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Determinants of Market Participation Regimes among Smallholder Maize Producers in Kenya

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Abstract.

More studies have been conducted on determinants of smallholder participation in markets as sellers, with scant attention to why farmers participate in markets as either net sellers, autarkic or net buyers. Employing a random effect ordered probit model, this paper examines factors determining households' participation in maize markets as either net sellers, autarkic or net buyers. Contrary to government intentions for producer price supports, this study showed that households that faced high producer selling prices of maize were likely to be net buyers. However, household membership to agricultural production groups increased the likelihood of farmers being net sellers. Similarly, adoption of inorganic fertilizer and improved maize varieties were positively associated with being net sellers. Therefore, policies supporting high producer selling prices should be discouraged and instead encourage those that ease smallholder access to fertilizer and improved maize seed.

Keywords: Kenya; maize, market participation regimes, ordered probit model

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1. Introduction

Since majority of the population in developing countries like Kenya live in rural areas and mainly dependent on agriculture as their source of livelihood, participation of these households in agricultural markets is expected to positively affect their welfare outcomes. It is on the basis of this expectation that governments in these countries have promoted policies aimed at ensuring overall commercialization of smallholder agriculture (Siziba *et al.,* 2011; Macharia *et al,* 2014). These policies are aimed at increasing the ability of smallholder farmers to participate in markets as output sellers and input buyers. Most commonly used policy instruments include producer price supports and import tariffs aimed at increasing producer prices particularly for the main staple grains. The first assumption in this approach has been that higher producer prices will not only increase the income of producers and subsequently improve their welfare but will also induce positive supply response in subsequent seasons. Secondly, policy makers pursuing this kind of approach assume that all smallholder farmers are a homogenous group that will be affected by the policy uniformly.

However, there is little empirical evidence if any to support the argument that high producer prices of main staples will improve the welfare of market participating households despite the fact that many developing countries continue to pursue this policy (Jayne *et al.,* 2001). Similarly, agricultural market participation literature has shown that smallholder farmers are heterogeneous with great differences in terms of size, access to markets, agro-ecological conditions, and other characteristics, including their capacity to innovate (Jayne *et al.,* 2001; FAO, IFAD and WFP, 2014). Therefore a given policy will affect these farmers differently. For example, in output markets of staple grains, smallholder producers find themselves operating in one of the three market regimes i.e. either as net sellers, net buyers or autarkic (Goetz, 1992; Bellemare and Barrett, 2006; Barrett, 2008). Net sellers are those who sell in the market more than what they buy. Similarly, net buyers are those who buy from the market more than what they actually sell. On the other hand, autarkic are those who are self-sufficient or the amount they sell in the market is just equal to the amount they buy again from the market. Therefore the relative position of the households in these market regimes is bound to affect their welfare outcome in response to a given market policy instrument. While a substantial amount of effort has been directed in understanding factors that determine smallholder participation in markets as sellers per se, little literature exists on why farmers find themselves participating in maize markets as either net sellers, autarkic or net buyers. It is therefore important to understand the factors that condition households to participate in different market regimes so that carefully targeted policy interventions can be designed to ensure that majority of

smallholder farmers and even non-food producing urban consumers benefit from market participation.

This study analyzed the factors that conditioned smallholder farmers to participate in maize markets as either net sellers, autarkic or net buyers using a random effects ordered probit model. Due to frequent government intervention into maize markets via producer price supports and imposing of maize import tariffs at harvesting time in the country, special emphasis in this study was drawn on how producer maize selling price support policies condition market participation regime of smallholder producers. While initial descriptive work of Jayne *et al.*, (2001) elaborated on how high producer price are detrimental to majority of smallholder maize farmers in Kenya because majority of them are net buyers, there has been no quantitatively rigorous analysis of this important issue in Kenya. Evidence based policy decision on the impact of government price support and import tariffs on maize has on the smallholder farmers' market participation is important to stimulate increased and largely beneficial market participation that will eventually enhance demand for productivity enhancing technologies like improved seed and chemical fertilizer (Barrett, 2008).

2. Previous Research

Since early 1990s, literature on agricultural commercialization and output market participation in particular has been growing rapidly. Overall, most of these past literatures aim at understanding the reasons behind limited market participation by smallholder farmers despite the opportunities presented by the liberalized markets. These studies were driven by the fact that if many households do not participate in markets or do not respond to market signals, then market based development strategies were bound to fail in facilitating wealth creation and poverty reduction (Barrett, 2008). Most of the theoretical contribution in this area of agricultural market participation is credited to de Janvry *et al.*, (1991) and Fafchamps (1992) who separately developed formal household models to explain smallholder supply response in the presence of market failures. However, this was not without empirical analysis challenges. Smallholder market participation analyzes had to deal with selection bias that had been addressed using Heckman (1979) approach.

In a widely cited paper, Goetz (1992) studied determinants of households' discrete decision of participation in coarse grain markets as sellers or buyers and the continuous decision of how much to sell or buy conditional on participation using household data from Senegal. A selectivity model that endogenously switched households into alternative market participation regimes was used to correct for the bias caused by the unobserved variables. On the other hand, using a nationally representative household level data collected from maize (corn) farmers in Mexico, Key *et al.*, (2000) advanced on the conceptual framework of Goetz (1992) by identifying the role of transaction

costs (fixed and proportional) on market participation. They used an endogenously switching regression that automatically switched households into three different market participation regimes i.e. market participation as sellers, buyers and autarkic. Later on, Bellamere and Barrett (2006) developed a two stage econometric method to test whether rural households in northern Kenya and southern Ethiopia make livestock market participation decision and volume to sale decision simultaneously or sequentially using ordered probit and ordered tobit models. In the first discrete decision making stage where ordered probit model was used, households were put into three categories i.e. net buyers, autarkic and net sellers. In the second stage, determinants of how much to sell or buy conditional on having decided to participate in the market was analyzed using the tobit framework which the authors called "ordered tobit model" due to the analytical approach used in the first stage.

Empirical literature on market participation in Africa continued throughout the first decade of the 21st century. This could have been driven by the continued dismal participation of smallholder farmers in markets even after liberalization. Using a selectivity model and applying a two stage decision making process as it had been done by Bellamere and Barrett (2006), Alene *et al.,* (2008) analyzed the role of transaction costs on market participation. They expanded the scope of study to include market participation in both output and input using the maize sub-sector in Kenya. In the same breadth of investigating the impact of transaction costs on smallholder agricultural commercialization, Omiti *et al.,* (2009) studied factors that influenced market participation intensity in rural and peri-urban areas in Kenya. A truncated regression model was applied with households that did not participated in the market being excluded from the analysis i.e. the lower bound of the truncation. Mathenge *et al.,* (2010) used household level panel data to analyze factors influencing market participation and its impacts on income and poverty among poor and marginalized households in Kenya. Using the Double Hurdle model developed by Craigg (1971), Mathenge *et al.,* (2010) analyzed household's binary decision to participate in the market and the continuous decision on how much to sell conditional on having decided to participate in the market. Similarly, Mather *et al.,* (2011) analyzed the determinants of maize market participation in selected eastern and southern Africa countries by fitting a double hurdle model on panel data in in a random effects framework. Recently, Macharia *et al.,* (2014) used the censored tobit model to analyze the impact of transaction costs on maize market participation in Kenya.

The analytical methodologies adopted in past empirical literature are varied. Though majority of the studies used two step selectivity models to analyze the discrete decision of market participation and the continuous decision of market participation intensity conditional on having made the decision to

participate (Goetz, 1992; Alene et al., 2008; Bellamere and Barrett, 2006; Mathenge *at al.,* 2011), other studies just analyzed the continuous decision of market participation intensity (Omiti *et al.,* 2009; Macharia *et al.,* 2014). However, to the best of our knowledge, no study, particularly in Kenya, has analyzed factors that condition households to participate in staple grain markets as either net sellers, autarkic or net buyers. Yet it is widely acknowledged that smallholder producers will not benefit by just a mere fact that they are participating in the market but instead they should participate profitably as net sellers.

3. Conceptual framework and model specification

The decision to participate in the maize market as a net seller, an autarkic or a net buyer is "trichotomous" in nature. Households are assumed to participate in a market regime that maximize their expected utility over their planning horizon. Consider the following latent model M_{ji}^{*} which describes the i^{th}household's behavior of participating in market regime j $(j = 1,2,3)$:

$$M_{ji}^{*} = \beta_j X_{ji} + \varepsilon_{ji} \qquad (1)$$

where M denotes the latent dependent variables which can be represented by the level of expected benefit and/or utility derived from participating in market regime j, Xs area vector of covariates influencing the j^{th} market participation regime and βs are associated vector of parameters, and ε are the unobserved factors influencing market participation. The household's utility from participating in a given market regime is not observable but the decision to participate is observable. The farmer will choose market regime j if:

$$M_{ji} = \begin{cases} 1 \; if M_{ji}^{*} > 0 \\ 0 \; otherwise \end{cases} \qquad (2)$$

The parameter β_j is estimated using a random effects ordered probit that allows for multiple ordered values (net sellers, autarkic and net buyers). The random effects will enable us to control for unobserved household specific heterogeneities that affect farmers market position.

4. Data sources, study area, sampling procedure and Data

This study is based on household level panel data collected from western and eastern parts of Kenya by International Maize and Wheat Improvement Center (CIMMYT) and its local partners in Kenya (KARI and Egerton Univeristy) with financial support from the Australian Center for International Agricultural Research (ACIAR) and the Australian International Food Security Research Center(AIFSRC) . The first round of the survey was conducted between January – April 2011 while the second round was conducted between August – November 2013. A total of 613 households were surveyed in the first round. During the second round survey, 536 households out of the targeted 613 were successfully surveyed. The sampled households were from five districts that were

purposively sampled based on their maize-legume intercropping potential because the objective of the intervening project was to promote these farming systems as a way of tackling rural food security and poverty in general. Two districts were from western Kenya region (Bungoma and Siaya) and three districts from eastern Kenya region (Embu, Meru South and Imenti South). A total of 600 households were targeted for this survey (300 in each region). In western Kenya, each district was allocated 150 households. Similarly, in eastern Kenya, each district was allocated 100 households. Thereafter, multi-stage sampling method was applied to select lower level sampling units i.e. divisions, villages and households. First, all divisions in each district were purposively targeted in order to get a more representative sample i.e. a total of 28 divisions (17 from Western Kenya and 11 from Eastern Kenya) were included in the sample . Each division in each district was assigned sample households proportional to total number of households found there as per the 2009 Kenya national census. The number of villages to be surveyed in each division was proportional to the total number of households in each of the division. The actual survey villages in each division were randomly picked from the list prepared for each division. On the other hand, the number of households to be surveyed in each village was proportional to the number of households in that village. Finally, the surveyed households were randomly picked from a list of households that was made from each of the selected villages.

A semi-structured data collection tool (questionnaire) was developed to capture key information for profiling targeted farming communities, enable refinement of project intervention strategy and monitor the impact of project interventions. The questionnaire captured data on various aspects including socioeconomic profiles of the households like characteristics of household members (sex, age, education, main occupation, household head etc.), household social capital and other village networks (membership to farmer groups, number of dependable relatives and non-relatives, number of grain traders known etc.). The questionnaire also captured information on household specific transaction costs variables like distances to output and input markets, ownership of transport, information and communication equipment like bicycles and mobile phones etc. The questionnaire had specific modules to capture data on household annual income from other sources apart from crops and livestock enterprises on the farm. Finally, the questionnaire had also a module to elicit respondents' subjective assessment of household food security status in the last 12 months preceding the date of the survey.

5. Results and discussions

5.1 Descriptive statistics

The descriptive statistics of the variables used in the analysis are presented in Table 1.Majority of the surveyed households were male headed (82%) and net buying households had the lowest male headed households (80%) compared to autarkic (81%) and net sellers (84%). Most of these household heads reported farming as their primary occupation (82). The highest proportion of household heads that reported farming as their main occupation was among the net sellers (85%), followed by autarkic (79%) and then net buyers (78%). On the other hand, the average level of education achieved by the household heads was about 7.6. The net sellers group had household heads with the highest level of education, followed by autarkic and then net buyers (Table 1). The average size of the surveyed households was about 5 adult equivalentswith dependency ratio of about 1. Net sellers had the smallest household size and lowest depnedency ratio of about 4.6 and 0.9, respectively while net buyers had the largest family size and highest dependency ration of about 5.6 and 1.2, respectively. The high dependency ratio among net buyers means that each household member that is in the productively active age brackets supports more than one household member that is in productively inactive age bracket. Autarkic households had an average household size of 5.1. About 70% and 88% of the housеhiold surveyed owned mobile phone and radio, respectively. A higher proportion of net sellers (%) owned these important equipment for communication and information compared to autarkic and net buyers. Similarly, majority of the surveyed households reported that they were, at the least, food secure. About 55% households felt that they were at least food secure (41% were at break-even point while 14% had food surplus). However, when households were disaggregated by market participation regimes, it was found that almost 75% of the net sellers were at least food secure, compared to just slightly more than 50% of the autarkic and just about 25% of the net buyers (Table 1).

On the other hand, most of the households had adopted maize productivity enhancing technologies. About 90% of the households had applied inorganic fertilizer on their maize plots while almost 80% had planted improved maize varieties. A higher proportion of those who had adopted these production intensification technologies were from the net sellers group (Table 1). Overall, household membership to agricultural production networks (APNs) i.e. input and output production and marketing groups was about 46%. Net buyers reported a high proportion of households belonging to these APNs compared to autarkic and net buyers (Table 1). Similarly, the descriptive statistics showed that the average distance to main markets among the surveyed households was about 6.1 km. Against the expectation, net sellers of maize were found to be much further away from main markets compared to the autarkic and net buyers. Annual non-farm income among the

surveyed households was KSh. 94,950 with autarkic households having a higher average of about KSh. 113,000 compared to KSh. 95,000 among the net sellers and KSh. 88,000 among the net buyers. Finally, the average price of maize among the sampled households was about KSh. 25 kg^{-1}. Net buyers received the highest producer selling price of almost KSh. 28 kg^{-1}, followed by autarkic households KSh. 25 kg^{-1} and then net sellers with the lowest price of about KSh. 24 kg^{-1}.

5.2 Econometric results

The econometric results from the ordered probit regression estimation are presented in Table 2. Most of the explanatory variables included in the model were found to be statistically significant in determining the market participation regimes of the surveyed households. Particularly important in this study was the impact of producer selling price in determining the maize market participation regime of the households. The results showed that those households that faced high producer selling price were likely to be net buyers of maize compared to either being self-sufficiency or net sellers. This behavior among producers could be informed by the fact that because maize is a staple, higher producer selling price is interpreted by these producers that maize price in the next lean season is going to be even higher and thus holding back their stocks in order to reduce their buying burden during the lean season. They therefore end up only participating in the market as buyers or in some cases participate as both buyers and sellers though buy more than what they sold. The vice versa is true in cases where the producer selling price is perceived to be low. On the other hand, results from the average marginal effects analyses shows that an increase in producer selling price of KSh. 1 kg^{-1} is likely reduce the probability of a household being net seller of maize by about 1%. In other words, if the price of a 90-kg bag of maize is increased by KSh. 500 (approximately KSh. 6 kg^{-1}), then this will reduce the probability of a household being a net seller of maize by more than 5% while increasing the probability of being a net buyer by 5% (Table 2).

This finding on the impact of price on farmers' market participation is contrary to the intentions of the government price support policies that are usually aimed at making farmers net sellers of maize so that their incomes can be increased and welfare in general. These results however, suggest that such policy interventions make smallholder farmers worse-off because it limits those who enter the market as sellers and those who sold end up buying from the market more maize than what they sold, even at a much higher price than their selling price. This behavior by farmers is what Stephens and Barrett (2011) called the "sell low and buy high" puzzle of farmers. Even when the Kenyan government intervenes in the market during the lean season by releasing part of the strategic grain reserves to smoothen the prices, the amounts that the government holds is usually far much below the deficit which is usually met by the private traders who dictate the price at such times. This

happens to the disadvantage of the smallholder farmers who are essentially net buyers of maize in this case. More so, because maize is a staple food grain, its demand is very inelastic and farmers buy it at such exorbitant prices thereby eroding their welfare. This empirical finding points to the fact that against all odds, government intervention into the maize markets by way of price support during peak marketing season ends up transferring income from majority poor rural smallholder maize producers to a few relatively better-off private grain traders.

The study also analyzed the influence of household perception about its own food security status on the maize market participation regime it finds itself. The main respondent was asked to subjectively assess the food security status of the household in the last 12 months prior to the survey visit. The results showed that food insecure households were likely to be net buyers of maize compared to otherwise. This finding has far reaching implications for a staple food grain like maize in a country where all food security issues are usually related to maize availability and accessibility. For example, for smallholder farmers to participate in maize markets as net sellers, their food security needs have to be assured first, especially in terms of staple grains like maize. The average marginal effect results showed that a household that perceives itself to be having food shortages throughout the year has over 50% probability of not being a net maize seller; 4% chances of being self-sufficiency in maize and almost 50% chances of being a net buyer of maize compared to a household that perceives itself to be having food surplus throughout the year (reference group). On the other hand, households that felt they had occasional food shortage had 34% chances of not being net sellers of maize, 3% of being autarkic and 32% probability of being net buyers of maize compared to the reference group (food surplus). Similarly, those households that felt they had no food shortage and no food surplus i.e. breakeven had 19% probability of not being net sellers of maize, 2% of being self-sufficiency and about 18% of being set buyers of maize compared to the food surplus households (Table 2).

Since these smallholders produce and consume maize as their staple food, then their food security could be assured with improved productivity of this important crop. To explore this further, we controlled for two important maize productivity enhancing variables i.e. adoption of improved high yielding maize varieties and adoption of inorganic fertilizers on maize plots. As expected, the two productivity enhancing variables (improved maize varieties and fertilizer) showed statistically significant negative relationship with net buying market participation regime (Table 2). A household that adopted inorganic fertilizer had 8% chances of being a net seller of maize, 1% chance of not being self-sufficiency in maize and 7% probability of not being a net buyer of maize. Similar trends were observed when the household adopted improved maize varieties. There was

11% probability that a household that adopts improved maize varieties will be a net seller of maize in the market, 1% that it will not be self-sufficient (autarkic) and almost 10% that it will not be a net buyer of maize. The implication for these finding is that for households to participate in maize markets as net sellers, it is important for them to access maize productivity enhancing technologies rather than high producer selling price. Simply put, given two options of producer price support and input subsidy, then it is much beneficial to both smallholder farmers and urban non-maize producing consumers for the government to give carefully targeted subsidy to seed and fertilizer rather than producer price supports and import tariffs. Such policy approaches will have a positive effect on increasing incomes for smallholder maize producers while at the same time availing maize at affordable prices to net buyers including non-maize producing urban consumers. This will effectively address the classic "food price dilemma" that Kenyan policy makers have been struggling with for some time now (Jayne *et al.,* 2008). Though subsidies are not sustainable in the long-run, they are a less evil compared to price support as per the empirical results presented in this study. Furthermore, if used strategically, targeted and time bound subsidies can stimulate sustainable supply.

Other factors that significantly determined the maize market participation regime of smallholder farmers included household size, dependency raio, education of the household head, main occupation of the household head, household membership to APNs (input and output marketing groups), non-farm income and transaction costs proxy variables (household ownership of mobile phone, bicycle and radio, and distance to the nearest main market). District location dummies were also significant in explaining the net position of the household in the maize market. Large households and those with high dependency ratio were more likely to be net buyers of maize compared to smaller ones. An increase in household size and dependency ratio by a unit, is likely to reduce the probability of the household to participate in the maize market as a net seller by about 2% and 1%, respectively, while at the same time increase its probability of participating in the market as an autarkic and net buyer (Table 2). This could be attributed to the fact that maize is a staple grain among the surveyed households and most of these households do not produce enough from their farms to meet their home consumption needs. Therefore, any increase in the household size or dependency ratio will put more pressure on the maize produced on the farm to meet home consumption needs. On the other hand, education of the household head was also negatively and significantly associated with being a net buyer of maize though marginally. An increment in education level of the household head by one year results into a 1% in the probability that the household will be a net seller of maize and reduces the probability of being a net seller by almost 1% too (Table 2). This finding emphasizes the importance of formal education in enhancing the

ability to critically analyze, understand and respond to information on various aspects of livelihoods including new technologies and markets (Mauceri *et al.,* 2005). Similarly, the main occupation of the household head was negatively and significantly related to net buying market participation regime. This means that those households whose heads had farming as their primary occupation were unlikely to be net buyers of maize. Having farming as the main occupation of the household head increased the chances of being net seller of maize by about 7% while reducing the chance of being autarkic and net buyer by almost 1% and 7%, respectively.. The implication of this finding is that those who have non-farming main occupation are likely to get income from those non-farming activities and use that income to buy maize for home consumption. This main occupation finding is corroborated with the finding on total annual household non-farm income. The positive and significant relationship between total annual household income from non-farm activities with net buying market participation regime implies that higher non-farm income will lead to a household being a net buyer of maize.

It is also important to note that collective action proxied by membership to agricultural production networks (APNs) was strongly, negatively and significantly related to self-sufficiency and net buying market participation regimes. Belonging to APNs increases the probability of being a net seller of maize by 16% while reducing the probability of being an autarkic and net buyer by 1% and 15%, respectively (Table 2). This result shows how important collective action is in breaking information and technology access barriers for improved agricultural productivity and market access (Shiferaw *et al.,* 2011; Fischer and Qaim, 2012). Essentially, this implies that government policies should be designed to enable quick evolution and growth of collective action institutions for increased market participation of smallholders as net sellers.

Similarly, all transactions costs variables were statitically signficant in determining the market participation regime of surveyed households (Table 2). However, distance to the main market, though highly significant, had unexpected sign on its coefficient. Mobile phone and radio ownership were used as proxy variables for fixed transaction costs while bicycle ownership and distance to main markets were proxy variables for proportional transaction costs (Key *et al.,* 2000; Mather *et al.,* 2011). The negative and significant signs on the coefficient of mobile phone and radio ownership variables imply that their ownership reduces the chance that a household will participate in the maize market as a net buyer but instead increases the likelihood that the household will participate in the maize market as a net seller. Owning mobile phone and radio increases the chance of a household being a net seller of maize by 7% and 1%, respectively while on the other hand, it reduces its chance of being a net buyer by 6% and 1%, respectively. This is because mobile

phone and radio ownership relaxes information access constraint that sometimes limits market participation as demonstrated by Key *et al.,* (2000) and Alene *et al.,* (2008).

Househods that owned bicycle we less likely to be net buyers of maize. The average marginal effects results presented in Table 2 shows that households that owned bicyles were 3% likely to be net sellers of maize and 2% unlikely to be net buyers of maize. This finding explains the importance of proprtional trasaction costs in explaining the market participation intensity (quantity sold). Those households with bicycles were likely to be net sellers than otherwise becauise bicyle ownership reduces the per unit cost of transporting the produce to the market. On the other hand, distance to the main market had a totally unexpected sign and it was statistically significant. The negative sign of this variable implied that the nearer the household was from the main market, the most likely the household was to participate in the maize market as a net buyer. Alternatively, the further the household was from the main market, the most likely was the household to participate in the maize market as a net seller. An increase in distance of 1 km away from the main market was found to increase the likelihood of a household being a net seller of maize by about 1% and the likelihood of being a net buyer of maize was likely to reduce by about 1% (Table 2). This is completely the reverse of theory and past empirical findings in this area of agricultural market participation. Past empirical studies established that distance was inversely related with not only the decision to participate in the market but also with the amount or volumes sold (Key *et al.,* 2000; Alene *et al.,* 2008). However, there could be a valid reason for this finding. Given the fact that maize is a staple crop, bulk and low value grain, farmers who are closer to main markets are likely to grow high value and more perishable crops for the nearby niche markets and only end up buying maize afterwards. This is perfectly in line with von-Thunen theoretical model of land use.

Lastly, when the district dummies were used in the regression, it was found out that Embu, Imenti South and Meru South district households were less likely to be net buyers of maize compared to Bungoma district farmers (the reference district). Embu district households were 5% more likely to be net sellers and 4% less likely to be net buyers of maize than their counterparts in Bungoma district. On the other hand, Imenti South district households were 18% likely to be net maize sellers, 1% less likely to be autarkic and 16% less likely to be net buyers of maize compared to Bungoma district households. Similarly, farmers in Meru South district were 21% more likely to be net sellers of maize, 2 % less likely to self-sufficient (autarkic) and 19% less likely to be net buyers of maize compared to Bungoma farmers (Table 2). These trends across the survey districts could be possibly associated with the importance of maize in the food basket of these districts. While maize is the staple food grain in the whole country, western Kenya farmers (households) like those in

Bungoma and Siaya districts could be more dependent on maize for food compared to Embu, Imenti South and Meru South districts farmers. In eastern Kenya where Embu, Imenti South and Meru South districts are found, maize is usually mixed with legumes like beans to make their popular dish called *githeri*. On the other hand, in western Kenya, the most popular dish is *ugali* – which is just stiff porridge made from milled maize flour. This stiff poridge is usually served with cooked vegetables and other stews.

6. Conclusions

Policy makers in developing countries like Kenya are faced with the challenge of increasing incomes for smallholder farmers who are the majority producers of main staple grains on one hand and providing more affordable food grains to urban non-food producing households on the other hand. A common approach has been adoption of producer selling price support policies in the hope that producers will be motivated to sell more and invest more in productivity enhancing technologies thereby eliciting positive supply response. However, the implications of such price support policies on smallholder farmers have not been fully analyzed, at least in Kenya. In a staple food crop like maize, farmers participate in its market either as net sellers, autarkic (self-sufficiency) or net buyers. The results presented in this current study show that producer selling price support policies are detrimental to smallholder farmers' welfare because they make them to be more net buyers than net sellers of maize. Lower producer selling price of maize is not only beneficial to producers but also to urban non-maize producing consumers. On the other hand, approaches that ensure food security at household level are likely to make farmers participate in the markets as net sellers. Therefore, lower producer selling price that can be achieved through increased productivity by way of adopting productivity enhancing technologies like improved maize varieties and inorganic fertilizer will go a long way in unlocking the "food price policy dilemma" in Kenya. Similarly, local institutions that can reduce transaction costs are very important in ensuring that farmers participate in the markets as net sellers. Such institutions include collective action groups like farmer input and out marketing groups and ownership of communication equipment like mobile phones that are used to reduce transaction costs.

Therefore, for sustainability and increased welfare gain, producer price support policies for staple food grains should be discouraged and instead such resources used, if necessary, to subsidize productivity enhancing technologies like improved seed and fertilizer. Policies that encourage expansion and penetration of mobile telephony e.g. tax reduction on mobile handsets and legal framework that encourage expansion of mobile telephone signal coverage can go a long way in enabling farmers participate in markets as net sellers. Similarly, policies that encourage evolution

and growth of agricultural production networks like production and marketing groups should be put in place.

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Tables

Table 1. Descriptive statistics for the variables used in the regression

	Net sellers (N=542)		Autarkic (N=139)		Net buyers (N=337)		Total (N=1018)	
Variable	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Price of dry gain maize (KSh/kg)	23.83	8.35	24.92	9.75	27.64	9.62	25.24	9.14
Household size (Adult equivalent)	4.57	2.08	5.06	2.38	5.60	2.30	4.98	2.24
Sex of the household head (1=Male; 0=Female)	0.84	0.37	0.81	0.40	0.80	0.40	0.82	0.38
Age of the household head (years)	49.73	13.67	52.53	14.45	51.80	14.28	50.80	14.02
Education of household head (completed years)	8.07	3.80	7.39	4.12	7.08	3.81	7.65	3.87
Own Mobile phone (1=Yes; 0=No)	0.75	0.43	0.71	0.45	0.62	0.49	0.70	0.46
Own bicycle (1=Yes; 0=No)	0.58	0.49	0.58	0.49	0.54	0.50	0.56	0.50
Own radio (1=Yes; 0=No)	0.91	0.28	0.83	0.37	0.84	0.37	0.88	0.33
Distance to the main market (km)	6.73	8.18	5.98	4.28	5.11	3.71	6.09	6.57
Member to agricultural production group (1=Yes; 0=No)	0.48	0.50	0.38	0.49	0.45	0.50	0.46	0.50
Adopted fertilizer on maize crop (=Yes; 0=No)	0.96	0.18	0.86	0.35	0.81	0.39	0.90	0.30
Adopted improved maize varieties (=Yes; 0=No)	0.88	0.32	0.71	0.46	0.63	0.48	0.78	0.42
Food shortage throughout (1=Yes; 0=No)	0.01	0.10	0.03	0.17	0.09	0.29	0.04	0.20
Occasional food shortage (1=Yes; 0=No)	0.26	0.44	0.43	0.50	0.64	0.48	0.41	0.49
No food shortage and no surplus (1=Yes; 0=No)	0.50	0.50	0.42	0.50	0.25	0.43	0.41	0.49
Food surplus throughout (1Yes; 0=Otherwise)	0.23	0.42	0.12	0.32	0.02	0.14	0.14	0.35

Dependency ratio	0.85	0.75	0.85	0.89	1.15	0.90	0.95	0.83
Total owned land (ha)	1.11	1.21	1.55	6.55	1.25	4.33	1.22	3.58
Total annual non-farm income (KSh)	94,748	199,759	113,366	276,470	87,678	186,419	94,950	207,712
Main occupation of household head is farming (1=Yes; 0=No)	0.85	0.36	0.79	0.41	0.78	0.41	0.82	0.39
Bungoma district dummy (1=Yes; 0=No)	0.17	0.38	0.26	0.44	0.35	0.48	0.24	0.43
Embu district dummy (1=Yes; 0=No)	0.20	0.40	0.19	0.39	0.13	0.34	0.18	0.38
Imenti South district dummy (1=Yes; 0=No)	0.25	0.43	0.15	0.36	0.03	0.18	0.16	0.37
Meru South district dummy (1=Yes; 0=No)	0.25	0.44	0.12	0.33	0.04	0.20	0.17	0.37
Siaya District dummy (1=Yes; 0=No)	0.12	0.33	0.28	0.45	0.44	0.50	0.25	0.43

Table 2. Fixed Effects Ordered Probit Regression Results with Average Marginal Effects

Variable	Coef.	Std. Err.	Average Marginal Effects (dy/dx)		
			Net seller	Autarkic	Net buyer
Price of dry gain maize (KSh/kg)	0.039***	0.004	-0.011	0.001	0.010
Household size (Adult equivalent)	0.060*	0.033	-0.016	0.001	0.015
Sex of the household head (1=Male; 0=Female)	0.188	0.344	-0.051	0.004	0.047
Age of the household head (years)	0.066	0.204	-0.018	0.001	0.017
Education of household head (completed years)	-0.021***	0.001	0.006	0.000	-0.005
Own Mobile phone (1=Yes; 0=No)	-0.255***	0.011	0.069	-0.005	-0.063
Own bicycle (1=Yes; 0=No)	-0.098***	0.017	0.026	-0.002	-0.024
Own radio (1=Yes; 0=No)	-0.047***	0.007	0.013	-0.001	-0.012
Distance to the main market (km)	-0.031***	0.002	0.008	-0.001	-0.008
Membership to agricultural production networks (1=Yes; 0=No)	-0.609***	0.127	0.164	-0.013	-0.151
Adopted inorganic fertilizer on maize crop (=Yes; 0=No)	-0.296***	0.072	0.080	-0.006	-0.074
Adopted improved maize varieties (=Yes; 0=No)	-0.420***	0.047	0.113	-0.009	-0.104
Food shortage throughout the year (1=Yes; 0=No)	1.946***	0.399	-0.524	0.040	0.484
Occasional food shortage during the year (1=Yes; 0=No)	1.272***	0.201	-0.343	0.026	0.316
No food shortage and no surplus during the year (1=Yes; 0=No)	0.715***	0.004	-0.193	0.015	0.178
Dependency ratio	0.047*	0.027	-0.013	0.001	0.012
Natural log of total owned land	-0.013	0.121	0.003	0.000	-0.003
Natural log of total annual non-farm income	0.008**	0.003	-0.002	0.000	0.002
Main occupation of the household head is farming (1=Yes; 0=No)	-0.264**	0.109	0.071	-0.005	-0.066
Embu district dummy (1=Yes; 0=No)	-0.167**	0.073	0.045	-0.003	-0.042
Imenti South district dummy (1=Yes; 0=No)	-0.656***	0.150	0.177	-0.014	-0.163
Meru South district dummy (1=Yes; 0=No)	-0.768***	0.112	0.207	-0.016	-0.191
Siaya district dummy (1=Yes; 0=No)	0.135	0.151	-0.036	0.003	0.033
/cut1	0.820	0.897			
/cut2	1.344	0.978			
/sigma2_u	0.000	0.000			