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Traditional food crop marketing in Sub-Saharan Africa: Does gender matter?

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Abstract

Specialization and commercialization of agricultural production is seen as a key to lift small-scale farmers in developing countries out of poverty. While participation in high-value markets has been shown to be beneficial for farmers, especially the smallest and least endowed farmers are often excluded from these markets due to high transaction costs. In this context, marketing traditional food crops poses an important income alternative. The present study aims to contribute to the scarce literature on traditional food crops by analyzing the factors influencing (a) the households' decision to participate in the finger millet market and (b) the selling prices obtained by the household. A special focus of our analysis lies on the role of gender and collective action. Based on household data from 270 finger millet producers, a probit model on market participation and a linear regression model on the selling price are estimated. Results show that participation in a finger millet group positively influences the decision to market finger millet. While female household members who do not participate in a group are disadvantaged in terms of selling prices, there is no gender effect on selling prices if a female household member participates in a finger millet group.

Key words: Kenya, finger millet, marketing, collective action, gender

1. Introduction

Many small-scale farmers in Sub-Saharan Africa suffer from persistent poverty and food insecurity. Besides the improvement of agricultural practices, specialization and commercialization of agricultural production has been shown to benefit small-scale farmers in developing countries (von Braun 1995; Maertens, Swinnen, 2009; Rao, Qaim 2011). Yet, many farmers have not been able to enter agricultural markets due to high transaction costs that result from market risks, deficient infrastructure and little coordination along the value chain (Key et al. 2000; Barrett 2008; Shiferaw et al. 2008).

In order to participate in agricultural markets and increase their farm incomes, small-scale farmers often turn to typical cash crops such as cotton and coffee or to high-value crops, especially fresh fruits and vegetables. Cash crops and high-value crops have a high income potential and are important for the livelihoods of many farmers worldwide. However, transaction costs are particularly high in these markets. Specializing on cash crops often entails high risks due to high input costs, considerable price volatility, and a dependency on one or few large buyers (Poulton et al. 2004; Gemech, Struthers 2007). Another barrier to specializing on the production of cash crops that cannot be consumed by the household is high food price volatility, which induces farmers to prioritize on food crop production (Fafchamps 1992). In the case of fruits and vegetables, transaction costs for entering high value markets are particularly high due to increasingly complex food safety and quality requirements (Reardon et al. 2009; Kersting, Wollni 2012). Existing literature suggests that high fixed transaction costs of entering high-value markets exclude especially the smallest and least endowed farmers (Maertens, Swinnen, 2009; Handschuch et al. 2013).

In general, barriers to commercialization are often found to be especially high for female farmers. For example, female farmers have less access to credits and as a result less access to inputs that are needed for market-oriented agricultural production (Zeller et al. 1998; Quisumbing, Pandolfelli 2010). Cash cropping is considered a male domain in most parts of Sub-Saharan Africa, while women are responsible for the production of subsistence food crops. The male domination of cash crops can have negative impacts on food security, especially when the cash crop area is expanded at the expense of food crops (Kiriti, Tisdell 2003). It has been shown that female incomes have a stronger positive effect on household food expenditures and food security than male incomes (Hoddinott, Haddad 1995; Fischer, Qaim 2012a).

One possibility of increasing market access for small-scale farmers is the organization of farmers in farmer groups. Group marketing has the potential to reduce transaction costs and increase the bargaining power of small-scale farmers (Roy, Thorat 2008). Farmer groups furthermore facilitate farmers' access to inputs and information on improved cropping practices (Fischer, Qaim 2012b). Existing literature shows that producer marketing groups (PMGs) or other forms of farmer collective action can increase market access and the income derived from the marketing of agricultural products (Kaganzi et al. 2009; Narrod et al. 2009; Wollni et al. 2010). On the other hand, there is no guarantee for the success of farmer collective action. Returns to collective action

vary depending on group characteristics, product characteristics, and other factors (Markelova et al. 2009). Moreover, female farmers might be the ones excluded from the benefits of farmer collective action. In their study on banana marketing in Kenya, Fischer and Qaim (2012a) conclude that participation in mainly male dominated PMGs leads to an increased male control over the crop and the income derived from it. While the formation of women groups may prevent this development, Barham and Chitemi (2009) show that female PMGs are disadvantaged in terms of market access when compared to male dominated PMGs.

Despite the large amount of literature dedicated to smallholder market access, very little attention has been given to the marketing of food crops. Selling traditional food grains like finger millet could be a viable income alternative, especially for those farmers who are excluded from cash crop and high-value markets. Furthermore, food grains are usually female crops and therefore have the potential to increase female incomes. As opposed to many cash crops, food grains can be consumed by the household in case of unfavorable markets or food shortage, which decreases market risks and increases food security. The good storability and easy handling of food grains reduces transportation costs and standard requirements, leading to lower transaction costs in the value chain and reduced marketing barriers. However, transaction costs and market risks are not absent in the often poorly developed food grain markets and can still represent substantial market barriers for small-scale farmers (Barrett 2008). An important work concerning transaction costs in the food grain sector was done by Goetz (1992), who modeled the negative effect of transaction costs and lacking market information on the marketing of coarse grains by smallholders. Similarly, Key et al. (2000) show that Mexican maize producers opt for self-sufficiency when transaction costs for marketing are too high. The important role that collective action can play for the marketing of traditional cereals is stressed by Gruère et al. (2009), who conducted a qualitative study on the marketing of minor millets in India. Bernard et al. (2008) assess the impact of collective action on food grain marketing, but do not specifically focus on traditional cereals.

This paper aims to add to the sparse literature on food grain marketing by assessing the marketing of finger millet among small-scale farmers in Western Kenya. Among the food grains grown in Kenya, finger millet is known for its nutritional value, high market prices, little price volatility, adaptability to unfavorable agro-ecological conditions, and good storability (Oduori, Kanyenji 2005; Oduori 2005). Despite the potential of finger millet, it has hardly been given any attention by researchers and policy makers in the past decades. Based on a household survey among 270 finger millet producers, we analyze the factors that determine (1) the decision of farmers to participate in the finger millet market and (2) the selling price obtained by farmers. The main interest of our analysis is twofold: first, we assess the role of collective action for the marketing of finger millet; second, we analyze the effect of gender on market participation and selling prices. The remainder of the paper is organized as follows. The next section gives an overview of the Kenyan finger millet market. Sections three and four summarize our data collection approach and the methodology applied. Descriptive and econometric results are described in sections five

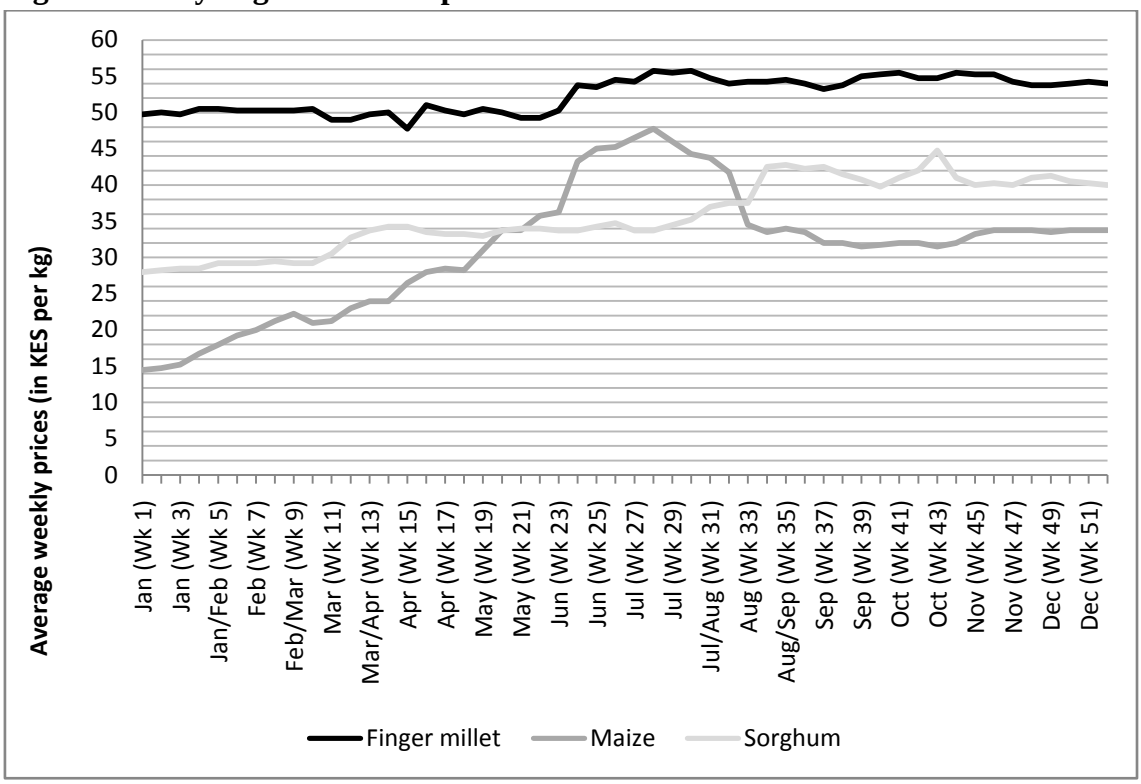
and six, respectively. Finally, we discuss our findings and point out policy implications in section seven.

2. The Kenyan finger millet market

The production of finger millet and its importance as a main staple food have declined dramatically in the past decades, as farmers have continually increased their maize production area at the expense of traditional food grains (Crowley, Carter 2000). Compared to maize, finger millet is better adapted to poor agro-ecological conditions and could therefore make an important contribution towards more resilient agro-ecological systems, especially against the background of climate change and ongoing soil degradation. Furthermore, the highly nutritious crop is seen as a key to improve food security in terms of micronutrient supply (Vietmeyer 1996; Oduori 2005).

Despite the declining importance of finger millet as a main staple food, demand is still high since the crop is appreciated as a valuable food for diabetics, infants, pregnant women, HIV patients, as well as for special occasions such as weddings and for brewing beer. Finger millet prices are consequently high and have been well above the prices for maize and other cereals in the past years (Oduori 2005). Market prices for the year 2011 are depicted in Figure 1 and show that throughout the year finger millet prices were not only higher, but also less volatile than maize prices. The average market price in 2011 was 52 Kenyan Shillings (KES) for finger millet and 31 KES for maize. Finger millet is mainly traded on the spot market and farmers sell their produce to local traders, neighbors, or on the local market without formal contractual agreements. Some farmers try to increase their earning from finger millet by selling value added products such as beer or cookies. Selling finger millet residues as cattle or poultry fodder is another possible source of income.

Figure 1: Kenyan grain market prices in 2011



Source: Kenyan Agricultural Commodity Exchange (KACE)

Being a traditional food crop, information on the finger millet market is scarce. To get a clearer picture of the finger millet market in Western Kenya, we interviewed several actors of the finger millet value chain, including farmer groups, local traders and processors. In addition, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) provided us with information from interviews with farmer groups and larger finger millet processors.

A total of six local traders were interviewed in June 2012, two in each district of the research area. Altogether, we identified four procurement strategies: (1) The traders buy from farmers on market days and sell outside of market days, (2) the traders buy from smugglers who smuggle finger millet from Uganda, (3) the traders travel to Uganda themselves to buy finger millet on the local market, and (4) the traders have the phone contact of finger millet farmers and buy from them at the farm gate.

The large amount of finger millet that is procured from Uganda reflects the scarcity of finger millet on the Kenyan market. All interviewed traders stated that they would like to buy more finger millet, but are constrained by local supplies. The traders complained about quality problems with finger millet from Uganda, which is often soiled with large amounts of sand and stones. Traders who buy at the farm gate usually have the phone number of key farmers, e.g. group leaders, who act as (free) intermediaries for other finger millet farmers. Trading margins are higher for finger millet than for maize. For example, one trader stated that she is currently

buying finger millet for 100 KES per gorogoro[1] and selling it for 120 KES per gorogoro, while buying maize at 50 KES per gorogoro and selling it at 55 KES per gorogoro. The high trading margins for finger millet are one indication for the general scarcity of information on finger millet prices as compared to information on maize prices.

Farmer groups engaged in finger millet activities follow different strategies to facilitate finger millet marketing. Many farmers simply get in contact with buyers through a well-connected group leader or obtain important market information from each other. In some cases, the group leader acts as a trader buying from other finger millet producers and selling (with or without margin) to larger traders. Other groups bulk their harvest for a larger buyer and negotiate a common selling price for all members.

Although most of Kenya's finger millet is marketed and consumed locally, there are large finger millet traders and processors in the country. Unga Mills, the country's third largest processor of finger millet, processes about 500 tons of finger millet per month. According to Unga Mills representatives[2], it is difficult to find larger quantities of finger millet in Kenya and all of their finger millet is therefore sourced through middlemen in Uganda. Unga Mills tried to establish supplier relationships with farmer groups in Eldoret and Western Province, but did not succeed in their endeavor. According to the company, small-scale farmers in Kenya do not consider finger millet as a business and currently are not able to provide the crop in sufficient quantities. On the other hand, several of the farmer groups interviewed in 2011 claimed to lack good marketing opportunities that would allow them to bulk their produce and sell to larger buyers instead of selling small quantities in the market. One of the groups had been in a commercial relationship with Unga Mills, which failed according to the group because of their inability to supply the required minimum quantities and due to the delayed payments by the company. Overall, communication and coordination along the millet value chain in Western Kenya is very limited. On the one hand, local traders and large processors have an unmet demand for locally produced finger millet. On the other hand, small-scale farmers have little access to reliable market information. This is notwithstanding the fact that market information services that aim to link farmers with buyers are available. The Kenyan Agricultural Commodity Exchange (KACE) for example provides market price information through text message services and radio broadcasts. In addition, for a small commission KACE offers to facilitate farmer group formation and links them with buyers. This service, however, has only been used by one finger millet farmer group and one finger millet buyer in 2011.

3. Data collection

Our research is based on a household survey among 270 finger millet farmers in Western Province. While finger millet used to be a main staple crop in the area, it was largely replaced with maize and is nowadays only grown by a minority of farmers. Acknowledging the untapped potential of finger millet in terms of food security and farm household incomes, the Kenyan

[1] Gorogoro is a volume measure and roughly equivalent to 2 kg of grains.
[2] Unga Mills representatives were interviewed by ICRISAT in December 2010.

Agricultural Research Institute (KARI) implemented a finger millet extension program in Western Kenya. The main goal of the extension program was to promote modern finger millet varieties and improved finger millet cropping practices, but KARI also provided information on marketing and value addition. To reach the farmers, KARI contacted existing village groups and those who showed interest were subsequently used as platform for the extension program.

We interviewed farmers from 15 locations in the districts of Busia, Teso, and Butere-Mumias[3]. These three districts represent the focus area of the KARI extension program and vary with respect to their farming systems. Teso is a relatively remote region of Western Province, were finger millet still plays an important role in peoples' diets and farming systems. Cotton and tobacco are grown as cash crops, but mostly the region is dominated by subsistence agriculture. In contrast, farmers in Butere-Mumias tend to practice a more modernized and commercialized agriculture with sugarcane being the most important cash crop. Finger millet is of minor importance in Butere-Mumias. Geographically and in terms of agricultural production systems, Busia is located between Teso and Butere-Mumias. Using a stratified sampling design, we randomly chose twelve locations from around 32 KARI intervention locations and three locations where no interventions had taken place. Lists containing all farmers who cultivated finger millet in 2011 were compiled with the help of group leaders and village elders. In each of the twelve KARI intervention locations, we randomly selected nine members and nine non-members of the village group that had received KARI extension. In each of the three non-KARI intervention locations, we randomly selected 18 finger millet farmers. We used a standardized questionnaire to obtain information on household characteristics as well as finger millet cropping and marketing practices. All production and marketing data refer to the year 2011. Since our stratified sampling design oversamples beneficiaries of the KARI extension program, we use sampling weights in the econometric analysis.

4. Methodology

We use an econometric approach to analyze the farmer's market participation decision and the selling price obtained by the farmer. Farmers who market their produce usually receive selling prices below the actual market price. The gap or price band between the selling price and the market price is determined by household-specific transaction costs. A farmer will only decide to sell his or her product when the shadow price, i.e. the opportunity costs of selling the produce instead of consuming it, falls below this price band (de Janvry et al. 1991). We model the decision to sell finger millet in a probit regression:

$$y_i^* = X_i{}' \beta + \varepsilon_{1i},$$

where y_i^* represents the expected utility of farmer i to participate in the market, X is a vector of variables influencing the expected utility, β is a vector of parameters to be estimated, and ε is a

[3] The administrative areas in Kenya were regularly subject to reforms that split districts into smaller units. The last district reform took place in 2007, were e.g. Teso District was split into Teso North and Teso South. For reasons of simplicity, we are referring to the district boundaries of the 8 districts that existed before the 2007 reform.

normally distributed error term with mean zero and variance one. While we cannot observe the expected utility of market participation, we do observe $y_i = 1$ if the expected utility is greater than the shadow price of the produce and $y_i = 0$ otherwise.

The vector X contains exogenous variables that are likely to influence the transaction costs and the opportunity costs of marketing the produce. In terms of transaction costs, our main variables of interest are gender and group participation. Female farmers are often found to face higher marketing barriers than their male counterparts. We measure the effect of gender on market participation by including a dummy variable that takes on the value one if finger millet is cultivated by a woman. Furthermore, farmers who participate in a village group that is involved in finger millet activities are expected to face lower transaction costs than farmers who do not participate in a finger millet group. Since we are interested in the gender-specific effects of group participation, we control for group participation of male household members and group participation of female household members separately[4]. A major concern of using group membership as an independent variable is the issue of endogeneity. If farmers chose to participate in a finger millet group in order to increase their market access for finger millet, the model would suffer from selection bias. However, as we will show in the next section, none of the interviewed farmers joined a village group with the motive of improving his or her finger millet marketing possibilities. We are therefore optimistic that including group membership into the model does not cause problems of endogeneity in the specific context of our study.

Besides group membership, we include ownership of a cell phone, ownership of a radio, and being situated in a non-KARI location as proxies for access to information into the model. Information on agricultural commodity prices is radio broadcasted or available via text message services. Ownership of a cell phone furthermore facilitates communication with traders or other farmers. In contrast, farmers who live in a non-KARI intervention location are likely to have less access to market information and are therefore expected to be less likely to engage in millet marketing. Transportation costs are influenced by market distance and available means of transport. Since finger millet is mainly marketed locally, we include the distance to the next village market. In addition, we add a dummy variable that equals one if the household owns a means of transport such as a cart, motorbike, or car.

Apart from the transaction costs of marketing, the shadow price of finger millet influences a farmer's decision to market. For a household that produces finger millet for subsistence purposes, the shadow price is determined by its production level and consumption needs of finger millet. We therefore include the number of children and adults in the household and the quantity of finger millet harvested in 2011 as independent variables in the model. Since finger millet can be substituted by other food grains in the household's diet, we also include the quantity of maize harvested in 2011 as an explanatory variable. Finally, we include a number of variables related to household characteristics, namely age and education of the household head and a housing index

[4] Note that the two dummy variables included in the model are not mutually exclusive as some households have both female and male members who participate in groups.

that is used as a proxy for household wealth. The household index is composed of different properties of the dwelling, namely the material of the walls, roof, and floor, the number of rooms, the availability of tap water, and electricity. As opposed to other wealth indicators, the characteristics of the dwelling are not changing in the short term and are therefore less likely to entail problems of endogeneity. To control for regional differences, we include dummy variables for the districts of Mumias and Teso, with Busia being the excluded category. Table 1 lists the variables included in the econometric analysis.

In the second model of our analysis, we assess the factors influencing the selling price obtained by farmers. The selling price is modeled using a linear OLS regression:

$$P_i = Z_i^{'}\gamma + \varepsilon_{2i}$$

where P_i represents the selling price obtained by farmer i, Z is a vector of variables influencing the selling price, γ is a vector of parameters to be estimated, and ε_2 represents a normally distributed error term with mean zero and variance one.

Similarly to the first model, we are particularly interested in the effect of gender and group membership on the dependent variable. We therefore include dummy variables for female seller, female group participation, and male group participation. The selling price a farmer obtains for his or her produce is mainly influenced by his or her bargaining power. We expect women to have less bargaining power than men and group members to have more bargaining power than non-group members. Furthermore, we hypothesize that group participation might be of particular importance for female sellers, who are otherwise disadvantaged. We therefore add an interaction term between female group participation and female seller. Other variables that potentially influence the farmer's access to market information and subsequently his or her bargaining power are the ownership of a cell phone or radio, the proximity to the next market, and being located in a non-KARI intervention location. Again, we include district dummies for Mumias and Teso to control for regional differences. Finally, variables reflecting the age and education of the household head are included in the model.

Table 1: Variables used in regression models

Variable name	Variable description	Mean	Std. Dev.
Household characteristics			
Age head	age of the household head (in years)	54.468	13.449
Education head	1 = household head has a secondary school education	.404	.492
Adults	number of adults in the household	3.496	1.767
Children	number of children in the household	3.441	2.279
Housing index	index of several housing variables (e.g. number of rooms and construction materials)	.002	.981
Market connectedness			
External village	1 = household is situated in a non-KARI intervention location	.200	.401
Cell phone	1 = household owns a cell phone	.848	.360
Radio	1= household owns a radio	.815	.389
Transport	1 = household own a means of transportation (cart, motorbike, car)	.137	.345
Market distance	distance to next village market (in walking minutes)	25.328	21.247
Farming			
Female crop	1 = finger millet was cultivated by a woman	.493	.501
Millet harvest	finger millet harvest in 2011 (in kg)	294.174	674.636
Maize harvest	maize harvest in 2011 (in kg)	1176.110	1612.006
Marketing			
Female seller	1 = finger millet was sold by a woman	.400	.491
Female group member	1 = female household member participates in a group with finger millet activities	.326	.470
Male group member	1 = male household member participates in a group with finger millet activities	.241	.428
Inter_female_group	interaction term between female sale and fm group	.211	.409
Location			
Mumias	1 = household is situated in Butere-Mumias	.333	.472
Teso	1 = household is situated in Teso	.400	.491

While the decision to market finger millet is observed for the whole sample, the marketing price is only observed among those households who participate in the market. Since the marketing decision is not random but the result of marketing transaction costs and the shadow price of finger millet, there might be systematic differences between the households who market and those who do not. Selectivity bias can be controlled for by using a two step model which simultaneously estimates both decisions. This approach has been applied by Goetz (1992) and Bellemare and Barrett (2006), who simultaneously estimated the discrete decision of market participation and the continuous decision of the transaction volume. We control for potential selectivity bias by using a full information maximum likelihood (FIML) Heckman's sample selection model. The model assumes that the selling price P_i is observed when $X_i^{'}\beta + \varepsilon_{1i} > 0$ and the error terms ε_1 and ε_2 have a correlation ρ. A selectivity bias is observed when $\rho \neq 0$.

Estimations of the Heckman model are more robust with an exclusion restriction, i.e. the inclusion of an instrumental variable that has an influence on the outcome of the first stage, but is unrelated to the outcome of the second stage (Cameron, Trivedi 2009). We use the variable maize

harvest and the housing index as exclusion restrictions. The quantity of maize harvested is likely to influence the farmer's decision to market finger millet, since maize and finger millet partly or fully substitute each other in the household's food consumption utility function. At the same time, the quantity of maize harvested does not have a direct effect on the farmer's bargaining position in finger millet markets. Similarly, household wealth is expected to influence the farmer's marketing decision, e.g. through its effect on opportunity costs, but to have no direct effect on the selling price.

5. Descriptive Statistics

The farmers in our sample are small-scale farmers who on average own four acres, of which 0.84 acres are planted with finger millet. Among the interviewed farmers, 64% sold finger millet or finger millet products in 2011[5]. It is evident that finger millet is an important crop for female farmers: in 49% of the households, millet is grown under the sole responsibility of female household members and in 20% of the households both men and women are jointly responsible for millet cultivation. Furthermore, in 40% of the households women are involved in millet marketing.

Group membership in general is very common in rural Kenya and village organizations fulfill a variety of functions (Place et al. 2004)[6]. Among the interviewed households in our sample, a large majority (86%) participates in at least one group (see Table 2). Since agriculture plays a key role in the livelihoods of rural families, most groups are involved in agricultural activities, even if the group is not considered a farmer group in the first place. Overall, 44% of the households in our sample participate in a village group that is involved in finger millet activities. Most of them also had access to KARI extension through these groups (41%). Regarding gender-specific group membership, 33% of the households in our sample have female members and 24% of the households have male members, who participate in finger millet groups[7]. In the remainder of the paper, we refer to groups that are involved in finger millet activities as 'finger millet groups' and to groups that had access to KARI extension as 'KARI groups'. However, all groups were originally formed as multi-purpose village groups, and existed before the start of the millet extension program implemented by KARI.

When asked about their motives to join a group, 75% of the farmers who participate in at least one group stated that they expected to obtain financial benefits such as access to credits, building up savings, and receiving financial assistance in the case of an emergency. Furthermore, 41% of the farmers aimed to improve their farming practices through better access to information, inputs, and extension. Only 16 farmers (7%) specifically mentioned improved finger millet practices as a motive to join a group. Improved marketing possibilities were only mentioned by ten farmers

[5] Six farmers sold only value added millet products during 2011 and are therefore excluded from the remainder of the descriptive and econometric analysis.

[6] In our sample, we find a variety of groups, including self-help groups, widow groups, religious groups, youth groups, and farmer groups. Typical group activities include savings and credit schemes, labor sharing, joint purchase of agricultural inputs, and financial assistance in the case of an emergency.

[7] In 13% of the households we find both male and female members participating in finger millet groups.

(4%), with eight of them referring to a specific product, but none of them referring to finger millet.

Table 2: Participation in village groups

	Frequency	Percentage
Participation in at least one village group	232	85.93
Participation in a group involved in finger millet activities	119	44.07
Female group member	88	32.59
Male group member	65	24.07
Participation in a group involved in finger millet activities and with access to KARI extension	112	41.48

Farmers in our sample received an average selling price of 55 KES per kg of finger millet, which is very close to the average market price of finger millet in Kenya in 2011 as indicated by the Kenyan Agricultural Commodity Exchange (see section two). Among the farmers who market finger millet, 19% sell to neighbors or family within the village, 45% sell their produce at the village market, 26% sell to a local trader, 14% sell to an institution such as an orphanage or a school, and 7% sell to a local processor. Table 3 compares average prices received in these different market outlets and reveals that they do not vary significantly. In contrast, we can see that membership in finger millet groups is associated with higher prices: group members receive 58 KES per kg, while non-group members receive only 51 KES per kg, on the average. Although in our research area group leadership is usually male, we have four finger millet groups with female group leaders in our sample. Yet, in contrast to the findings from Barham, Chitemi (2009), we do not find a significant difference in selling prices between groups with female and groups with male leadership. Overall, we do not observe a significant difference in the prices obtained by male and female sellers. However, when we restrict our sample to households selling individually, i.e., households who do not participate in a finger millet group, we find that female sellers receive significantly lower prices.

Table 3: Selling prices

	Selling price finger millet (in KES)	
	no	yes
Gender and group participation		
Finger millet group	50.95 (16.82)	58.02 (17.53)***
Female group leadership	57.63 (16.16)	58.80 (20.25)
Female seller	56.95 (12.46)	54.30 (19.72)
Female seller (non-group members)	56.80 (16.09)	48.71 (16.72)**
Marketing channel		
Selling to neighbors / family	55.23 (17.94)	55.18 (16.08)
Selling on market	55.52 (15.16)	54.86 (20.17)
Selling to trader	55.38 (18.31)	54.74 (15.29)
Selling to processor	55.33 (17.81)	53.85 (14.34)
Selling to institution	54.57 (17.49)	59.42 (17.77)

All variables were tested using a t-test
Values in brackets are standard deviations
*, **, and *** indicate that the mean difference is significant on a 10%, 5%, and 1% significance level, respectively

6. Econometric results

Estimation results of the Heckman selection model show that the hypothesis that $\rho = 0$ cannot be rejected based on the model statistics (Prob > Chi^2 = 0.295) (see Table 6 in the annex). This indicates that selectivity bias is not a major problem in our data and two separate models can be estimated instead. When comparing the Heckman selection model with the two separate models, we find that coefficient estimates and significance levels do not vary substantially across the different model specifications.

Results of the model on market participation are presented in Table 4. We find that *ceteris paribus* the probability to market finger millet is 21 percentage points higher for households in which a female member is responsible for finger millet production. Since the person who crops is mostly the person who sells, this indicates that women do not face particular barriers to enter the finger millet market[8]. Yet, group membership seems to be particularly important for female finger millet producers: female membership in groups increases the probability of market participation by 23%. In contrast, male group participation does not have a significant influence on participation in millet marketing. Furthermore, the quantities of finger millet and maize harvested in 2011 positively influence the decision to sell finger millet on the market. A harvest increase of 1% increases the probability of market participation by 0.08% in the case of the finger millet harvest and by 0.01% in the case of the maize harvest. This provides evidence that market participation is more likely once the household's subsistence needs are met. Moreover, the housing variable has a negative effect on market participation, indicating that poor households are more likely to participate in finger millet marketing. This is consistent with the hypothesis that poorer households, who are often excluded from more remunerative high-value markets and

[8] When finger millet is cultivated by a woman, it is also sold by a woman in 92% of the cases in our sample.

off-farm activities, face lower opportunity costs to engage in finger millet marketing. Finally, farmers living in Mumias or Teso are less likely to market finger millet compared to farmers in Busia.

Table 4: Regression results on market participation

Variable	dy/dx	Coefficient		Standard Error
Female crop	.209	.546	**	.212
Age head	-.002	-.006		.009
Education head	-.046	-.118		.219
Adults	-.011	-.028		.065
Children	.024	.062		.050
Millet harvest	.001	.002	***	.001
Maize harvest	.000	.000	**	.000
Cell phone	.101	.256		.302
Radio	-.055	-.144		.267
Housing index	-.169	-.436	***	.124
Transport	.029	.076		.344
Market distance	-.002	-.004		.005
Female group member	.227	.629	**	.259
Male group member	.082	.217		.297
Mumias	-.221	-.568	**	.261
Teso	-.196	-.503	**	.239
External village	-.154	-.390		.238
Constant		-.084		.698
N	262	Pseudo R2		.228
Wald-Chi2 (15)	68.850	Log pseudolikelihood		-498.526
Prob > Chi2	.000			

** and *** indicate a significance level of 5% and 1%, respectively

Table 5 presents regression results on the selling price. Results reveal that female sellers who are not participating in a finger millet group obtain selling prices that are 5.6 KES lower, indicating that women selling individually have relatively low bargaining power in the millet market. In contrast, the joint effect of being a female seller and female group participation is positive, increasing the selling price by 3.5 KES[9]. These results provide evidence for the important role that collective marketing arrangements can play for female farmers. Furthermore, the ownership of a cell phone leads to an increase in selling prices by 8.0 KES, on the average. Finally, our results reveal regional price variation with selling prices being substantially higher in Mumias as compared to Busia and Teso.

[9] The joint effect of two variables is calculated by adding their coefficients with the coefficient of their interaction term (Wooldridge 2009)

Table 5: Regression results on the selling price

Variable	Coefficient			Standard Error
Female seller	-5.641	*		3.232
Inter_female_group	9.843	*		5.383
Age head	.116			.087
Education head	-3.640			2.956
Cell phone	8.020	*		4.366
Radio	-1.559			5.118
Market distance	.001			.717
Female group member	-.663			4.741
Male group member	3.169			3.318
Mumias	12.094	***		4.343
Teso	-3.561			2.671
External village	3.958			4.364
Constant	41.369	***		7.608
N	164		R-square	.239
F (12, 151)	5.140		Root MSE	15.628
Prob > F	.000			

* and *** indicate a significance level of 10% and 1%, respectively

Altogether, results from our analysis indicate that market access *per se* is not restricted to advantaged and better-off households. While disadvantaged farmers including the poor as well as female farmers are often found to be excluded from high-value agricultural markets, this is not the case for traditional food markets, such as finger millet. On the contrary, marketing finger millet in our research area is more common among female producers and less endowed households. However, female group participation is an important factor facilitating access to markets. While we do not find high barriers to enter the finger millet market, selling prices received by the farmers vary greatly and female sellers are found to be disadvantaged. Here again, group participation plays an important role, as female group participation significantly increases the prices received by female sellers.

7. Conclusions

A shift from subsistence agriculture to more specialized and commercialized production systems is considered to be a key factor for the alleviation of poverty and food insecurity among smallholder farmers in developing countries. However, especially the least endowed farmers are often found to be excluded from remunerative markets due to high transaction costs, e.g. in the form of standard requirements, transportation costs, or market risks. While female income has been shown to contribute more to the household's food security than male income, women often face even higher market barriers than their male counterparts. The marketing of food grains might be a viable alternative especially for those farmers who are excluded from high-value markets. Compared to high-value crops, producing and marketing food grains entails a lower income potential, but also lower market barriers in terms of market risks and other transaction costs. We add to the scant literature on traditional food grain marketing by analyzing the marketing decisions of finger millet farmers in Western Kenya.

Altogether, coordination along the finger millet value chain in Western Kenya is rather weak. While traders and processors do not find sufficient quantities of finger millet for their operations, producers lack knowledge about suitable buyers to sell in larger quantities. Selling prices vary greatly and finger millet traders earn higher margins from finger millet than from trading other food grains. Although price information services exist, they are not widely used by farmers.

Our main interest lies in the effect of collective action and gender on the household's marketing decision and selling prices. Results from a probit model on market participation show that female producers and less endowed farmers are not excluded from market participation. On the other hand, a linear regression model on selling prices reveals that female sellers receive substantially lower selling prices than male sellers unless they participate in a finger millet group. While male collective action does not seem to have an important effect on the marketing of finger millet, female collective action is positively influencing both the decision to market and the selling prices obtained by female sellers.

In order to increase the income from finger millet for small-scale farmers, market coordination has to be improved. Existing services to obtain market information and link farmers with buyers need to become better known and more attractive for farmers as well as for buyers. Improving information flows along the value chain and linking farmer groups to larger buyers is essential to decrease the currently high trader margins. In addition, extension services should strive to professionalize farmers groups and enable them to provide finger millet in a sufficient quantity and quality. Collective action is a key factor to prevent female sellers from being disadvantaged on the market. Any training of farmer groups should therefore include gender aspects to ensure that female group members are not marginalized in the often male dominated farmer groups. Furthermore, women groups should receive special attention from policy makers to guarantee equal opportunities for those groups.

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Annex

Table 6: Regression results of the Heckman sample selection model

Variable	Coefficient		Standard Error
Selling price			
Female seller	-5.722	*	3.189
Inter_female_group	9.264	*	5.268
Age head	.138		.088
Education head	-3.485		2.917
Cell phone	7.783	*	4.150
Radio	-1.453		4.869
Market distance	-.017		.680
Female group	-1.903		4.733
Male group	2.390		3.520
Mumias	13.131	***	4.622
Teso	-3.058		2.762
External village	5.030		4.280
Constant	42.923	***	7.781
Marketing decision			
Female crop	.564	***	.210
Age head	-.006		.009
Education head	-.105		.217
Adults	-.035		.065
Children	.076		.055
Millet harvest	.002	***	.001
Maize harvest	.000	**	.000
Cell phone	.273		.299
Radio	-.161		.267
Housing index	-.434	***	.123
Transport	.059		.336
Market distance	-.003		.005
Female group	.602	**	.257
Male group	.229		.294
Mumias	-.518	*	.276
Teso	-.488	**	.237
External village	-.392	*	.236
Constant	-.173		.711
N	262	Log pseudolikelihood	-2649.997
Censored observations	98	Rho	-.300
Uncensored observations	164	Wald test of indep. eqns. (rho = 0): chi2(1)	1.100
Wald-Chi^2 (12)	60.370	Prob > Chi^2	0.295
Prob > Chi2	.000		

*, **, and *** indicate a significance level of 10%, 5%, and 1%, respectively