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Effects Of *Khat* Production On Rural Household's Income In Gachoka Division Mbeere South District Kenya

Nelly Njiru[1*] Augustus Muluvi[2] George Owuor[1] Jackson Langat[1]

1. Department of agricultural Economics and Agribusiness Management, Egerton University, P.O Box 536, Egerton, Kenya

2. Department of Economics, Egerton University, P.O Box 536, Egerton, Kenya

*Corresponding author Email: mnjiru.2003@gmail.com

Abstract

This paper explores the factors that influence diversification into *Khat* production and its contribution to rural household's income in Kenya. Using probability and non-probability sampling procedures, a sample of 125 households composed of both *Khat* producers and non producers was selected. Logit regression was used to estimate the factors that influence participation in *Khat* production while propensity Score Matching (PSM) was used to assess its contribution to rural household's income. The factors that enhances participation are access to extension services, number of school going children, agricultural land size, household's income and main occupation of the household head whereas the factors that hinder participation are age of the household head, distance from the main market and access to credit. Subsequently, *Khat* production positively contributes to the household's income. Hence, as an alternative measure to boost the rural household's income, *Khat* enterprise should be promoted.

Keywords: Diversification, *Khat*, Propensity Score Matching, Smallholder farmers.

1. Introduction

Majority of the Sub Sahara Africa's (SSA) poorest people live in rural areas where agriculture is the main source of livelihood. Agriculture accounts for more than 30 percent of Africa's gross domestic product (GDP) and 75 percent of total employment (World Bank, 2008). In Kenya, agricultural sector supports the livelihoods of about 80 percent of the rural population and accounts for 24 percent of the country's Gross Domestic Product (GDP) and about 19 percent of the formal wage employment (KIPPRA, 2009). In general, agricultural sector employs 70 percent of the national labor force through forward and backward industrial linkages, thus providing food and incomes to individuals and households (Omiti *et al.,* 2009). Approximately 60 percent of all households in Kenya are engaged in farming activities making it key to national food security (KIPPRA, 2009). In spite of its importance to the economy, the agricultural sector has been performing poorly in recent years. This has raised serious concerns especially in pastoral, agro-pastoral and marginal agricultural regions where it is currently estimated that 10.5 million people are food insecure (FAO, 2010).

According to Mongabay (2006) 80% of the total land in Kenya is arid and semi arid (ASAL) and is characterized by poor households. Such households are unable to meet their most basic needs and have inadequate income, lack of access to productive assets, low productivity, subsistence farming as well as deprivation of social infrastructure and markets (Mariara and Ndeng'e, 2004). Hence this has led to unpredictable income and a major cause of poverty among the many rural households (Zeller and Oppen, 2007; Démurger *et al.*, 2009). As a way to mitigate this, there has been an outstanding trend of most smallholder farmers to diversify from low value crops to high value crops over the past few decades (Démurger *et al.*, 2009). Most studies suggest that rural households adjust their agricultural activities in order to exploit new opportunities created by market liberalization (Barrett *et al*., 2001a; Carter, 1997; Delgado and Siamwalla, 1997). These adjustments in agriculture have an important impact on income among most rural households (Block and Webb, 2001; Canagarajah *et al*., 2001; de Janvry and Sadoulet, 2001; Reardon *et al*., 2000).

The high value crops that are predominant in the study area include; water melons, French beans, fruit trees like mangoes, and *Khat (Miraa)*. Diversification into *Khat* production as a strategy to improving household's income is common in Meru and Embu County. *Khat*, is a type of tree, the twigs of which can be chewed and act as a stimulant

(Carrier, 2005b). It is an outstanding cash crop, very profitable to farmers as it is grown for the local market as well as for the export market (Carrier, 2005a; Carrier, 2005b; Klein *et al*., 2009). As a cash crop it provides employment to many people; farmers, middle men, businessmen, and transporters. In terms of Miraa exports, on daily basis about 5 tons goes to Amsterdam, 7 tons to London and 20 tons to Somali while over 40 tons are consumed locally and within the region (Maitai, 1996).

However, in spite of the increased diversification into *Khat* production in Mbeere-south district, there is still high poverty level among the rural households estimated at 57.42%. This implies that more than half of the total population lives below the poverty line (Mbeere District Vision Strategy (MDVS), 2005; Mbeere District strategic plan (MDSP), 2005). Hence, the contributions of *Khat* production to the rural household's income remain unknown. This paper therefore seeks to explore the social economic characteristics of *Khat* farmers and the contribution of *Khat* production to rural household's income.

2. Methodology

This study uses primary data drawn from a sample of 125 household in Gachoka Division, Mbeere South district which is the second largest *Khat* producing area in Kenya after Nyambene in Meru County. In analyzing the factors that influence diversification into *Khat* production logit model was used to estimate the relationship between binary outcomes and a number of households' characteristics, which are socioeconomic and institutional. Following Consuelo and Amaury (2007) the probability of a household choosing *Khat* crop can be specified as follows:

$$prob(.) = \frac{1}{1+\ell^{-y_i}} \qquad (1)$$

Mathematically, the logit model in its linear form can be illustrated as:

$$y(0,1) = \beta_0 + \beta_i x_i + \varepsilon_i \qquad (2)$$

Where y is a binary exogenous variable taking the value of 1 when a household participates in *Khat* production and 0 otherwise, β_0 is the intercept, X_i is a vector of household's socioeconomic factors, β_i is a vector of the respective parameter, ε_i is the error term. The socio economic factors considered in the study are age of the household head, household size, education levels, gender of the household head, income levels, number of school going children, and the main occupation of the household head, institutional characteristics including extension, credit and land tenure system. Estimation of the model was done using Maximum likelihood estimation technique.

In assessing the contribution of *Khat* production to rural household's income the Propensity score matching (PSM) was used. PSM is the most widely used type of matching in which the comparison group is matched to the treatment group on the basis of a set of observed characteristics or by using the "propensity score" (predicted probability of participation given observed characteristics). Following the modern treatment effect estimation literature (Diagne *et. al*., 2007; Wooldridge, 2002; Heckman, 1996; Angrist *et. al*., 1996; Rosenbaum and Rubin, 1983), the study uses a *counterfactual* outcome framework by which every farmer in the population has two *potential* outcomes: participation and non- participation in *Khat* production.. In this case only one of the potential outcomes is observed for each household *i*. The unobserved outcome is called the counterfactual outcome. Let y_1 be the potential outcome of a farmer participating in *Khat* production, and y_0 the potential outcome when not participating in *Khat* production. Therefore, this is a dichotomous status and the participation effect for household is *i* given by $y_{i1} - y_{i0}$. Hence, the expected population participation effect of *Khat* production is given by the expected value $E(y_1 - y_0)$, which is, by definition, *the average treatment effect*, ATE. The average participation effects on the subpopulation is given by the conditional expected value; $E(y_i | w = 1)$, which is by definition the *average treatment effect on the treated*, commonly denoted by *τAT T or* by ATE1

However, outcome is inevitable with or without participation and so $y_0 = 0$ for any household whether participating in *Khat* production or not. Hence, the effect of participation of a household *i* is given by y_{1i} and the average participation effect is given by $ATE = Ey_1$.

The expected treatment effect of participating in *Khat* production is therefore given as;

$$ATT = E(y_{1i} - y_{0i} | w_i = 1) \quad (3)$$

Where y_{1i} denotes the income when i-th household participates in *Khat* production, y_{0i} is the income of i-th household when it does not participate in *Khat* production, and w_i denotes *Khat* production participation, 1=participate, 0=otherwise. ATT, also called conditional mean effects or Average Treatment effect on Treatment (ATT), is conditional on *Khat* production participation. The mean difference between observable and control is written as;

$$D = E(y_1 | w_1 = 1) - E(y_0 | w_i = 0) = ATT + \varepsilon \quad (4)$$

Where ε is the bias also given by;

$$\varepsilon = E(y_0 | w_i = 1) - E(y_0 | w_i = 0) \quad (5)$$

The true parameter of ATT is only identified if the outcome of treatment and counterfactual under the absence of *Khat* production are the same. This is written as:

$$E(y_0 | w_i = 1) = E(y_0 | w_i = 0) \quad (6)$$

Whether households participate in *Khat* production or not is dependent on the characteristics of households and farms, hence the decision of a household to participate in *Khat* production is based on each household's self-selection instead of random assignment. Therefore, the basic relationship considered in examining the effects of participation in *Khat* production on household income is a linear function of explanatory variables (x_i) and a participation dummy variable (w_i) specified in a regression framework as;

$$y = a + bw_i + \beta x_i + \mu_i \quad (7)$$

Where y is the household's income, a is a constant of household's income, w_i is a dummy variable that takes the value 1 if household i participates in *Khat* production and takes the value 0 otherwise. x_i is a vector of control variables such as household characteristics (age, gender of household head, education level..,) b identifies the average treatment effect as well as the treatment effect on the treated, β measures the influence household characteristics have on the household's income, μ is an error term. After estimating propensity score, the next procedure is matching the controls to each treatment using selected non-parametric method, (including the so-called matching methods). There are several matching methods that can be applied. All matching algorithms should yield the same results. However, in practice, there are tradeoffs in terms of bias and efficiency involved with each algorithm (Caliendo and Kopeining, 2005). This paper adopted the nearest neighbor matching (NN)

method because it is the most straight forward matching method. It involves finding for each individual in the treatment sample, the observation in the non participant sample that has the closest propensity score, as measured by the absolute difference in scores (Caliendo and Kopeining, 2005).

3. Results And Discussions

3.1 Descriptive Analysis

Descriptive statistics on participation in *Khat* production are shown in table 2(appendix). Among the 125 households sampled 58.4 percent were *Khat* producers and only 41.6 percent were non producers. This implies that majority of farmers have embraced *Khat* production as a diversification strategy to boost their income as well as mitigate the production risks inherent in food crop production given the ASAL climatic conditions prevalent in the area.

3.2 Results of Logit Regression Model

The results are provided in Table 3(appendix). Factors that influence the decision of farmers to participate in *Khat* production include contact with agricultural extension, number of school going children, age of the household head, agricultural land size, distance from the main market, main occupation of the farmer, access to credit and total household's income. Increased contact with extension services increases participation into *Khat* production at 5 percent significance level. These results imply that, having contacts with extension agent increases the possibility of participation in *Khat* production by 36.27 %. This is because extension agents are sources of information and knowledge to the farmers. As contacts of farmers with the extension agents increases, so does the farmers' knowledge on farming practices, holding all factors constant. However, in Kenya extension services are not offered on *Khat* production, but, farmers apply the agronomic practices taught in production of the food crops on *Khat* production due to their similarity. Therefore, as farmers become more knowledgeable they become more enlightened on the benefits of agricultural diversification. These results are consistent with findings of Pieniadz *et al*. (2008) that contact with extension agents increases farmers' preference to upscale. Moreover, Herath and Takeya (2003) found that extension agents are the major information sources for farmers.

The number of school going children is a proxy for the expenditure in education by a household. An increase in the number of school going children in a household increases the probability of a household to participate in *Khat* production. In line with the apriori expectations, it has positive effect at 5 percent significance level. This implies that, a unit increase in number of school going children increases participation in *Khat* production by 8.51 percent. This may be because as family needs increases due to payment of school fees, and other household's needs, a household will likely engage in *Khat* production as a way of generating extra income to meet the rising needs Similarly, the size of agricultural land owned by a household has a positive influences on the farmers' decision to grow *Khat* at 1 percent level significance level. Farmers with more land are able to allocate some land to *Khat* trees as well as grow other food crops. Hence a unit increase in land size increases the likelihood of growing *Khat* by 4.64 percent. In addition, as farm income increases, farmers' likelihood of participating in *Khat* production increases. This is possibly because the extra farm income can be used to acquire seedlings and other inputs needed in *Khat* production. Most individuals also have an increasing marginal utility of wealth meaning that as cash income increases such individuals will look for activities that can generate even more cash income.

The main occupation of the household head also influences the decision to produce *Khat* positively at 1 percent significance level. This implies that when the household head is a full time farmer, the chances of participating in *Khat* production increase by 0.8 %. When the farmer is available and working on the farm on a full time basis, it implies that labour supply on the farm will be higher than if the farmer had an off farm occupation. With more family labour, the households engaged in full time farming are able to engage in several farming enterprises including *Khat* production.

Age of the household's head plays a key role in determining participation of a household in *Khat* production. It has a negative influence to adoption of *Khat* at 1 percent significance level. Thus a unit increase in age of the household head decreases the expected value of participation in *Khat* production by 1percent. These results indicate that as a household head gets older the probability to participate in *Khat* production decreases. This arises from the fact that as the decision maker grows older, they become risk averse and are less willing to venture into new activities that they are not sure of, while younger farmers are more flexible in their decision to adapt new practices. This is in agreements with findings by Rogers (1995), who found that young people in the community

are early adopters of innovations. In another study, Langyintuo and Mungoma (2008) reveal that young people are more flexible in deciding for change than aged people. Furthermore, older members are less energetic and hence find it difficult to engage in activities which require quite some energy. This is coupled with the fact that older people are more conservative in adoption of new crops.

Access to credit was also found to have a negative effect on participation in *Khat* production at 10 percent significance level. Contrary to apriori expectations, the results show that having access to credit services decreases the possibility of participation in *Khat* production by 25.49%. This indicates that as households' access credit, there is likelihood not to participate in *Khat* production and instead engage in off farm activities. These results are however in line with findings by Reardon *et al.* (1998) that households that received credit facility diversify their income sources out of the agricultural sector. Agricultural based enterprises in the area are predominantly rain fed and their success depends on the reliability of the weather patterns. Hence farmers would rather diversify to non-farm activities to mitigate on the fluctuation of returns that is prevalent in farm enterprises. Some of the highlighted sources of credit by participants include banks, self help groups, and micro finance institutions. However, farmers highlighted some challenges to credit access including; inability to pay back, insufficient collateral and lack of awareness on sources of credit as well as illiteracy on loan requirement.

The distance from the farm to the main *Khat* market is used in the study as a measure of the state of infrastructure and has a significant negative effect on the chances of a farmer engaging in *Khat* production. Given that *Khat* is a commodity with a short shelf life, only farmers with an easy access to the market can economically grow the crop due to low transaction costs. Farmers far off from the main market may need to invest in transport equipments which may be too expensive for an individual farmer hence low adoption of the enterprise. An increase in the distance from the farm to the main market by one kilometer leads to a 6.28% percent decline in the likelihood of growing *Khat*.

- *3.3 Results for Propensity Score Matching (PSM)*

The results for PSM are given in table 4(appendix) where 73 *Khat* producers (treated) are matched with 52 non-producers (control). When each treatment unit is matched with a control unit, the difference between the outcome of the treated units and the outcome of the matched control units is computed. The results show that producers have a lower total household income (Kshs. 42 427) than their non producing counterparts (Kshs. 52 183) in the absence of *Khat* income. These results further shows that the total crops income for both producers and non producers is different at 1% significance level, with producers having an annual crops income of Kenya shillings 178 096 and 5 606 for non producers. This shows the great contribution *Khat* production makes to the rural household's income. Regarding the total household's income (inclusive of *Khat income),* the results reveal that there is a difference between the producers' income and non producers' at 1% significance level. The *Khat* producers have an annual total income of Kshs. 209 271 while non producers have Kshs. 52 183. These results imply that *Khat* production has a positive contribution to the rural household's income. This explains why most farmers in the study area are diversifying into production, while abandoning production of other food crops.

4. CONCLUSIONS AND POLICY RECOMMENDATIONS

The major findings of the study reveal that age of the household head influences farmer's decision to participate in *Khat* production. Hence, access to extension services which also positively influences participation should be packaged in such a way that it will target the younger famers who are less risk averse and who are also early adopters of new technologies. Specifically, extension packages geared towards sensitization of non producers as well as improving the capacity of farmers should be formulated and administered sufficiently. As a means of enhancing participation, the state of road and market infrastructure plays a key role since *Khat* is a very perishable cash crop. In addition improvement of *Khat* marketing by finding new markets and streamlining the market channels as well as linking the farmers to urban and international markets should be considered so as to minize the possible exploitative potential of middlemen. Therefore, on the policy front, great attention on the local infrastructure and targeted extension services would promote participation in and productivity of *Khat* enterprise which will translate to improved livelihoods in the rural areas.

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Appendix

Table 1. Description of variables used in the Propensity score matching model

Variable	Description	Unit of measurement	Expected sign
Dependent variable			
Total household income	Total amount	Ksh	
Independent variables			
Age	Age of household head	Number of years	-VE
HHSZ	Household size	Number	+VE
Education	Education level	Number of years of schooling	-VE
Gender	Gender of household head	1=Male , 0=Female	+VE
Lsize	Total land size	Acres	-VE
Credit	Access to credit	1=Yes, 0=No	+VE/ -VE
Numbrschlch	Number of school going children aged between 6 and 18	Number	+VE/ -VE
Offcrvst	Access to extension	Number of visits	+VE

Table 2. Participation in *Khat* Production

Response	**Frequency**	**Percent**
Yes	73	58.4
No	52	41.6
Total	125	100

Source: Computed from Household survey data, 2011

Table 3: Results of logit regression model (N=125)

Explanatory Variables	Coef.	Std. Err.	Z	dx/dy
Age	-0.0543	0.0183	-2.96***	-0.0099
Extension Contact	1.3475	0.6855	1.97**	0.3627
Gender	0.6165	0.4457	1.38	-0.0797
Agricultural Land	0.7139	0.2599	2.75***	0.0464
Education Level	0.0939	0.2355	0.40	0.690
Distance to main Market	-0.7037	0.2457	-2.86***	-0.0628
Land tenure	0.4753	0.5165	0.92	0.0856
Credit Access	-0.8343	0.4735	-1.76*	-0.2549
Number of School Children	0.1171	0.4059	2.00**	0.0851
Percent Food crop loss	-0.0092	0.0088	-0.81	-0.0014
Main occupation	0.9408	0.3559	2.64 ***	0.008
On-Farm Total Income	13.07	3.51	3.72***	0.0012

Note: *; ** and *** significant at 10 %, 5% and 1% significance levels respectively

Source: Computed from Baseline survey data, 2011

Table 4. Average Effects of Participation in *Khat* production on household's incomes

Variable	Sample	Participants N=73	Control N=52	Difference	S.E	T-Value
Total Household Income less *Khat*	ATT	42426.96	52182.60	-9755.64	13878.47	-0.70
Total crops income	ATT	178095.77	5605.77	172490	23553.28	7.32***
Income from Crops and Livestock	ATT	189932.54	13928.75	176003.79	24053.09	7.32 ***
Total Off-Farm Income	ATT	19788.46	38253.85	-18465.39	13244.51	-1.39
All Total Household Income Including *Khat*	ATT	209721	52182.60	157538.40	25481.50	6.18***

Note: *** indicates 1% significance level

Source: Computed from Household survey data, 2011

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