European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.10, No.27, 2018

Finger Millet Output Commercialization Among Smallholder Farmers: Role of Agricultural Innovations in Kenya

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Abstract
Finger millet has been an alternative form of sustenance for resource-poor farmers, especially in arid and semi-arid areas in Kenya. However, lack of innovational improvement has often locked small producers into subsistence production and less commercialization. As a result, integration of smallholder farmers into finger millet output markets is still limited. Recently, research and development organizations facilitated the development of new innovations and market linkages for finger millet and other traditional crops for marginal areas in Kenya. But, little is known about the role of these innovations on finger millet commercialization. This study, therefore, sought to determine the level and factors that influence finger millet commercialization in the rise of innovation promotion. Multi-stage sampling technique was used to select a total of 384 smallholder finger millet farmers from Elgeyo-Marakwet County, Kenya. The household commercialization index was used to assess the degree of commercialization, while the double hurdle model was used to determine factors that influence market participation and intensity of participation. The mean household commercialization index was 0.33. The results of the study indicate that education, finger millet yield, finger millet crop area, contact with extension officers, integrated pest and weed management, improved finger millet variety, off/non-farm income and membership to finger millet group marketing were the major determinants of market participation. The study found out that many smallholder finger millet farmers are subsistence oriented. Thus, the study recommends that innovations that help farmers reduce market transaction cost could be promoted alongside yield-enhancing innovations to facilitate farmers' participation in output markets hence increased incomes and food security.
Keywords: Agricultural innovations, output commercialization, finger millet, smallholder

1. Introduction

Agricultural innovations are crucial to increase agricultural productivity for food security and incomes, especially in developing countries (Godfray et al., 2010). However, in today's more integrated world economy, success in productivity-based agricultural growth depends on the transition from subsistence farming to market-oriented farming (Asfaw et al., 2011). To this end, transformation of smallholder agriculture from subsistence to market-orientation has been a subject of debate among policy makers and development practitioners for the last few years (Barrett, 2008).

This has necessitated the development of numerous initiatives in Kenya aimed at transforming low-productive subsistence farming to market-oriented agriculture (Alila, 2006). The purpose is to promote sustainable food security and boost monetary welfare of smallholder farmers who are the majority in the agricultural sector (Alene et al., 2008; Chipeta et al., 2015). The majority of the available studies on commercialization of smallholders and especially in Kenya and other developing countries has targeted high value cash crops appropriate for high potential areas (Poulton et al., 2006; Gyau, et al., 2014). However, sustainable commercialization also requires taking cognizance and integration of arid and semi-arid areas and their resources on the ground that they form the largest proportion of the total land mass in Kenya (over 80%) and home to about 38% of the population (Huho et al., 2010). These areas are characterized by low agricultural productivity, poverty and food insecurity resulting from frequent crop failure due to the production of non-adaptive crop species and varieties (Onyango, 2016), as well as unreliable rainfall, high temperatures and poor soil fertility (Bationo et al., 2011). Crop production in these areas is mainly subsistence (Cereals, 2013). This could be attributed to the little attention given to ASAL areas,

mainly in enhancing productivity and commercialization through the promotion of agricultural innovations in contrast to high potential agricultural areas (Schipmann-Schwarze et al., 2013).

The production of finger millet presents a possibility of reversing the poor traits in productiveness, poverty and food insecurity in semi-arid region (Huho et al., 2010). The cereal crop is known to be more nutritious, particularly in terms of increasing the supply of micronutrients (Thilakarathna & Raizada, 2015). Besides, finger millet is more resilient to poor or unpredictable agro-ecological conditions than commonly produced cereals such as maize, wheat and rice and have the capacity to grow well on marginal lands with poor soil fertility (Onyango, 2016). Moreover, the growing demand in domestic markets exceeds supply, thus the crop could be a potential source of cash for the resource constrained farmers (Handschuch & Wollni, 2016).

Despite the crucial role of finger millet in poverty reduction and food security, lack of innovational improvement has often locked small producers into subsistence production and contributed to stagnation of the sector (Onyango, 2016). As a result, the integration of smallholder farmers into finger millet output markets is still limited. Recently, research and development interventions have attempted to understand these constraints and facilitated the development of new innovations and market linkages for finger millet and other traditional crops for marginal areas in Kenya. The opportunities for commercialization are apparently favourable for finger millet, which tends to have higher domestic demand especially in the urban areas and the crop fetches more than double the price of sorghum and maize (Oduori & Kanyenji, 2005).

To harness the untapped potential of finger millet for the poor, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in collaboration with the Kenya Agricultural Livestock Research Organizations (KALRO) has developed and promoted market-oriented and resource-conserving innovations which include; improved finger millet varieties, conservation tillage, integrated pest, weed and disease management. The objective of these initiatives is to enhance productivity and resilience of finger millet production system in marginal areas in the face of climate change. Barrett (2008), pointed out that yield-enhancing agricultural technologies are however necessary but not sufficient conditions to trigger market participation. Farming households face other numerous constraints, including few asset holdings and poor infrastructure resulting to high transaction cost (Fischer & Qaim, 2012). Thus, besides yield-enhancing technologies research institutions are promoting finger millet marketing organizations to reduce transaction cost and contribute to a better bargaining position of the smallholder farmers.

There are several studies focusing on the role played by innovations in marketing. For example, Asfaw and Neka (2017) showed that in Ethiopia use of improved technologies played a direct role in market participation among the rural households. Zamasiya et al. (2014) found out that use of inoculant and improved soya bean varieties enabled smallholder farmers to participate in soya bean market in Zimbabwe. Fischer & Qaim, (2012) reported that banana marketing groups facilitated smallholder farmers' market participation in Kenya. Most of these studies are on high-value crops with little information on the traditional food crops like finger millet which are underutilized. As such there is a need to better understand the role played by these innovations on finger millet market participation. The main objective of this article, therefore, is to determine the level of finger millet output commercialization, investigate the factors that impede or facilitate finger millet farmers' participation in the market as well as role played by finger millet innovations on market participation.

2. Conceptual Framework

Transitioning from subsistence-oriented farming to market-oriented farming can occur on either side; on the input side with increased use of purchase inputs or on the output side with an increased marketable surplus which is measured as a ratio of output sold to total output produced (Leavy & Poulton, 2007). Smallholder finger millet farmers have varying choices to make; either to commercialize traditional crops or high-valued crops. According to Rabbi et al. (2017) commercializing high-valued cereal crops like maize on average tends to generate more income to farmers than from traditional food crops. This is because of advanced methods of production and marketing of these crops. However, smallholder farmers living in arid and semi-arid areas are constrained by production resources and they also experience crop failure of most common crops due to harsh weather conditions and marginal soil factors. Following this, diversification into traditional food crops offers an alternative source of income. These crops are more resilient to environmental extremes than the common crops and farmers have more experience in producing them (Dolan & Humphrey, 2000). Thus, sustainable market-oriented innovations for these crops could help in generating more surpluses to the market, increasing household income and food security at a lower risk.

This study assumed that there is an enormous potential for finger millet to improve food security and incomes if smallholder farmers participate in the markets. Many smallholder households in Kenya and other developing countries, however, produce and market the agricultural products under uncertainty and imperfect market conditions. In this case, the decision to participate or not is based on non-separable agricultural household model which production and consumption decisions are related (Barrett, 2008). In perfect market conditions, household decisions of production and consumption are determined differently, that is, the household maximizes profits as

producer and allocates the proceeds to maximize utility as a consumer. For this reason, commercialization occurs when the production is in response to the market signals and based on comparative advantage (Jaleta et al.,2009). This is unrealistic among most smallholder farmers in the Kenyan context where decisions to commercialize are based on production feasibility and consumption requirements. The decision to commercialize is also conditioned on several other factors which are non-separable.

Famers participate in the market if they have marketable surplus and this is influenced by production factors. For instance, lack of productive assets like land limits production of marketable surplus, hence could hinder market participation despite favourable market conditions. Household specific transaction costs are also very important when making commercialization decisions (Woldeyohanes et al., 2017). This explains why smallholder finger millet farmers in rural areas may either participate in the market or not. Transaction costs specific to households include, among others; the experience and bargaining power of the farming household, which is related to age, education of the household, household size, access to credit, access to information among others (Woldie & Nuppenau, 2011). Also, market related factors such as better access to market, institutional and physical infrastructure can have a direct influence on finger millet commercialization (Jaleta et al., 2009).

Barret (2008) points out that innovations and market participation influence each other. Sustainable yield-enhancing innovations in this case conservation tillage, integrated pest and weed management and improved finger millet variety can contribute to increased sustainable marketable surplus, but it will only become profitable if there is a market to absorb the surplus. Due to poor infrastructure markets are poorly connected and hence increased finger millet surplus may not be profitable as a result of high transaction cost and fluctuating prices. Innovations in finger millet group marketing offer another opportunity for reducing farmers' individual transaction costs. Common storage facilities and sharing of other market-related costs by farmers reduce per-unit transaction costs hence, enhancing market participation.

3. Research Materials and Methods

3.1 *Description of the Study Area and Sampling Procedure*

The study was based on data collected in December 2016 in two semi-arid sub Counties- Marakwet west and Keiyo South in Elgeyo-Marakwet County, Kenya. A total of 384 finger millet households were selected using a multi-stage sampling technique. The study site was chosen due to the various initiatives in the area targeting improvement of livelihoods using traditional, underutilized crops and owing to its socioeconomic conditions since 57 percent of the people live below the poverty line (CIDP, 2013-2017). In the County, finger millet together with sorghum used to be the most important cereal crops until the introduction of maize (Östberg, 2015). The production and consumption of these crops declined due to the shift towards maize production among smallholder farmers and a widespread neglect by researchers and policy makers lately.

3.2 Empirical model

The estimation of the factors that determine market participation can be achieved by first estimating the intensity of participation. The Household Commercialisation Index (HCI) (Govereh, Jayne, & Nyoro, 1999) was used but modified to estimate the level of HCI for finger millet only and specified as follows:

$$HCI_i = \left[\frac{Gross\ Value\ of\ Finger\ millet\ sold_{ij}}{Gross\ Value\ of\ Finger\ millettotal\ output_{ij}}\right] \quad (1)$$

Where $HCI_i$is thei^{th}household commercialisation index for finger millet; the numerator is the total amount of finger millet sold by the i^{th}household in the year 2015/2016 cropping season and the denominator is the total output of finger millet by the i^{th}household in the period 2015/2016. HCI is a ratio ranging from zero for non-commercialized to one for the fully commercialized households. To determine factors that influence finger millet market participation, this study employed the double hurdle model proposed by (Cragg, 1971). In modelling market participation, the concern is the fact that not all households participate in the output market resulting to zero sales. When some farmers decide not to participate in the market, the outcome is continuous for those who participated in the market. This type of distribution in the data can generate problems for OLS standard regression estimation (Wooldridge, 2010). To overcome this challenge, past studies model market participation as a two-step process that is, the decision whether to participate in the market and the extent of participation. In this case, Heckman Two-Stage, Tobit and the Double hurdle model can be used.

Several studies have used the tobit model to determine the probability and intensity of market participation. In this model the decision to participate and the intensity of participation are made jointly and affected by the same factors (Martey, Al-Hassan, & Kuwornu, 2012). Thus, if a given factor leads to whether to participate in the output market then this factor has a positive effect on the intensity of participation. The tobit model also allows one type of zero observation (corner solution) since it is based on the implicit assumption that zeros for non-market participating households are due to rational choice of the households, though it may be due to market barriers as noted by (Greene, 2005). Another limitation of the tobit model is that the censoring of the independent variable could result to underestimating the intercept and overestimating the slope (Lotz et al., 2013). The Heckman two-

stage and Double Hurdle models are the two step models that relax the tobit assumptions by allowing different factors to determine the decision to participate and the extent of participation. However, the Heckman two-stage selection model developed by (Heckman, 1979) assumes that zeros come from unobserved data due to non-random sample from survey or non-response in survey. In market participation zeros can reflect a rational decision of a smallholder not to participate in finger millet market due to multiple factors such as insufficient expected returns from the market.

The two-step double hurdle model nests the tobit model and therefore allows to overcome restriction implied in the tobit hypothesis (Martínez-Espiñeira, 2006). Also, unlike the Heckman sample selection models where households that do not sell output at the market are treated as missing observations in the second step (Reyes et al., 2012), the double hurdle model treats such households as corner solutions. Therefore, the double hurdle model was used in this study. The model consists of two hurdles representing two-stage decision-making process. The two decisions are whether to participate in the finger millet market and the extent of participation. The extent of participation in this study was the household commercialization index which is a ratio ranging between 0 and 1 developed based on equation (1). In this case, HCI=0 represents non-commercialized household and HCI=1 means that the household is fully commercialized. The households must cross two hurdles to be considered as participants in the finger millet output market. Each hurdle is conditioned by household agricultural innovations, farmer characteristics and institutional factors.

The first hurdle relates to the decision to participate in the finger millet output market and is presented as follows:

$$Y_i^* = \alpha' X_i + v_i \quad (2)$$

$$Y_i = \begin{cases} 1 \; if \; Y_i^* > 0 \\ 0 \; otherwise \end{cases} \quad (3)$$

Where,Y_i^* is a dependent dichotomous choice variable that takes the value of 1 if a household participated in the marketand 0 otherwise, *x'* is a vector of innovations, farmer and institutional characteristics and α is a vector of parameters for the first hurdle. The second hurdle is expressed as follows:

$$Z_i^* = \beta' W_i + u_i \quad (4)$$

$$Z_i = \begin{cases} \{\beta' W_i + u_i \; if Y_i = 1 \; and \; Y_i^* > 0 \\ 0 \; otherwise \end{cases} \quad (5)$$

Where, $Z_i$is the dependent variable for the intensity of finger millet market participation equation conditional on $Y_i = 1$. $W_i$is a vector of the innovations, farmer and institutional characteristics and $W_i$is a vector of parameter for the second hurdle? The respective errors ($v_i$and u_i) are assumed to be independent and normally distributed according to Goodwin and Smith (2003)

$$u_i \sim N(0,1), v_i \sim N(0, \partial^2) \quad (6)$$

The observed variable in a double hurdle model is specified as follows:

$$Z_i = Y_i \, Z_i^* \quad (7)$$

Although the double hurdle model helps to determine factors that influence each stage in the market participation decision making process, it decomposes the effects of the first hurdle onto the second hurdle while interpreting results. To overcome this challenge this study estimated the unconditional average partial effects (APE), and ran bootstrapping replications on each observation (Burke, 2009)

Table 1. Description of variables used in the model

Variables	Description of variables	Expected sign
Age	Age of the household head in years	-/+
Sex	Gender of the household head (1=male 0=female)	+
Education	Years of schooling of household head	+
Household Size	Number of people in households(persons)	+/-
Yield	Yield of finger millet in Kg/acre	+
Plot size	Area of land allocated to Finger millet in acres	+
Non/off farm income	Income earned outside the farm (1=yes 0=no)	+/-
Group membership	Household head membership to any association (1=yes 0=no)	+
Distance to the market	Distance to the nearest market in walking minutes	-
Household received credit	Household head access to credit (1=yes 0=no)	+
No of contacts with extension	Number of contacts with extension officer	+
Technical training	Household head received training (1=yes 0=no)	+
Conservation Tillage	Household practiced conservation tillage on finger millet (1=yes 0=no)	+
IPW	Household practiced IPW on finger millet (1=yes 0=no)	+
Improved Variety	Household planted improved finger millet variety (1=yes 0=no)	+
Group marketing	Household head membership to finger millet marketing group (1=yes 0=no)	+

4. Results and Discussion

4.1 Innovations, farmer, farm and institutional characteristics of market participants and non-participants

Table 2 below presents descriptive statistics of the variables used in the study. Sixty eight percent of the finger millet households sold at least some of the finger output produced. This means that about 32 % of the sampled households were practicing pure finger millet subsistence farming. For the households participating in the market, they were selling on average 33% of the total finger millet output produced. Therefore, even those who were participating in the market were consuming more than 60% of the finger millet output they produce.

The majority of the surveyed, households were male headed (86%) with the gender distribution of household heads being similar among market participants and non-market participants. The education level in terms of years of schooling of household heads had a mean of 8.8 years. Finger millet market participating households had, on average, significantly more years of formal education (9.06) compared to those heading the non-commercialized households (8.26).

On the other hand, there was no statistical difference in age between those who participated in the market (42.1) and non-participants (42.99). The results also showed the average household size of the sampled households in the study area was five persons with a minimum of one person and a maximum of 12 persons per household. The average family size in the study area captured the effect of dependency ratio and availability of family labour in the household. There was no significant difference between the average family size of participants (5.29) and non-participants (5.39) in finger millet output market.

The average land under finger millet was 0.6 acres which accounts for about 30% of total cultivated land. There was a significant difference in the average land size under finger millet between participants and non-participants at 1% significance level. There was no significant difference in income earned from non-farm activities between farmers who sold their finger output in the market and those who did not. Distance to the market has significant importance in market participation. On average, to reach the nearest village market, household members had to walk for 50 minutes. The minimum time taken to walk to the nearest village market was a one minute while the maximum was 375 minutes. There was a significant difference in the average distance to the market between participants and non-participants in finger millet output market.

Farmers' membership to a group plays a role in spreading information about some important aspects of the market. Most of the farmers in the sample were found to be members of groups (64.58%). Most (69.96%) of the farmers who participated in finger millet marketing were in groups compared to non-participants (52.89%). The majority of the households in the sample participated in one or two active social groups, while 5% participate in three and more groups. The social groups are very diverse in their membership and activities, including for example, self-help groups for women, youth groups, merry go round, farmer groups, or church groups among others. There was a positive significant difference in access to credit between participants and non-participants in finger millet output market.

Extension services usually play an important role in transmitting market information. These services are also

important in getting feedback from farmers about experience and the challenges they faced in participating in the market. The results of this study indicate that, about 30 percent of the farmers had contact with the extension officers at least once during the cropping period. The average number of contacts with extension officer between farmers and extension officers during the cropping season was found to be 0.58. This average number of contacts were significantly different between market participants and non-participants at 1% significance level.

Agricultural innovations used by finger millet farmers in the study area include; improved varieties, conservation tillage, integrated pest and weed management and group marketing. Among all the technologies, integrated pest management was used by most of the finger millet farmers (68.3%), few farmers participated in finger millet marketing group in the study area (28%). Significant variations were observed in the use of the innovations considered between participants in the output market and non-participants at one percent significance level.

Table 2. Comparison of finger millet market participants and non-participants

Variables	Mean	Market Participation	Non-Market participation	2 or Ttest
Proportion of crop produced sold	0.33 (016)	0.48 (0.16)	0 (0)	-21.240 **
Age	42.38 (0.620)	42.1 (12.73)	42.99 (12.73)	0.6647
Sex % Male (1)	86.46	87.45	84.3	0.401
Education	8.8 (3.851)	9.06 (3.786)	8.26 (3.949)	-1.8887*
Household Size	5.29 (2.10)	5.391 (2.144)	5.09 (2.02)	-1.2998
Finger millet Kg/acre	589.36 (240.96)	643.67 (226.249)	471.28 (230.28)	-6.8975
Land allocated to finger millet(acre)	0.6 (0.440)	0.65 (.4843)	0.484 (.293)	-3.569***
No/off farm income (KES 1000)	37.32 (88.389)	40.46 (96.47)	30.50 (67.438)	-1.0253
Group membership% Yes (1)	64.58	69.96	52.89	10.556**
Distance to the market(walking(min)	50.208 (48.22)	53.33 (53.71)	43.41 (32.45)	-1.8792*
Household received credit% Yes (1)	13.8	15.97	9.09	3.2959*
No of contacts with extension	0.58 (1.095)	0.688 (1.185)	0.347 (.823)	-2.861***
Technical training% Yes (1)	27.6	30.04	22.31	2.474
Practiced Conservation Tillage% Yes (1)	51.82	57.79	38.84	11.922***
IPW% Yes (1)	63.8	69.2	52.07	10.536***
Used Improved Variety% Yes (1)	40.89	50.19	20.66	29.898***
Member of finger millet Group marketing% Yes (1)	28.13	33.46	16.53	11.752***

*, ** and *** indicate statistical significance at 10, 5 and 1 percent level of significance

cχ2 ratio was used to determine relationships in categorical variables, between smallholders participating in the market and non-participants

T-test was used to determine significant differences in continuous variables, between smallholders participating in the market and non-participants

4.2 Double hurdle model results

The double hurdle model was estimated using STATA 14.2 software. Diagnostic tests for the existence of multicollinearity and heteroscedasticity were conducted using Variance Inflation Factor (VIF) (Gujarati, 2004) and the White Test (White, 1980), respectively. The VIF results ranged between 1.08 and 1.33. Hence, multicollinearity was not a problem among the continuous variables. Similarly, for dummy variables the contingency coefficient test was employed. For the dummy variables, if the value of contingency coefficients is greater than 0.75, the variable is said to be collinear. The coefficients varied between 0.002 and 0.281, which indicated that there was no evidence of a strong correlation between the dummy variables. The White test for heteroscedasticity showed there was no problem of heteroscedasticity among the variables and the error term.

The maximum likelihood parameter estimates for the double hurdle model were obtained using the Craggit command in Stata (Burke, 2009). The Average Partial Effects of each independent variable were computed to

represent the marginal effect. In Table 3, the results of the determinants of market participation and extent of market participation are presented. The likelihood ratio test was -168.385 and it was significant at 1% supporting the use DHM compared to Tobit model. Also, the correlation between v_i and u_i as indicated in equation 6 measured by the sigma constant shown in Table 3 is relatively high (0.251) and statistically significant at one percent, this is a clear indication of the relationship between the two tiers thus reinforcing the superiority of the double hurdle model over the Tobit model (Muricho, 2015).

Sixteen factors were estimated in the first market participation hurdle and five of them were found to be statistically significant. In the second hurdle only four factors were significant. Education of household head was insignificant in the market participation hurdle, but significant in the extent hurdle at the 5% significance level. This showed that as years of schooling increased, quantity of finger millet sold in the market increased. Educated farmers can search and process market information, hence reducing transaction costs compared to those who have less and, therefore, increased market intensity. The results are consistent with the findings of the study (Adeoti et al. 2014; Martey et al. 2012; Tufa, Bekele, & Zemedu, 2014) who argued that education helps farmers to make informed decisions and therefore produce to take advantage of prevailing market opportunities.

The coefficient of land allocated to finger millet production by the household was significant in market participation hurdle at 1% level. This can be explained by the fact that large area allocated to finger millet production provides opportunity for surplus production. In the extent hurdle, the land size coefficient was not significant. This can be explained by the fact that extent of market participation involves the ratio of output sold to total output produced; therefore, the extent of market participation may not be conditioned by the size of land allocated to finger millet production. This was in line with the results of several studies (Achandi & Mujawamariya, 2016; Bellemare & Barrett, 2006) who found cropping area positively related to the market participation.

Contact with extension officers by finger millet farmers positively influenced the extent of market participation at the 5% level. The unconditional marginal effect on the number of contacts with extension officers indicated that contact with extension agents increased the quantity of finger millet output by 1.7%. Contact with extension agents is one way of disseminating new innovations to farmers as a way of increasing agricultural productivity hence increased marketable surplus. Also, contact with extension agents encourages participation because exposure to information reduces market uncertainties. The finding of the study is consistent with the results obtained by Musah et al. (2014) as well as Olwande & Mathenge, (2011) who reported a positive correlation between extension contact and market participation.

The coefficient for off/non-farm was negative and significant at 1% level indicating that the higher the earnings from off/non-farm activities the lower the probability of market participation. In the second hurdle, the coefficient of off/non-farm was not significant. Households that engage in a more profitable off-farm activity can earn higher income and increase their consumption of both agricultural and non-agricultural goods, hence a food crop like finger millet can be grown mainly for subsistence. Also, farmers who engage in extra farm activities have less time for marketing activities. These findings are in agreement with Jaleta et al. (2009) who found out that the ownership of livestock as a form of off-farm income negatively affects participation in crop market, because of the distraction from farming. The results were in contrast with the results reported by (Martey et al. 2012; Rabbi et al. 2017) who reported a significant positive relationship between off farm income and market participation.

The coefficient for yield or total finger millet output produced was positive and significant at 1% level for the two hurdles. Results suggest that as the finger millet yields increase the decision to participate and extent of participation increased. One possible explanation is that higher the yields enhance the farmer's probability to participate in the market because of the surplus above their household consumption needs. These results were consistent with results reported by Achandi and Mujawamariya (2016) who highlighted that high yields affect both the decision to market participation and the quantity smallholder farmers sells in the market

Planting improved finger millet variety by farmers positively influence the decision to participate in the market at 1% significance level. This could be attributed to the fact that the use of improved variety may increase finger millet yields and consequent marketable surplus above their household consumption needs. The results were consistent with findings of Zamasiya et al. (2014) who found out that, the improved soya bean variety had a positive and significant effect on the farmer's decision to participate in the market. A study by Achandi & Mujawamariya (2016) reported a positive effect of improved variety on the quantity of rice sold in the market.

The practicing of integrated pest and weed management (IPWM) on finger millet production by farmers positively and significantly influenced the decision to participate in the market at 1% level (Table 3). This could be because IPWM controls weeds, pest and disease, hence increase marketable surplus. Intercropping finger millet with legumes such as cowpeas, beans and pigeon peas enhance control of major weeds and parasitic ones like striga, reduce effects of blast disease and improves soil fertility by fixing nitrogen. These could also increase finger millet productivity and consequently, marketable surplus. Practicing integrated IPWM was not significant in influencing the quantity of finger millet sold in the market.

Table 3. Finger millet market participation and extent of market participation

Variables	Market participation Decision Coeff & SE	Extent of Market participation Coeff & SE	Aaverage partial Effects Coeff & SE
Age		0.0021(.001)	0.001(.001)
Sex	0.237(0.218)	0.055(0.056)	0.061(0.056)
Education	0.02(0.023)	0.011(.005) **	0.009(.004) *
Household Size	0.014(0.040)	-0.007(0.009)	-0.003(.008)
yield	0.946(0.18) ***	0.139(0.049) ***	0.197(.043) ***
Plot size	0.431(0.136) ***	-0.018(0.029)	0.043*
off farm income	-0.049(.015) ***	0.001(.003)	-0.005(.003) **
Group membership	0.228(.163)	0.006(.041)	0.032(.037)
Distance to the market	0.002(0.002)	-0.003(.003)	0.0000
Household received credit	-0.123(.251)	0.008(.050)	-0.0106(.029)
No of contacts with extension	-0.045(0.096)	0.04(.019) **	0.017(.018)
Technical training	0.067(0.191)	-0.022(.044)	-0.004(.035)
Practiced Conservation Tillage	0.212(.173)	-0.029(.044)	0.009(.0444)
IPW	0.35(0.177) **	0.01(0.042)	0.049(.033)
Improved Variety	0.538(.181) ***	0.009(.041)	0.0721(.038) *
Group marketing	0.102(0.197)	0.143(.040) ***	0.094(.037) **
Constant	-6.015(1.197)	-0.701(0.335)	
Sigma cons		0.251(0.014) ***	
No. of Observation		384	
Wald chi2(16)		76.98	
Log likelihood		-168.385	

*, ** and *** indicate statistical significance at 10, 5 and 1 percent level of significance

5. Conclusions and Recommendations

The goal of this study was to determine the level of finger millet output commercialization and examine the factors which influence commercialization in the wake of promotion of innovations in finger millet production and marketing. It is argued that with the increase in market participation the income of households will increase, which will have a positive impact on food security and poverty reduction. This study sought to fill the knowledge gap in literature on the level and factors influencing finger millet commercialization giving special focus to innovations in finger millet production and marketing.

The results of the current study show that most smallholder farmers produce finger millet mainly for consumption with a small surplus sold in the market. The econometric results of the study also showed that improved finger millet variety and integrated pest and weed management as well as other factors such as yield, finger millet crop area, positively influenced the decision to participate in the market. The study also found out that extra income from non-farm activities negatively influence finger millet farmers' decision to participate. The extent of market participation was positively influenced by finger millet yield, education of the household head, contact extension officer and group marketing.

Based on the findings, strategies that promote the production and marketing of finger millet should not only focus on yield-enhancing innovations, but also encourage innovations that reduce per unit transaction costs for resource constraint farmers and enhance information and knowledge sharing. This will augment, not only the decision to participate, but also increase the quantity of output sold in the market and consequently, increase income and household food security.

Acknowledgements

The authors are grateful for funding provided by German Academic Exchange Service (DAAD) through the African Economic Research Consortium (AERC). The enumerators are highly acknowledged for collecting the data and the survey respondents for answering our questions.

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