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# Gender and the conservation of traditional crop varieties: the case of traditional sorghum in Agago District, Uganda

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This study examines the roles men and women play in the cultivation, processing, and marketing of traditional sorghum varieties and gendered trait preferences as they relate to the continued existence of these varieties in Agago District. The study utilized primary data which was collected through a survey and focus group discussions. The results suggest that continued production and utilization of traditional sorghum is a result of the efforts of both men and women, although the general labor burden fell on women. There was a differential preference for the traditional sorghum characteristics of market, taste, storage, threshing, and milling by gender. Technology advancements in processing ease women's time constraints and could result in the conservation of difficult-to-process varieties that otherwise possess good traits. Lastly, a gender dimension should be included in future strategies to understand the conservation of varieties as well as the adoption of improved sorghums.

**Keywords:** On-Farm Conservation, Sorghum Varieties, Gender Roles, Gendered Traits, Traditional Crops.

## Background

Traditional crop varieties constitute an important component of crop resources. They are the basic unit for crop improvement programs for the development of future crop varieties that are adapted to local and harsh climate as well as soil conditions (Asrat et al. 2010). Their unique adaptation to farming environments over the years has enabled traditional varieties to contribute to farm-level resilience in the face of production shocks, environmental stresses and climatic variability (Cavatassi et al. 2005; Swiderska et al. 2011; Bradburn 2014; Jarvis et al. 2011). Over the years, there has been a gradual loss of traditional crop varieties on farmer fields; in fact, between the 1970s and the 1980s it was widely assumed that traditional crop varieties would be rapidly and completely replaced by improved varieties. However, in many production systems this has not been the case (Jarvis et al. 2011). The continued cultivation and use of traditional crop varieties by farmers imply that these crop varieties still meet the needs of farmers and communities in which they exist, as farmers tend to continue to cultivate and use a crop variety in line with their labor requirements, taste preferences, and social and market needs rather than for the sake of conservation (Asrat et al. 2010). The fact remains, however, that scholars have found traditional crop varieties to be under threat of loss under various cropping systems (FAO 2008a; Ahuja et al. 2016).

## Literature review

Sorghum (*Sorghum bicolor* (L.) Moench) is one of the most important cereal crops in the semi-arid tropics of Africa and South Asia, supporting the livelihood of more than 500 million people worldwide (Reddy et al. 2012; Macauley 2015). In Uganda, sorghum is the second most important cereal crop after maize, with the highest production coming from the Northern region (UBOS 2010). Sorghum is mainly grown by smallholder farmers, who tend to grow the majority of traditional crop varieties. Traditional sorghum varieties are critical in the food security puzzle because they form the basic germplasm from which genetic material for crop improvement programs is obtained in the development of new sorghum varieties that are adaptable to biotic and abiotic stresses. Studies on traditional sorghum varieties in Uganda (Mbabwine et al. 2004) and Benin (Dossou-Aminon et al. 2014; Kondombo et al. 2016) have revealed that these varieties are under threat with farmers generally discarding them over time and villages as a whole growing only a small number of the available varieties identified in those studies.

In Uganda, traditional sorghum varieties are at risk of being phased out by farmers due to agricultural modernization policies that promote the use of improved sorghum varieties, farmers' increased access to brewery markets that require improved sorghum varieties, and climate change which endangers sorghum production by exacerbating the parasitic striga weed (NARO 2008; Mbabwine et al. 2004). As a result, the National Semi-

Arid Resources Research Institute (NaSARRI) in Serere initiated a collection process of some of the traditional sorghum varieties to be conserved in gene banks and used in future breeding programs that aim for sustainable agriculture production. However, effective sustainable agriculture production would also benefit from complimentary on-farm conservation of these traditional sorghum varieties (Bezançon et al. 2009). On-farm conservation entails maintaining these varieties in farm communities. Cultivation of these traditional varieties allows the crop's continued evolutionary processes, providing an invaluable source for environmental adaptability genes, and facilitates the preservation of indigenous knowledge associated with these crop resources (Asrat et al. 2010). The most common strategy that farmers use to conserve a given crop variety within their communities for many years is its continual production and use (Nakabonge 2017).

Traditional crops are produced and utilized within a social context, and gender has been recognized as one of the major social categories important in understanding the maintenance of most crop varieties cultivated by humans (Amri and Kimaro 2010; Christinck et al. 2017). Gender relates to socially assigned roles and behavior attributed to men and women. It is central to the social organization of crop variety and seed management in terms of division of labor, knowledge or skill, and access to and utilization of resources (Leclerc and d'Eeckenbrugge 2012). Different types of activities and tasks are generally allocated to women and men within families in terms of subsistence production and production for the market (Ogato et al. 2009). Women have been noted to be responsible for seed management and processing plant to meet household needs (Howard-Borjas and Cuijpers, 2013). In many cropping systems, women may arguably play a bigger role than men as they often control management of various crop varieties (Howard 2003; Ogato et al. 2009). Some scholars have therefore suggested that it is mostly women who are responsible for the conservation of crop resources and have greater local plant knowledge (Amri and Kimaro 2010; Hellin et al. 2010). Moreover, the role of gender in the management of so-called food crops is often ignored in studies of agro-biodiversity because it is often assumed to occur within the domestic realm, where women are mostly responsible for production and use of these crops.

Nuijten (2010) however cautions against the general claim that seed and variety management resides primarily with women, based on his study on gender and the management of crop diversity in The Gambia, which highlighted that men not only were involved in millet seed management but also possessed the knowledge that pertained to the practice. Similarly, in Peru cassava is considered a "woman's crop", but men played a crucial role in the conservation of traditional cassava varieties (Salick et al. 1997). In north-east Ghana, the role of sorghum seed storage has long been known as men's responsibility in the household, although women have over time started engaging in it (Kudadjie 2016). The same is true for sorghum seed selection in north-east Benin (Dossou-Aminon et al. 2014) and rice seed storage in Sierra Leone (Jusu 1999). While in Ethiopia men also mostly engage in field activities and marketing of sorghum, the contrary was found to be the case in Kenya, Uganda, Mozambique, and Zimbabwe, where it was women who mostly engaged in field and post-harvest activities including seed management and marketing of sorghum (Wortmann et al. 2006). Gender roles in the management of crop varieties are thus complex and vary across different crops, crop value chain nodes, and geographical locations, and roles could change over time amongst members in a household (Nuijten 2010; Aregu et al. 2010). The complementarity of the roles and responsibilities of men and women in the conservation of traditional food crop needs to ascertained, as assumptions would perpetuate an important gap in our understanding of the conservation of traditional crop varieties (Amri and Kimaro 2010) – in this case sorghum.

Additionally, gender also comes into play in men's and women's appreciation of particular characteristics of a crop variety, especially when they undertake different roles during the production of that crop (vom Brocke et al. 2010; Christinck et al. 2017). Since women and men are often socially assigned different activities or phases of crop production, such as processing, use, or marketing, this leads to different perceptions of the value of different crop characteristics and hence gender-differentiated trait preference (Hellin et al. 2010; Dansi et al. 2010). These trait preferences tend to be about agronomic characteristics such as yield, maturity period, drought tolerance, and grain size; consumption related characteristics like taste, ease of processing, and cooking quality; and management characteristics such as marketability and labor requirements. Women often express strong preferences with respect to consumption attributes such as taste, cook ability, and ease of processing whereas men generally focus on criteria related to agronomic characteristics and market value (FAO 2008b; Smale and Jarvis 2002). Women's responsibility for post-harvest activities, seed processing, and food supplies have often meant that they ensure that varieties are palatable, nutritious, in line with culinary traditions, and meet processing requirements (Mulatu and Zelleke 2002; Amri and Kimaro 2010). Research has shown that inclusion of preferred traits for both genders in the development of new crop varieties increases their adoption by farmers (Christinck et al. 2017). Likewise, the continued production and utilization of traditional crop varieties, where both men and women undertake complementary activities, is as a result of the varieties possessing the traits preferred by both genders, which relate to their roles in production and use. Understanding gendered preferred traits would help unravel part of the complexity behind farmers' decision-making in continuing to cultivate a given variety, especially when both men and women are involved in the production and utilization of a crop.

In Uganda, the role of women and men in on-farm conservation (i.e., production and utilization) of traditional sorghum is yet to be documented. Existing literature reveals that both men and women are actively involved in production, post-harvest handling, and marketing of sorghum (Wortmann et al. 2006) but their roles in the sub-activities encompassed within production, post-harvest handling, and marketing is not documented. In their study on sorghum production in Uganda, Lubadde et al. (2019) highlighted only harvesting and threshing activities as being predominately done by women. Site-specific understanding of the different activities that men and women engage in during production and utilization, decision-making, and the sharing of benefits is essential for development initiatives for food security (Aregu

et al. 2010) and on-farm conservation (Amri and Kimaro 2010). The gender context within which production and utilization of traditional sorghum is located needs to be understood if strategies and interventions aimed at supporting the maintenance of traditional sorghum in farmers' fields are to be effective. Additionally, this study will inform sorghum improvement programs of which traits and trait combinations bring benefits for men and women sorghum farmers in Agago District. The overall objective of the paper was therefore to investigate the gender dynamics in on-farm conservation of traditional sorghum varieties in Agago District, Northern Uganda, by looking at gender roles and gendered trait preferences. The study was organized around the following two research questions: (i) What are the roles of men and women in the production, processing, use, and marketing of traditional sorghum varieties? (ii) Are the preferences for traditional sorghum traits gendered in Agago District? We anticipate that women's participation along the different production and utilization stages is greater than men's, based on prior work on gender roles in different crops (Wortmann et al. 2006; Howard-Borjas and Cuijpers 2013). Similarly, we would expect gender differentials in preferences for the different sorghum characteristics with women more focused on processing and consumption characteristics and men more focused on the market.

## Methodology

The study utilized a mixed methods approach: qualitative data collection using focus group discussion (FGD) and quantitative data collection using a survey method. The study was carried out in Agago District in the Northern region of Uganda. Agago District has bimodal rainfall that peaks in the months of March and August. The major crops grown in Agago District include maize, sorghum, millet, beans, sesame, rice, cassava, and ground nuts. Sorghum is a priority food crop, with virtually every household in the district growing the crop. Agago District was specifically chosen because it is the highest producer of sorghum in the Northern region of Uganda (JICA 2012; UBOS 2010). The study area was also one of the target areas for a larger research project under the Regional University Forum for Capacity Building in Agriculture (RUFORUM) exploring the status (i.e., amount and distribution) of traditional sorghum varieties in the Northern region of Uganda.

Before study commencement, the researchers undertook a series of preparatory activities, including a Gender-responsive Researchers Equipped for Agricultural Transformation (GREAT) training targeted at social scientists and plant breeders from selected national agriculture research institutions around Africa. The aim of the training was to introduce researchers to the concept of incorporating gender in research on participatory cereal breeding, to present methodologies, and to plan for fieldwork to implement the theory learned. Participatory plant breeding is the process by which farmers are routinely involved in plant breeding programs with opportunities to make decisions throughout (Halewood et al. 2007), which is meant to improve uptake of new crop varieties.

A preliminary study comprising a sample size of not more than 50 farmers was conducted August 12–16, 2017 to define traditional sorghum varieties, to find out reasons why farmers continue to grow these varieties, to identify the traditional sorghum characteristics important to farmers, the practices important in the management of traditional sorghum varieties in the community, and to gain insight into farmers' perspectives of on-farm conservation of traditional sorghum varieties. From the pilot study, we defined traditional sorghum varieties as varieties that farmers had grown over the years and that have been passed down from mother to daughter or from mother-in-law to daughter-in-law. This definition helped delimit improved varieties and traditional varieties during the identification process and to ascertain characteristics of traditional sorghum. The characteristics identified as important to farmers during the pilot study were used in pairwise rankings to establish whether there was a gendered difference in ranking but also to establish whether the level of importance attached to the different characteristics differed by gender. The practices identified in the management of traditional sorghum varieties during the pilot study were used in the gender activity profile. The main research study was conducted July 14–24, 2018; focus group discussions and the survey were conducted concurrently. A research team comprising two researchers and seven enumerators was established to conduct the focus group discussion and survey. In each site, a preliminary meeting was held with sub-county agricultural extension officers and site coordinators to introduce and explain the purpose of the study and its impact on the overall sorghum breeding program in Uganda. The site coordinators, who had local knowledge of the area, made contact with local council chairpersons who connected the research group to the sorghum farmers, who in turn were the key stakeholders and unit of analysis for this study.

A multistage sampling technique was employed, beginning with the selection of sub-counties. First, all the sub-counties in the district were listed and, with the help of the district agricultural officer, the highest sorghum producers as well as those that had central markets were purposively selected. The sub-counties that have a central market included Kalongo town council, Patongo town council, and Agago town council. The second category was the highest producing sub-counties and these included Adilang, Kotomol, Patongo, Lapono, Paimol, Parabong, Wol, Omiya Paciwa, and Lira Palwo. Proportionate sampling was carried out with one sub-county randomly selected from the market category (Kalongo town council) and five sub-counties randomly selected from the highest producing category (Lapono, Paimol, Parabong Wol, Omiya Paciwa). A list of villages that had received no known intervention of improved sorghum seed over the years and so were likely to still be growing a diversity of traditional varieties was generated with the aid of the field extension workers from each of the selected sub-counties. Each of the villages was assigned a number and placed in different tins representing the sub-counties. Proportionate random sampling was employed to calculate the number of villages that were to be selected from each sub-county. The respective number of villages was drawn from each tin. A total of 19 villages was randomly selected (Table 1). Villages/wards are the smallest unit of administration in Uganda and were the sites from which par-

ticipants were selected. To determine the number of farmers to administer the questionnaire to, a list of households currently growing traditional sorghum varieties (TSV) was obtained from the selected villages with the help of the local council chairpersons. Proportionate sampling was also employed to determine the number of households to be surveyed per village in each of the sub-counties. One member from each household was then subjected to the questionnaire – either the household head or their spouse or any available adult. The Cochran (1977) sample size formula was used to determine the sample size of 246. $P_x$, the proportion of households from each village to be included in the survey, was obtained using the formula from Kothari (2004):

$$P_x = \frac{N_x \times n}{N},$$

where $P_x$ is the number of HHs to be sampled from a particular village, $N_x$ is the number of HHs growing TSV in that particular village, n is the total sample size of the study obtained from the Cochran formula, and N is the total number of HHS growing TSVs in all the villages included.

In identifying the various groups of participants for FGDs, a purposive sampling strategy was followed in consultation with local chairpersons in each of the villages and extension workers. Criteria were developed and used in identifying the focus group discussion participants. The key selection criteria included for farmers to currently be growing traditional sorghum varieties and to have been known to grow traditional sorghum varieties over the years. In addition, a participant had to be willing and available to take part in the group discussion. The study conducted 12 focus group discussions in the six selected sub-counties (one men-only and one women-only FGD in each sub-county) with participants from the selected villages.

| Sub-county | Villages/Wards | Respondents |
|---|---|---|
| Parabong | Dungu, Albilnino, Kolir | 46 |
| Wol | Rogo, Amida, Kodem | 50 |
| Lapono | Ongalo, Kapere, Kaket | 48 |
| Omiya Paciwa | Coo dong, Coo megi, Kaciciro, Kalik | 40 |
| Paimol | Alupere, Akado | 34 |
| Kalongo | Alupere, Akado, Alokiwinyi | 28 |
| **Total** 6 | 19 | 246 |

**Table 1** Sampled villages in Agago District by sub-county and corresponding sample size. *(Source: Survey data, July 2018.)*

## Data collection

### *Focus group discussions*

The key questions discussed included the identification of traditional sorghum varieties grown in the community, the purpose for which each variety is grown, women's and men's reasons for continuing to grow traditional sorghum varieties, a pairwise ranking of the different traditional sorghum characteristics, and the role men and women play in the production and utilization (processing, use, marketing) of traditional sorghum. A trained research assistant, conversant with the Acholi dialect, and researcher conducted FGDs with the help of a translator. Information was saved on an audio recorder. The recordings were later transcribed and translated. Separate FGDs were held with men (both youth and older) and women (both youth and older). "Youth", as defined by the Uganda constitution and understood in this study, is a person between 18 and 35 years old.

### *Household survey*

Using a questionnaire, quantitative data was collected for the purpose of triangulating it with the information from focus group discussions. The information collected included traditional sorghum varieties grown in the household, a gender activity profile for the production and utilization of sorghum, the gender distribution of control and benefits from sale of the crop, and the levels of importance of different sorghum characteristics by gender. The questionnaire was pretested and a few adjustments were made. Trained research assistants fluent in the Acholi language administered the questionnaire. For the selected households, the questionnaire was administered to either the household head or their spouse. This depended on availability and willingness of the individual to take part in the study. A total of 246 respondents were interviewed, of which 96 were men and 150 women (Table 2).

### *Data analysis*

The quantitative data collected was entered into SSPS software and analyzed using descriptive statistics to determine the average gender distribution of labor for activities in the production and utilization of traditional sorghum. To determine whether trait preferences were gendered, the ranks for each characteristic were obtained from each FGD's pairwise ranking. The different ranks for each characteristic were subjected to a Garrett ranking test to determine the overall assigned rank for each characteristic by gender. A Mann–Whitney test was also carried out to determine whether there was a significant difference in the levels of importance men and women attached to the different sorghum characteristics.

The qualitative data was organized and analyzed in relation to conservation concepts. The data from different group discussions was coded, and similar codes from different transcripts were categorized and interpreted in line with the conservation of the identified traditional sorghum varieties. The qualitative data helped explain why some varieties were popular over others

and helped to understand the composite nature of the production and utilization practices in the gender activity profiles as well as the complementary nature of men's and women's participation in the conservation of traditional sorghum.

## Results and discussion

In Agago District, farmers are very much dependent on rain fed agriculture. Land preparation starts with the first rains in February and fields are generally worked twice, the second time before sowing as the first peak rain season begins in March. Sorghum is broadcast either in a single stand or a mixed stand with cowpea. An extensive period of weeding ensues while land preparation continues for other crops like maize and sunflowers. Harvest of the early-maturing sorghum varieties starts in the month of May. Harvest of the late-maturing traditional sorghums takes place from September until January. Farmers are mainly reliant on home-saved seed.

The results of descriptive analysis show that more women than men were interviewed, mainly because they were available more often than men (Table 2). Secondly, men often suggested for their wives to be interviewed because sorghum was perceived as a "woman's crop" in the household and thus women were more likely to be knowledgeable in this area. In female-headed households the household heads were mostly elderly widowed women, while men that lived in female-headed households were generally below 35 years and lived with widowed mothers. The most popular traditional sorghum varieties were Godda and Lawera because of their good yields, good taste, marketability and ease of processing (threshing and milling). The least popular varieties were characterized either by difficulty in threshing and milling (Gaya and Maaocikka) or low yields (Lubule). For a description of the sorghum varieties' main characteristics, see Appendix.

### *Men's and women's roles in the production and utilization of traditional sorghum*

This section of the analysis considered the participation of men and women in the production and utilization of traditional sorghum in the community. Using the Harvard Analytical Framework, questions were included in the survey questionnaire aimed at eliciting information on gender roles, decision-making as well as access to and control over the benefits from production of traditional sorghum. Proportional piling was used in order to establish the percentage of men's and women's contribution in the production and utilization of traditional sorghum. The results showed that men and women often work together but the general labor burden falls on women (Table 3).

Conservation of traditional sorghum involves the continued cultivation, seed management, consumption, and marketing of the crop. The practices entailed in the conservation of traditional sorghum were therefore categorized into five activities: seed management, cultivation, processing, consumption, and marketing. Each of the major five activities consisted of sub-activities about which the participants were asked who in their household carried out the activity. Table 3 provides the percentage of respondents that reported that an activity in the production

| Variable | | Men | Women | Total (%) |
|---|---|---|---|---|
| Age | Below 35 | 53 | 72 | 50.8 |
| | 35 and above | 43 | 78 | 49.2 |
| Household head | MHH | 93 | 126 | 89 |
| | WHH | 3 | 24 | 11 |
| | | **Farmers growing the variety** | | **Farmers growing the variety (%)** |
| Traditional sorghum variety | Bette | 68 | | 12.7 |
| | Gaya | 12 | | 2.2 |
| | Godda | 137 | | 25.7 |
| | Kabii | 8 | | 1.5 |
| | Kibworo | 86 | | 16.1 |
| | Lakitgum | 73 | | 13.7 |
| | Lawera | 131 | | 24.5 |
| | Lubule | 5 | | 1 |
| | Maaocikka | 14 | | 16.1 |

NB. Some farmers grew more than one variety.

**Table 2** Description of respondent characteristics and sorghum variety popularity. *(Source: Authors' calculations from survey data collected in July 2018.)*

| Activity | Men (%) | Women (%) | Jointly by men and women (%) |
|---|---|---|---|
| Seed sourcing | 8.3 | 68.4 | 23.3 |
| Seed selection | 3.9 | 69.1 | 27.0 |
| Seed/grain storage | 5.4 | 74.1 | 20.0 |
| Seed sharing | 1.7 | 77.5 | 20.8 |
| **Average for seed management** | **4.9** | **72.3** | **22.8** |
| Land preparation | 9.7 | 7.8 | 81.1 |
| Planting | 28.2 | 5.8 | 66 |
| Weeding | 3.9 | 50.2 | 45.9 |
| Harvesting | 2.9 | 12.1 | 85 |
| **Average for cultivation** | **11.2** | **19.0** | **69.5** |
| Drying grain | 2.5 | 60.3 | 37.3 |
| Threshing | 1.9 | 65.5 | 32.5 |
| Milling using a machine | 2.0 | 63.4 | 34.7 |
| Grinding on a stone | 0.5 | 97.9 | 1.6 |
| **Average for machine processing** | **2.13** | **63.1** | **34.8** |
| **Average for traditional grinding stone processing** | **1.63** | **74.6** | **23.8** |
| Making bread | 1.5 | 92.2 | 6.3 |
| Making brew | 0.6 | 98.8 | 0.6 |
| **Average for consumption** | **1.05** | **95.5** | **3.5** |
| Sale of sorghum brew | 0.6 | 98.2 | 1.2 |
| Sale of sorghum grain | 12.1 | 18.6 | 69.3 |
| **Average for marketing** | **5.96** | **58.4** | **35.3** |
| **Average in households using machine processing** | **5.03** | **58.24** | **33.18** |
| **Average in households using traditional grinding stone processing** | **4.93** | **60.54** | **30.98** |

**Table 3** Average gender distribution of labor for activities in seed management, cultivation, processing, and marketing of traditional sorghum varieties in the household. *(n=246) (Source: Authors' calculations from the gender survey data collected in July 2018.)*

and utilization of traditional sorghum was carried out only by a man, only by a woman, or jointly by both men and women in the household. Overall participants tended to report that both men and women were involved in the conservation of traditional sorghum. However, their involvement varied across the different activities.

The majority of participants (72.3 percent) suggested that women were solely responsible for carrying out much of the activities that pertain to traditional sorghum seed management (seed sourcing, seed selection, seed storage and seed sharing) in their households. In this role, women endeavor to pass down seed and knowledge that pertains to seed management to their daughters and daughters-in-law. In focus group discussions, participants often stated that women are charged with ensuring that the household does not lack food and that one of the ways women do so is by ensuring there is enough seed for planting every season. The results are in line with what tends to be reported in the literature on gender and biodiversity management (Howard-Borjas and Cuijpers 2013; Ogato et al. 2009; Tapia and De La Torre 1998). However, studies on traditional sorghum in north-east Ghana (Kudadjie 2016) and north-eastern Benin (Dossou-Aminon et al. 2014) and on traditional rice in Sierra Leone (Jusu 1999) have indicated the contrary, with men perceived as providers and keepers of staple foods and thus tasked with ensuring that seed is available and viable at the next planting. This suggests that seed management is regulated in variable and complex way dependent on the roles assigned to men and women in a given society.

In the communities of Agago, mothers and mothers-in-law share seed with their daughters and daughters-in-law first to ensure a continuity of the culture of sorghum seed sharing, as one woman respondent said.

> *When I was leaving my parents for my marital home, my mother gave me sorghum and millet seeds, saying, "My daughter, take this seed, do with it as you have always seen me do and chase away hunger from your home with these seeds."*
>
> (Woman in FGD, Northern Uganda, July 12, 2018)

Sorghum is referred to as a "famine management crop" in these communities, a statement highlighting the fact that women have the responsibility to "keep hunger from the home" using these traditional sorghum seeds. Continued cultivation of traditional sorghum varieties over the years can be attributed to women's ability to fulfill this role. Women share traditional sorghum seed with their daughters not only for continuity of tradition but also as a strategy for seed security. When asked why women passed down seed to their daughters, the majority of the farmers (52.6 percent) said that passing down seed to daughters or daughters-in-law was a strategy of multiplying and maintaining their original seed (see Figure 1). One older woman said,

> *I gave my sorghum seeds that I got from my mother to my daughter because I know if I ever had any problem with my yields here and lost my seed, I would go to my daughter to recover my original seed.*
>
> (Woman in FGD, Northern Uganda, July 14, 2018)

The older women shared not only sorghum seed with their daughters or daughters-in-law but also knowledge associated with seed selection and preservation. The seed selection process begins after harvest during the drying process when the grain is brought from the field to the homestead. More than half of the participants agreed that the drying process was predominately the responsibility of women. When drying the sorghum heads, women will select sorghum heads that are bigger than average with large grain and with the grain color of their preference. The selected seed is left on its stalk, sun-dried to reduce moisture, and later hanged above the kitchen fireplace to accumulate soot, which repels weevils. Farmers claimed that seed stored above the cooking area could be stored for as long as three years without any weevil damage. Given their closeness to traditional sorghum

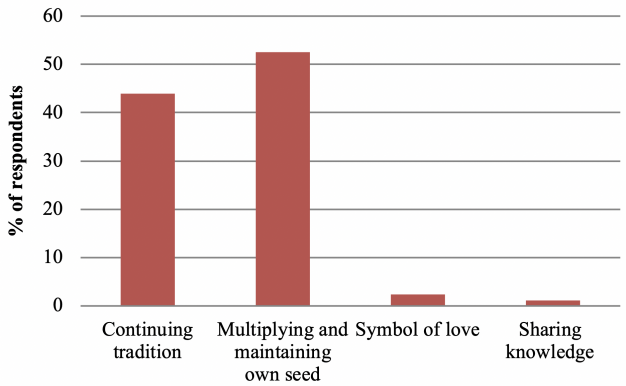


**Figure 1** Reasons reported by women for sharing traditional sorghum seeds with their daughters or daughters-in-law.

seeds, women do most of the seed sourcing as they are often aware of "good" sorghum seed, meaning the kind of seed that could germinate. In group discussion, discussants often noted that men were custodians of seeds and planting materials for crops such as cassava, maize, and sunflowers, because these are major cash-earning crops in the community, fetching more money at the market than traditional sorghum. The division of labor in seed management therefore depends on the type of crop, and since sorghum is majorly grown for home consumption, the women are predominately responsible for its seed management. This is similar to findings by Amri and Kimaro (2010), according to which men take an active role in seed management of cash crops while seed management of food crops is seen as an extension of women's domestic duties. The role of seed management therefore also depends on the economic importance attached to the crop in a community.

Field activities related to the cultivation of traditional sorghum, such as land preparation, planting, weeding, and harvesting were mainly carried out jointly by both men and women (69.5 percent). However, some roles within the sub-activities were clearly divided up along gender lines as observed in the case of weeding, that was mostly done by women. Similarly, studies conducted in Ethiopia on gender roles in crop production have indicated that women play a more significant role than men in manual weeding (Ogato et al. 2009; Feyso et al. 2013). One explanation is that men are less involved in the weeding of sorghum because at that time of the season they are clearing and preparing gardens for other crops, including sunflowers, cotton, and maize – activities considered more labor-intensive than weeding. From group discussion, it was noted that field activities were carried out in a complementary manner. For instance, in land preparation men were responsible for the first land clearing, which involved cutting down trees and pushing the oxen plough and which is considered hard manual labor, while women were tasked with the second land preparation, which involved hoeing. When it came to planting, men were responsible for broadcasting while women were responsible for covering the seed with soil. Women in different focus group discussions often implied that men were skilled in broadcasting seed because they had learned and improved the technique over the years but also that they were more aware than women of the seeding rate per plot. During harvesting, men (not necessarily the household head) and children (when present) were responsible for bending the sorghum crop while the women harvested or cut the sorghum head. While the data suggested that field activities were mostly done jointly by both men and women, there was further role division when carrying out the different sub-activities. It is this complementary nature of their roles that has enabled timely implementation of sorghum field activities over the years, consequently producing continued yields even amid climate variability.

Roles in traditional sorghum processing, including activities such as drying grain, threshing, taking grain to the mill machine, or milling grain on the traditional grinding stone, were generally women's responsibility in the household. Processing grain into flour is a role that was exclusively assigned to women as long as it was done using a traditional grinding stone. The recent introduction of milling machines in the communities has seen

| Quantity and type of market | Respondents' involvement (%) | |
|---|---|---|
| | Men | Women |
| **Quantity of sorghum grain one is entitled to sell** | | |
| A few cups | 15 | 68 |
| One sack | 37 | 26 |
| More than one sack | 48 | 6 |
| **Common market destinations** | | |
| Local market | 36 | 29 |
| Middlemen | 32 | 6 |
| Neighborhood | 7 | 35 |
| Local market and middlemen | 22 | 2 |
| Local market and neighborhood | 3 | 28 |

**Table 4** Involvement of men and women from male-headed households in Agago District in the marketing of traditional sorghum. *(Source: Authors' calculation from gender survey data collected in July 2018.)*

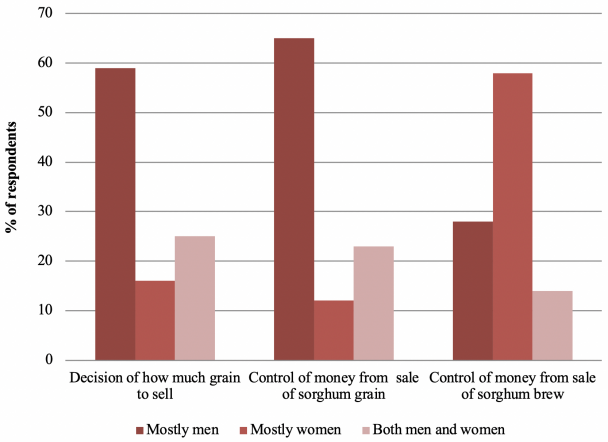


**Figure 2** Gender distribution of decision-making and control with regard to traditional sorghum sales and use of benefits in male-headed households in Agago District. *(n=219)*

an increased engagement of men in grain processing, such that men are now exclusively responsible for grain processing in 2 percent of households (up from about 0.5 percent) and the share of households in which the task is carried out jointly by men and women has increased from 1.6 percent to 34 percent (see Table 3). Women also stated that they no longer select against varieties such as Maaocikka that were difficult to grind on the traditional grinding stone. Grinding the Maaocikka sorghum variety on traditional grinding stone would take a very long time, which they preferred to spend doing other chores. The development of processing technologies more friendly to women's time constraint may be a positive impact for on-farm conservation (Hellin et al. 2010), especially of varieties such as Maaocikka. Since the introduction of milling machines in the communities, men can assist in taking the sorghum to the milling machines and, in some households, provide money to be used for the machine processing. The preparation of sorghum bread and brew was predominately done by the women in the household as it falls with their responsibility to prepare food for the family.

The role of marketing sorghum products was also mainly, but not exclusively, undertaken by the women (Table 3). It is to be noted that while the marketing of brew was largely done by women, more than half of the respondents (69.3 percent) suggested that the marketing of sorghum grain was the done by both men and women in the household. Interestingly, in focus group discussions, participants often stated that it was a taboo for a man to be seen taking sorghum to the market because sorghum was a crop mostly consumed within the household. When a man was seen taking sorghum to the market, it was assumed that he was stealing from his home, and this was a crime punishable by clan leaders. This was, however, contradictory to the figures attained in the survey. These showed that men were not only prominently involved in the marketing of the sorghum grain but were also making decisions on the quantity to be sold and were entitled to sell one or more sacks in local markets or to middlemen. We found that men were more likely than women to sell the sorghum grain at the local market or to middlemen, who usually required larger quantities of sorghum, such as a sack of 100 kg or more. More than half of the participants reported that men in their households sold large quantities (one or more sacks of sorghum grain) while women were permitted to sell only small quantities (a few cups of sorghum) in order to earn money to buy sugar, salt, and other small home necessities (see Table 4). This signified the changing role of sorghum as not only a food crop but also a cash-earning crop for households – hence the increased involvement of men in the marketing of sorghum crops.

The decision about how much sorghum is planted, how much sorghum grain is to be sold, and who controls money from the sale of sorghum grain was predominantly taken by a man in the household, especially in male-headed households. Women mostly had control of money from the sale of sorghum brew (see Figure 2).

### *Are preferences for traditional sorghum traits gendered in Agago District?*

To answer this question a pairwise ranking analysis of some characteristics of traditional sorghum important to farmers in Agago District was carried out in men-only and women-only focus group discussions. The pairwise ranking scale was between 1 and 8: 1 marked the most desirable attribute and 8 the least desirable. Characteristics of traditional sorghum included late maturity (5–9months), long storage (lasting six months and more in storage), grain yield (500–600 kg per acre), bread taste, brew taste, ease of threshing, ease of grinding, and market demand (whether there is a market for a particular variety within the village and at nearby markets). Individual characteristics were compared directly against each other so as to emerge with a ranking of the most desirable trait to the least desirable from each focus discussion group. The result was used to gain an appreciation of the importance farmers attach to these characteristics when selecting traditional sorghums and whether there were differences

by gender in the level of importance attached to each characteristic. The pairwise ranking from each gender was subjected to a Garrett ranking technique to obtain the average Garrett score. The highest average Garrett score represents the most desirable characteristic and from it the overall rank of each characteristic by gender is determined. The same characteristics were all subjected to a three point scale (1=not important; 2=somewhat important; 3=very important) in the questionnaire to determine the level of importance each gender attached to these characteristics. A Mann–Whitney U test was run to determine whether there was a significant difference between the levels of importance men and women attached to the different characteristics of traditional sorghum.

The ranking for the variety characteristics of marketability, thresh ability, ease to grind, taste of bread, and storage duration differed by gender. Based on the overall ranking, the three characteristics ranked "most desirable" in both men-only and women-only groups were market demand, bread taste, and grain yield. This corresponds to what others have documented regarding one or all of the three traits in sorghum (Dossou-Aminon et al. 2014; Basavaraj et al. 2015) and in other crops such as cowpea (Gbaguidi et al. 2013) and rice (Addison et al. 2014). The three most highly ranked attributes are indeed characteristic of the popularly grown traditional sorghum varieties in this community, Godda and Lawera (see Appendix). There were over nine varieties of traditional sorghum identified in the communities of Agago District, and most of the interviewed farmers grew Godda and Lawera (see Table 2).

Market demand ranked highest in women's groups while bread taste ranked highest in men's groups (Table 5). This stands in contrast to what trait preference studies often suggest, namely that men tend to rank market-related traits more highly while women rank consumption-related traits most highly (Addison et al. 2014; Christinck et al. 2017). Men in different focus group discussions often stated that traditional sorghum is a crop grown to be consumed at home and that this was why the taste of resulting bread was their most desirable trait. Even though it was discovered that the men did partake in the selling of sorghum grain, it is not their main source of income since they also engage in growing and selling of cash crops like sunflowers, cotton and cassava. For women, on the other hand, traditional sorghum is not only a crop consumed at home but also a crop that provides an income which enables them to acquire household necessities; hence the high ranking of the market attribute. This study's hypothesis was that men were more market-oriented than women and hence likely to place market demand above all the other traditional sorghum characteristics. This, however, was not the case, as we have discovered that women are as likely as men to be market-oriented. In focus group discussion, women stated that due to alcoholism most men had in recent years abandoned their financial responsibilities towards their families, and so women had assumed the responsibility of financing their households – from buying small household necessities to even paying the school fees for the children. Sorghum is one of the crops in the household which women have the liberty to sell and acquire some money from.

| Variety characteristic | Men's Garrett score | Rank | Women's Garrett score | Rank |
|---|---|---|---|---|
| Taste of bread | 72.1 | 1 | 63.0 | 2 |
| Marketability | 70.3 | 2 | 74.6 | 1 |
| Good yields | 62.0 | 3 | 58.4 | 3 |
| Ease to grind | 51.2 | 4 | 46.1 | 6 |
| Long storage | 49.5 | 5 | 56.1 | 4 |
| Thresh ability | 46.7 | 6 | 52.7 | 5 |
| Taste of brew | 38.7 | 7 | 29.3 | 7 |
| Late maturity | 29.8 | 8 | 28.4 | 8 |

**Table 5** Gendered preferences for traditional sorghum variety characteristics, ranked by desirability using the Garrett ranking method. *(Source: Survey data, 2018.)*

| Variety characteristic | Average rating | | P-value |
|---|---|---|---|
| | Men | Women | |
| Taste of brew | 120.0 | 115.9 | 0.615 |
| Marketability | 118.7 | 116.7 | 0.768 |
| Taste of bread | 116.9 | 117.9 | 0.859 |
| Good yields | 114.7 | 119.3 | 0.302 |
| Late maturity | 110.9 | 121.6 | 0.196 |
| Long storage | 109.6 | 122.5 | 0.062 |
| Ease to grind | 107.3 | 124.0 | 0.030** |
| Thresh ability | 103.1 | 126.7 | 0.001** |

** Significant at 0.05 level

**Table 6** Mann–Whitney U test for statistically significant differences between men's and women's reported importance levels for traditional sorghum characteristics. *(n=246)*

The women-only groups ranked long storage of grain in fourth place while the men group ranked ease to grind at number four (Table 5). An explanation for the high ranking of the ease-to-grind attribute in the men-only discussion groups was further explored, and men claimed that the introduction of milling machines has partly shifted the responsibility for milling to men. This is confirmed in the gender activity profile shown in Table 3, which indicated a 34.5 percent decrease in women's sole responsibility for this activity when households took grain to the milling machines. This was a clear indication of a change in gender roles in some households, which has spurred men's interest in the characteristic of ease-to-grind. Women were interested in the storability attribute more than men because grain and seed storage was almost exclusively the role of the women in the households (again, see Table 3) since women are responsible for ensuring that the household not only has food but also sorghum seed for the next season. Thresh ability of a traditional sorghum variety ranked higher in desirability than ease to grind in women's groups because of the existence of milling machines in the community. Since the introduction of milling machines,

the difficult to grind sorghums are no longer as much a problem for women and as such ease to thresh ranks higher in their preferences. This may be explained by the fact that more than half of the sampled respondents reported that threshing sorghum was solely a woman's responsibility in their households (Table 3). Traditional sorghum varieties that require to be threshed twice take up a lot of the women's time, which could have been used for other activities around the household. Women therefore tended to discard those varieties. For instance, varieties Gaya and Maaocikka were difficult to thresh and women often mentioned that they had over time stopped selecting seed for those varieties. Hence, fewer farmers were growing these varieties in the present day, as seen in Table 2.

This highlights the impact women's trait preference have on the decision of continued cultivation of a given variety. In Benin, women's least preferred millet varieties were characterized by difficulty in threshing and were eventually discarded over time whilst women in households that still grew those varieties tried to convince their husbands to abandon them (Dansi et al. 2010). As reported by Howard (2003), Dansi et al. (2010) and Howard-Borjas and Cuijpers (2013), women's trait preferences influence decision-making for on-farm conservation of traditional crop varieties. Results from the Mann–Whitney U test showed significance for the traits of ease to mill on traditional stone and ease to thresh. Women's mean for these two traits was significantly higher than men's (see Table 6). This can be attributed to women's high engagement in these processing activities. The work domains of men and women during production and utilization of a crop thus somewhat influences what traits they desire in their crop variety (Howard-Borjas and Cuijpers 2013; Bellon 1996).

Late maturity was ranked as the least desirable attribute in both groups (Table 5). However, when this trait was explored independently, asking the farmers why they continue to grow the late maturing traditional sorghum varieties, men mostly considered this characteristic important because it provided them a source of spare income in times when they lacked income from the sale of their cash crops. By contrast, women considered the late maturity characteristic important because these sorghum varieties provide food in the households when every other food crop had already been depleted from storage. Moreover, the late-maturing sorghum hits the market in January and February when the food prices are quite high and so will generate more income for the farmers compared to the early-maturing sorghums. The late maturity attribute also was labor convenient for women since harvesting of these sorghums happened after the harvest of all the other crops. Varieties such as Godda, Kibworo, Kabii, Maaocikka, and Kabii are generally characterized by late maturity (see Appendix) and as such meet the food and income security needs of both men and women as well as women's labor needs – hence the continued conservation of these varieties in the communities. This confirms the hypothesis, that farmers do not maintain crop varieties solely for the sake of on-farm conservation but rather because the varieties are adapted to particular needs (Nakabonge 2017).

## Conclusion

Continued production and utilization of traditional sorghum is a result of the efforts of both men and women. Although the labor burden tends to fall on women, men's role in the continued existence of traditional sorghum varieties cannot be ignored. Men's involvement in field activities such as land preparation and planting is important in the conservation of late-maturing sorghums (such as Godda, Kibworo, Maaocikka, and Kabii), which need to be planted on time in order for the crop to escape the severe effects of the striga weed and to consequently attain good yields. Continued attainment of yields ensures the availability of planting materials for the next season, an important feature in on-farm conservation of traditional sorghums, given that farmers largely depend on home-saved seed. Additionally, men are involved in making critical decisions about how much is to be planted and the quantity of grain that should be sold. Men are also entitled to benefits from the sale of the sorghum grain.

In many households, women's interest in processing characteristics of traditional sorghums has an impact on the decision to conserve some traditional sorghum varieties. This was evidenced by the least popular varieties, Gaya and Maaocikka, being characterized by difficult processing (threshing and milling on traditional grinding stone). Women's reduced labor burden during the processing of traditional sorghum varieties can likely foster the conservation of some of these varieties. Technology advancement and men's increased participation in the process of milling has in some households lessened the burden on women. This has seen varieties like Maaocikka that are difficult to mill yet have desirable attributes in terms of taste and long storage (see Appendix) reconsidered in the selection of traditional sorghum varieties for cultivation in the next season, as highlighted by women in some focus groups.

From this study, sorghum improvement programs can draw the lessons that besides marketability, taste, and yield, close attention should also be drawn to local women's processing-related trait preferences in order to enhance effective adoption of new sorghum varieties. Improvements that come at the cost of ease of threshing could, for instance, negatively affect variety assessment by women and could consequently affect the successful introduction of improved varieties.

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| Variety | Time to maturity | Characteristics |
|---|---|---|
| Bette / Bel lango / Lalira | 4–5 months | Dark red and moderately large grain;<br>Preferred for brewing;<br>Popular on the market in the Lango sub-region |
| Gaya | 4–5 months | Red and moderately large grain;<br>Not easily destroyed by weevils;<br>Difficult to process (hard to grind on traditional millstone);<br>Preferred on the Karamojong market |
| Godda /Awoya | 8–9 months | White and large grain;<br>Preferred taste and popular on the market;<br>Easy to process (threshing and milling on traditional grinding stones);<br>Highly affected by striga since it takes the longest in the garden;<br>Good yield of 500–600 kg per acre |
| Kabii otaara / Kabii makwar | 7–8 months | White or red with relatively small grain;<br>White grain is liked by birds;<br>Keeps up to four months in storage |
| Kibworo /Anuka / Isingiri | 7–8 months | White and moderately large grain;<br>Preferred by the market;<br>Easy to process (grinding on traditional millstone);<br>Can be kept in storage for over a year with minimal pest damage |
| Lakitgum /Ayuma | 5–6 months | Brown and moderately large grain;<br>Keeps for over 4 months in storage;<br>Popular with traders from Kitgum District, where it is believed to have originated |
| Lawera / Labwoma | 3–4 months | White or brown, moderately large grain;<br>Keeps only a short time in storage (less than three months);<br>Fills the hunger gap before other varieties are harvested;<br>Good yield of 500-600 kg per acre |
| Lubule / Lolirwa / Sweet sorghum | 3–4 months | White or red, moderately large grain;<br>Low yield because it is prematurely harvested for stem chewing due to its sweet stems |
| Maaocikka / Jowol | 8–9 months | Red and moderately large grain;<br>Not easily destroyed by weevils;<br>Difficult to process (hard to grind on traditional grinding stone);<br>Produces little flour and results in rough bread that is nevertheless filling and tasty;<br>Good yield of 400–500 kg per acre |

**Appendix** Characteristics of traditional sorghum varieties.