga coincided in naming deforestation, poor farming methods, over cultivation, and encroachment on wetlands as drivers of the climatic events. Men distinctively mentioned pollution, land degradation, poor drainage systems, brick making, and bush burning as other drivers. Women's groups also noted over population and bush fires. Both women's and men's groups highlighted land's low fertility, citing several of the drivers of climatic events mentioned above as reasons. Low fertility was also emphasized as an important driver of poor yields.

Women and men in Masindi coincided in naming deforestation and wetland encroachment as drivers of climatic events. Men additionally noted over-cultivation and disposing of waste from ethanol distillation into the swamps. Women distinctively reported farming on hills, use of chemicals for de-vegetation in swampy areas, bush burning and oil drilling operations. Both women's and men's groups tended to report that land fertility was low, due to changes related to over-cultivation, soil erosion, mono cropping and excessive use of chemicals.

Women and men in Kapchorwa reported that drivers of climate events included deforestation, over-cultivation, over population, soil erosion along streams and slanting

terrains, mining, stone quarrying, and increased pests. Women’s and men’s groups also tended to report that land had low or no fertility, attributing this to changes related to the reasons mentioned above including over cultivation, soil erosion and poor farming methods in general.

It should be highlighted that, although a number of men’s and women’s groups mentioned over-cultivation and soil erosion as drivers of climate events, they are rather effects that exacerbate the recurring cycles of climate events, rather than the causes itself.

Seasonal calendar

The seasonal calendar tool helped to provide general information regarding women’s and men’s agricultural activities (especially maize production) and other livelihood concerns as they typically develop over a year. The tool was also used to probe gender roles and participation in household decision-making.

We discussed the seasonal calendar for maize and one other crop. Table 4 below shows the other crops that men’s and women’s groups chose to discuss. The seasonal activities and decision-making for the other crops were similar to the maize seasonal calendar and therefore not discussed separately.

Table 4. Crops other than maize discussed using seasonal calendar, by men’s and women’s groups.

	Men’s groups	Women’s groups
Dokolo	beans, soy beans, cassava	soy beans, groundnuts
Iganga	beans, rice, coffee	beans, rice, groundnuts, sweet potatoes
Masindi	beans, sesame	beans, sesame
Kapchorwa	bananas	bananas, beans

In general, across districts women and men reported that maize production occurred over two seasons, the first beginning in January and ending in July or August and the second beginning in July or August and ending in December or January. An exception arose in Kapchorwa district, wherein both groups in one village reported the growing season ending in August or September. The women’s group in the other village in Kapchorwa reported the growing season ending in October or November. These groups also reported only having one maize growing season. Across districts, the first task starting a season tended to be planning or clearing the field and it ended with the tasks of harvesting, storage and marketing.

Seed sourcing

For the purposes of the study, the tool was used to analyze women's and men's participation in maize seed buying/sourcing and other activities related to maize cultivation. This involved understanding who in the household carries out the task of seed buying/sourcing and also who is involved in decision-making on seed buying/sourcing (Figure 5). It is important to note that not all women's and men's groups identified seed buying/sourcing as a task of the maize production cycle, although a majority did. Those groups who did not note seed sourcing might pertain to cases wherein NGOs or other outside organizations provided seed and inputs to farmers.

Men never noted that women alone were responsible for maize seed sourcing, or that women alone took decisions on this task. Men's groups reported most frequently that both women and men carried out seed buying/sourcing and that they both contributed to decision-making on maize seed sourcing. Similarly, women's groups also reported most frequently that women and men participated in maize seed buying/sourcing, although women in some cases in Iganga reported that women alone carried out maize seed sourcing and a few women's groups from Iganga noted that women alone are responsible for the decision-making. We note that in Dokolo men's groups from two villages allocated themselves the role as decision maker on which seed to source while the women's groups indicated it is both men and women. In Masindi and Kapchorwa men's and women's responses varyingly noted that men alone or both men and women decide on and source seed.

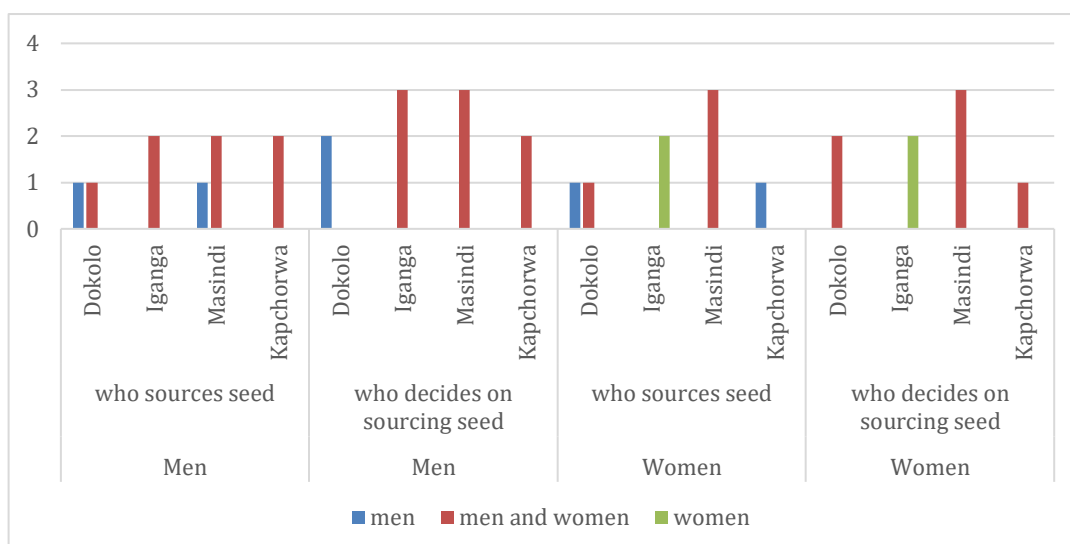


Figure 5. Gender roles in seed sourcing and deciding on seed sourcing for maize, by men's and women's groups.¹

Maize sales

Recognizing income control as an important indicator of women's and men's agency, we also assessed women's and men's roles in maize sales and in decision-making over sales, as well as income control. Figure 6 summarizes trends for men's groups and women's groups.

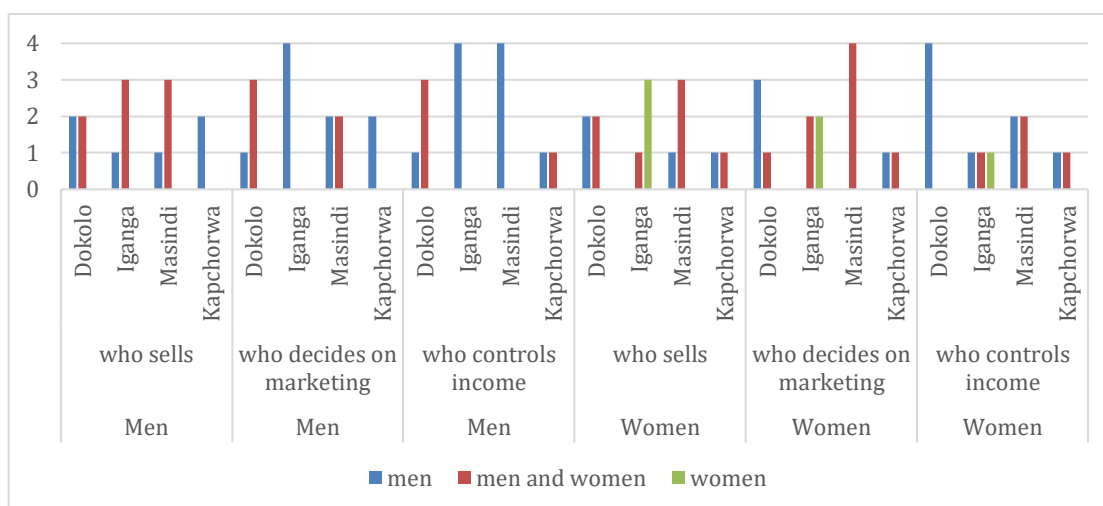


Figure 6. Gender roles in sales, marketing and control over income, by men's and women's groups.

¹ Not all groups noted seed sourcing as an activity; one Iganga group did not indicate who is responsible.

Concerning maize marketing, responses were more split with some groups reporting that men alone carried out sales and with others indicating that both women and men sold maize; however, both women's and men's groups may have tended to report most frequently that both women and men carry out marketing. On sales decision-making, men tended to report most frequently that men alone made decisions concerning maize marketing and that they alone controlled maize income. Women's groups contrasted with men's in reporting that both women and men contribute to decision-making on marketing (rather than men alone). Women coincided with men in noting most frequently that men alone controlled maize income. It should be noted that some women's groups in Iganga noted that maize marketing, decision-making on marketing and even income control pertained to women alone. In Dokolo all women's groups reported that men control income, while the men's groups generally indicated that both men and women participate in decision making on marketing and control income.

Agronomic practices

In Dokolo all men's groups and women's groups mentioned that ploughing is done either by hand using a hand hoe or with an ox plough. Only one women's group mentioned a tractor. In Iganga, all men's group mentioned ploughing is done by either tractor, ox plough or hand hoe, while one women's group mentioned hand hoe only and three groups mentioned ox plough or hand hoe. In Masindi and Kapchorwa all men's and women's group mentioned ploughing is done either by tractor, ox plough or hand hoe. It should be noted that ploughing by ox-plough and operating a tractor is generally carried out by men, while women more commonly operate the hand hoe. It should be noted that, in general, ownership of ox-plough is not common among smallholder farmers (both women and men), and the services are often hired. In all villages the men's and women's groups mentioned that they do line planting. This is one of the good agronomic practices that most farmers apply. Line planting with rope and sticks is quite labor intensive and the rope is not always used. Row planting facilitates weeding, spraying and fertilizer applications. In the villages in all districts weeding is done manually. Only one women's group in Iganga mentioned a chemical weed killer. Men's groups and women's groups across districts tended to note that weeding is carried out by men and women and by children when they are not in school. An exception arose in Iganga, wherein women's groups (three out of the four) noted that women and children

carried out weeding, without men. In Dokolo, men's groups noted that spraying is carried out by men. Not all women's groups in Dokolo mentioned spraying, but when they did they noted that it was men's responsibility. In Iganga, men mentioned that spraying is a men's task and the women did not mention spraying as an activity related to cultivating maize. In contrast to the other districts, in Masindi, men's and women's groups noted that either men or men and women carried out spraying. In Kapchorwa, spraying was mentioned by men, but not by women. This could indicate that women primary decision-makers in Dokolo and Iganga depend on men for spraying; either via family or hired labor. With the FAW infestation, spraying has become an even more important activity to prevent yield loss during crop growth and it is not surprising that most groups mentioned spraying as one of the activities in the seasonal calendar.

Other farm and non-farm activities

For those groups that discussed livestock production as a primary livelihood activity, income generation surrounding the sale of cows and cows' milk arose most frequently in the discussions. Men's focus groups tended to report that men alone or both women and men were involved in the sale of cows, including the decision-making. Women tended to report that women alone or both women and men were involved in the sale of cows' milk, including the decision-making on milk sales. Men tended to indicate that men alone or both women and men controlled income related to livestock production; in contrast, women's responses were more varied, noting that in some cases men alone, both women and men, or women alone controlled income related to livestock production.

In general, concerning income sources, men and women most commonly mentioned farming and animal rearing as income generating activities, followed by casual labor and petty business (**Error! Reference source not found.**). Concerning non-farm income-generating activities, men tended to indicate that men or men and women controlled this income, while women's responses were more varied. Men's and women's groups tended to coincide in reporting that men were largely responsible for income from boda boda (motorcycle transport) and brick-making, while women were greatly responsible for weaving baskets/mats and tailoring. Men's and women's groups reported that both men and women were responsible for income from brewing alcohol businesses and petty businesses such as

making pancakes, retail and hotel businesses; however, a few women’s groups clarified that women might carry out the activities, while men control the income.

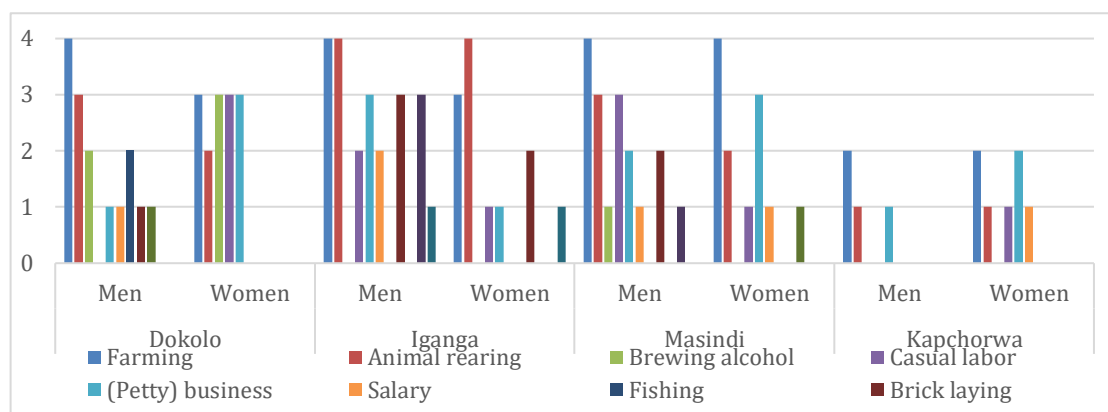


Figure 8. Main income sources in the villages, by district and by men’s and women’s groups.

Both women’s and men’s groups tended to report that women were mostly responsible for household/homecare activities; however, those activities wherein men were noted to contribute at times included childcare, fetching water, collecting firewood, cleaning the compound, praying and reading the Bible, washing clothes, house building/maintenance, and caring for the sick. One women’s group in Masindi noted that men and women carried out cooking. It is also worth highlighting that one men’s group in Kapchorwa and one in Dokolo reported that “providing for the family” was an activity carried out by men alone.

Typical “male” vs. “female” activities

When women and men were asked about any activities in their villages that were typically male activities that women were not allowed to do, the activities named most frequently tended to be building houses and digging latrines (Figure 7). Figure 7 and Figure 8 below display only those activities that were mentioned by more than one group. In comparison to women and men in other districts, women in Dokolo mentioned building houses most frequently (all four focus groups), and men in Dokolo mentioned digging latrines/graves most frequently (all four focus groups). When asked what would happen to a woman if she performed the activities reported, some women’s and men’s groups noted that nothing would happen, others noted that it would be shameful, and others noted that it was culturally unacceptable. A few women’s groups mentioned that it was taboo for a woman to climb up a house. Those groups that mentioned that nothing would happen clarified that the

activity required significant physical strength that disabled women from carrying it out. Similarly, a few men’s groups and one women’s group noted that climbing trees would be inappropriate for women. While all men’s groups named various activities inappropriate for women to carry out, there were a few women’s groups from Iganga and Masindi who gave no response.



Figure 7. Men’s activities inappropriate for women, by men’s and women’s groups.

Subsequently, when men and women were asked if there existed typically female activities that men were not allowed to do, cooking and using a grind stone were noted most frequently (Figure 8). Cooking was mentioned by a few men’s groups in Iganga and Kapchorwa and by several women’s groups in Dokolo. Using a grind stone was noted by several men’s groups in Dokolo and one from Iganga and few women’s groups in Dokolo. When asked what would happen to a man if he were to carry out the activities mentioned, both women and men reported that it would be a shame for him, similarly to responses given concerning repercussions if women were to carry out typically male activities. However, in contrast to women’s and men’s responses given during the discussion on typically male activities that women could not perform, in the discussion of typically female activities it was not mentioned that men were physically incapable of carrying out typically female activities.

Additionally, despite the number of women’s activities named, it should be highlighted that women’s groups frequently responded that there were no women’s activities inappropriate for men to carry out (See Figure 10, “None”). This was mentioned across districts for women,

but most prominently in Masindi, Iganga and Kapchorwa. In particular, one group in Masindi mentioned that men and women share roles. One men’s group from Iganga and two from Masindi similarly named no women’s activities inappropriate for men. While taking note of the trend across women’s groups, it is important to note possible discord between women’s and men’s responses per district. For example, while several women’s groups in Iganga mentioned that no women’s activities are inappropriate for men, men’s groups in Iganga noted that men should not cook (two men’s groups) and men should not use a grinding stone (one men’s group). Both women’s groups in Kapchorwa listed no women’s activities that men could not do, but men’s groups in Kapchorwa noted cooking and smearing a house with cow dung. In Masindi there may have been more agreement between men’s and women’s responses: two men’s groups and three women’s groups noted that there were no women’s activities inappropriate for men. In Dokolo district, women’s and men’s groups seemed to be in agreement that there do exist typically female activities that men should not carry out (although they might disagree on what those activities are), except for one women’s group.



Figure 8. Women’s activities inappropriate for men, by men’s and women’s groups.

Saving and borrowing from community groups

Village groups reported by men and women tend to be Savings and Credit Cooperatives (SACCOs), VSLAs, self-help groups and farmers’ groups or associations. Some differences between districts are that in Iganga, self-help groups were mentioned and in Masindi and Kapchorwa cooperatives and SACCOs. In general villages do not have social safety nets in

place for those that do not have sufficient food or are in financial crisis. Casual labor is then the most common activity to generate some food or cash or survive. Those villages that mentioned self-help groups and cooperatives, indicated that those institutions sometimes helped.

Throughout all villages, saving is done on a weekly basis. Saving is generally done for medical treatment, school fees, buying food, agricultural inputs and animals. Apart from Dokolo, the groups in the other districts also mentioned saving to invest or start small businesses.

Most groups mentioned that borrowing is done at VSLAs at a rate of 10%. Purposes for borrowing are the same as for saving. In some villages no collateral is needed, while in other villages some form of security is needed, which can be either other group members or small equipment such as motor cycles, bicycles, house equipment or animals or land. Interest rates from VSLAs and SACCO's is around 10%, banks 26% and loan sharks 20%. Repayment period for VSLA's and SACCOs is generally 3 months with a maximum of 6-9 months. Repayments are done monthly.

Annual activity cycle

Men's groups reported that busiest months of the year tended to be March-April and July-August, due to planting and harvesting. Similarly, women's groups reported the busiest times of the year as March through May and August and September, due to planting, weeding and harvesting activities. Both women's and men's groups coincided in naming April and May as times of food scarcity, as this coincides with the time just before harvest. In addition this is the period where sickness is common (malaria and diarrhea). This means that during the peak period that family labor is needed to cultivate crops, people are weakest due to food scarcity and sickness. This period also coincides with the period that households have less money available (to buy food and pay for medical care).

According to women and men, expenditures tended to be highest during December and January, due to festivities and deadlines for school fees. Groups indicated that men and women spend more time carrying out non-agricultural work in December and January. This tends to coincide with times of no rain. Saving and borrowing occurs over the year as necessary, and both women and men are involved in decision-making over when to save and borrow.

Four cell analysis

The four cell analysis tool was used to provide information about crops grown by men and women in categories of a) Many households, large production area; b) Many households, small production area; c) Few households' large production area; and d) Few household, small production area. Overall, the tool was used to generate information about the type of crops commonly grown in the area, reasons for growing the crop as food, income or both, yields and whether the groups perceived the yields as high or low.

The indication of which crops are grown for which purpose gives an indication of which crops are commercialized and where farmers potentially invest resources. The explanations around why certain crops are at a particular scale gives us an insight in barriers that farmers face. The yields give an indication whether the yield potential is achieved or whether there would be options to increase productivity if barriers were addressed.

Cropping pattern

Figure 9 shows the number of crops that were mentioned by men's and women's groups, whereby the maximum number of crops discussed was 16. Four crops per category. On average, both men's and women's groups mentioned at least 12 different crops, except for men's groups in Kapchorwa, which averaged at 11.5. Women mentioned more crops than men, with the exception of groups in Iganga. Men and women indicated around eight crops that are the same for both men's and women's groups in each village of which at least half in the same category, except for Kapchorwa. In Dokolo men mentioned more cash crops than women.

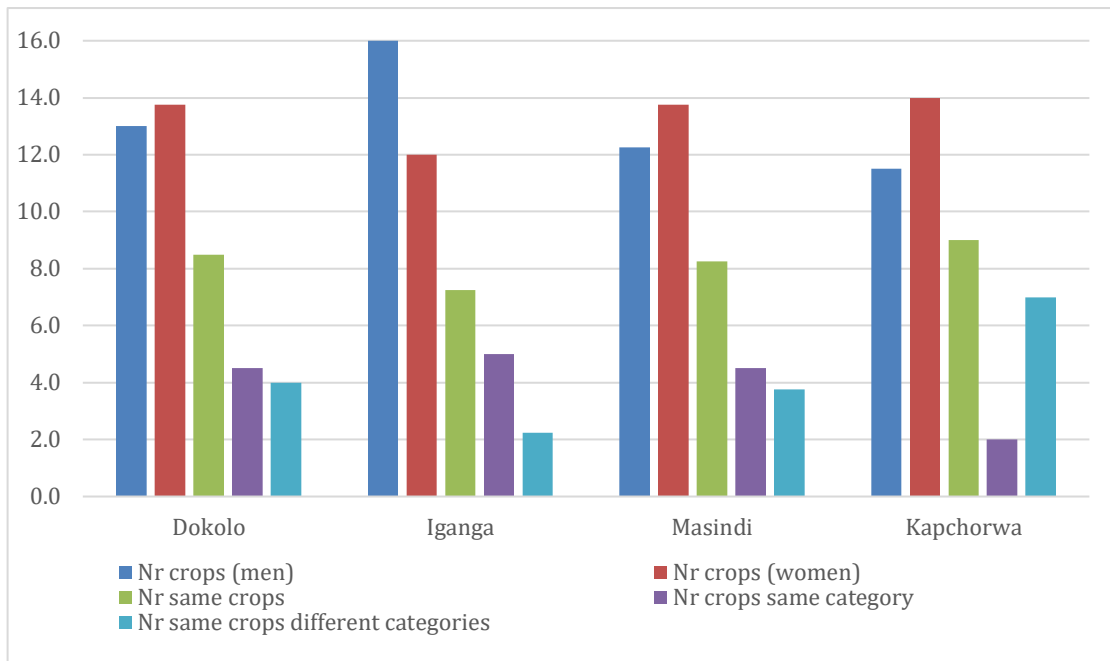


Figure 9. Average number of crops, number same crops, crops in the same category and same crops per category, by district and men's and women's groups.

Figure 9 shows that in all districts the cropping pattern is diverse and communities grew a large number of different crops at different scale within a year. All men's and women's groups in the villages in all districts mentioned maize in the same category, many farmers growing maize on a large area. Other crops that were mentioned in the same category by men's and women's groups in at least three villages were soy beans and beans in Dokolo, beans in Iganga, and cassava in Masindi. In Kapchorwa only 2 villages were interviewed. We note that the number of crops and overlap of crops mentioned by men's and women's groups in the districts follows a similar pattern in all districts. Roughly 60% of crops mentioned by men's and women's groups are the same crops and of those crops, between 50% and 60% in the same category, with the exception of Kapchorwa district. We note gender differences in crops mentioned as approximately 40% of the crops mentioned by men's and women's groups differ. In the subsequent sections, we further explore these differences and commonalities.

Figure 10 shows the twelve crops that were mentioned most by both men's and women's groups, but not necessarily in the same category. Maize, beans and cassava are common crops in most districts, which corresponds with the main staple food in Uganda. Groundnut

is commonly used in sauce in the selected districts and is also an important food crop in all districts.

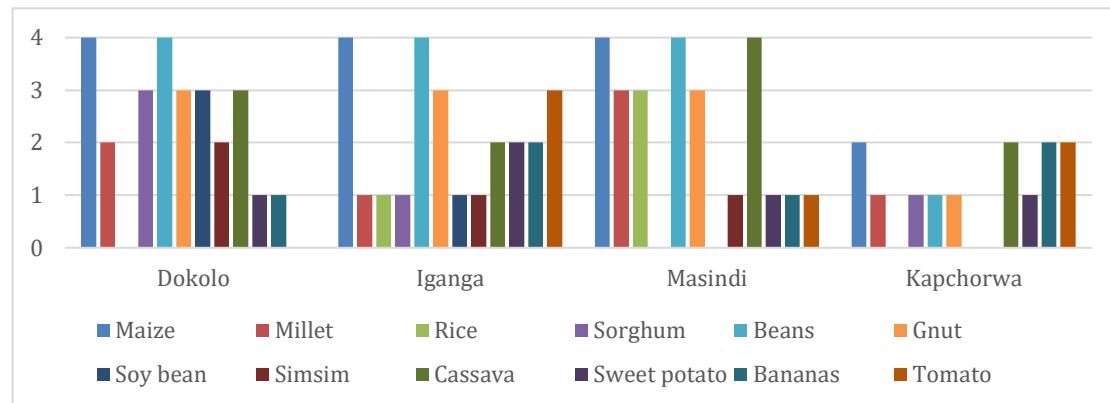


Figure 10. Number of times crops mentioned by both men and women in a village, by district.

Purpose of growing crops

To understand the role these crops play in the village for generating income and food security as well as to assess whether it is likely smallholder farmers would invest in the crop we asked the purposes for which the crops were grown. The purposes were defined as food, if the crop was mainly grown for household food consumption, for income in case the main purpose was to sell the harvest or both purposes when neither one outweighed the other. Not all groups mentioned the purpose of growing a particular crop.

In all villages maize is grown on a large area by many farmers. All groups except for one, a men’s group in Masindi, mentioned that maize is grown for both food and income purposes. In Iganga, men mentioned that maize is easy to grow. Although men and women both look at crops for both purposes (food and income), the method that income is generated from maize seems to be different. From the group discussions we derived that men tended to sell in bulk and women tended to sell piece meal every time they need some money to cater for their needs. Maize is considered as a very important crop in all villages and not only for the grain, but other purposes as well. In Dokolo maize is used for food, animal feed, income, preparing local brew and firewood. In Iganga and Kapchorwa material for mulching was also mentioned. In Masindi and Kapchorwa cobs (after harvest) are not used as firewood. By products that are commonly sold are bran in all districts and cobs in Iganga and Kapchorwa.

Figure 11 provides an overview of the purposes that men's and women's groups indicated for the staple crops most commonly mentioned and the category of production in the village. We observe from the figure that most staple crops are grown for dual purposes.

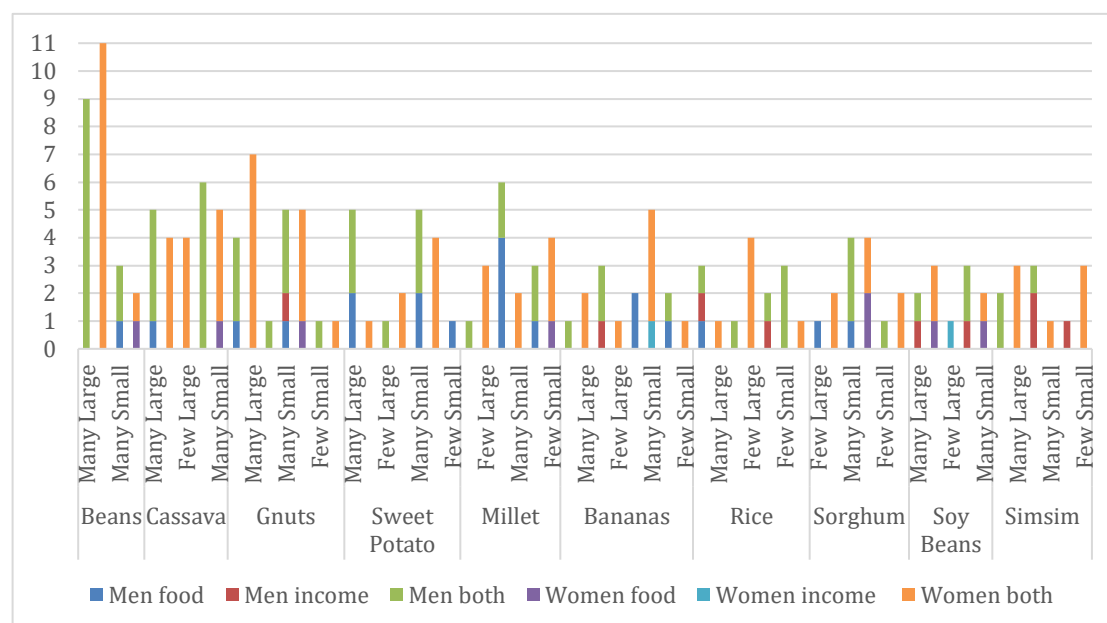


Figure 11. Purpose staple crops grown by gender, crop and category.

Crops grown for food alone are more commonly grown by many farmers on a small area. However, mostly crops are grown for dual purposes as mentioned 31 times by men's groups and 38 times by women's groups.

Barriers to expand production or productivity

When we review the explanations around why which crops were grown on what area, we observe the following trends and reasoning:

- Beans is generally grown for food and cash. It is sometimes intercropped to improve soil fertility.
- Traditional cash crops have a major labor constraint and for some also a land constraints.
- For the new cash crops (vegetables), having the right skill set appears to be a major constraint.
- In Masindi land shortage was mentioned a few times or rather that crops require a lot of land.

- In Iganga, men explained that groundnut is popular because it is not labor intensive, seed is available and has an easy market. In Kapchorwa, groundnuts have a good market.
- In Masindi, men considered sweet potatoes as a food security crop, while women consider it as a good and income generating crop. In Kapchorwa it is grown because it is drought tolerant.
- Millet is mainly grown on a small area because it is labor intensive (Iganga and Kapchorwa), easily affected by birds (Masindi).
- Sorghum is not widely consumed and easily affected by birds and other pests. It is mainly grown to supplement household food and prepare local brew. In Iganga and Kapchorwa it has no market demand.
- In Dokolo soy bean was considered a cash crop as it fetches high market prices. There are two large processors that have factories in Northern Uganda explaining the high(er) demand. In Iganga soy beans demand is low and it is considered a labor intensive crop and thus not very popular. Soy bean is grown for food, milk, livestock feed and intercropping with maize.
- In Dokolo sesame fetches a good market price and therefore grown by many households. In Iganga the yield of sesame is affected by low soil fertility and it is considered labor intensive. In Masindi, men look at sesame as a cash crop, while women also consider it for food. It has a high market demand, is labor intensive and sensitive to soil (fertility).
- In Dokolo men mentioned land shortage for bananas, oranges, rice (many farmers, small area), and cow peas (few, small); crops cultivated for income (and food).
- In Dokolo land infertility is mentioned with regards to millet (also easily affected by pests), cabbage (and lack of skills) and onion (also lack of skills and high maintenance). In Dokolo growing cotton is labor intensive and high maintenance. The women's groups did not provide further detail, apart from high market prices for sesame and land shortage for sweet potatoes.
- In Iganga men noted that sugarcane and watermelon are expensive to produce and that is why few farmers grow them. In Iganga crops grown by few farmers on a large area mentioned by both are sugarcane, tomatoes and watermelon. Women attributed the choice to small scale business opportunities and food, while men emphasized

challenges like pest and diseases for tomatoes, high cost of production for watermelon.

Figure 12 provides the overview for the most commonly mentioned vegetables and more traditional cash crops. Fruits and vegetables were often mentioned. In addition to those mentioned in Figure 12, others that were mentioned less frequently include watermelon, passion fruits, oranges, ethula (bitter berries) and Sukuma wiki (green leaves).

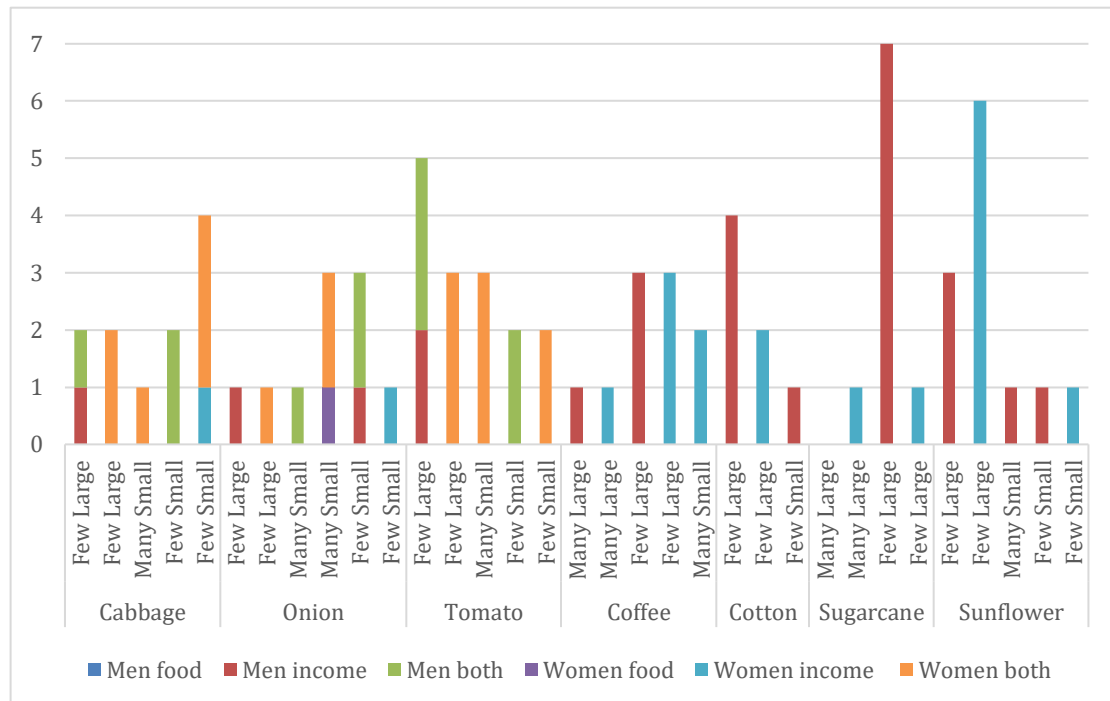


Figure 12. Purpose vegetable and cash crops grown by gender, crop and category.

A gender difference is noted in Iganga, where men’s groups mainly mentioned cash crops (coffee - 1 group, sugarcane – 4 groups, tomatoes – 4 groups and watermelon – 3 groups) for few farmers on a large area, while women’s groups only mentioned sugarcane (1 group) tomatoes (2 groups) and watermelon (1 group) for few farmers on a large area, but for both purposes. Men noted that sugarcane and watermelon are expensive to produce as a reason why few farmers grow them. For tomatoes, women’s groups attributed the choice to small scale business opportunities and food, while men’s groups gave emphasized challenges of pests and diseases as reason why few farmers grow tomatoes. In Iganga, men mentioned sesame, sunflower and onions as crops grown by few farmers on a small area because of loss of market value, difficult to grow and labor intensive.

In Dokolo some groups mentioned that onion, tomatoes and cabbages are grown by few people on a small scale because they are hard to manage crops (skills and labor as these crops are still relatively new crops in Dokolo. In Iganga some men mention that they do not know the management practices for tomatoes and onions and that onions are labor intensive and the soils are poor. In Kapchorwa onion and tomatoes are mainly grown for income. According to some men, many farmers do not understand the hard agronomic practices of onions and tomatoes. Majority is grown by people who completed school but have no jobs.

Figure 12 also shows that the more traditional cash crops in Uganda are still somewhat common in the districts. Cash crops that are grown by many farmers on a large area only for cash are few. They were mentioned by four men’s groups and two women’s groups and include coffee, soy beans, sorghum, rice and sugarcane. Cash crops grown by few farmers on a large area were more common. These included sunflower (9 times), coffee (8), cotton (6) and tobacco (3).

Estimated yields and yield perception

Table 5 provides an overview of the crops, yields and whether the groups perceived the yield as high or low. For the crops with an * the yields given with a low yield perception were significantly different the yields given with a high yield perception. All focus groups, except one women’s group and one men’s group in Dokolo, mentioned that soil fertility is low in their communities, which could partly explain (in combination with low fertilizer use and occurring weather events), why most yields are much lower than their yield potential.

Table 5. Estimated yield per ha. for low and high yield perceptions and yield potential.

Crop	Low yield perception			High yield perception			Yield potential (kg/ha)
	No of responses	Mean (kg/ha)	SD	No of responses	Mean (kg/ha)	SD	Variety list
Maize*	14	2043	1081	14	3,948	2,101	8-10,000 (hybrids) 5,0000 (OPVs)
Finger millet	6	844	244	12	1,661	1,187	2,000 – 3,000

Crop	Low yield perception			High yield perception			Yield potential (kg/ha)
Rice	5	2,270	1,543	10	3,248	3,008	
Sorghum	5	912	616	6	1,058	553	2,500 – 3,500
Simsim	9	516	430	5	777	731	
Beans*	13	650	357	13	1,346	860	2000
Cassava	6	4,300	2,443	18	10,507	13,882	40,000
Gnuts*	7	841	458	16	1,721	760	2,500
Soy Beans*	9	722	421	5	1,815	1,285	2,000 – 3,500
Sweet potatoes	4	2,125	1,237	12	4,291	3,161	30,000

Source variety list: [National crop variety list for Uganda \(2015\)](#)

When comparing the yield given by focus groups and the yield potential, we see that for all crops the yields that are perceived as low are indeed less than half the yields that are perceived high for the crops where the mean is significant different (*) and for some of the other crops as well. In addition, the yield of maize and sorghum in the high perception column are only half of the yield potential as stated in the National Variety list. Millet, beans, soybeans and groundnut high perceived yields are around 2/3 of the potential. For some crops like cassava, sweet potatoes and coffee, women (Dokolo) found it difficult to quantify volumes of crops grown in small areas as they harvest small portions at a time, according to needs for food or cash. In one village in Dokolo both men's and women's groups mention that the yield of soy beans is low, probably because as mentioned in the resource mapping the soil fertility is low. In Iganga groundnuts suffer from degraded soils, for beans they do not have a good variety that gives a high harvest. We noted that women in Dokolo, Iganga and Masindi had more difficulties estimating yields than men and some had lower yield perceptions.

Maize related focus group discussions

Focus group discussions with open ended question were used to gain an in-depth understanding of why smallholder farmers are not generally buying quality seed from agro-dealers and seed companies. The discussions were to probe the underlying reasons that are generally provided by farmers in surveys (for example, seed is expensive, no access, not enough information) and to understand whether beliefs about seed sources, and particularly

the agro-dealers and seed companies, may be a bottleneck in adoption of drought tolerant maize varieties. The agro-dealer and seed companies are part of the formal seed value chain that would be necessary for disseminating new varieties commercially. The focus group discussions also tried to gain a deeper understanding on variety and seed selection criteria such as yields and markets.

Maize varieties in the districts

The most common varieties mentioned in the focus group discussions were the Longe series, released through the national research institutes; both open pollinated varieties (OPVs) and hybrids. Figure 13 shows the most mentioned maize varieties. The older Hybrids were released between 1991 and 2009 and the newer ones in 2012 and 2013. The Kenyan public varieties were released in 2005. Pannar and DK were released by the private sector around 2004. Most OPVs were released in 1999 and 2000, whereby Longe 5 was further developed into Longe 5D, which was release in 2012.

As shown in Figure 13 a wide range of varieties were mentioned by men's and women's groups. The average number of varieties mentioned per group is six. Apart from Dokolo, men's groups named more varieties than women's groups. These varieties included hybrids, mainly the older ones, open pollinated varieties (OPVS) and in each group at least one local variety was also mentioned. In Iganga one local variety, Mawalampa, was mentioned by all men's groups and three women's groups. In the other districts not one specific local variety was mentioned by all groups. Longe 10H was mentioned by all groups except two in Kapchorwa, where the variety is not very suitable climatologically. Longe 5 was mentioned by 25 groups, with only once in Kapchorwa where the variety is not very suitable climatologically. Longe 5 is the most well-known OPV in Uganda and one of the key varieties together with Longe 10H that is distributed for free by OWC/NAADS (government program).

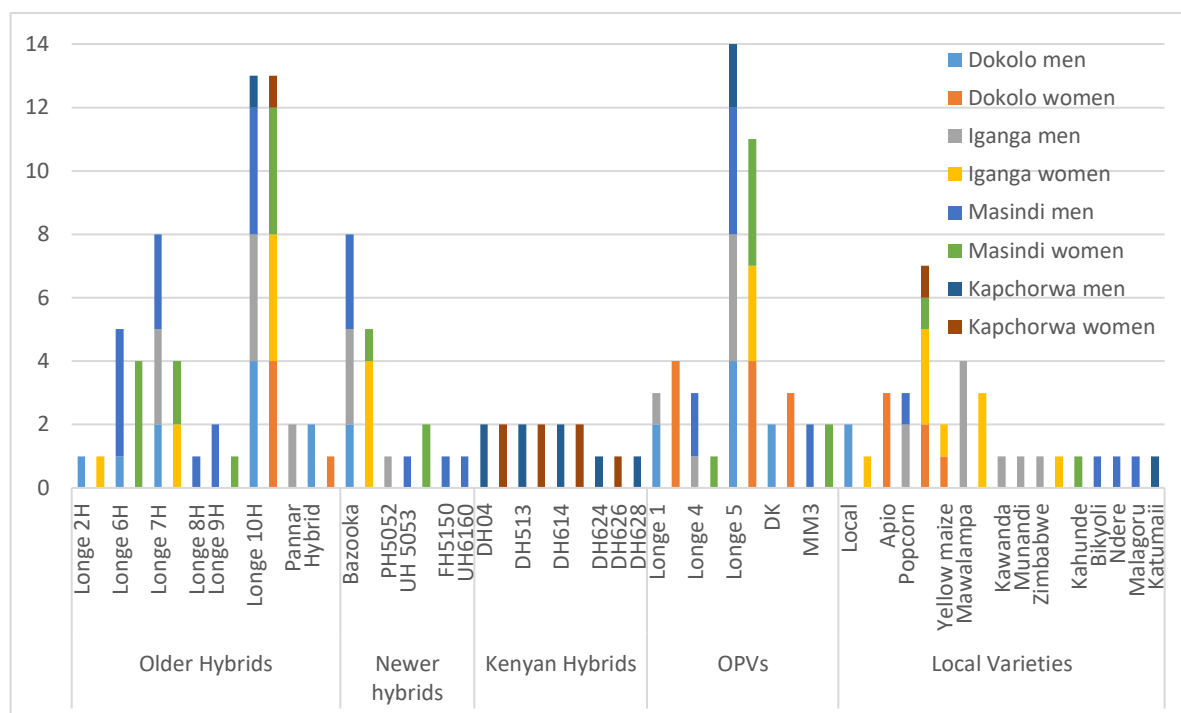


Figure 13. Varieties known in villages, by district and men's and women's groups.²

When we look at district differences we noted that in Kapchorwa only Kenyan hybrids were mentioned apart from Longe 10H. In Dokolo most varieties are older varieties, with the exception of Bazooka, a variety released by NARO and promoted by NASECO seed company (2 men's groups). In Iganga, Bazooka was mentioned by three men's groups and four women's groups and in Masindi by three men's groups and one women's group. The following newer Hybrids were also mentioned: PH5052 in Iganga, promoted by Pearl seed company, once by a men's group; UH5053 in Masindi promoted by Masindi seed company, by a men's group and by two women's groups; and FH 5150 in Iganga, promoted by FICA seed company by one men's group. The so called new varieties were released from 2012 onwards and are characterized as drought tolerant maize varieties. Yet, these new varieties are not yet very common in the villages as one was only mentioned once, by a women's group in Masindi (see Figure 14). The most common varieties grouped in type of variety as mentioned by men's and women's groups in the different districts is shown in Figure 14. In Dokolo and Masindi, older hybrids and OPVs are most common, while in Iganga older

² The variety name "Local" in the category local varieties was used in case where groups only mentioned local variety without giving the local name.

hybrids and one particular local variety are mentioned more often and in Kapchorwa the Kenyan varieties.

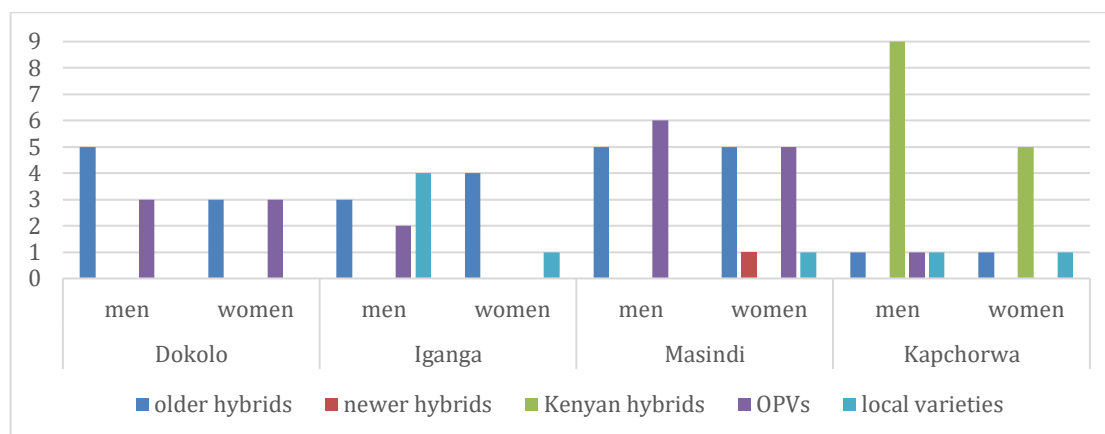


Figure 14. Variety types most commonly grown in villages, by district and men's and women's groups.

Farmers look at the performance of the varieties during the previous season to decide which varieties they want to grow the next season. They look at maturity periods, yields, pest and disease resistance. Three women's groups in Dokolo, one men's group in Iganga and one women's group in Kapchorwa mentioned that they decide on the variety as a family. The other groups did not mention this. One women's group in Kapchorwa also indicated that it depends on whether there is money at home. Support from government, NGO and/or seed company extension workers was mentioned by more men's groups than by women's groups. Extension services seem to be more available in Iganga and Masindi compared to other districts.

Most common seed sources in the districts

Figure 15 shows the most common sources of seed mentioned by men's and women's groups in the different districts. The main source of seed for women in Masindi is the agro-input dealer and for women in Dokolo and Iganga home saved seed. The main sources of seed for men in Iganga and Masindi were formal sources (agro-input dealer and seed companies) and in Dokolo informal sources (local market, homes saved and neighbors). A number of seed companies produce seed in Masindi and Iganga districts, making them more accessible to farmers. A number of group members indicated that they are out-growers for these seed companies, benefiting from contract farming (secure grain price and planting material on credit). Groups gave as main reason for using seed from neighbors, friends

and/or home that it is cheap. In addition, for home saved seed farmers are sure of the germination and quality as they observed previous harvests and were involved in processing the seed. Twelve women’s groups and eleven men’s groups among all districts indicated that they do not have money to buy seed or that seed is expensive (See also Figure 19— reasons not to plant DT maize). This was most frequent in Dokolo and Iganga, and less so in Masindi and Kapchorwa. At the same time those that grow maize commercially (more men than women) go to the agro-dealer to buy good quality seed even though at times agro-dealer seed is not trusted. Seed from the government is free and therefore used. One women’s group in Dokolo expressed a misconception about seed from agro-dealers and believed the seed had FAW.

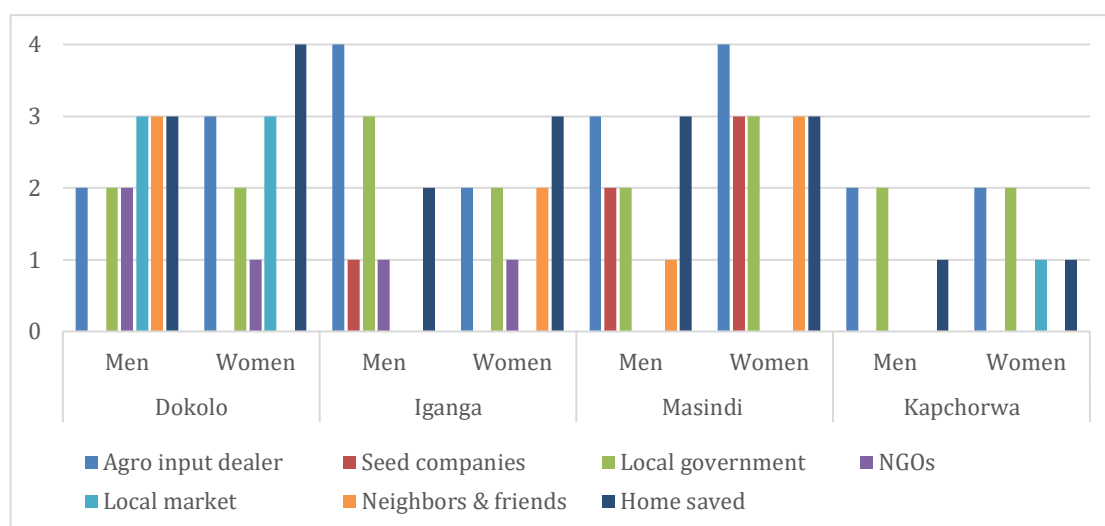


Figure 15. Main sources of seed across districts, by men’s and women’s groups.

As shown in Figure 16 the most and the least trusted seed sources as perceived by men’s and women’s groups vary across districts and gender. When home saved seed is mentioned as most trusted it is because, amongst other reasons, the farmers know the germination potential, it is not mixed, and it is well stored. In Iganga, the local variety Mawalampa is perceived as high yielding, big grained and therefore popular in Iganga. When home saved seed was mentioned as least trusted it was because the grains are small and low yielding and easily attacked by weevils during storage. Agro input dealers are trusted because the seed is treated, high yielding and not easily affected by pests and diseases. Kenya seed company is trusted because it gives a warranty on the seed pack and seed is certified. In Masindi seed companies are most trusted because the farmers are their out-growers, they get seed on credit and the company buys back the yield. Agro dealers were least trusted because of

counterfeit seed, the crop is affected by FAW, germination is unreliable. When local government/ projects/ NGOs were mentioned as most trusted it was because the farmers receive training (only in Iganga), the varieties are high yielding and because they are either free or sold on credit (Iganga). When local markets were mentioned as most trusted it was because seed is always available and cheap. Local markets, middlemen and local traders were mentioned only in Dokolo and Kapchorwa as least trusted source. Groups gave as reasons poor storage conditions leading to low germination rates, mixed seed/ fake seed, high cost of seed and no business connection when mentioning local markets, middlemen and traders. Fellow farmers were mentioned as least trusted because they do not always give good quality seed. Local government was mentioned because the seed comes late and is susceptible to pests and diseases.

Figure 16 shows that home saved is a trusted source, particularly by women's groups in Dokolo. Agro-dealers are least trusted, particularly by groups in Iganga and men's groups in Masindi, while two women's groups indicated that they trust agro-dealers. Free hand-out of seed was trusted mainly in Iganga by both men's and women's group and one men's group in Kapchorwa, but not in Dokolo or Masindi. Despite the lack of trust in some seed sources farmers do use these sources commonly as indicated in Figure 15.

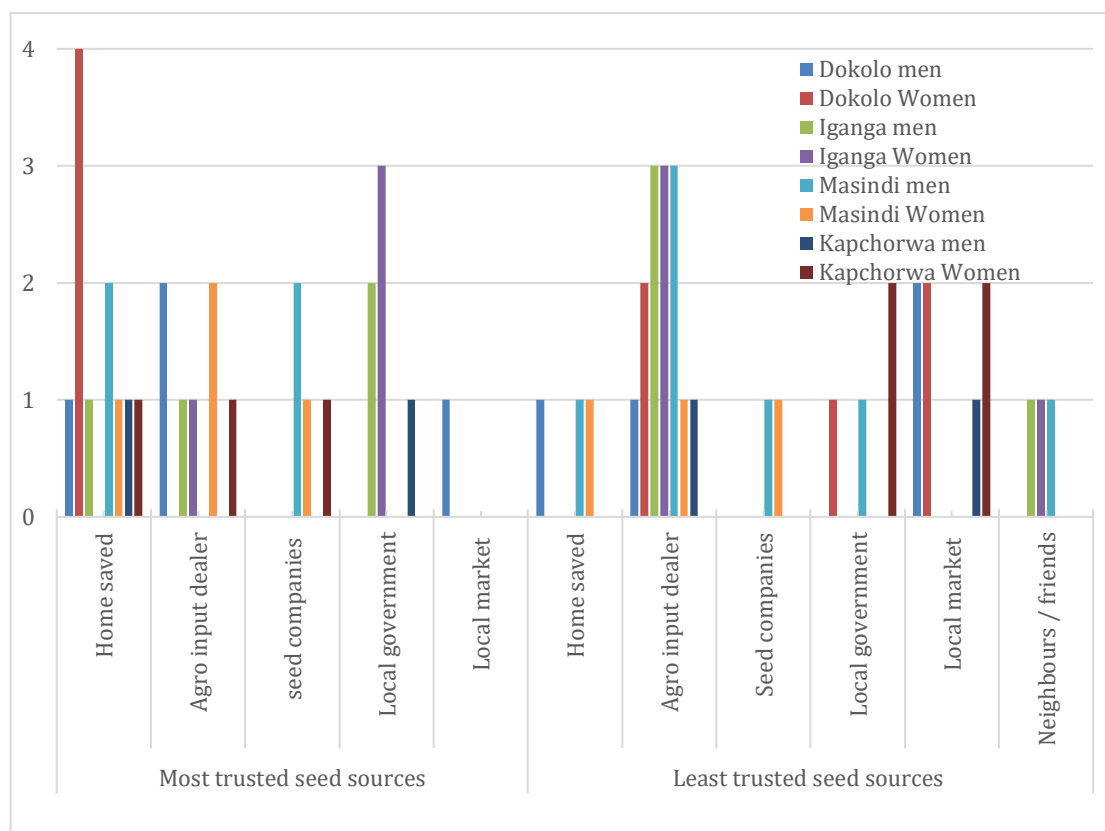


Figure 16. Most and least trusted seed sources across districts, by men’s and women’s groups.

We asked the groups to elaborate on the reasons for buying seed from agro-dealers and for not buying seed from the agro-dealers. We particularly zoomed in on agro-dealers because these are the optimum channel to disseminate drought tolerant hybrid maize varieties; our varieties of interest in this study. This section looks at reasons for (not) buying seed at agro-dealers unlike the previous section, which looked at reasons to (not) trust agro-dealers. In Dokolo, some men in three men’s groups bought seed from the agro-dealers because they wanted to get high yielding varieties which are resistant to drought and to get good quality seed. In one village some women bought seed from the agro-dealer shop after seeing their neighbors getting good yields. In all villages men and women that did not buy seed from agro-dealer shops said that that high seed price/lack of funds was the major deterrent to buy seed. In addition, some said that the seed is susceptible to pest and disease, agro-dealers bring seed late and it sometimes fails to germinate. Another reason not to buy was that NAADS already gave seed for free. In Iganga the experiences with the agro-dealer shops seemed to be mixed. Reasons why farmers bought seed at agro-dealer shops were high

yielding, early maturing, and pest and disease resistant or because they did not have an alternative. Reasons not to buy seed were that the seed is expensive, shops sell fake seed and their own seed germinate better. There seemed to be a stronger negative opinion about agro-dealers in Iganga compared to Dokolo. In Masindi most men and women bought seed from the agro-dealers for various reasons, including that the seed is treated, early maturing, high yielding and the seed is genuine. In addition they mentioned that their home saved seed is not always harvested in time for planting. Reasons not to buy seed from agro-dealers were inconsistent quality, lack of trust and lack of money. In Kapchorwa all men and women mentioned they bought seed from agro-dealers because the seed is high yielding, certified well packed, genuine and fairly priced. Agro-dealers cannot afford to lose their reputation. Some women do not buy seed because transport to town is expensive and they lack knowledge on what is sold in agro-dealer shops. If OWC brings free seed, they do not buy seed from a shop.

Knowledge and use of hybrid varieties

One village in Dokolo, four villages in Iganga and Masindi and two villages in Kapchorwa know what hybrids are and most have used them. In Dokolo in one village the men know about hybrids and the women didn't. In two villages in Dokolo and one village in Masindi, both the men's group and the women's group said they did not know what hybrids are, yet they are using Longe 10H in their village. Longe 10H is a common variety to be distributed by OWC for free.

Figure 17 shows the yield potential ranges farmers think that hybrids can reach and the actual yield ranges they harvested for hybrids. Most of the men's groups and most of the women's groups underestimated the potential yield of hybrids by one third to half of the potential. The actual yields remain much behind the potential. Generally the women's groups estimated a lower yield potential than the men's groups and they also harvested less yield. Most male and female farmers are aware that they should use fertilizer with hybrids. In Dokolo, only one men's group indicated they used fertilizer, in Iganga four men's groups and one women's group, in Masindi two men's and two women's groups and in Kapchorwa two men's groups and some women. The main reason farmers gave for not using hybrids was that the seed is perceived expensive and/or fertilizer is considered expensive. In 2019 the price for a kilogram of hybrid ranged between 7,000 UGX and 10,000 UGX depending on

the variety. The average price for an OPV was 2,500 UGX. While hybrids in Uganda could yield between 8,000 kg – 10,000 kg per hectare depending on the variety, the yield potential for OPVs range between 4,000 and 6,000 kg per hectare. At the same time, hybrids need two rounds of fertilizer application and good agronomic practices, which increases the costs of using hybrids considerably.

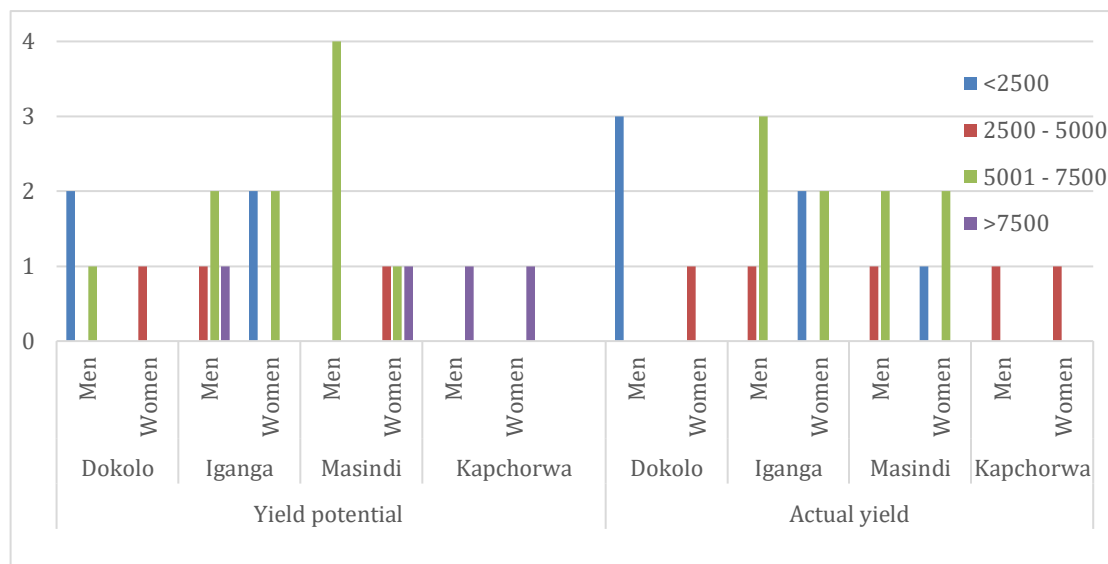


Figure 17. Estimated yield potential and actual yields of Hybrids (kg/ha), by districts and men's and women's groups.

Groups' knowledge on maize varieties with drought tolerant maize (DTM) characteristics

The drought tolerant varieties in Uganda under the DTMASS project were FH5055, Longe 9H, Longe 10H, Longe 11H, PH5052, PH5355, UG5051, UG5052, UH5053, UH5354, UH5355, Victoria 1, WE1101, WE2106, WE2115 and WE3106. To find out what farmers know about drought tolerant varieties we asked a few questions related to the characteristics, where farmers get the information from and their fears/worries around drought tolerant maize varieties.

Most farmers based their responses on their personal experiences growing different varieties and characteristics that were mentioned were dark green leaves, short(er) stems and early maturing. A number of characteristics that were mentioned were related to improved varieties in general, such as early pests and disease resistant, high yielding, two cobs on a stem, large grains. This is reflected in the examples of variety names farmers gave.

In Dokolo all men's and women's groups said that they know drought tolerant characteristics of maize varieties. Examples of varieties were Hybrids, Bazooka, Longe 1, Longe 5, Longe 7, Longe 10H and DK. One women's group mentioned a local variety. They learned about drought tolerance in maize from NGOs, radio and fellow farmers, the latter mentioned more by women's groups. In Iganga three men's groups and two women's groups indicated they know about drought tolerant characteristics and gave examples. They indicated they were trained by an NGO. The other groups did mention some names of varieties they considered drought tolerant. The main varieties the groups mentioned were Bazooka, Longe 10H and Longe 7H. In Masindi four men's groups and three women's groups mentioned they know about drought tolerant characteristics of maize. The main sources of information were radio ads, personal experience and fellow farmers. Varieties that were mentioned included Longe 10H, Bazooka, UH5053, Longe 5, Longe 7H and Mawalampa (4 men's group). In Kapchorwa, two men's groups and one women's group mentioned they know about drought tolerant varieties. Main sources of information were personal experience, extension workers, demonstrations and radio ads. They mentioned a number of Kenyan hybrids, Longe 10H, Longe 5 and a local variety.

Reasons to plant Drought Tolerant Maize varieties and not to plant DTM varieties

Figure 18 shows reasons men's and women's groups gave to plant/buy drought tolerant maize varieties. The main reasons given were drought resistant and high yielding, including big grain sizes, high flour rates and two to three cobs on a stem. While women in Masindi and Kapchorwa were able to speak to experiences with DT varieties, in Dokolo none of the women bought DT varieties. They indicated that they do not have money and keep recycling their own seed. In Iganga only one women's group indicated planting DT maize varieties.

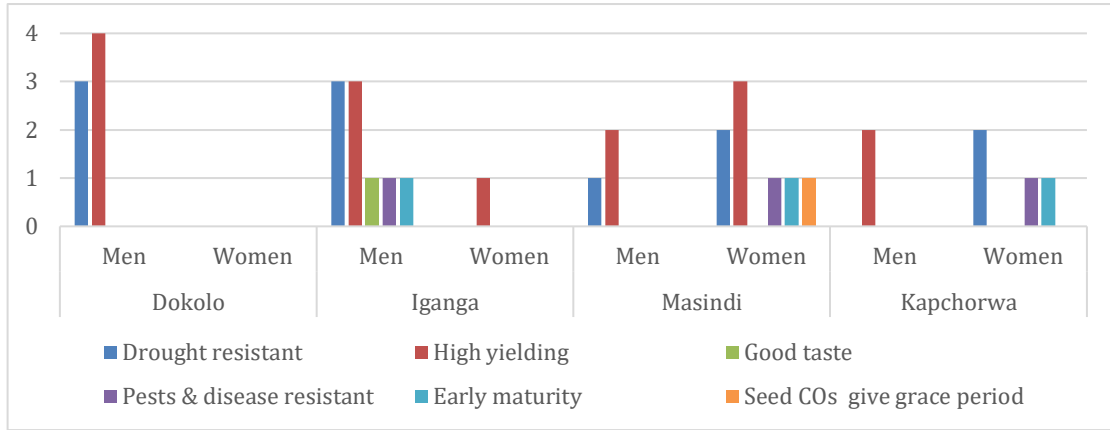


Figure 18. Reasons for farmers to plant DT maize varieties by districts and men's and women's groups.

Overall, the reason for not planting DTM mentioned across most groups is the high seed price or not having money to buy seed (Figure 19). Lack of information was mentioned most often in Iganga as well as by one women's group in Dokolo and one men's group in Masindi. Women in Kapchorwa gave different reasons from all other districts including; limited access to quality seed, low soil fertility and consumer preferences (1 out of 2 villages) as hindrances to growing DTM.

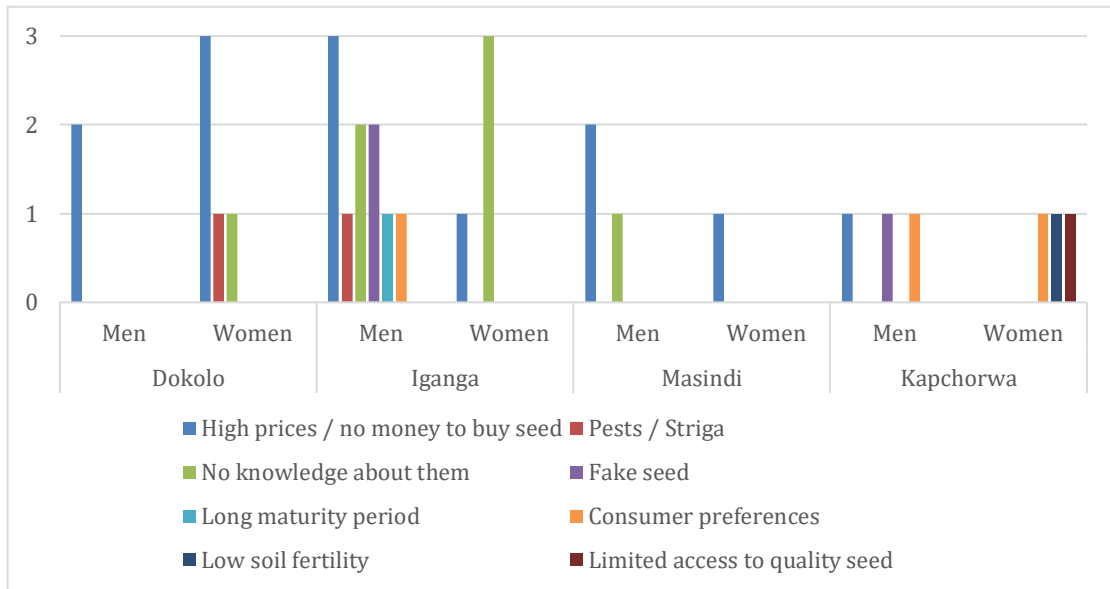


Figure 19. Reasons not to buy DT maize seed, by districts and men's and women's groups.

Risk and concern ranking

The risk and concern ranking and prioritization tool was useful for assessing district and gender trends in the most important concerns perceived by men's and women's groups in the study districts. The information was gathered asking farmers to discuss the main problems they experienced in providing for their families. The concerns named were listed and then ranked against each other, on a scale of 1 to 6 with one being the most important. The results were analyzed and categorized according to the different risk categories defined in **Error! Reference source not found.** While results from the tool show similarities across women's and men's responses, differences among women's and men's groups concerning risks perceived and their prioritization also arose. These distinctions may be associated with women's and men's differing roles and responsibilities in the household. We also see some differences between districts which may be associated with the agro-ecological zones in these districts.

Figure 20 provides an overview of the risk and concerns reported by men's and women's groups in the different districts, irrespective of the ranking (sum of the total). The risks and concerns mentioned by groups were categorized using the categories and sub-categories in **Error! Reference source not found.** As a result some risk categories were mentioned more than once by a group. In addition we used 6 ranks in each group, hence each district has a total of 20 -22 responses for the men's groups and for the women's groups, with the exception of Kapchorwa, which has 10 for each and women's groups in Iganga as the exercise was not conducted in one village. Apart from women's groups in Iganga, poverty related risks are frequently mentioned as risks in the other districts. In total poverty related concerns were mentioned 39 times, with the highest frequency in Dokolo by both men's (7) and women's (6) groups. The second most frequently mentioned risk/concern is health risk, which was mentioned 4/5 times by men's and women's groups in Dokolo and Masindi. It also worth highlighting noticeable gender differences within Iganga district. Men's groups tended to note poverty as a concern more frequently (7 times) than women's (2); also, women noted climatological concerns more frequently than men, six times versus two times. Lastly, women's groups in Iganga noted health-related risks only once in comparison to four times by men's groups.

Concerning social risks and cultural norms, it is important to note marital concerns and spousal conflicts discussed by women’s and men’s groups per district. Women (1 group) and men (1 group) in Dokolo both mentioned domestic violence as a problem; the same women’s group also mentioned poor family planning as a concern related to providing for their families. In Masindi, men did not mention intra-spousal problems; however, women’s groups noted domestic violence (by two groups), and one women’s group mentioned drinking, gambling and lazy men as concerns. With respect to the last problem, the women’s group highlighted that even though women might have purchased their own land for themselves, men will still demand the income from the land’s production. In Iganga, women’s and men’s responses suggest intra-household tensions between women and men. Women do not mention domestic violence; however, one group mentions “marriage issues” in general, and another notes conflicts over income with men and labor burdens (“overload activities”) that they would wish to share more with men. In comparison, men’s groups in Iganga mention sexual immorality (on the part of men), poor family planning, and mistrust within families. One men’s group mentions domestic violence. It is worth highlighting that a men’s group in Iganga notes that “stopping women’s empowerment” would be a solution to the intra-familial problems mentioned, potentially suggesting male resistance to the lead roles some women’s groups in Iganga had noted playing (i.e., sole responsibility for maize sales and income control).

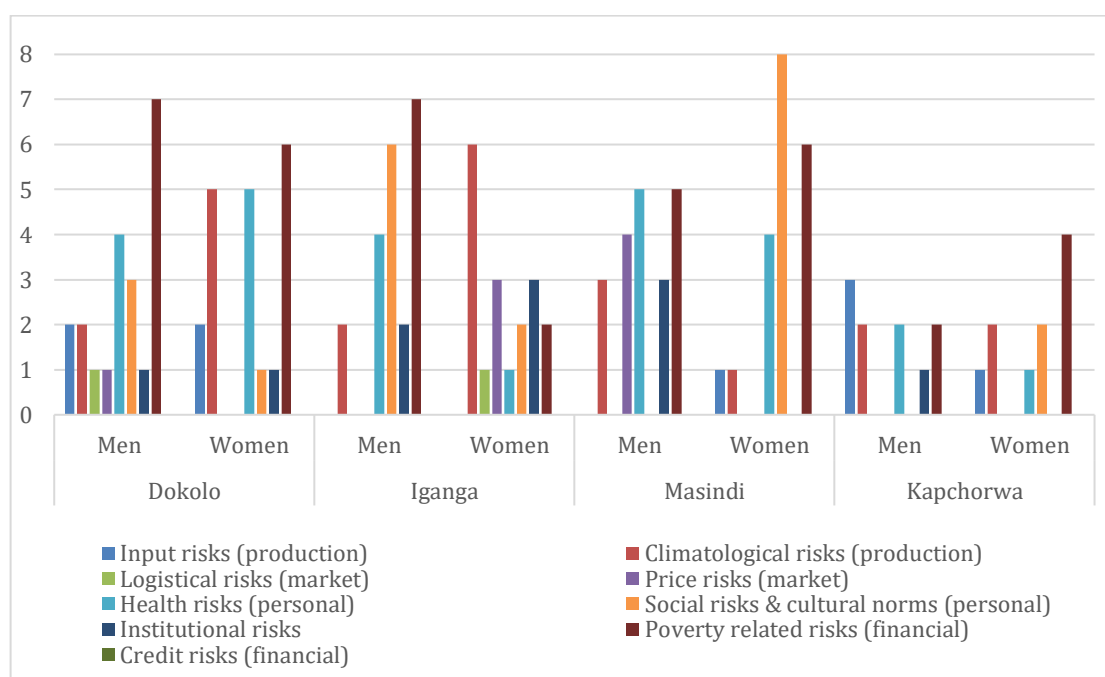


Figure 20. Risks and concerns reported, by district and men's and women's groups.

What follows is a short description of the concerns and risks that were mentioned in each of the sub-categories:

- **Production risk:** We identified two sub-categories in relation to production risks; input risks and climatological risks. Input risks were categorized as access to seed and other inputs (non-monetary), as information and as management decisions pertaining crops, seed and other inputs. Under this category men's and women's groups mentioned concerns related to poor quality of seed, lack of agro-equipment. Climatological risks were categorized as periodic deficit and/or excess in rainfall or temperature, storms, changes in cropping patterns and contamination and degradation of natural resources. Men's and women's groups mentioned hail storms, strong winds, flooding and drought, crop and livestock pests and diseases, water scarcity, distance from water sources and low soil fertility.
- **Market risk:** We identified two sub-categories in relation to market risks; logistical and infrastructural risks and price risks. Under logistical and infrastructural risks we group changes in access (physical or economic) to transport, communication, energy, degraded transport, energy infrastructure, lack of maintenance. Under this category poor roads were mentioned. Price risks relate to marketing of agricultural produce. Fluctuations in prices of inputs and/or outputs due to different causes such as changes in national, regional or international supply and/or demand that impact domestic, regional and/or international markets, changes in demands for quantity and/or quality attributes, changes in food safety and production requirements; delays and disruptions of charges along the value chains. Men's and women's groups mentioned unstable prices, low prices for produce, i.e. maize, market price changes, few enterprise development (opportunities), and few markets available.
- **Personal risks:** we identified health related risks and social risks and cultural norms. Under health risks we categorized health risks for farming households and farm workers, production failure for health and/or food insecurity reasons. Men's and women's groups mentioned human diseases, poor health services, scarcity of health centers, no medicine in the government hospitals, limited hospital, distance to health center, poor family planning, and lack of clean water as associated concerns related to

health risks. Social risks and cultural norms we identified risks related to needs for social support, safety nets, welfare services and socially or culturally influenced threats such as communal conflicts. Concerns mentioned by women's and men's groups under this category were domestic violence, mistrust in families, sexual immorality, lack of skills (generic – life skills), lack of education/ignorance on social norms and behaviors, lack of knowledge, conflicts on income and labor between husband and wife, mis-use of household resources, family neglect, high school dropout, theft at home, gambling, drunkenness, lazy men, poor quality of shelter.

- Financial risks: are risks associated with how the farm is financed and additional variability of cash flow. Concerning that we look at smallholder farmers who are ranging from semi-subsistence to enterprising, we consider the farm as a family farm, whereby the financial flows within the households are considered. We identified two sub-categories. The first is risks associated to levels of poverty, these are risks related to general poverty, generic lack of money in the household and/or food insecurity, and low levels of cash-flow within semi- subsistence households. Men's and women's groups mentioned the following concerns under this category: poverty, famine, lack of money, lack of capital to buy seed, other inputs and agro-equipment, lack of capital, food scarcity, lack of income, high cost of living, poor levels of education (opportunity for skilled jobs). The second sub-category is risks associated to credit and other financial products, which are defined as risks related to access, costs, collateral, and/or grace period of financial products, availability of financial products, and suitability of financial products to the agricultural sector. The groups did not mention concerns related to this sub-category.
- Public policy and institutional risks are risks related to unpredictable changes in policies and regulations. Under this risk category we group macroeconomic shocks and downturns, changing or uncertain policies and weak enforcement of those monetary, fiscal/tax, and financial (credit, savings, insurance) policies; unpredictable regulatory and legal measures; trade and market disruptions; uncertainty in land tenure, governance uncertainty, conflicts and political or labor disputes, corruption, weak institutions. The men's and women's groups mentioned the following concerns related to institutional risks: late delivery of free seed, insecurity, bad leadership, few schools,

unemployment, sugarcane production, lack of secondary schools, land issues and high taxes.

When we look at the distribution by main category, we note that personal risks which includes both health risks and social risks and cultural norms was mentioned 48 times. Financial risks, with no concerns on access to credit and other financial products, was mentioned 39 times. Production risks, which included input risks and climatological risks was mentioned 32 times. Institutional risks were mentioned only 11 times and market risks only 10 times. This gives an indication that most group members are not very integrated in the market system and do not consider those risks their highest concerns.

Risk ranking

Figure 21 summarizes the primary risks perceived by men’s (14) and women’s (13) focus groups across all districts, organized according to the priority rank they were given, with 1 being the highest priority and 5 being the lowest (those of rank 6 are excluded from this particular analysis). In general, women and men recognized risks and concerns related to personal risks and financial risks high across all ranks, with men giving financial concerns a higher rank than women. In comparison, women reported production related problems as a higher priority more frequently than men. Institutional and market risks are of lower ranking, apart for two men’s group and one women’s group which ranked market risks higher.

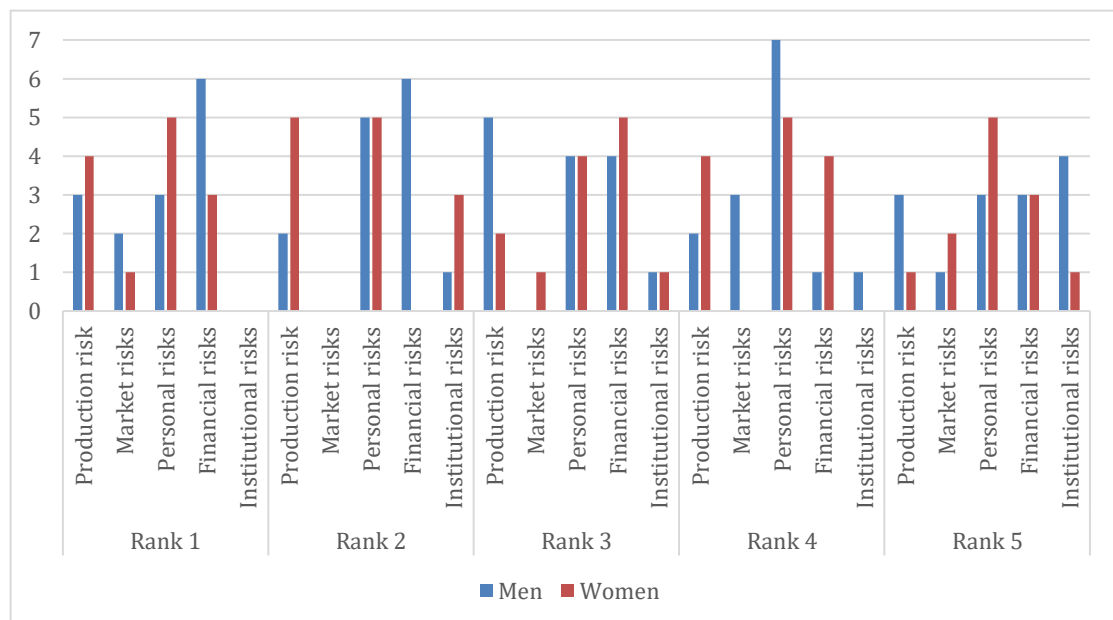


Figure 21. Risks and concerns according to priority rank, by men's and women's groups.

Conclusion

This section summarizes the main finding from the tools that were applied in the focus group discussions. We describe the main information by tool, and highlight gender and district commonalities and differences where applicable. In this section we also compare the information collected in Dokolo, Iganga and Masindi with the information collected from Kapchorwa and answer the question on whether there are key features provided in the different tools that could explain why adoption of (hybrid) certified maize seed is higher in Kapchorwa compared to other districts.

Village resource mapping

Across districts, land tends to be scarce and has multiple, competing purposes. In all villages, groups indicate that soil fertility has gone down, due to amongst others, over-cultivation, no/less crop rotation and soil erosion, Land fragmentation and land (boundary) conflicts.

Men's and women's groups tended to coincide in noting that land was controlled by men. For example, in Dokolo, Iganga, Kapchorwa and three out of four villages in Masindi, women indicated that land control is with men. Three out of four men's groups in Dokolo, Iganga and Masindi and one men's group in Kapchorwa also indicated this. There was more of a divergence between women's and men's responses across districts concerning decision-making on land use: men tended to report that men alone carried out decision-making on land use, while women noted that both women and men carried out the decision-making. Concerning other natural resources, there was more variation in responses between men and women, with men tending to recognize women's control over natural resources less than women. Among both women and men, local government was named most frequently as having control and decision-making power over water resources including streams, lakes, wells and boreholes. Concerning district-specific trends, across the types of resources (land, swamps, woodlots/forests), women's groups from Masindi tended to consistently report that both women and men control and participate in decision-making over them. Men's groups in Iganga tended to report that men alone controlled and participated in decision-making over resources.

In Dokolo, land is relatively more available compared to the other districts. In Iganga, roads were mentioned as important assets, which were not mentioned in the other districts. In Masindi part of the land is under game reserves and some villages were affected by wildlife.

Kapchorwa has a higher adoption rate for hybrid seed and fertilizer use compared to Dokolo, Iganga and Masindi and we therefore used Kapchorwa as a district for comparison. When we look at the village resource mapping we do not see noticeable differences that could explain the higher adoption rate.

Historic timeline

In terms of infrastructural development Dokolo is the least developed, followed by Iganga and Kapchorwa. Masindi is most developed with relatively more access to services and Dokolo least. Dokolo received less extension services compared to the other 3 districts. In discussions of new seed initiatives and their effects, men tended to mention extension services more than women. Despite the possible gender inequality in access to extension services, men's groups in Iganga seemed to note a trend of changing gender norms wherein women were taking on more productive roles, as a result of women's education and increased participation in community meetings.

Agriculture is the main income source in all districts and adverse climate events directly impact household food security, health status, and societal disruptions, the latter including male out-migration, school dropouts, domestic conflicts and violence. Although domestic violence was mentioned as an effect of extreme climatic events by at least one women's group or men's group across districts, it was mentioned most frequently by men and women of Dokolo. A few women's groups (from Dokolo and Masindi) noted that male violence towards women in the household can develop due to the stresses of hunger resulting from climatic events. Climatologically Dokolo and Iganga seem to be more affected by droughts and agricultural pests and diseases compared to Masindi and Kapchorwa. Drivers of climate change were identified as deforestation, encroachment of swamps, over-cultivation and pollution.

Apart from Kapchorwa being a district with a more temperate climate (higher altitude), we do not see noticeable differences between Kapchorwa and the other districts.

Seasonal calendar

Men's and women's groups reported most frequently that both women and men carried out seed buying/sourcing. Women in some cases in Iganga reported that women alone carried out maize seed sourcing. Men's and women's groups in Dokolo tended to be split, with half respondents reporting men alone and the others men and women. One women's group in Kapchorwa reported men alone source seed. Concerning decision-making on seed sourcing, men's groups and women's groups tended to coincide in noting that both women and men participated in the decision-making. Only men's groups in Dokolo noted that it was men alone, and women's groups in Iganga mentioned that it was women alone.

Responses were more split with some groups reporting that men alone carried out sales and with others indicating that both women and men sold maize; however, both women's and men's focus groups may have tended to report most frequently that both women and men carry out marketing. It should be noted that some women's groups in Iganga noted that maize marketing was carried out by women alone. Concerning decision-making on sales, men tended to report that men alone participated in the decision-making, while women tended to note that it was both women and men. Responses in Dokolo diverged from this trend, with more men's groups reporting that both women and men participated in decision-making on sales, and more women's groups reporting men alone. In Iganga, a few women's groups reported that women alone made decisions on sales activities.

Men's groups and women's groups tended to report that men alone or both women and men controlled maize income. All men's groups from Masindi and Iganga and all women's groups in Dokolo noted that men alone controlled income. Most men's groups in Dokolo noted that both men and women controlled income. Women's groups in Masindi, Iganga, and Kapchorwa and men's groups in Kapchorwa were split, with half noting men alone and the other half noting women and men. One women's group in Iganga noted that women alone controlled maize income.

Related to other farm and non-farm activities we note that all groups mentioned activities that generate small amounts of income such as sale of milk, brick-making, motorbike transport services, weaving baskets etc.. Men or both men and women together may have

control of income from these activities, although in some cases women reported that women alone can control this income.

Meal preparation tends to be a primary responsibility for women more than men, except in Masindi district, where women's groups reported that men shared in household care-work with women. Although not discussed widely across all groups, in some men's groups (Dokolo and Kapchorwa) men noted that a "household activity" they are responsible for is providing for the family.

In discussions of typically male and female activities, women and men often noted that it would not be culturally appropriate for members of the opposite gender to carry out the activities identified; furthermore, it would be shameful if they were to carry out the gender-inappropriate activity. Only in the case of typically male activities inappropriate for women did some women's and men's groups note that women could not carry them out due to their biology and the physical strength that the activities required (i.e., building houses, digging latrines). In contrast, cultural norms were the primary explanation given for why men were not allowed to carry out the typically female activities noted (i.e., cooking, using the grinding stone). Despite responses from some women's and men's groups concerning female activities inappropriate for men to carry out, it was frequently mentioned by other women's and men's groups that none existed.

Both men's and women's groups indicated that social safety nets are generally not present. Weekly saving in groups is the most common way of saving. Main purposes for saving are for medical treatment, school fees, buying of agricultural input and animals. Apart from Dokolo, groups in the other districts also mention saving for investing to start a small business.

April and May are months when food is scarce and where sickness is most common (malaria, diarrhea). This means that during the peak period when family labor is needed to cultivate crops, people are weakest due to food scarcity and sickness and have least money available.

In the seasonal calendar we did not notice any differences between Kapchorwa and the other districts, except that the maize growing season tended to be longer in Kapchorwa and farmers there might only cultivate one season with a longer duration.

Four cell analysis

On average men's and women's groups mentioned at least 12 different crops, of which around eight crops were mentioned by both men's and women's groups in the village. Many farmers grow maize on a large area for both food and cash purposes in all districts. Some other crops that were mentioned by both groups in the same category were soy beans and beans in Dokolo, beans in Iganga and cassava in Masindi. We noted a gender difference in approximately 40% of the crops mentioned. For example, for the category many farmers on a large area, women's groups mentioned 46 times that crops are grown for both purposes, while men's groups mentioned that 32 times. In Dokolo men mentioned more cash crops than women. Cash purposes are mentioned 26 times by men's groups and 16 times by women's groups in the category few farmers large area, while women mentioned that crops are grown for both purposes more often. From the four cell analysis we can derive that most farmers grow (part of) their own food, as main staple foods in each district are grown by many farmers and was mentioned by both men's and women's groups.

The four cell analysis shows that farmers diversify their cropping patterns. There are some minor differences between districts and gender on areas cultivated and number of farmers growing crops. The yields estimated by the groups are not reaching yield potential. For maize, beans, groundnut and soybean, the groups' perceptions for those with high perceived yields and low perceived yields are significantly different. For maize the higher obtained yields do not reach half the yield potential. For the three other crops (legumes) the reported high yields are approximately 2/3rd of the yield potential. Except for Kapchorwa where men and women estimated the same yield range and realized the same yield range, we noted that women had more difficulties estimating yields compared to men. It is not clear if women were reporting on yields from their household's plots (and that they labored on with the rest of the family) or on yields from plots that they alone may have owned. Most common barriers to expand production and productivity were land availability, skills for commercial vegetable growing, soil fertility, labor limitations and for some crops (vegetables, sugarcane) inputs were considered expensive.

We did not notice any major differences between Kapchorwa and the other three districts that could explain why adoption is higher in Kapchorwa compared to other districts.

Maize related focus group discussions

Longe 5 (OPV) and Longe 10H (Hybrid) are common in all districts and were mentioned by both men's and women's groups, whereby Longe 5 was released 2000 and Longe 10H in 2009. Groups did not differentiate between Longe 5 and Longe 5D.. Longe 5(D) and Longe 10H have been commonly part of free hand-outs by government and NGOs, which may explain why groups were able to mention these variety names. The new hybrid DTM varieties are not yet commonly grown in the districts. We noted that in Kapchorwa, farmers mainly use Kenyan hybrids.

We noted some differences between districts and gender in relation to seed sources and the level of trust in those seed sources. In Dokolo both men's and women's groups mentioned informal seed sources, with home saved seed mentioned by all women's groups. In at least half of the villages some farmers buy seed from the agro-dealers. In Iganga men's groups more often mentioned formal sources compared to women's groups. In Masindi it was the other way around. In Kapchorwa seed either came from agro-dealers or from the government or from home. Home saved seed is an important source of seed mentioned by most groups. We saw that agro-dealers were frequently mentioned as least trusted seed source among all groups. Noteworthy is that the Kenyan seed company, the main (hybrid) seed source in Kapchorwa, was marked as a trusted seed source. Distrust against agro-dealers is higher amongst men's and women's groups in Iganga and men's groups in Masindi; however, trust appears to be highest amongst women's groups in Masindi. Main reasons for buying seed from agro-dealers was to get high yielding varieties that are resistant to drought and pests and diseases. Other reasons were that seed is certified, well-packed, genuine and fairly priced. It was also noted that agro-dealers guard their reputation (as compared to local markets/traders). Major barriers to buying seed from agro-dealers was the seed price (or no funds to buy seed) and the fear that seed is counterfeited. Some women mentioned they do not have access (transport to town). Seed sourced from agro-dealers was highest in Kapchorwa, followed by Masindi. Free seed distributions were a deterrent for buying seed from agro-dealers. Local markets were distrusted by women's groups in Kapchorwa. Local markets were also distrusted in Dokolo where use is high. Local markets were only mentioned by those two districts.

Apart from groups in Dokolo, groups in the other three districts tended to know what hybrids are. However most did not know the yield potential, with women estimating lower yield potentials and harvesting less. The major deterrent to use hybrids is the seed price and the need for using fertilizer with hybrid seed. Across the districts, knowledge of drought tolerant maize varieties was low. The main sources of information were NGOs, radio, fellow farmers and personal experience, with women's groups in particular reporting the latter. Furthermore, when discussing how maize variety selection was carried out, support from government, NGO and/or seed company extension workers was mentioned more by men's groups than by women's groups. Across districts, reasons for not buying DTM were high seed price and not enough knowledge.

Risk and concern ranking

Financial risks in the form of poverty related concerns were mentioned most often, with the highest frequency in Dokolo. The second highest concern was health (as part of personal risks) and domestic violence (as part of social risks being a subcategory of personal risks). In order of main category personal risks scored highest, closely followed by financial risks and production risks, while market risks and institutional wishes were scored relatively low. It should be noted that Masindi is the district with the highest maize market integration and there all men's groups mentioned low/unstable maize grain prices as a concern (2 groups highest rank and 2 groups 4th rank).

Results from the risk and concern ranking show that women and men might share similar risks and concerns, except in Iganga. However, there might also be some gender-specific differences in how men and women rank and prioritize risks. For example, while women and men recognized risks and concerns related to personal risks and financial risks high across all ranks, men gave financial concerns a higher rank than women. While men gave financial concerns a higher rank, it is important to note that financial concerns were relevant for both women and men. In comparison, women reported production related problems as a higher priority more frequently than men. It is important to note that the production-related category includes sub-categories of climatological and input risk though the climatological were noted more frequently by respondents.

Women's and men's responses also show important socio-cultural concerns related to marital tensions and intra-household conflicts, noted across districts. Results in Iganga in particular suggest discontent among women and men household members, with women dissatisfied with unequal labor burdens shared between spouses, distrust of men's income control and expenses, and male dissatisfaction with women's mistrust and "empowerment."

We did not see any large differences in risk and concern conception between Kapchorwa and the other 3 districts.

In conclusion, the main difference between Kapchorwa and the other districts is the seed varieties used (Kenyan varieties), positive experience with certified hybrid seed from agro-dealers, the level of trust in agro-dealers and accessibility of agro-dealers. They do hold agro-dealers accountable if the seed is not good (option to return the seed). It should be noted though, that only two villages were visited and this thus provides an impression only. We therefore do not further discuss findings from Kapchorwa district in the subsequent chapter.

Engendered risk spectrum analysis

Introduction

This chapter analyses the risk spectrum that male and female smallholder farmers face in their agricultural livelihoods and barriers to and drivers of adoption of drought tolerant maize varieties. We start with an analysis of gender findings from the three districts of interest; being Dokolo, Iganga and Masindi. We then summarize the agricultural risks and coping strategies that were identified by the male and female groups. We use the five types of agricultural risks described by Komarek et al. (2020) and work done by IFAD on agricultural risk managements as described in chapter 1. We reflect on the risk management strategies of smallholder rural households in relations to the identified risks. After looking at the agricultural risks and risk management strategies from a livelihood perspective, we zoom in at adoption of hybrid drought tolerant maize varieties as a narrow bracket choice from a behavioral perspective using the COM-B framework (Michie et al., 2011).

Gender analysis

As mentioned previously, the roles and responsibilities that women and men carry out in their households and communities can critically influence their risk perceptions concerning maize production and condition their needs for agricultural technologies, such as drought tolerant maize varieties. It is equally important to consider other factors influencing women's and men's capacities to demand and adopt new technologies, such as control over productive resources, voice in agricultural decision-making processes, and local normative structures surrounding gender relations. Consequently, the following assesses the results from the various tools discussed in chapter three, focusing on key findings concerning gender roles, resource control, agricultural decision-making, and normative structures in Dokolo, Masindi, and Iganga districts.

Roles

Findings show that while women and men can share in various agricultural and other livelihood roles, some responsibilities tend to be more gender-specific, with some district-specific divergences; consequently, this will influence women's and men's differing knowledge on certain livelihood activities, as well as their varying priorities and concerns. From women's and men's roles in maize sales activities, it is possible to infer that both women and men would perceive the cash purpose of maize, and other similar staple crops (although the analysis of participation in sales activities was not carried out for other crops) for their household. However, it is important to highlight that in some cases, such as in Dokolo, men are reported to be solely responsible for sales of produce. Income generation and providing for the family is an important concern for both women and men generally; however, income generation may be a role more socially-ascribed to men. This can explain men's higher ranking of financial concerns in comparison to women. Furthermore, meal preparation tends to be a primary responsibility for women more than men (except in the district of Masindi). For this reason, women may seek to derive a dual purpose from more crops than men, while men in some cases may focus on the cash purpose/value of crops more.

Additional investigation will be important to understand why women in the sites might rank climatological concerns more highly than men; however, it is possible that the trend is also related to women's roles in the household. For example, concerns related to distance from water and water and firewood scarcity would be important for time required for meal preparation.

Concerning other gender roles in maize cultivation, it is important to note that both women and men tend to be involved in tasks of seed sourcing and buying; consequently, both women and men have knowledge of maize seed varieties and their appropriateness for their livelihood strategies.

Resources

Across districts, both men's and women's responses highlighted that land was controlled by men. Concerning natural resources, there may be more opportunity for shared control by women and men; however, shared control tended to be noted more by women than men.

Women's and men's uses of the resources in order to carry out their roles can also influence their perceptions of who has the control. For example, while women and men noted that men alone control forest and tree resources, women tended to note that they shared in decision-making over those resources with men. This could be due to the differing uses women and men give to forest and tree resources. Women and men both noted that men typically carry out construction activities, and in general, climbing trees and roofs can be inappropriate activities for women. For this reason, it can be inferred that management of timber is a primary responsibility of men. Nonetheless, women contribute significantly to fetching firewood for meal preparation and other homecare activities.

In addition to land and natural resources, access to other productive resources is key for implementing new agricultural practices and livelihood strategies. For example, results suggest that women may have less access to extension services than men, potentially restricting women's capacity to adopt new practices. Men tend to know more about hybrid maize seed in comparison to women, also suggesting the former's greater access to productive input information. Limited income control and access to monetary resources can critically restrict capacities to make changes in farming practices on one's own.

Correspondingly, while it could be a limiting factor for women that they might rarely have sole income control of maize, in several instances women and men noted that women and men can have joint control. Furthermore, there were other income-generating activities that women were reported to control (i.e., mat-making, tailoring, dairy).

Decision-making

Participation in decision-making processes is also critical in order to implement new farm practices and livelihood strategies. The differences per women's and men's groups concerning women's involvement in decision-making processes can suggest that women and men have differing perceptions of how household decisions are carried out. Nonetheless, that it is noted very rarely that women alone make decisions on maize sales can be an indication of normative structures that designate men as primary providers for the household and more engaged in commercial activities than women. That women rarely carry out decision-making on land use on their own can also be indicative of certain normative structures and institutions concerning land ownership. It is worth highlighting that both women and men tended to recognize women's and men's participation in decision-making

on maize seed sourcing; with this in mind, any awareness raising or capacity-building on the benefits of improved varieties should target both women and men.

Norms

Socio-cultural norms can also serve to limit the opportunities available to women and men. Trends noted in discussions of typical male and female activities suggest that socio-cultural norms can define certain activities to be more appropriate to women or to men. Biology could be more of a limitation for women than for men.

Findings suggest district-specific trends, particularly as they relate to marital concerns and spousal conflicts. In Iganga, women might be taking on more responsibility and control in agricultural activities. They may perceive that men ought to share more in the work-burden of home-care activities. Yet, their views may be in conflict with men's, whom reported definite home-care activities culturally inappropriate for men to carry out. Women and men in Iganga also frequently reported marital problems. In Masindi there may be more agreement between women and men concerning women's and men's appropriate roles; women in Masindi also tended to note that men and women shared homecare responsibilities like meal preparation. Men's and women's responses in Dokolo tended to coincide in affirming rigidity of gender-specific, socially ascribed roles; women in Dokolo also tended to recognize men's role in decision-making processes and income control more than men.

Although some groups might have reported a strong voice for women in some decision-making processes or income control in some districts, domestic violence was reported to exist across districts. In particular, men's and women's groups in Dokolo noted increasing occurrences of domestic violence as a result of climatic events. It is worth highlighting that Dokolo was also the district most affected by the LRA war. Increased domestic violence was also mentioned as a result of extreme climatic events in Masindi and Iganga, but not to the extent as in Dokolo. It is interesting to note that while women's groups in Iganga made no mention of domestic violence, men's groups did.

Men's mention of women's changing role in agricultural production in Iganga suggest a few factors that can contribute to the change, i) gender-inclusive community meetings and ii) education. Community meetings can be an important source of information for agriculture

and related livelihood activities for women and men farmers; furthermore, participation in community meetings can contribute to women's enhanced voice in community decision-making, often a domain of empowerment biased towards men. Education can also help promote that any capacity-building received is implemented in farm and livelihood management.

Agricultural risks and coping strategies

In this chapter we analyze the different perceived risks according to whether the risks pertain production risks, market risks, personal risks, financial or institutional risks. We aim to answer the question on the major agricultural risks that smallholder farmers perceive in Dokolo, Iganga and Masindi districts and whether there are gender differences noted in the perceived risks. We then discuss the risk management strategies identified by the men's and women's groups based on the information described in the previous chapter.

Agricultural risks

Under production risks extreme weather events were commonly mentioned and considered a risk together with the associated pests and diseases. Droughts are more common in Dokolo and Iganga compared to Masindi. Pests and diseases were mentioned across all groups. Particularly the fall army worm and in Iganga also Striga were mentioned as common. Men also mentioned pests and diseases in relation to exotic vegetable production for cash. Women and men both attribute increased risk of crops getting more affected by pests and diseases and weather events having adverse effects on yields because of monocropping, overcultivation (no longer using fallow periods) and deforestation. In addition degradation of agricultural lands and encroachments of swamps and forests were also frequently mentioned as well as the occasional hail storm. Women's groups tended to rank climatological risks higher compared to the men's groups. In Iganga in particular, women may experience climatological risks more frequently than men.

In terms of agricultural inputs, farmers generally use older maize varieties which increase the risk of weather affected yield loss. The older Longe maize varieties are relatively more susceptible to droughts, pests and diseases compared to the newer released varieties. Trust in agro-dealers varies across villages and within the focus groups. Though responses varied in villages and within focus groups, farmers consider a (perceived) risk that the seed from

the agro-dealer could be bad and fails to germinate. Most group members do not use fertilizer. Not using fertilizer increases the risk of low productivity. Access to mechanized land opening and ploughing differs by district, with Dokolo having fewest opportunities. Women lack control of land and access to other productive resources such as extension services, in comparison to men, which as a result, can make them more vulnerable to agricultural loss and to risks related to climate variability and extreme events.

In relation to the logistical and infrastructural risks, communities are relatively isolated. We noticed that Dokolo has least infrastructural development followed by Iganga and Masindi being the most developed. Availability of storage facilities for agricultural produce are limited; with farmers in Dokolo having the least options and in Masindi the most. Without adequate storage facilities the risk of post-harvest losses is high. Since communities are relatively isolated, they are less affected by infrastructural and logistical risks, apart from storage. The large majority of crops cultivated are not very perishable, including the most commonly grown vegetables (onion, cabbages, tomatoes) and thus do not depend on highly efficient logistical structures or cold chains. For some crops a number of groups mentioned that they don't have a market for certain crops (e.g. Soy bean and millet) in their areas. This indicates that the state of infrastructure is important in the development of the agricultural sector but it does not really pose a large risk affecting farmers choices under the current conditions. Some women reported lacking affordable transport to town to purchase maize seed from markets, again suggesting the remoteness of communities from major infrastructural development. Focus groups also noted detrimental effects of infrastructural development, which could pose more of a risk to women than men, for example, defilement and domestic violence.

In the price risk sub-category, the fluctuating and low output prices, particularly for maize, are a major risk perceived by the groups and was mentioned a number of times. The low maize prices are a disincentive for investing in maize production and the unpredictability of produce prices cause an agricultural risk. Food safety issues and fluctuating input prices were not mentioned as an issue.

Under health risk, sickness was very commonly mentioned and directly affects agricultural labor availability because of the sick person being weak or unable to work and/or the care

taker being unable to work. It also poses a risk to available household budget as sickness may lead to unplanned health expenditures. Limited options for family planning and access to health facilities was also frequently mentioned.

In the social risks and cultural norms category, intrahousehold tensions came as most mentioned issue, together with a number of other undesired social behavior (e.g. gambling, drunkenness). Some of the intrahousehold tensions, such as domestic violence, can affect women more detrimentally than. Conflicts over land were also mentioned a number of times. Socio-cultural norms may be more limiting for women than men; for example, findings showed more gender-inappropriate behaviors for women than men. Additionally, women may be less involved in maize sales and have less maize income control in comparison to men, which as a result can render them less financially autonomous and empowered. Some district specific trends exist. In particular, in Dokolo women's autonomy might be particularly limited in that men were reported to control sales in all cases; in comparison, women in Iganga have a larger role in sales and income control and assert concerns that men should assist women with household domestic work. Cultural and social norms pose a risk in terms of long-term human capital development, social fabric and health. These undesired behaviors affect available labor and household resources and pose a risk that these resources are not available when households need them for productive purposes.

Risks associated with general poverty were mentioned frequently together with famine and food scarcity. These latter concerns are also health issues as hunger affects the ability to work and increases chances of getting sick. As discussed further below, these issues have an implication on how we should perceive agricultural activities within these communities. It directly affects capabilities of households to manage their agricultural risks, rather than analyzing agricultural risks from a business perspective with separate financial flows. Poverty and famine can also contribute to increased domestic violence, in Dokolo particularly. Furthermore, men and women can have conflicting priorities over land use and crop purposes, also creating intrahousehold tensions.

Credit and financial products were hardly mentioned as an issue or risk from an agricultural production perspective. Within communities, households have some options to access credit and these were not mentioned as problematic. Most likely many community members do

not get large loans to develop their farms as a business. Although both women and men are poverty-stressed, women may be more challenged than men to invest in cash crops, due to their comparative lack of income control.

Public policy and institutional risks were not commonly mentioned. Issues around land tenure pose the largest institutional risk affecting agricultural production. In addition issues around bad leadership, limited educational options were mentioned.

Based on the focus group discussions in the different districts, we could rank the risks from high to low. Weather related production risks, health risks, price risks and risks related to general poverty are all ranked as high/very high. Input risks and risks related to social and cultural norms would be ranked intermediate and logistical and infrastructural risks, credit risks, and public policy and institutional risks would be ranked lowest.

Risk management strategies

From the data, we can infer that many community members engage in semi-subsistence farming and a few farmers are more oriented towards commercial farming (e.g. large sugarcane plantations; nontraditional cash crops and remarks such as 'few educated farmers do vegetable growing', 'lack of markets', 'general poverty'). These semi-subsistence farmers integrate consumption and production decisions, thus we cannot perceive their farms as 'businesses' but rather as households. This is important for risk management options that these households have to manage agricultural risks. Semi-subsistence farming households do not have separate financial streams for farming activities and for their household consumption needs, but rather have an integrated household consumption and income generation budget.

Risk management strategies engaged by households thus address these dual purposes. We use the terms 'risk reduction strategies' as those strategies that prevent the event to happen, 'risk mitigation strategies' as those activities that reduce the effect while the event happens and 'coping strategies' as those strategies to deal with the effect of the event after the event has occurred. Though it is difficult to neatly categorize risk management strategies into the three categories of risk reduction, risk mitigation and coping (Siegel and Alwang, 1999), we will attempt to document and organize these strategies identified by the male and female groups. A second precautionary remark is that we identify strategies that were

mentioned by groups and inferences we make on their responses in the different tools. The actual risk management strategies differ per household and depend on the socio-economic status of the individual household as the asset and labor endowment affect the capacity to smooth consumption when shocks occurs (Baulch and Hoddinott, 2000).

The risk management strategies identified in this study are:

- Risk reduction strategies:
 - Both women and men identified good agronomic practices like planting early maturing crops, using drought and pest and disease resistant varieties and choosing food security crops to prevent famine.
 - To prevent the effects of drought, water scarcity, and lack of clean water groups mentioned strategies such as timely planting, irrigation and training on how to adapt, harvesting rain water and making more shallow wells.
 - Management decisions pertaining crop choices and agricultural practices are diversifying crops, choosing food crops and risk spreading practices.
 - We observe that households are diversifying income streams. The agricultural calendar showed diversified income sources (e.g basket weaving, daily income from sale of milk, boda-boda driving, crop production) to spread risk and generate small daily incomes; while most crops generate seasonal food supply and income.
 - In relation to agricultural inputs we observe that using home-saved seed is common. Home-saved seed does not cost money, provides a low but reasonably stable yield that is more or less reliable, whether or not the optimum level of labor is provided during the season.
 - Farmers choose less money-making crops to optimize labor. From the four cell analysis it became apparent that labor is a limiting factor because many times the reason why a crop was not popular was because it is labor intensive. Traditional cash crops have a major labor constraint and for some also a land constraint. For the new cash crops (vegetables), skills appears to be a major constraint.
 - Farmers refrain from growing expensive crops to produce. For a number of crops (e.g. onion and cotton in Dokolo, sugarcane and water melon in

Iganga) groups indicated that these are expensive to produce and therefore either few farmers or many farmers invest in these crops on a small area, indicating that financial resources is a constraint.

- Risk mitigation strategies:
 - For instances when pests and diseases occurred, men's and women's groups mentioned spraying crops and using kitchen droppings to control them.
 - When famine or other negative events occur, groups indicated a reduction in opportunities for borrowing during those times. In general, most groups indicated that there are no formalized social safety nets or fallback options. In most communities there are saving groups that sometimes serve as informal social safety nets. Saving for school fees, medical treatment, buying food, agricultural inputs and animals is done on a weekly basis. Both women's and men's groups highlighted poverty and general lack of money frequently as a major concern. Women and men identified borrowing money, engaging in casual labor, engaging in non-agricultural enterprises, obtaining loans and participating in Village Savings and Loan Associations (VSLAs) as mitigation strategies for poverty, lack of money and unemployment.
 - Health risks were discussed frequently in women's and men's groups, although not necessarily in the context of the agricultural production cycle. Human disease, poor health services and scarcity of health centers were discussed as problems concerning both women and men. Women and men identified use of local herbs, purchase/use of painkillers from drug stores, going to health centers, and obtaining immunizations and vaccinations as mitigation strategies for health-related risks. Women in particular mentioned visiting the Village Health Team (VHT).
 - Men's and women's mitigation strategies for drought included lining up for water, buying water, looking for water in other villages, boiling and treating drinking water. Women in particular mentioned borrowing food or money, storing food and hiring out labor in sugarcane plantations; the latter only in Iganga.
- Coping strategies:

- Women and men coincided in mentioning buying food, providing casual labor for food, borrowing money for buying food, obtaining food from neighbors, serving smaller portions of food, refraining from wasting food as strategies for coping with famine. In addition, selling of property to buy food was also mentioned as a last resort measure, by men in particular.
- Women and men both mentioned negative coping strategies limiting investments in maintaining soil fertility because of poverty, resulting in reduction in soil fertility over time. Some examples of these practices are mono-cropping, over-cultivation (no longer using fallow periods) and deforestation.
- Groups mentioned that food insecurity/hunger leads sometimes to temporal male migration and school drop outs. Intra household issues were mentioned frequently, including domestic violence, household conflicts, mistrust, 'immoral' behavior and in some cases men abandoning the household as negative coping strategies to stress and poverty.

From the identified risks and risk management strategies we can infer that labor is perceived as the most flexible resource to be optimized. Financial resources are hardly available and land availability is fixed in most cases, though some groups mentioned renting additional land as an option. A number of groups mentioned conflicts over land boundaries and land titles, shortage of land and reducing soil fertility as a result of over cropping and soil erosion. This implies, possibly due to uncertain land tenure and lack of funds for fertilizer, that households are unable to invest in maintaining soil fertility. In a number of tools, scarcity of labor was mentioned as a factor hampering investment in particular crops. Scarcity of labor affects crop choice. We can infer that households optimize family labor. This is an important observation for agricultural risk management strategies and gender considerations. In Dokolo and Iganga and to a lesser extent in Masindi, women are responsible for most of the reproductive work.

From the seasonal calendar, it appears that many farmers mostly apply good agronomic practices manually, such as row planting, weeding, and spraying, which are labor intensive. We noted that the hunger period coincides with the peak agricultural labor period and that period is also the period with most sickness. This means that during the peak agricultural

period when family labor is needed to cultivate crops, people are weakest due to food scarcity and sickness. This period also coincides with the period that households have less money available (to buy food and pay for medical care). This may explain why health risks were ranked very high, together with general poverty, climatological risks and output price risks.

Logistical and infrastructural risks, credit risks, and public policy and institutional risks were ranked low. From the historic timeline and other tools, we concluded that the villages are relatively isolated, with those in Dokolo the least developed and in Masindi the most developed. Therefore we could cautiously conclude the low ranking of these risks are related to the absence of services in the case of logistics, infrastructure and credit. A possible explanation why public policy and institutional risks were ranked low could be that public policy and institutional set-up may be stable and therefore not pose any uncertainty and thus not a risk. These services are part of rural development and outside the direct control of households. This has implication for risk management strategies available to households. Hansen et al. (2019) reviewed a number of technological and institutional climate risk management innovations, such as drought tolerant seed varieties and crop insurance that have the potential to contribute significantly to rural poverty reduction. They find that in order for these innovations to have uptake the following condition needs to be met: “(a) household land and labor endowments, available technologies, supply chains and markets are sufficient to allow for stepping up through intensification and/or commercialization; but (b) climate-related risk currently excludes poor farmers from accessing available technologies, credit and market opportunities” (Hansen et al., 2019, p36). From the information we collected we see that these conditions are not sufficiently met, particularly in Dokolo moving towards more integration in Iganga with most in Masindi. This has implications for uptake of drought tolerant maize varieties by poor households as these varieties may have a strong effect on stabilizing production and smoothing consumption (Hansen et al., 2019).

Behavioral barriers and drivers in choosing maize varieties

In the previous section we analyzed agricultural risks and risk management strategies from a household portfolio perspective. Households, and within household different

members, have differing and sometimes conflicting goals and the first decision is which one(s) to prioritize (Mathews, 1987) centered around income and consumption smoothing.

According to Matthews (1987) some of the goals conflict and the first decision to be taken is which goal to prioritize; another way is that more basic goals are subsumed by hierarchically more dominant goals, such as the decision on whether to grow/buy maize seed could be part of a more overarching goal of household food security and utility maximization. The question regarding available household labor could be related to this as labor utility may be higher in other crops or non-farm activities and thus it may be more worthwhile to invest in other enterprises and not maize. Household portfolio management choices can be considered as broad bracketing choices to achieve the household's goals. This means that the household (member) assesses the consequences of large sets of choices grouped together, while narrow bracketing means sets with one or very few choices (Read et al., 1999). Goals could also be organized by themes, which are bundles of discrete goals packaged together. Focus group discussions highlighted that in the case of decision making regarding the purchase of quality maize seed, the goal of maize production is to provide food and income to the household.

Once the household narrows down on growing maize, the choice which maize variety to use becomes a narrow bracket choice with a limited choice set of available options. These include home saved seed or purchasing seed, OPVs or hybrids and preferred variety traits. We frame the adoption of drought tolerant maize varieties as a narrow bracket choice. We use the COM-B framework for analyzing behavior (Michie et al., 2011), whereby we look at three sources of behavior to identify the barriers and drivers to uptake of hybrid/DT maize seed. These are capabilities, motivation and opportunity.

Sources of behavior

Capabilities are the ability to do something. This ability is either psychological or physical and includes knowledge and skills. Motivation are conscious and unconscious brain processes that prompt and guide behavior. These include habits, emotions and analytics and are either automatic or reflective. Opportunities are those elements that are outside the individual that facilitate or prompt that behavior. These elements are either physical, provided by the environment, or social, provided by culture (Michie et al. 2011). The capabilities, motivation

and opportunity cause behavior and can prevent changes in behavior. From the perspective of adopting drought tolerant maize varieties we can identify positive conditions (drivers) and negative conditions (barriers) for each of the components in the behavioral framework.

These are presented in Table 6.

Table 6. Drivers and barriers to adoption of drought tolerant maize varieties.

Components	Barriers	Drivers
Capabilities	<ul style="list-style-type: none"> - Free seed without skills provision (Dokolo) - Low yield perceptions (knowledge on potential) - Inadequate information and knowledge of available varieties, including DTM - Labor shortage to engage in GAP - Physically weak during peak season due to hunger, sickness - No/limited knowledge on hybrid seed (Dokolo) - Misconceptions towards hybrids - In some villages women indicated lower levels of knowledge of DTM 	<ul style="list-style-type: none"> - Ability to engage in risk assessments - In projects, improved varieties showed higher yields - Good agronomic practices are known and applied - Knowledge of link between low yields and soil fertility - Knowledge that seed from agro-dealers is high yielding and high germinating. - Knowledge on hybrid seed (Iganga, Masindi) - (Female) Farmers learn from fellow farmers - Extension workers reaching (male) farmers - Radio messaging is reaching farmers
Motivation	<ul style="list-style-type: none"> - Home saved seed (easy fall back option) - Free seed from OWC/NGOs - If no money at home, farmers automatically fall back to home saved seed - Only looking at the seed price itself and comparing it to home saved seed, not difference in yield - (dis) trust in agro dealers - Bad prior experience with germination of seed from agro dealers (or hearsay bad stories) - Need to use fertilizer with hybrids - Low market price grain - Maize is grown for both food and cash (dual purpose) - Poverty, income generation, and food security are important concerns for both women and men, food 	<ul style="list-style-type: none"> - Farmers look at performance of previous season to decide the varieties to grow in the next season, maturity period, pest and disease resistance and yields - Kenyan seed company trusted (give warrantee) - In Masindi, seed companies are generally trusted - Those that grow maize commercially do buy seed from the agro-dealer - Free hand out of DT hybrid maize varieties - Although men may often be the primary household decision-makers, women participate jointly with men in decision-making on seed sourcing. - Poverty, income generation, and food security are important concerns for both

	provision might be keenly important for women	women and men, cash provision might be keenly important for men
Opportunity	<ul style="list-style-type: none"> - Lack of money to buy seed - Land shortage - Low soil fertility - Fall army worm - Droughts - Climatologically, Dokolo and Iganga are more affected by drought & pests compared to Masindi - Gender inequalities in land ownership, access to extension services, and income access/control that affect women - Male resistance to women's empowerment in some sites - Some women have less (physical) access to agro-dealer shops 	<ul style="list-style-type: none"> - Apart from groups in Dokolo, agro-dealers are within physical access for farmers. - Hybrid DT maize varieties are available in shops - Saving clubs (to save money to buy seed) - In some villages (Masindi) women report sharing homecare responsibilities, therefore time-labor burdens, with men - Women may control some income from other livelihood activities, besides maize cultivation. - Women and men in many cases both participate in seed sourcing activities

Barriers and drivers related to *capabilities* can be grouped around three themes:

Knowledge on how to grow hybrid DT maize varieties: From the data we observe that in general the good agronomic practices to grow (hybrid DT) maize are known (driver) and in Iganga and Masindi the focus groups mentioned knowledge of hybrid seed (driver). In Dokolo groups' knowledge about hybrids was less compared to the other districts (barrier). In addition, groups in Dokolo mentioned that they received free seed without extension services, and from the collected information we saw they were using hybrid DT maize varieties unknowingly (barrier). We also noted some misconceptions about hybrid maize seed and drought tolerant maize varieties (barrier). Knowledge about newly released drought tolerant maize varieties was lowest in Dokolo and not widespread in Iganga and Masindi (barrier). In some villages women's groups expressed less knowledge of DT maize varieties compared to men (gender barrier). Relatively more women's groups mentioned that they learn from fellow farmers and relatively more men's groups mentioned that they receive information about varieties from extension workers (gender driver). In some instances, it was observed that women have misconceptions about hybrids, drought tolerant maize varieties and reliability of seed source, indicative that women have less access to information and possibly extension services (gender barrier). Radio messaging seems to be

effective in informing farmers about drought tolerant maize varieties (driver). In the focus group discussions, lack of information was a major reason for not using DT maize varieties.

Knowledge on yield performance: From the data we observe that knowledge on yield potential is low across districts, with the lowest estimates in Dokolo and the highest in Masindi (barrier). Women generally estimated the yield potential lower than men (gender barrier). The actual yields are close to the perceived (low) yield potential in the districts and across gender (barrier). We observe that the groups know the relationship between soil fertility and yields (driver). In villages with maize seed projects, groups noticed that improved varieties showed higher yields (driver). In general, groups portrayed knowledge that seed from agro-dealers is high yielding and has high germination (driver). Free seed distribution without skills provision as mentioned in Dokolo, provides a disconnect between yield performance and variety (barrier), especially when it is a hybrid and no fertilizer is used. Free seed as a means of experiencing quality seed/high yielding varieties without proper information leads to misconceptions as either quality can be poor or the variety did not perform under the occurring weather conditions.

Physical capacity: we noted in the section on agricultural risks that labor capacity may not always be available when needed during the peak agricultural season due to sickness and it being the lean season (barrier).

Barriers and drivers related to *motivation* can be grouped around two themes:

Affordability and other financial considerations: The availability of free seed (home saved or distributed) is a disincentive to invest in DT seed (barrier) both as an automatic process (not considering the option of buying when seed is available) and deliberate process (investment deliberations based on costs, not on gains/benefits (yields)). Maize is a dual purpose crop for both men and women which leads generally to relatively low capital investments in the crop (barrier), whereby women may be more keen on optimizing food production portfolio (gender barrier) and men on cash provision (gender driver). The low/uncertain grain price is a concern for both men and women (barrier). Although men may often be the primary household decision-makers, women in many cases participate jointly with men in decision-making on seed sourcing (gender driver).

Prior experiences: we observe that there are both positive prior experiences (driver) and negative prior experiences (barrier) with drought tolerant maize varieties and or agro-dealer shops (source of DTM). Bad experiences included both personal experiences and hearsay. As positive experiences, we note that farmers observe the performance of previous seasons and free hand out of DT seed, that the Kenyan seed company is trusted, and that the more commercially oriented smallholder farmers do buy seed from agro-dealers. Trust in agro-dealers is highest in Masindi, followed by Iganga, and trust is lowest in Dokolo. In Iganga, men's groups indicated using fertilizer with hybrids (gender driver), while only one women's group did (gender barrier). Majority of farmers does not use fertilizer (barrier).

Barriers and drivers related to *opportunity* can be grouped around two themes.

Environmental opportunities: production risks such as pests and diseases were provided as reasons for not using hybrids/DTM varieties (barriers) as were lack of financial resources to buy the seed (barrier). Groups mentioned access to saving clubs to save money for investments (driver). Physical access is hampered in Dokolo (low density of agro-dealer shops (barrier) and some women indicated that they have difficulty reaching the agro-dealer shop (gender barrier). Hybrids and DT varieties are available in agro-dealer shops (driver).

Social/Cultural opportunities: Gender inequalities in land ownership, access to extension services, and income access/control affect women (gender barrier). We also noted male resistance to women's empowerment in some villages (gender barrier). At the same time we also noted that women have some control over income and participate in seed sourcing (gender driver). In Masindi home care is (more) shared providing more time for women to engage in productive activities (gender driver).

Intervention functions and policy categories

We use the COM-behavioral change wheel to identify which intervention functions could promote the adoption of (hybrid) drought tolerant maize varieties. Michie et al. (2011) identify nine intervention functions that could address barriers and drivers related to capability, motivation, and opportunity. These are education, persuasion, incentivization,

coercion, training, restriction, environmental restructuring, modeling and enabling.³ The intervention functions of education, persuasion, incentivization, training and enablement focus more on personal agency and coercion, restriction, environmental restructuring and modeling focus more on external influences and less on personal agency (Michie et al., 2011). Com-B framework distinguishes between interventions (activities aimed at changing behavior) and policy (actions on the part of responsible authorities that enable or support interventions). It lists seven policy categories: Communication/marketing, guidelines, environmental/social planning, legislation, service provision, regulation, and fiscal measures.⁴ Communication and marketing, service provision, fiscal measures and environmental/social planning are policy categories that could facilitate the intervention strategies to increase adoption of DT maize varieties. When we look at enabling intervention function in relation to the broader household risk management strategies and equal opportunities for male and female farmers, we could also include regulation and legislation to stimulate rural development.

We identified two types of knowledge gaps that could benefit from education. The first one is related to the variety characteristics and has relatively more drivers to adoption as the varieties are known. We do note a knowledge gap for women compared to men. The depth

³ Terms are defined as: Education: increasing knowledge and developing understanding; persuasion: using communication to induce positive or negative feelings, or stimulate action; incentivization: creating expectation of reward; coercion: creating expectation of punishment or cost; training: imparting skills; restriction: using rules to reduce the opportunity to engage in target behavior (or increase the target behavior by reducing the opportunity to engage in competing behavior); environmental restructuring: changing the physical or social context; modeling: providing an example for people to aspire or imitate (using our propensity to imitate as a motivational device) and enabling: increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring) (Michie et al. 2011).

⁴ Michie et al use the following descriptions: guidelines: creating documents that recommend or mandate practice. This includes all changes to service provision; Environmental/social planning: designing and/or controlling the physical or social environment; Communication/marketing: using print, electronic, telephonic or broadcast media; Legislation: making or changing law; Service provision: delivering a service; Regulation: establishing rules or principles of behavior or practice; Fiscal measures: using the tax system to reduce or increase the financial costs.

of the knowledge is limited as portrayed by misconceptions or farmers sometimes using particular varieties without knowing this. Current means of education seem to work in Iganga and Masindi. Information provision in Dokolo seems to be less. We also note that women indicated less knowledge. These education intervention will address the psychological capabilities and should address information gaps that are perceived as barriers. The second type of knowledge gap identified is the perception of potential yields of DTM. This is part of the 'profitability' and expectations related to using hybrid DT maize varieties. Without proper expectation of yield potential, seed will be perceived as too expensive for the yield, gets a negative cost-benefit evaluation and is discarded as uninteresting. This type of knowledge was limited in all districts and across genders. This type of knowledge gap links both capabilities and motivations. Therefore education should be delivered in such a way that it engages the reflective (deliberate) brain processes, tailoring to specific needs in the different districts and by gender.

To stimulate the reflective processes, interventions that use persuasion and incentivization may be appropriate to change perceptions of 'profitability'. Persuasion could also be used to engage the automatic brain processes that base their motivation to not adopt on prior (hearsay) experiences and the pre-attentive decision when there is sufficient seed at home. Considering that groups indicated low soil fertility on most villages, our proposition is that in order to gain from investing in hybrid drought tolerant maize varieties, the investment in seed needs to be accompanied with purchase of fertilizer. This for short and long term soil fertility management. This has gender implication as in most districts men have relatively more control over household income. Combining seed and fertilizer makes the profitability - affordability consideration an even more pertinent issue. Affordability is in its core about whether someone perceives value for money and has the means to purchase the good. The value for money comes back partly in the 'economic' benefits of the variety, the risk spectrum and available means to manage risk and household portfolio management. Most households perceive maize as both a cash and food crop and the risk of drought and pests and diseases, does not incentivize investment in seed and fertilizer. Investment in seed and fertilizer makes economic sense if profit maximizing, not for income and consumption smoothing; yet it stabilizes production. Incentivizing could include subsidies when

motivation is needs engagement of reflective processes and free samples when motivation relies on automatic processes.

In addition to education we also identified a skills gap in the psychological capabilities in relation to the 'profitability-affordability' knowledge. From the assessment we saw that in general groups had knowledge and skills related to good agricultural practices. Yet the considerations on whether or not to invest in hybrid DT maize varieties, was many times related to the seed price (in comparison to free seed at home or lower quality products available on the informal markets). Rather than just informing (education) farmers about the yield potential and profitability of hybrid DT maize, skills training in cost-benefit analysis and building further on prior experience could facilitate decision making. Farmer Field Schools and the use of model farmers are examples of such interventions. This can be particularly important to ensure that information reaches women, considering that they may rely on peer networks more than men as communication channels, and that there may be a gender equity gap in access to extension services.

The automatic brain processes could be triggered by role models when it comes to barriers related to affordability and prior experiences. However, considering the diversity in farming systems and socio-economic characteristics of households, the investment required to popularize these models, would not be cost effective. Model farmers, as mentioned above would fall under the training category in this classification.

Interventions that focus on environmental restructuring could be a meaningful intervention to address motivation. This would involve interventions that change the physical or social context to trigger the automatic brain processes and stimulate farmers to purchase seed, instead of home-saved seed. In addition we also noted that a barrier in physical opportunity; access to DT maize is less of an issue in Iganga and Masindi, though it is in Dokolo. Access is also more of an issue for some women. Increasing sales points would address some of the opportunity related barriers to adoption. For example, the village agent model (e.g. OneAcre fund, BRAC, USAID project) and selling seed at weekly village markets (ISSD) may increase access in remote villages and for women particularly. Barriers under the social/cultural opportunity relate mainly to providing equal opportunities to women that could benefit from social restructuring.

Enablement is increasing means/reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring). To address the physical capability (physical weakness during lean period and risk of sickness), healthy diets and health insurance, as well as social safety nets/insurance would reduce health risks and may open up investments in activities with higher labor productivity. To increase environmental opportunity we may look at the provision of index/crop insurance. To increase equal opportunities for female farmers more needs to be done on access to and control over resources for women, including secure land tenure. Enablement should address the risk spectrum and risk prevention, mitigation and coping strategies to enable smallholder farmers to invest in crops they grow and maintain soil fertility. In general, women may have less agency than men, as suggested by their tendency to have less income control; this can limit their possibilities to make changes in farming practices on their own, due to restricted resources and capacities. To increase social opportunity for women empowerment we may incorporate the household approach, gender action learning (GALS) and/or working with existing women groups or organizations into strategies to increase adoption of DTM.

Table 7 provides an overview of potential policies that will enable the intervention functions that address the identified sources of behavioral barriers to adoption of hybrid DT maize varieties.

Table 7. Potential policies and interventions to address sources of behavioral barriers to adoption of DT maize varieties.

Policy category	Intervention function	Source of behavior
Service provision	Education	psychological capabilities: knowledge on varieties and knowledge on yield performance
		motivation – reflective: knowledge of yield performance combined with affordability perceptions
	Incentivization	motivation – automatic: affordability of DTM (and fertilizer) – free samples
	Enabling	Physical capabilities: physical strength, labor availability and health risk
		Physical opportunity: risk spectrum and risk prevention, mitigation and coping strategies
		Social/cultural opportunity: equal opportunity for male and female farmers

Policy category	Intervention function	Source of behavior
Communication/ marketing	Education	psychological capabilities: knowledge on varieties and knowledge on yield performance
		motivation – reflective: knowledge of yield performance combined with affordability perceptions
	Persuasion	motivation – reflective: affordability of DTM (in combination with fertilizer)
		motivation – automatic: prior experiences
	Incentivizing	motivation – reflective: affordability of DTM (in combination with fertilizer)
Fiscal measures	Incentivizing	motivation – reflective: affordability of DTM (in combination with fertilizer)
Environmental and social planning	Environmental restructuring	Motivation – automatic: affordability
		Opportunity – physical: increasing access points
		Opportunity – social: gender
	Enabling	Physical capabilities: physical strength, labor availability and health risk
		Physical opportunity: risk spectrum and risk prevention, mitigation and coping strategies
		Social/cultural opportunity: equal opportunity for male and female farmers

Under service provision we recommend a combination of education, persuasion, incentivization, and training to address capability and motivation barriers. Service provision could focus on for example farmer field schools, field experimentation and model farmers to build positive experiences and create reflections on affordability in relation to yield (potential), free samples of small seed packs (100 seeds + fertilizer) to try at home (building on the fact that men and women indicated they look at the experiences in the prior season – provide free samples at places where women gather e.g. at health clinics to reach women. Use of model farmers within the community to follow up and ask questions while farmers are experimenting with the free seed. This needs developing training materials that increase reflective processes to question under which circumstances (household goals and agricultural risks) growing hybrid DT maize would be attractive, taking into consideration the climate risks, labor availability and general poverty. To address opportunity we recommend service provision in creating more access points in such a way that it addresses noted gender barriers and promotes equal opportunities. Current information provision practices should look into misconceptions about hybrid seed, and address those. From the tools it was apparent that knowledge of hybrids and drought tolerant maize varieties is lower in Dokolo

compared to other districts, that it has a lower infrastructural development and that it received less extension services. It is therefore recommended to increase extension services in Dokolo, making sure that they are accessible to women and men.

We recommend a combination of education and persuasion in communication and marketing. Key findings from the seasonal calendar include that both women and men contribute to seed sourcing/buying, including decision-making on maize seed sourcing and buying; consequently, it will be important that any campaign to change farmers' behaviors concerning seed sourcing/buying (i.e., raise awareness or enhance trust in drought-tolerant maize for enhanced adoption) reach both women and men. While poverty, monetary income generation, and food security are important concerns for both women and men, food provision might be keenly important for women. Campaigns that highlight the capacity of DTM to help avoid production loss and promote increased production (income) and/or food security should target men and women accordingly. We noted a gender barrier in knowledge of DTM. This requires special attention when looking at new information channels targeting women. E.g radio messaging to create awareness on varieties, women model farmers, women communicators; and also, tailoring informational messaging to target women's interests.

We recommend fiscal measures, subsidy, to incentive smallholder farmers to try out new varieties with fertilizer to experiment with new technologies in a relatively low (financial) risk environment. This would build on positive prior experiences. At the same time, we are cautious as subsidies should go hand in hand with environmental and social planning to restructure current systems and provide a more enabling environment. These policy categories relate more to the broader risk spectrum, absence of institutional risk management strategies and household portfolio choices.

Conclusions

Both men and women are involved in seed sourcing and buying and applying agronomic practices. Men seem to be more in control of maize marketing and income generated from sales, consistent with it being a more socially ascribed role to men. Women may have less access to productive resources, including extension services, and control over income to purchase agricultural inputs. This has implications for how information about new varieties is

disseminated to male and female household members and how the products on sale should be offered.

Based on the group discussions in the different districts, we could rank the risks from high to low. Weather related production risks, health risks, price risks and risks related to general poverty are all ranked as high/very high. Input risks and risks related to social and cultural norms would be ranked intermediate and logistical and infrastructural risks, credit risks, and public policy and institutional risks would be ranked lowest.

From the data, we infer that many community members engage in semi-subsistence farming and few farmers are more oriented towards commercial farming (e.g. large sugarcane plantations; nontraditional cash crops and remarks such as few educated farmers do vegetable growing, lack of markets, general poverty). Semi-subsistence farming households do not have separate financial streams for farming activities and for their household consumption needs, but rather integrate production and consumption decisions. This has implications for risk management options that these households have to manage agricultural risks and that were discussed under risk prevention and mitigation strategies and coping strategies. For (institutional) risk management strategies to be effective, households need to be able to intensify production. We noted that the logistics and infrastructure risk, credit risk and public policy risks were not rated frequently, and the absence indicates that households mainly use their own resources to manage agricultural risk. They do this by optimizing labor and consumption and income smoothing leading to relatively safe, stable and low output choices. We need to consider the barriers to the adoption of drought tolerant maize varieties in this context, taking into account the highly rated production risk, health risk, general poverty and low and unstable maize grain market prices. Once a household chooses to grow maize as part of the portfolio, the choice of which variety to grow becomes a narrow bracket choice and we can analyze the drivers and barriers to adoption from 3 sources of behavior (capabilities, motivation and opportunity).

In most seed sector literature we look at the barriers to adoption of new improved varieties from the perspective of knowledge, access and affordability (Simtowe et al., 2019), these match with the described capability, opportunity and motivation barriers and drivers. We have shown that in all three areas there are barriers to adoption and drivers which can be

used. We have identified a few interventions that together with policy support could contribute to behavioral change and adoption. In terms of variety knowledge, it is mainly a capability issue which in Masindi and Iganga was less of a barrier compared to Dokolo, where farmers were less exposed to these varieties. We also noted that men have relatively more knowledge compared to women, and pointed out areas of attention in the interventions. Access is more of an external barriers than an personal agency barrier, for farmers in Dokolo and female farmers more so than those in Iganga and Masindi and male farmers. Increasing access needs extensive intervention strategies which include environmental restructuring, enabling and social and environmental planning, particularly when we incorporate DTM adoption in the broader context of the risk spectrum and risk management strategies. Affordability links partly to risk management strategies, optimizing labor and the role of maize in the broader household portfolio. Affordability also links to motivation, both the ability to engage the reflective process and go beyond automatic processes that stops at the consideration that there is seed at home and to be persuaded/incentivized to purchase the seed.

Conclusion and recommendations

Even though drought tolerant maize varieties have proven yield stabilization benefits, the adoption remains low. This research on community based gendered risk spectrum analysis for adoption of drought tolerant maize varieties in Uganda used exploratory research methods, using various PRA tools, and qualitative data analysis. The study was conducted in four villages in Dokolo, Iganga and Masindi districts and two villages in Kapchorwa district in March 2019. In each village one men's group and one women's group was interviewed and PRA tools applied. Tools included village resource mapping, historic timeline, seasonal calendar, four cell analysis and focus group discussions on maize seed buying behavior. Kapchorwa district was included in the research as a reference because adoption of hybrid maize varieties is relatively high there. Apart from farmers in Kapchorwa using hybrids from Kenya, the growing season being longer and Kapchorwa being on a higher altitude, we did not find other explanations why adoption is higher in Kapchorwa and the district was subsequently left out in further analysis.

Groups indicated a wide variety of resources available in their villages, with more land available in Dokolo in comparison to the other districts. The endowment differed in districts and villages. In some villages and districts land is more scarce than in others. In many villages there are cases of land (boundary) conflicts and in some insecure land tenure. Almost all groups did mention that soil fertility has gone down, affecting yields. We noted that women have less agency when it comes to control and decision-making over household (land) and village resources. Agriculture is the main income source in all districts. Dokolo and Iganga districts seem to be more affected by droughts and related pests and diseases compared to Masindi. Adverse climate events seem to have direct effects on household food security, health status and social fabric.

Masindi is most developed in terms of infrastructure and services, followed by Iganga and then Dokolo. We noted that Dokolo has received less extension services and has a relatively lower knowledge level about hybrids and DT maize seed. In addition, we noted that women seem to have received less support from extension services.

Household activities include both productive and reproductive activities. All groups indicated that households engage in activities that generate small daily income, in addition to seasonal agricultural activities. Households grow a variety of crops, including the main staple foods. The main crops such as maize and beans are grown by many farmers on large fields, while responses for other crops were more diverse. We noted that women mentioned that crops are grown for both purposes slightly more often, while men's groups mentioned growing a crop for only cash purposes more often. Yields are generally well below yield potential in all districts and groups underestimated yield potentials. Most common barriers to expand production and productivity were land availability, skills for commercial vegetable growing, soil fertility, labor limitations and for some crops (vegetables, sugarcane) inputs were considered expensive.

We noted that both women and men participate in crop cultivation and in many cases make joint decisions on seed sourcing and other activities. Men tend to be more in control of (maize) marketing and income generated from sales, consistent with it being a more socially ascribed role to men. Women may have less access to productive resources, including extension services, and control over income to purchase agricultural inputs. In all districts women have particular reproductive tasks, that would be culturally inappropriate for men to engage in. This was most pronounced in Dokolo, followed by Iganga and while in Masindi some groups indicated that tasks were shared.

April and May are months when food is scarce and where sickness is most common (malaria, diarrhea). This means that during the peak period when family labor is needed to cultivate crops, people are weakest due to food scarcity and sickness and have least money available. Formal social safety nets are not present.

Maize is a crop grown on a large area by many farmers in all villages for both food and income. Most common varieties were Longe 5 (OPV) and Longe 10H (hybrid) and local varieties. The more recently released drought tolerant maize varieties were not commonly grown, except by one group in Iganga. The use of home saved seed was mentioned in almost all groups. In Dokolo both men's and women's groups mentioned mainly informal sources, while in Iganga men's groups more often mentioned formal sources compared to women's groups and in Masindi other way around. In at least half of the villages some farmers buy

seed from agro-dealers. Levels of distrust of agro-dealers varied between groups and group members. At the same time, reasons for buying seed from agro-dealers were to get high yielding varieties. Major deterrents were seed price and fear of buying counterfeit/fake seed. Apart from groups in Dokolo, groups tended to know what hybrids are. Most groups did not know the yield potential of these varieties. Major deterrents for using hybrids were seed price and the need for fertilizer. Drought tolerant maize varieties were less known. Main sources of information about maize varieties are NGOs, radio messaging, fellow farmers and personal experiences, whereby we noted that women have less access to extension services compared to men.

Based on the focus group discussions in the different districts, we could rank the risks from high to low. Weather related production risks, health risks, price risks and risks related to general poverty are all ranked as high/very high. Input risks and risks related to social and cultural norms would be ranked intermediate and logistical and infrastructural risks, credit risks, and public policy and institutional risks would be ranked lowest. We observed some gender-specific differences in how they ranked the risks. Men ranked financial risks higher than women, while women's groups mentioned production and particularly climatological and weather related risks higher. Groups across districts also mentioned some important socio-cultural concerns related to marital tension and intra-household conflicts.

Many rural household are semi-subsistence and integrate their production and consumption decisions. Agricultural risk management strategies identified in the focus group discussions consisted of risk reduction strategies, risk mitigation strategies and coping strategies. Risk reduction strategies included applying good agronomic practices, optimizing use of (rain)water, growing a wide crop portfolio, diversifying income streams, using home saved seed and refraining from growing crops that are 'expensive' to grow. Risk mitigation strategies included spraying when pests and diseases infested crops, providing casual labor or borrowing when households are out of money, treating sickness with herbal medicines and/or visits to clinics, and buying water, storing food and hiring out labor in times of droughts. Coping strategies included buying food, borrowing money for food, eating smaller portions, selling assets, mono-cropping and overcultivation, temporal migration, school drop-outs and 'immoral' behavior.

Households tend to optimize family labor in their productive portfolio and risk spreading by engaging in many different activities; both on- and off-farm. As the lean period coincides with the period for diseases, the health risk perceived high and investment choices could take potential labor shortage into consideration.

Absence of high-end markets and distribution systems, such as cold chains, limits available options for investing in perishable crops. At the same time, because of this absence, it was not perceived as a high risk, along with credit risks and public policy and institutional risks. This results in households being in relative isolation and not integrated into the markets with household portfolio choices focusing on optimizing labor, risk spreading and low (financial) input low output activities.

When we look at the maize crop from the household portfolio perspective, it is a crop that provides both food and income, it has a low and unstable grain market price and it is susceptible to pests and diseases and droughts. In addition the reducing soil fertility as observed by almost all groups, suggest that without applying fertilizer potential yields will be hard to meet. Despite these drawbacks, the use of DTM varieties has a positive effect on stabilizing yields and income (Hansen et al.). Once a household decides to grow maize, choosing the variety becomes a narrow bracket choice and we zoom in on behavior to identify barrier and drivers to adoption and possible intervention and policy options to change behavior into adopting (hybrid) drought tolerant maize varieties.

We identified three broad categories of sources of behavior, which included both barriers to and drivers of adoption: i) psychological and physical capabilities; ii) motivation and iii) physical and social opportunities. Drivers and barriers related to capabilities were grouped around i) knowledge of DTM and on how to grow hybrid DT maize varieties; ii) knowledge on yield performance; and iii) physical capacity (risk of falling sick and labor shortage during peak season). Barriers and drivers related to motivation were grouped around financial considerations and prior experiences. Barriers and drivers related to opportunity were grouped around environmental opportunities, related to the broader risk spectrum and social/cultural opportunities related to equal opportunities of male and female farmers. To increase action of drought tolerant maize varieties (combined with fertilizer use), intervention functions were identified as education, persuasion, incentivization, training,

environmental restructuring and enabling, where the first four engage with the personal agency and intrinsic motivation, while the latter two are external influences. Supporting policies could be developed around communication/marketing, service provision, fiscal stimulation and environmental and social planning.

Recommendations for further research:

To fully understand smallholder farmers' choices, we need to consider the environment that they operate in and assess their risk spectrum in the context of their household objectives of consumption and income smoothing. Uptake of any single technology will remain low if it is not tailored to any of the five types of impact: a) stabilized production or income, b) protected assets in the face of shocks; c) increased uptake of capital, production technologies and market opportunities, d) improved livelihood and welfare measures (linked explicitly to risk reduction); and e) reduced poverty (Hansen et al., 2019). Hansen et al. (2019) found evidence that DT maize stabilizes production. Introduction of new technologies, particularly DT maize varieties, needs behavioral change techniques that address all three sources of behavior, with particular attention to motivation; and secondly, it needs to reduce the effects of the most pressing risks. By making more transparent which type of impact the technology is aimed to address, it will be possible to evaluate which behavioral change techniques are most effective according to farmers' risk spectrum and their household environments.

Our main findings are: 1) we elicited that many households optimize labor in the portfolio of different income generating activities to spread risk and smooth income and production. 2) In the case of Dokolo, Iganga and Masindi districts, we identified that health risk, production risk, (grain) price risk and financial risk (general poverty) are the most urgent risks that affect households choices. 3) in the case of DTM adoption, we noted that motivation (affordability considerations) combined with capability (knowledge on yield performance) constitute the largest barrier to adoption in all districts. In Dokolo we note capacity (knowledge of varieties) and opportunity (access to agro-dealers) as additional barriers. We also observed that due to low(er) soil fertility uptake of hybrid DTM should go together with fertilizer. 4) we observed that these barriers are larger for women than for men. Further research should focus on the interplay of these four findings.

We identified labor as a good that is optimized by smallholder households. We need to see agricultural risk management from labor optimizing perspective – investing in low risk enterprises (thus low yielding), diversifying income crops and income streams. This may mean that labor productivity is more important than crop productivity and thus yield maximizing arguments may not resonate well with semi-subsistence households. More research is needed on labor productivity and the conditions that need to be present to enable households to adopt more productive enterprises. Without working market systems, credit markets, logistics and infrastructure, and public policy, semi-subsistence households only have ‘personal agency’ risk management strategies to manage risks and cannot fall back on institutional risk management strategies. We observed that in Dokolo, but also in Iganga and Masindi districts, households operate in relative isolation, which on the one hand, harnesses them against risks but on the other hand makes them more vulnerable for the negative effects of personal risk, production risks, price risk and general poverty. Secondly we observed that women have less agency compared to men making them more vulnerable to risk compared to men. Though women have less agency, men and women appear to be making joint decisions regarding crop production and other enterprises.

Literature has shown that most research focuses on only one of the five agricultural risks. Our study has shown that apart from production risk (and in particular climate risks), health risks, price risk and general poverty play an important role in semi-subsistent agricultural decision making. To better address barriers and bottlenecks to adoption of DTM varieties, adoption should be researched in this broad risk spectrum. The interplay between motivation and affordability considerations in adoption of DTM varieties and the broader risk spectrum at play in the background need further research, particularly the effect of health risk, market prices and general.

Appendix 1 Research tools

Adoption of drought tolerant maize varieties looking into barriers for uptake: PRA tools

Participants: 1 group of women, 1 group of men. Each group of 20 individuals will be of mixed socio-economic status and ages.

Village resource map

The Village Resource Map tool will be used to learn about a community and its resource base. The primary concern is to get useful information about local perceptions of resources. The participants will develop the content of the map according to what is important to them. The objective is to learn the villagers' perception of what natural resources are found in the community and how they are used. The map will be done with separate groups of men and women in the community. This is because men and women may use different resources in the area.

Time: 1 hour

Guidelines for drawing the resource map:

- Discussions have to be conducted separately for men and women groups.
- Find a large open place to work.
- Start by making a mark on the flipchart paper to represent a central and important landmark in the village.
- Ask the participants to draw the boundaries of the village on the map.
- Ask the participants to draw other things on the village map that are important. Don't interrupt the participants unless they stop drawing.
- Once they stop, you can ask whether there is anything else of importance that should be added.
- When the map is completed, facilitators should ask the participants to describe it. Ask questions about anything that is unclear.

Use the key questions to guide a discussion about resources in the village. One or more facilitators should ask the questions, another should take notes on what is said. Continue to

add details to the map, as the group responds to the questions and provides more information.

Be sure that the final map includes direction indicators (North, South, East, West).

Materials: Paper, marker, pens, colored pencils.

Key Questions:

1. Where do people go to collect water?
2. Who collects water?
3. Where do people go to collect firewood?
4. Who collects firewood?
5. Where do people go graze livestock?
6. What are the most important resources in the community? Why are they important?
How do you use them?
7. What resources are abundant?
8. What resources are scarce?
9. Are there enough resources for everyone? If not, who lacks which resources?
10. Does everyone have equal access to land?
11. Do women have access to land?
12. Do the poor have access to land?
13. Who makes decisions on land allocation? Who makes decisions on land use?
14. Who controls land?
15. What is the status of land?
16. Is its status changing?
17. If yes, what are causes for the change?

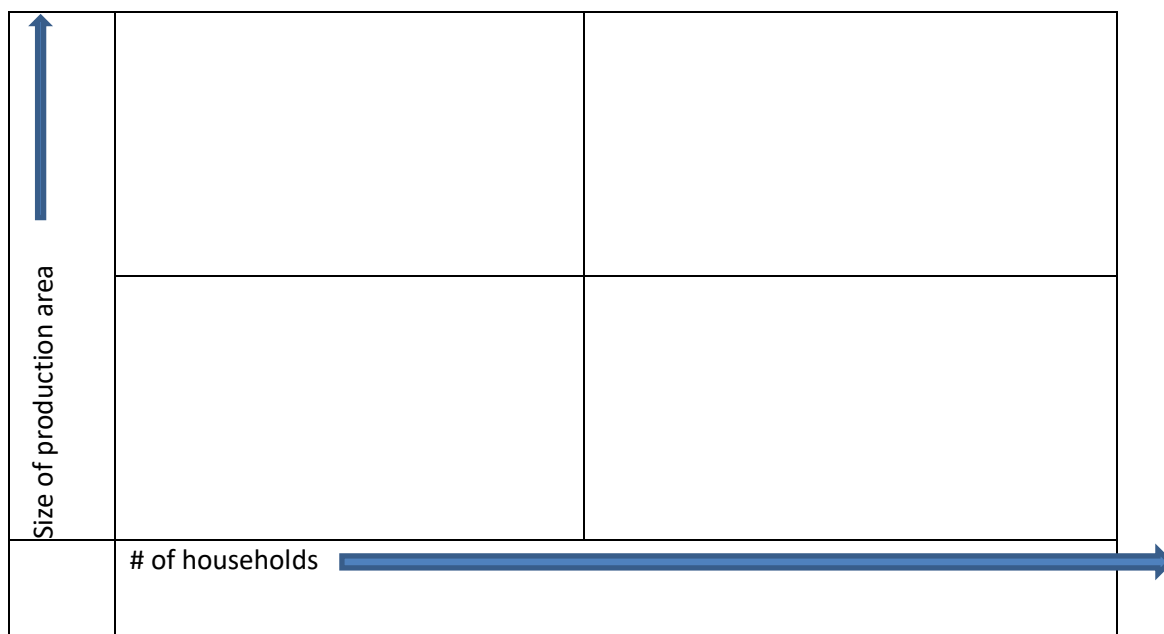
Repeat questions 10-17 for each of the most important resources identified in question 6, as applicable.

18. Which resources do you have the most problems with? (due to natural and human causes)
19. Which resources do you have conflicts over in the community?

20. What varieties of maize do you grow in the village? Do you have certain areas where you grow particular varieties? Why? Do certain kinds of households use particular varieties?
21. What are the most common varieties and what are the most common sources for seed?
22. How important is maize production in this community? Give reasons.
23. What kind of farming equipment is common in this village? Are there services for hire (other than hoe)?
24. Where do you keep farming equipment? Who owns them, and who is responsible for them?
25. Where do you sell maize and who is normally buying your maize?
26. Do you have maize processors/mills, stores within the community?
27. What maize by-products are commonly sold in the village?
28. What are the most common household income sources in this village?
29. What kind of village groups are active in your community (VLSA, SACCO, farming groups, cooperatives, other Income Generating Activities (IGA) groups)?
30. How does the village deal with members that do not have sufficient food or have a financial crisis?
31. What kind of development activities do you carry out as a whole community? Where? (Make sure to mark on the map.)
32. Which areas in your community are most prone to disasters? Which disasters? (E.g. flooding, drought, winds)

Four Cell Analysis

This tool is used for rapid assessment of farmers' knowledge on local production status of crops or varieties by using the two key variables: production area and HHs growing the crop or varieties. These variables are organized into four different cells viz. a) crop or varieties grown by many households in large production area b) crop or varieties grown by many households in small production area c) crop or varieties grown by few households in large production area d) crop or varieties grown by few households in small production area.



- First ask farmers to group their food and cash crops into the four different cells.
- Immediately after the analysis, ask farmers what the reasons are for a 'specific' crop being grown by many HHs in a large area. Ask for yield data for each of the crop and assess whether farmers find these yields high or low. The information is indicative and does not need to be exact. It will provide an insight in average yield compared to yield potential and farmers perception on the performance of such crops/varieties.
- Repeat the same questions for all crops which are distributed by farmers in the different four cells. This helps to identify priority crops for different reasons.

Time: 30 minutes.

Seasonal calendar

A seasonal calendar is a participatory tool which will be used to explore seasonal changes (e.g. gender-specific workload, diseases, income, expenditure etc.). The objective is to learn about changes in livelihoods over the year and to show the seasonality of agricultural and non-agricultural workload, food availability, human diseases, gender-specific income and expenditure, water, forage, credit and holidays.

Guidelines:

- Discussions have to be conducted separately for men and women groups.

- Draw a matrix and list major activities associated with production of maize, other crops, household activities and income-generating activities. Activities can be recorded in the left-hand column and the monthly tasks will be recorded across the row according to the month in which they occur. The matrix can be prepared separately for rain-fed as well as irrigation periods.
- It is important to stress that the questions are not about “what is the most appropriate time to conduct this task”, but rather “when did you conduct this task in the past year (the reality)”. Also, it is important to let the respondents discuss on what is most common, not what is advised by extension agents.
- Record the activities on flip chart paper.

Time: 2 hours.

An example of a seasonal calendar associated with production and marketing of maize:

Activity		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Maize production	Task												
	Who (women, men, boys, girls)												
Other production	Task												
	Who (women, men, girls, boys)												
Savings & borrowing													

Use the following questions to complete the matrix:

1. For maize production what are the tasks carried out over the year? Who does that task is it men, women, boys, girls? How do they carry out that task, what special equipment is used to carry out that task? Who makes the decision to carry out that task or on when to carry it out? Also, who controls income from maize production?

2. What other activities do you carry out other than maize production? (eg. Off farm labour, livestock, other food crops) For each activity, ask what tasks are carried out over the year and who carries them out. Is it men, women, boys, girls? Also, who controls income from this activity, if any (corresponds to tasks related to sales and marketing)?
3. What household activities do you carry out, (fetching water, fetching firewood, taking care of children, preparing food) Who else is responsible for them: is it men, women, boys, girls? For each activity, ask if it is daily or seasonal, and mark accordingly on the calendar?
4. When do you save and borrow money? Who in your household borrows money, men, women? What is the borrowed money used for? What do you use as security for borrowing money? What is the interest rate? When do you pay back the borrowed money? In your households, who decides to save and borrow money?

After completing the matrix make sure to address the following questions

1. What are the busiest months of the year?
2. When is most agricultural work carried out by women?
3. When is most agricultural work carried out by men?
4. When is most non-agricultural work carried out by women?
5. When is most non-agricultural work carried out by men?
6. At what time of the year is food scarce?
7. How does income vary over the year for men and women?
8. How does expenditure vary over the year for men and women?
9. How does rainfall vary over the year?
10. How does water availability for human consumption vary over the year?
11. How does livestock forage availability vary over the year?
12. How does sickness vary over the year?
13. a. Are there special holidays for this community?
14. B. What are they, and when do they occur?
15. In this village what are typical male activities that a woman is not allowed to do? What will happen if a woman does such a task?
16. In this village what are typical female activities that a man is not allowed to do? What will happen if a man does such a task?

Now guide the group through the construction of a timeline of the most important events over the last 30 years.

- Sketch a timeline beginning from 30 years ago and ending in the present, and ask the group to list the major events that have affected their agricultural development and about when they occurred.
- Guiding questions:
 1. How has the weather varied? (drought, flooding, extreme temperature, erratic rainfall)
Have you seen changes in the climate?
 2. Have there been major developments in infrastructure?
 3. Have there been important initiatives to support crop production and seed systems?
 4. Other important events that have affected agricultural development in the community?

Now, for each of the important events listed on the timeline, ask the group:

1. How has it affected maize production? Other food crops? Livestock?
 2. How has it affected which months you see the most pests and diseases?
 3. How has it affected food security?
 4. How has it affected service delivery?
 5. How has it affected which months you tend to save and borrow?
 6. How has it affected men's and women's activities and behavior? (Household and farm tasks, coping strategies)
- As a last question, ask the group: What do you think are the common drivers/causes of changes in the climate in the community?

Risk ranking and prioritization

This activity helps to identify the risks farmers face (inputs risks, weather, biological & environmental risks, logistical & infrastructural risks, market risks, health risks, social risks and cultural norms).

Time: 1 hour.

- Begin by asking the group: What problems do you find in providing for your family?

- Allow the group to brainstorm. List all the problems that participants name on the flipchart, until they have none left to name.
- Once complete, list the problems on another sheet, both vertically and horizontally. See the example below.

	Problem A	Problem B	Problem C	Problem D	Problem E	Problem F
Problem A						
Problem B						
Problem C						
Problem D						
Problem E						
Problem F						

- Use pair-wise ranking to assist the group to rank each problem in order of importance. For instance, for each row ask, “which is more important, Problem A or B? which is more important, problem A or C? etc.” and proceed to complete the matrix accordingly.
- Once the ranks are determined, transfer the top 5 ranked problems to the following table

Problem	Severity	Frequency	Coping	Solution
#1 -				
#2 -				
#3 -				
#4 -				
#5 -				

- For each, ask the group: how bad are the effects of the problem, high, medium or low? Include their response in the “severity” column.
- For each problem, ask the group: how frequent is it? Is it common, not so common, or rare? Include their response in the “frequency” column.

- For each problem, ask the group: how do you normally cope with the problem/concern? Include their response in the “coping” column.
- At the very end, for each problem, ask the group: What would be the ideal solution? What do you need to resolve the problem? Include their response in the “solution” column. (It can be helpful to cover the “solution” column until the end, so that the participants do not confuse coping strategies with solutions to the problem.)

Focus group discussion on maize seed buying behaviour

The main purpose of this focus group discussion is to gain an in-depth understanding why smallholder farmers are not generally buying quality seed from agro-dealers and seed companies. The discussion is to probe the underlying reasons that are generally provided by farmers in surveys such as seed is expensive, no access, not enough information. The focus group discussion will also try to gain a deeper understanding on variety and seed selection criteria such as high yielding and markets. To start the focus group discussion, refer back to the varieties that the group identified in the four cell analysis. We are interested in the gendered responses also around often gender differences or inequalities in new technologies have to do with differences in access to information (men tend to have more access to technical information than women; if people are not informed, they are found to be less able to use the new technology/practice). Also, women’s involvement in the decision-making process has been seen to influence men’s use of DTM on their plots. Ask the following questions:

1. What are the main sources of maize seed? Why?
2. How do you decide what varieties to plant? Does anyone help you decide? Who?
3. Which source of seed do you trust most? Why?
4. Which sources of seed do you not trust? Why?
5. Do you buy seed from the agro-dealer? Why? Why not? Probe
6. Do you know what hybrid maize seed is? Have you used it before? Why? Why not?
7. Do you know the yield potential for hybrid maize seed? How does it relate to yields of the varieties you use? Explain
8. If you have used hybrid maize seed before, what was the average yield? Do you think this is high or low? Explain
9. If you used hybrid seed before did you use fertilizer?

10. Do you know what is meant with drought tolerant characteristics are in maize?
11. Which are the maize varieties (both local and improved) that have drought tolerance characters to adapt with climate changes?
12. How did you learn or get to know about these maize varieties?
13. Do any of you buy and plant DTM? Of those who do, why do you? What are the reasons?
14. Are there reasons why you don't buy and plant drought tolerant maize varieties? What are these? Are there worries or concerns that prevent you from buying and planting drought tolerant maize? What are these? (Make sure to probe this set of questions in depth with the group!)

Appendix 2 Consent

Focus group/PRA information section and consent form

Your participation in this focus group has been requested by ISSD. Your opinion is vital to our research because you have rich experiences in maize production and agricultural in general. For this reason what you think will help us understand and refine our research on your decision making processes to invest in quality seed or to use other seed sources. Please feel free to share any information you wish during the focus group discussion. It is important to take the time you need in order to provide spontaneous and considerate opinions on the subjects of interest. If you want to change your response at any time, let the group discussion leader know before the focus group session ends. If at any time you do not understand one of the questions please ask for clarifications. You are an important part of this research and your ideas count! You are free to leave this focus group discussion at any time and do not need to stay up to the end.

In a bid to increase your access to drought tolerant quality seed for maize, ISSD-Uganda is doing a research project to understand why some farmers are buying quality seed while other farmers are not buying quality seed and what are reasons for that and the role of maize in your farming system. It looks at what is hampering you to buy seed and what are driving forces to buy quality seed. Understanding this decision making process will help policy makers, seed companies and agricultural extension workers to design products that better suit your needs

On this note, we are appealing to you as a key stakeholder in the maize production to provide us with some time to engage with us. In this community we would like to conduct a village resource mapping, household activity mapping, historic timeline and a focus group discussion with you. We would like to split the group into male and female participants groups for the focus group discussion, and then conclude jointly to reflect on the findings. The session will take about four to five hours and we will be providing you with a small snack and bar of soap at the end of the session. We would like to have 20 men and 20 women representing your village. Three of each with more than 3 acres and 3 with less than 1 acre and the others between 1 – 3 acres.

The information given will be treated with utmost confidentiality. Your responses are very important as they will help us to understand barriers to adoption of drought tolerant maize varieties, maize market risks in Uganda, map the maize varieties grown and climate smart agriculture which in turn will guide the selection of the research area. We will circulate a participant list for our accountability purposes but this information will not be used for any other purpose.

Please provide oral consent to be part of this focus group and that you are ok with us recording the conversations. Records are used solely for improving the report and will be destroyed immediately after the reporting is complete. Once you have consented, your group leader will sign this form on behalf of the entire group.

We will leave a copy of this form with you and thank you in advance and in case of any challenges concerning the question guide, please call (0774208901) or write an email to researchofficer@issduganda.org and you will be responded to.

Village: _____

Date: _____

Name group leader: _____

Signature group leader: _____

Name extension officer: _____

Signature extension officer: _____

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