

Determinants of the Maize Milling Firms' Decision to Import or Purchase Locally Produced Maize in Kenya; A Bivariate Probit Analysis

Priscilla Mkambe Nzaka[1*] Gladys Jepchirchir Koech[2] Hillary Bett[2] George Owuor[2]

1. Department of Agricultural Economics and Agribusiness Management, Egerton University, PO box 536-20115, Njoro, Kenya
2. Department of Agricultural Economics and Agribusiness Management, Egerton University, PO box 536-20115, Njoro, Kenya

* E-mail of the corresponding author: priscillamkambe97@gmail.com

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Abstract

Cyclical shortages in the supply of maize in Kenya have significantly affected operations of commercial maize milling firms in the country, forcing some to shut down. Most of the firms have been compelled to import maize from other regions, which is expensive. A dilemma therefore arises among the firms whether to import maize or use domestically produced maize and which alternative best maximizes their incomes. This study aimed to assess the determinants of the maize milling firm's decision to import or use locally produced maize. A total of 106 commercial maize milling firms that produce packaged maize flour were surveyed. Data collected was analyzed using Bivariate Probit model. Results indicate that employee skill level, average sales per month, licenses, government subsidies and purchases through NCPB were significant in influencing both the firm's decision to use locally produced maize only and the decision to use both locally produced and imported maize. Daily production capacity was found to influence the firm's decision to use locally produced maize only but had no significant influence on the decision to use both locally produced and imported maize. Based on the findings, the study recommends that micro, small and medium milling firms be sensitized to adopt advanced milling technology in their operations. Further, commercial maize milling firms should build the capacity and skill set of their employees through on-job training, employee workshops and performance appraisal programs. This will enhance production efficiency and enable firms increase their production capacity and purchase more maize from both local and import sources.

Keywords: Maize milling, Bivariate probit model, Maize, Import, Kenya

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1. Introduction

Maize is an essential component in the human diet and, together with rice and wheat, accounts for an estimated 42% of the world's food calories and 37% of protein intake (FAOStat, 2021). In Kenya, the staple food crop accounts for 36% of caloric intake and 2.4% of the country's GDP (Abodi et al, 2021; FAO, 2022). The country is a voracious consumer of maize with a per capita consumption of 98kg per year (Kang'ethe, 2011). The demand for maize has also been increasing owing to an increase in its demand as a livestock feed and industrial raw material. Major products obtained from industrial processing of maize include maize meal, biofuels, ethanol, starch, oil, and animal feed. The main products in Kenya are maize meal and animal feeds (Khamila, 2019;

Orhun, 2013).

The productivity of maize in Kenya has been declining overtime as compared to population growth estimated at 3.5%. In recent years, Kenya's annual maize production has averaged 40 million bags against an annual demand of 52 million bags (Marenya et al, 2021; Muchira, 2019). These shortfalls in the supply of maize have led to a spike in imports of maize, both official and unofficial, since the year 2000 (Short et al, 2019). Shortages in the supply of maize have also affected the operations of maize milling firms in the country, forcing them to either shut down or cut down on their operations (Andae, 2022).

The maize milling industry dates to the mid 1800's and has continued to grow with technology and increased demand of processed maize products. Industrial processing of maize can occur as either dry or wet milling (Josiah, 2019; Gwirtz and Garcia - Casal, 2013). Globally, the main dry milling products include corn flour, fine meal flaking grits and fine grits whereas the main wet milling products include corn starch, corn syrup, dextrose, and corn oil (Kang'ethe et al 2020). In Kenya, the main product of maize milling is maize flour since most of the people depend on it to make thick porridge called "ugali", which is the staple food consumed by majority of the households (Khamila, 2019).

According to Ndichu et al, 2015, there are 120 to 150 registered commercial maize milling firms in Kenya. The milling firms are categorized according to the technology used, available employed capital, packaging technique used and source of maize. There are formal large-scale commercial maize milling firms with a daily production capacity of more than 50 metric tons. These firms package their own flour, are capital intensive and purchase their maize from wholesalers, NCPB stores, large farmers, or imports. Additionally, there are small to medium-scale firms that have a daily production capacity of less than 50 metric tons. These firms use simpler technology and depend on maize that comes directly from farmers. They also stock maize for resale to consumers (Kang'ethe et al, 2020; Enzama, 2019).

According to the National Cereals and Produce Board (NCPB), the annual national maize milling capacity is estimated to be 1.77 million metric tons. Further, the Cereal Millers Association estimates that the combined milling capacity of medium to large-scale firms is 1.62 million metric tons annually while that of small-scale milling firms is 0.21 million metric tons annually (Kang'ethe et al, 2020). However, majority of the milling firms are operating below their full capacity due to shortage of maize supply in the country (Khamila et al, 2019).

The cyclical shortages in the supply of maize in the country have significantly affected the operations of maize milling firms over the years. According to Andae (2022), the lack of maize and insufficient funding to import the grain caused over half of the nation's small-scale maize millers to cease operations in 2022. Some of the large-scale milling firms were forced to cut down operations as well. The supply of maize from regional markets has also declined over the years. According to Abodi et al (2021), the supply of maize from Tanzania and Uganda has declined due to recurrent drought cycles which affect maize production. There has also been a shift in the supply of maize from Uganda as most of its stock is directed to the South Sudan market which offers higher prices (Mutuko, 2022). Consequently, some of the large-scale firms were compelled to obtain their maize from other regions outside the EAC, which was more expensive and economically unviable for them (Andae, 2022).

To curb maize shortage in the country, the government has often implemented policies aimed at stabilizing maize price so as to incentivize maize producers to increase production (Mwangi, 2023). Additionally, the government has often allowed subsidies and duty- free imports to enable maize millers and traders purchase maize from other countries. However, millers have argued that the grain is expensive in the world market thus unprofitable to ship (Andae, 2022). The firms are faced with the dilemma of whether to import maize or to use locally produced maize and which alternative best maximizes their incomes.

Several studies conducted on the determinants of maize import volumes in Kenya indicate that domestic price of maize plays a crucial role in the influencing maize imports. The studies further indicate accelerating domestic production can help curb overreliance on maize imports (Abodi et al, 2021). Further, studies conducted on the determinants of maize production in the country indicate that maize price in the previous season determines production level of the subsequent season (Masese et al, 2022). This study contributes to the above literature by analyzing the factors that determine the maize milling firm's decision to import or purchase locally produced maize in Kenya. Knowledge of these factors can aid the government in forming and implementing policies aimed at improving the economic wellbeing of maize milling firms in Kenya.

2. Methodology

2.1 Study Area

The study was conducted in Kenya, a country in East Africa that lies between 1^0N and 38^0E. The area covered by the country is approximately 582,646 square km. It is bordered on the east by Somali and the Indian Ocean, on the west by Uganda and the Lake Victoria, on the south by Tanzania and on the north by Ethiopia and South Sudan. The geography of Kenya varies across the 47 counties with the highest point being Mount Kenya at approximately 5,200 m above sea level and the lowest point being the Indian Ocean at sea level. The country is mainly formed by the Rift Valley and the central highlands. The central highlands are very cool and rich in agricultural productivity. Kenya also has a fertile plateau in the west. The country enjoys a tropical climate. The coastal region is usually humid; the central region is temperate while the north and northeastern regions are extremely hot and dry. Kenya's climate makes it one of the most agriculturally productive countries in Africa (Ominde et al, 2023; Ntarangwi, 2022).

According to the census carried out in 2019, the total population of Kenya is approximately 47 million with majority being youth. Most of the population have attained primary school education. The main economic activity is agriculture, practiced by 6.4 million households. The main crop cultivated is maize, grown by 5.1 million households (KNBS, 2019). The main counties where maize is cultivated include are Trans Nzoia, Uasin Gishu, Nakuru, Narok, Bomet, Kericho, Bungoma, Kakamega, Nyeri, Embu and Kiambu.Maize is mainly produced by small-scale farmers. Small-scale maize farmers account for 70% of the total production whereas large-scale maize farmers account for only 30% of the total production (Abodi et al, 2021).

2.2 Survey

A census of the entire population of commercial maize milling firms that produced packaged flour in the country was carried out. According to the study, this category of milling firms was the most affected by maize shortage in the country. The population of commercial maize milling firms in the country was estimated to be approximately120-150 (Ndichu et al, 2015). Therefore, the census method was deemed appropriate for this study to eliminate sampling errors and achieve a desirable level of precision.

The maize milling firms were classified based on the regions in which they are located. The country was stratified into 5 zones based on proximity and similarity in consumption patterns, level of urbanization and ethnic communities inhabiting them. These zones were the Nairobi/Central zone, Rift Valley zone, Western/Nyanza zone, Eastern/North Eastern zone and the Coast zone. From each zone, counties that harboured majority of the milling firms were selected for data collection. In the Nairobi/Central zone, the counties selected were Nairobi, Kiambu, Murangá, Kirinyaga, Nyandarua and Nyeri; in the Rift Valley zone, counties selected included Laikipia, Nakuru, Uasin Gishu and Trans Nzoia counties. Busia, Bungoma, Kakamega and Kisumu County were selected in the Western/Nyanza zone whereas only Meru, Machakos, Makueni and Kajiado counties were selected in the Eastern/Northeastern zone. Mombasa, Kilifi and Taita Taveta counties were selected in the Coast zone.

Data was collected using personal interviews and online surveys. A questionnaire was used as a guide to the interviews and online surveys. Pretesting of the questionnaires was first done in three companies located in Thika to ensure that they were relevant and reliable for the study.

2.3 Analytical framework

The data collected was analyzed using Bivariate Probit model. The bivariate probit model is a joint model for two binary outcome variables whose error terms are assumed to be correlated (Seyoum, 2018). The model was specified on the assumption that the maize milling firm's decision-making process is a simultaneous process in which an individual firm chooses among a stream of alternatives that maximizes the firm's utility rather than on a set of conditionally independent choices. Additionally, some of the factors that influence the firm's decision to use both locally produced and imported maize are linked to the factors influencing the decision to use locally produced maize only. This would cause modelling problems related to endogeneity (Zaefarian et al, 2017). The implication of such endogeneity would be inconsistent estimates from a standard probit model and inaccurate inference.

The maize milling firm's decision to use locally produced maize only or both locally produced and imported maize could be modelled separately as functions of a common set of explanatory variables using univariate probit regression model. Other methods including tobit regression and Heckman two-step model could also be used to model the two decisions. However, the bivariate probit model yields better, and more efficient parameter estimates since it takes into account the potential correlation between the disturbances of the two decisions

(Greene, 2008; Wooldridge, 2002).

The model is thus specified as follows,

$Y^*i1 = \alpha1\ Xi1 + \varepsilon i1$ Eq 2

$Y^*j2 = \alpha2\ Xj2 + \varepsilon j2$ Eq 3

Where $Y^*i1= 1$, if $Y^*i1> 0$ and 0, if otherwise

$Y^*j2= 1$, if $Y^*j2 > 0$ and 0, if otherwise

$\varepsilon i1$ and $\varepsilon j2$ are joint normal with means zero, variances one and covariance ρ

$$\left\{\begin{matrix}\varepsilon_{i1}\\ \varepsilon_{j2}\end{matrix}\middle| X\right\} \sim N\left(\begin{pmatrix}0\\0\end{pmatrix}\begin{matrix}1\\1\end{matrix}\begin{pmatrix}\rho\\ \rho\end{pmatrix}\right)$$

$Yi1 = 1$ was if the miller chose to use both locally produced and imported maize and 0 if otherwise, $Yj2 = 1$ was if the miller chose to use locally produced maize and 0 if otherwise. X1 and X2 were the vectors of the explanatory variables used in estimating the model. $\alpha1$ and $\alpha2$ were the vector of the parameters to be estimated by the model and $\varepsilon1$ and $\varepsilon2$ were the random error terms.

Y^*i1 and Y^*j2 are the latent variables representing the unobserved perceived utility derived from the firm's decision to use both locally produced and imported maize or the decision to use locally produced maize respectively. Therefore, the outcome $Yi1 = 1$ arises when the latent variable $Y^*i1 > 0$ whereas $Yi2$ is observed if and only if $Yj2 = 1$. The joint probability of the model was thus modelled as below.

$P (Y1 = i, Y2 = j) = F(\alpha'1\ X1,\alpha'2\ X2, \rho)$ Eq 4

This resulted in different observations with unconditional probabilities as shown.

$Y1 = 0, Y2 = 1$; prob $(Y1 = 0, Y2 = 1)= F (-\alpha'1\ X1,\alpha'2\ X2,- \rho)$

$Y1 = 1, Y2 = 1$; prob $(Y1 = 1, Y2 = 1)= F (\alpha'1\ X1,\alpha'2\ X2, \rho)$

The first probability refers to firms that used local maize only while the second probability refers to firms that used both local and imported maize. The coefficients $(\alpha'1,\alpha'2, \rho)$ were estimated using maximum likelihood estimation.

3. Results and discussion

This section presents analysis of findings with regard to the study objectives and discussions of the same. The first section discusses the descriptive results comprising of maize milling firms' characteristics, their distribution in Kenya and their sources of maize which was achieved through unpaired t-test statistics for continuous variables and Pearson Chi-squares tests for categorical variables. The second section discusses the factors influencing the maize milling firm's decision to import maize or to use locally produced maize which was achieved through a bivariate probit model. The results indicate that 44% of the maize milling firms obtain their maize from local sources only while 56% obtain their maize from both local sources and importation from other countries.

3.1 Characteristics of maize milling firms

3.1.1 Distribution of irms in the country

Data was obtained from 106 commercial maize milling firms that produced packaged maize flour. Majority of the firm's interviewed (55.7%) used both locally produced and imported maize in their milling operations while the rest (44.3%) used locally produced maize only in their operations. This implies that supply of the grain in the country has not been sufficient to meet the demand of the milling firms and consequently, majority of the firms have had to rely on imports from other countries (Masoud, 2013). The firms were located across the various zones in the country.

The Rift Valley zone had the highest number of firms which accounted for 30% of the firms interviewed. The zone is considered the food basket of the country and comprises of some of the major maize producing counties like Trans Nzoia, Uasin Gishu, Nakuru, Bomet and Elgeyo Marakwet. Therefore, majority of the firms were located in this zone to ensure consistent supply and minimize transportation costs (Tarus, 2019; Ouma and De Groote, 2011).

Another 27% of the firms were located in the Nairobi/Central zone. This zone is comprised of urban and regional centres with more than 6.5 million people who rely on maize as their main subsistence food. Therefore, a great number of the milling firms are located in this zone to try and capture this market (KNBS, 2019; De Groote and Kimenju, 2012). Additionally, the Eastern/ North Eastern zone, Western/Nyanza zone and the Coast zone accounted for 21%, 16% and 6% respectively. Very few firms were located in the coast zone since it is a perennial deficit area in maize production (Wangia et al, 2002).

Table 3. Distribution of Commercial Maize Milling Firms in Kenya

Region	Distribution of Maize Millers in Kenya
Rift Valley	30.19%
Nairobi/Central	27.36%
Eastern/North Eastern	20.75%
Western/ Nyanza	16.04%
Coast	5.66%

3.1.2Duration in Business and Number of Employees

The results in table 1 below indicate that firms that used both local and imported maize had been in operation for an average of 13 years compared to 9 years for firms that used local maize only. This implies that firms that use local maize only struggle to stay in business for long. This can be attributed to the shortage of maize supply in the country which forces some of the milling firms to shut down operations (Otieno, 2023; Andae, 2022).

The results further indicate that firms that used both local and imported maize had a significantly higher number of employees on average compared to firms that used local maize only. This is possibly because majority of the firms that used both local and imported maize were largescale firms. These results are consistent with Ndichu et al (2015) who found that the average number of employees in maize milling firms in Kenya was 70.

Table 4. Years of Operation and Number of Employees

Variable	**Local Only**		**Both**		**t-test**
	Mean	SE	Mean	SE	
Years in business	10	1.153	13	2.336	-1.4189*
Number of employees	31	10.608	61	7.658	-2.3980**

3.1.3 Firm Size and Technology Level

The firm's daily production capacities were used to classify firms into various sizes (Enzama et al, 2017). Majority of the firms interviewed (67%) were large-scale with a daily production capacity of greater than 50Mt/ day. Medium and small-scale firms with capacities of 21-50 Mt/day and 11-20 Mt/day respectively accounted for 13% and 9% of the total respondents respectively. Micro (posho) mills with capacities of less than 10Mt/day accounted for 11% of the respondents.

The results indicate a significant association (at 5% significance level) between firm size and the decision on where to source maize. Most of the micro (posho) mills (91%) used locally produced maize only. Similarly, studies by Kang'ethe (2011) and De Groote and Kimenju (2012) indicate that posho mills depend on maize brought to the mills by farmers themselves. They also offer milling services to clients that purchase maize from local markets. On the contrary, majority of the large-scale firms (65%) used both locally produced and imported maize in their operations. According to Short et al (2019), majority of the large-scale maize millers have the financial ability to obtain maize imports whenever there is shortage in the country.

Milling technology was broken down into 4 categories, hammer mill, attrition mill, roller mill and automated plc machines. The association between milling technology and firms' decisions on where to purchase maize was significant at 5%. Majority of the firms that used hammer mill technology (67%) purchased locally produced maize compared to 33% that used both locally produced and imported maize. The hammer mills are simple to use and inexpensive hence economically viable for micro, small and medium-scale milling firms (Nasir, 2005). Additionally, 76% of the firms that used attrition mills purchased locally produced maize. The attrition mills are efficient and more energy- saving compared to larger machines like roller mills (Akinoso et al, 2013). Majority of the firms that used roller mills (67%) used both local and imported maize. This type of milling technology produces uniform particle sizes, is energy efficient and allows for ease of adoption of maize flour fortification hence is used by most large-scale firms that also import maize (Khamila et al, 2019; Enzama et al, 2017). Further, 78% of the firms that used automated plc machines used both local and imported maize. The technology was preferred by large-scale firms as it increased operational efficiency of the machines and required few personnel (Rajkumar et al, 2021).

The association between employee skill level and firm's decision on maize source was significant at 1%. Majority of the employees in firms that used locally produced maize only were unskilled and semi-skilled (75% and 62% respectively). Additionally, majority of the employees in firms that used both local and imported maize were skilled and highly skilled. These accounted for 85% and 57% of the total employees. According to Khamila et al (2019), skilled labor is required in certain aspects of the maize milling process including administration, premix handling, machine operation and quality control.

Table 5. Chi Square Statistics of Firm Attributes

Variable	**Local Only (n=47)**	**Both (n=59)**	χ^2
Firm Size			12.3750**
Micro (11%)	91%	9%	
Small-scale (9%)	50%	50%	
Medium-scale (13%)	50%	50%	
Large-scale (67%)	35%	65%	
Employee Skill Level			25.1195***
Unskilled	75%	25%	
Semi-skilled	62%	38%	
Skilled	15%	85%	
Highly skilled	43%	57%	
Technology used			12.3331**
Hammer mill	67%	33%	
Attrition mill	76%	24%	
Roller mill	33%	66%	
Automated plc	22%	78%	

*, **, *** significance level at 10%, 5% and 1% respectively

3.1.4 Profitability of Firms

The results in table 2 indicate that firms that used both locally produced and imported maize had a significantly higher daily production capacity than firms that used locally produced maize only. This implies that firms that used both local and imported maize also processed maize in large volumes compared to firms that used local maize only.

Moreover, firms that used both local and imported maize had significantly higher mean monthly sales compared to firms that used local maize only. This can be attributed to the fact that firms that used both local and imported maize recorded higher daily production capacities. This is consistent with Mutunga and Owino (2017) who found that production capacity had a positive relationship with firm's financial performance.

In terms of production costs, firms that used locally produced maize only incurred significantly higher production costs compared to firm that used both local and imported maize. This is possibly due to the shortage of maize supply in the country which has led to an increase in the price of maize. Additionally, hoarding of maize by large-scale farmers in anticipation of increase in maize prices has tightened the maize supply in the country keeping prices high. This has forced majority of the millers to import maize at a cheaper price from neighbouring countries. Similarly, Abodi et al (2021) found that domestic price of maize had a significant influence in determining maize imports in the country.

Table 6. Mean Production, Monthly Sales, and Production Costs

Variable	**Local Only**		**Both**		**t- statistic**
	Mean	SE	Mean	SE	
Mean daily production Capacity	106.3	15.0	270.9	44.6	-3.1795***
Mean monthly sales (in tons)	206.6	31.1	451.1	49.6	-3.9369***
Mean production costs(in Kshs)	52,850	3,381.5	47,234	2,396.9	1.3905*

*, **, *** significance level at 10%, 5% and 1% respectively

3. 2 Determinants of the Maize Milling Firms' Decision to Import or Purchase Locally Produced Maize

To jointly model the factors affecting the firm's decision on whether to use locally produced maize only or to use both locally produced and imported maize, a bivariate probit model was used. Diagnostic tests were first conducted to determine whether the variables included in the bivariate probit model were suitable.

The variance inflation factor was used to test whether multi-collinearity existed between the variables in the model. Results indicated an average VIF of 1.37 for all the variables. According to Sparkman et al (1979), a VIF of less than 10 is indicative of inconsequential collinearity. Therefore, it was concluded that no collinearity existed between the explanatory variables used in the model since all the VIF's were found to be less than 10. Additionally, a linktest was performed to test whether the model was correctly specified. The results indicated a prediction coefficient of 1.709 and a prediction squared coefficient of 0.356. According to Pregibon (1980), the model is correctly specified if the prediction squared has no explanatory power. Therefore, it was concluded that the model was correctly specified since it had no explanatory power.

Results of the bivariate probit model are shown in table 4 below. The results indicate that employee skill level, average sales per month, licenses, government subsidies and purchases through NCPB had significant influence on the firm's decision to use locally produced maize only as well as the decision to use both locally produced and imported maize. Additionally, production capacity had significant influence on the firm's decision to use locally produced maize only but had no significant influence on the firm's decision to use both locally produced and imported maize.

Employee skill level was found to significantly and negatively influence the firm's decision to use local maize only. This implies that firms with low-skilled employees were likely to use locally produced maize only. This is possibly because majority of the milling firms that used locally produced maize only were micro to small scale firms that used less complicated technology for their milling operations which is simpler and easier to use. Similarly, Tambunan (2011), found that an important characteristic of micro and small enterprises in Indonesia was that they employ mostly low-skilled labor and use less sophisticated (old) technologies.

The employee skill level was also found to significantly and positively influence the firm's decision to use both local and imported maize. By implication, firms that had highly skilled employees were likely to use both locally produced and imported maize for their milling operations. This is possibly because the majority of the maize milling firms that used both locally produced and imported maize were medium to large-scale companies, and they used sophisticated technology in their milling operations which required skilled employees. This is consistent with Khamila et al (2019) and Ndichu et al (2015) who found out that large scale firms used more sophisticated and capital-intensive technologies and that most of the skilled employees were found in large-scale firms.

Table 7. Results of Bivariate Probit Model

	Miller's decision to use locally produced maize only		**Miller's decision to use both locally produced and imported maize**	
Variable	**Coefficient**	**Standard error**	**Coefficient**	**Standard error**
Number of years in operation	-0.0015	0.0152	0.0040	0.0153
Total number of employees	0.0010	0.0024	-0.0010	0.0024
Employee skill Level	-0.7927**	0.2564	0.7684**	0.2553
Average number of sales per month	-0.0017**	0.0008	0.0015*	0.0008
Daily production capacity	-0.0021*	0.0012	0.0020	0.0012
Milling technology used	0.0326	0.1280	-0.0050	0.1279
Import Duties	-0.5657	0.4302	0.4653	0.4280
Tax waivers	-0.6151	0.4003	0.6057	0.4001
Import licenses	-1.2929**	0.3759	1.2622***	0.3741
Government subsidies	0.8335*	0.4743	-0.6848*	0.4689
Gov't purchases through NCPB	0.7810*	0.4178	-2.7979**	0.7404
Constant	2.7786***	0.7395		
Athrho	-13.9409	496.3866		
Rho	-1.000	0.0000		

Note; Log likelihood=-41.415, Number of observations=104, Wald chi2(22)=35.84, Prob>chi2=0.0316, LR test of rho=0; chi2=70.2211, Prob> chi2=0.000; *,** and *** denote significance at 10%, 5% and 1% respectively

On the decision to use local maize only, average monthly sales had a significant and negative influence. By implication, firms that had lower average monthly sales were likely to use locally produced maize only. This can be attributed to the shortage of maize in the country which resulted to a decrease in production and consequently decrease in sales per month made by the milling firms. Similarly, Berhe (2010) found that the shortage of raw material supply, especially locally, led to fluctuation of sales volumes of the firm. Additionally, the average monthly sales had a significant and positive influence on the millers' decision to use both locally produced and imported maize. By implication, firms that had higher average monthly sales were likely to use both local and imported maize in their milling operations. This is because the firms that were able to formally import maize were able to cushion themselves during periods of short supply in the country. Similarly, Halpern et al (2015) found that importation of inputs increased firms' revenue productivity by 22% due to the imperfect substitution between foreign and domestic inputs.

Moreover, the results indicate that import licenses significantly and negatively influenced the firms' decision to use locally produced maize only. This means that firms that were not able to obtain licenses to import maize used locally produced maize only in their milling operations. Consistent with the results obtained by Apondi (2015) who found that trade documents required during importation partly influences the choice of trade patterns due to increase in transaction costs. On the decision to use both locally produced and imported maize, import licenses had a significant and positive influence. By implication, firms that were able to obtain import licenses were able to import maize from other countries. This is inconsistent with Bernini and Lembergman (2023) who found that non-automatic import licenses led to reduced imports by firms.

The results further indicate that government subsidies significantly and positively influenced the firms' decision to use locally produced maize only. This implies that an increase in government subsidy programs on maize influenced maize milling firms to purchase locally produced maize. This is because government subsidies on maize production inputs lower the cost of producing maize and consequently lowers the price of maize sold. On the contrary, Lundukaet al (2013) found that input subsidies had no statistically significant effect on retail maize prices. Additionally, government subsidies had a significant and negative influence on the firms' decision to use both local and imported maize. By implication, increase in government subsidy programs would lead to a decrease in the amount of maize that maize milling firms purchase domestically. This is consistent with the findings of Njeru (2017) who found that an increase in the government expenditure in the purchase of maize stocks from farmers at a higher price than the market price results to an upward pressure on the market price of maize.

On the decision to purchase local maize only, government purchases of maize through the NCPB had a significant and positive influence. By implication, an increase in government purchases of maize from local farmers would influence more maize millers to purchase their maize from local farmers as well. This is inconsistent with Jayne et al (2008) and Bii (2023) who found that while the government purchases maize at a set price, millers offer higher prices to maize farmers thus reducing purchases made by the government. The results further indicate that government purchases through NCPB had a significant and negative influence on the miller's decision to use both local and imported maize. By implication, as government purchases of maize from local farmers increase, more of the maize millers opt to import maize. This is because the government aims to offer better prices to maize farmers by setting price floors thus leading to an increase in the market price for maize. Similarly, Jayne et al (2008) found that the NCPB's administered prices raised the wholesale market price of maize by around 5%.

Further, the results indicated that the daily production capacity had a significant and negative influence on the firm's decision to use locally produced maize only. This implies that firms that had a lower daily production capacity were likely to use locally produced maize only in their milling operations. This is because of the shortage of maize supply in the country which leads to an increase in operational costs due to the inefficiency of their production capacity. Similarly, Adeyemi and Olufemi (2016) found that the inadequate supply of raw materials contributes to the high cost of production which significantly affects capacity utilization.

4. Conclusion

The objective of this study was to assess the factors that influence Kenya's commercial maize milling firms' decision to import or purchase locally produced maize. The study revealed that 55.7% of the maize milling firms used both locally produced and imported maize in their milling operations whereas 44.3% used locally produced maize only. Almost all the milling firms (94.3%) agreed that the maize supply in Kenya was not sustainable. Bivariate probit model results indicated that employee skill level, average sales per month, licenses, government subsidies and purchases through NCPB were significant in influencing the firm's decision to use locally produced maize only as well as the decision to use both locally produced and imported maize. Additionally, the daily production capacity was found to influence firm's decision to use locally produced maize only but had no significant influence on the firm's decision to use both locally produced and imported maize.

There is need to sensitize micro, small and medium milling firms to adopt advanced milling technology in their operations.In line with this, there is need for maize milling firms to build capacity and skill set of their employees. This can be achieved through on-job training, organizing workshops for employees and performance appraisal programs in the firms. This will enhance production efficiency of the firms thus enabling firms to increase their production capacity and purchase more maize from both local and import sources.

The study used cross-sectional data to assess the factors influencing the firm's decision to use locally produced maize only or both local and imported maize. The study failed to capture the effect of these factors overtime and the dynamism of the firm's decision-making overtime and under different circumstances. Therefore, future research should use panel data to capture overtime determinants of the firm's decision making and the effects of such decisions on the firm's income.

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