Rigorous Journal of Research and Development (RJRD)
ISSN (Online) 2790-3362
Vol. 2 Issue No. 6

Rigorous Scientific Publishers

Factors Influencing Subsidized Fertilizer Access and Use Intensity on Smallholder Farmers in Trans Nzoia County, Kenya

[1]Barasa, A.W., [2]Odwori, P.O., [1]Malaba, K.S. & [3]Barasa, J.

[1]Department of Agricultural Economics and Rural Development, University of Eldoret
[2]School of Economics, University of Eldoret
[3]Department of Soil Science, University of Eldoret

Abstract— Low crop yields as a result of inadequate application of fertilizer remains to be a challenge limiting optimum crop production especially among smallholder farmers in Kenya. The government of Kenya, under The National Accelerated Agricultural Inputs Access Programme (NAAIAP), introduced subsidized fertilizers aimed at increasing crop productivity. Despite these initiative, there has not been much achievements as far as general increase in crop yields and especially maize crop yields in the country is concerned. This study therefore sought to investigate the factors affecting the access and the use intensity of subsidized fertilizer among smallholder farmers in Kenya with the case of Trans Nzoia County. The specific objectives of the study were to establish the factors affecting the access to subsidized fertilizers and to assess the factors affecting the intensity of fertilizer used. This study employed cross -sectional survey using structured questionnaires to collect the data from 384 farmers who had been selected using multi-stage sampling technique. The data was analyzed econometrically using a double hurdle model which combined a probit model and a truncated regression model. The findings show ed that age, access to extension services, land size, distance to market, household size and non-farm income significantly affected the accessibility of subsidized fertilizer to the farmers while the intensity of subsidized fertilizer use was significantly determined by age, land size, access to extension services and non-farm income of household head. The study concluded that the government should target the smallholder farmers and consider their factors when formulating policies for distribution of subsidized fertilizers as they are the intended beneficiaries of the program.

Key Words— *Subsidized, Fertilizer, Access, Use, Intensity, Smallholder, Farmers.*

1. INTRODUCTION

Attaining optimum crop yields in smallholder farms of Sub Saharan Africa remains a challenge with most farmers recording low harvests. This is further translated to food insecurity and poverty especially in a country like Kenya where more than 70 percent of its population depend on agricultural related farm and off-farm activities for their livelihoods (Ng'ang'a, S. K., Notenbaert, A., Mwungu, C. M., Mwongera, C., & Girvetz, E. (2017). About 60% of the Kenyan population are currently living below the 1 dollar-a- day poverty line (FAO, 2018). Since agriculture is a major contributor to the country's Gross Domestic Product and revenue, declining crop yields creates a worrying situation that prompts for urgent response in terms of agricultural policies (FAO, 2018).The causes of these low crop yields are diverse with factors such as declining soil fertility taking the center stage (Vanlauwe, et al., 2008). Soil infertility in Kenyan smallholder farms is further caused by multifaceted factors such as of lack of /or inadequate use of inorganic fertilizers which can be attributed to high transaction and transport costs, weak market infrastructure and lack of institutional support (Druilhe & Barreiro-Hurlé, 2012). In order to address soil infertility, the government of Kenya through The National Accelerated Agricultural Inputs Access Programme (NAAIAP) introduced subsidized fertilizers. This was aimed at raising fertilizer use to optimal levels and increasing crop productivity from increased input use thereby raising land productivity and food security for smallholder farmers who form majority of households in Western Kenya (Ochola & Fengying, 2015). This study therefore sought to investigate the invariably unavailable information on the associated factors that may affect the access and the use intensity of subsidized fertilizer in Western Kenya. Trans Nzoia was purposely selected due its major role in maize production in Kenya. This is

Citation:
Barasa, A.W., Odwori, P.O., Malaba, K.S. & Barasa, J. (2018). Factors Influencing Subsidized Fertilizer Access and Use Intensity on Smallholder Farmers in Trans Nzoia County, Kenya. *Rigorous Journal of Research and Development, 2*(6), 1-5.

attributed to its favourable climatic conditions suitable for maize farming (Mwongera et al., 2017).

2. RESEARCH METHODOLOGY

2.1 Study Area

Trans Nzoia is an agricultural county in Kenya located between the Nzoia River and Mount Elgon. Trans Nzoia covers an area of 2495.5 square kilometers. The county is largely agricultural with both large scale and small scale wheat, maize and dairy farming. The county is referred to as the basket of Kenya for its role in food production in the country. Situated in the slopes of the mountain, Trans Nzoia has a cool and temperate climate with average annual temperatures ranging between a minimum of 10°C to a maximum of 27°C. The county receives annual precipitation ranging between 1000 and 1200mm, with the wettest months being experienced between April and October. Trans Nzoia County's arable land makes agriculture the top economic activity, where maize farming is widely practiced, and mostly at a commercial level. The county has 5 sub counties: Saboti, Cherangani, Kwanza, Endebess and Kiminini.

2.2 Study Design

The study employed a cross sectional survey design in conducting the research. The collection of data was aided by use of structured questionnaires. A combination of purposive and random sampling methods were used in selecting the farmers where Saboti, Cherangani and Kwanza Sub counties of Trans Nzoia county were purposively selected before farmers were randomly selected on condition that the farmer had less than 2.5 hectare of land to meet the merit of being a smallholder farmer. The required sample size was determined by formula developed by Cochran (2007).

$$n = \frac{z^2.p.q}{e^2}$$

Where n is the sample size, z is the confidence interval (Z-value), p is the expected proportion and e is the acceptable margin of error. In this study, a 95% confidence interval was assumed and an expected proportion of 0.5 Therefore the sample size was calculated as

$$n = \frac{(1.96)^2.(0.5)(0.5)}{(0.05)^2}$$

Giving a minimum sample size of 384 households.

2.3 Data analysis

To analyze the two objectives, the study used a Cragg's double hurdle model (Cragg, 1971) common in analyzing adoption and intensity especially in agricultural economics (Noltze et al., 2011; Mal et al., 2012). Another alternative model that could be used is the Heckman's selection model although is too restrictive with respect to the interpretation of the sources of zeros (Mal et al., 2012). The Heckman model assumes that the non-adopters will never adopt under any circumstances while double hurdle model assumes that non-adopters are a corner solution in a utility-maximizing model and can adopt a technology if encouraged (Mal et al., 2012).

These two hurdles were estimated using a binary outcome model for the access to subsidized fertilizerand a truncated normal model for the use intensity of subsidized fertilizer. To estimate the probability that a farmer would use subsidized fertilizer, a probit model was used while a truncated normal model estimated the use intensity of subsidized fertilizer (Noltze et al., 2011).

First Hurdle –Subsidized fertilizer access

The first stage of the model determined the factors that influenced the probability of a household to access subsidized fertilizers using the following formula: An individual's access to subsidized fertilizer is dichotomous, involving two mutually exclusive alternatives. The individual either has access or does not. The study used the probit regression model to estimate the factors influencing the probability of subsidized fertilizer use among smallholder farmers in Trans Nzoia. The Probit model was suitable due to its ability to constrain the utility value of the dependent variable to lie within zero and one, and its ability to resolve the problem of heteroskedasticity (Asante et al., 2011).

$$Y(0,1)=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\beta5X5+\beta6X6+\beta7X7+\beta8X8+\varepsilon$$

Where:
Y (0, 1) =Accessed Subsidized Fertilizer (1) or did not Access Subsidized Fertilizer (0)
β0 =intercept
β1… β8= coefficients of the independent variables
X1=GenderX5=Access to Extension Services
X2= Age X6=Household size
X3=Land Size X7= Non-farm income,
X4=Education level X8=Distance to market
ε=Error term

Second Hurdle –Subsidized Fertilizer Use Intensity

The second stage of the double –hurdle model was used to assess the factors that influenced the use intensity of subsidized fertilizer with the quantity of the used subsidized fertilizer being the dependent variable. The following truncated regression model was used:

$$Y=\beta0+\beta1X1+\beta2X2+\beta3X3+\beta4X4+\beta5X5+\beta6X6+\beta7X7+\beta8X8+\varepsilon$$

Where:
Y =Amount of fertilizer used (kgha-1)
β0=intercept
β1… β8= coefficients of the independent variables
X1=GenderX5=Access to Extension Services
X2= Age X6=Household size
X3=Land Size X7= Non-farm income,
X4=Education level X8=Distance to market
ε=Error term

3 RESULTS AND DISCUSSION

2.1 Factors influencing Subsidized Fertilizer Access and Use Intensity

The significant Wald chi-square value of 312.30 shows that the explanatory variables jointly influence the farmers' use of subsidized fertilizers. The accessibility of subsidized

fertilizer to the farmers was significantly determined by the age, access to extension services, land size, distance to market, household size and non-farm income.

The intensity of subsidized fertilizer use was significantly determined by age, land size, access to extension services and non-farm income of household head. The non-farm income of the household head and land size were the most influential determinant of the intensity of subsidized fertilizer use. The significant Wald chi-square values of 312.30 and 297.43 indicate that the explanatory variables jointly influence the access to and fertilizer use intensity (Table 1).

The probability of a farmer accessing subsidized fertilizer was influenced positively by age of household head. This might have been caused by the fact that, the older a farmer gets, the more experienced he becomes in knowing the benefits and savings gained from using subsidized fertilizer with the assumption that the farmer is rational. The same case applies to intense use of subsidized fertilizer since an older farmer knows the benefits of applying intense fertilizer for higher crop productivity. These results are in agreement with studies by Mathenge and Olwande (2010) who found that as farmers advance in age, they are more likely to participate in access of fertilizers. However, these results contradict withMartey et al. (2013) who found the probability of fertilizer technology adoption being influenced negatively by age of household head. They assert that normally younger household heads are more dynamic and innovative in terms of technology adoption as compared to older household heads.

As expected, non-farm income of households head had a positive effect on access and use intensity of subsidized fertilizer. This is attributed to the farmers' ability to purchase more fertilizer with ease and cater for the associated transport costs of delivery. These results are in agreement with Makau (2016) who found that households who accessed income from non-farm activities bought 0.01kg more than those who did not. She attributed this to the fact that they had extra income which strengthened their spending power and ability to purchase fertilizer.

Land size was also positively related to subsidized fertilizer access and intensity of use. There is usually a positive correlation between farm size and wealth status as large owners of land are deemed to be wealthier hence having the financial ability to access subsidized fertilizers and use more of it to cater for their large parcels of land. The marginal effect showed that a unit increase in the area in hectares under cultivation increased the probability of fertilizer adoption by 3.2. These results are in agreement with Akudugu et al. (2012) who found farm size to be a positively related to the probability of adoption of modern agricultural production technologies such as use of subsidized fertilizers. However, these results contradict with Martey et al. (2013) who advocates for farmers to own relatively manageable plots of farm lands after finding a negative relationship between area under cultivation and fertilizer adoption.

Table 1: Double hurdle estimates of access and fertilizer use intensity

	First Hurdle			Second Hurdle		
Variable	**Coefficient.**	**Std. Error.**	**z-value**	**Coefficient**	**Std. Err.**	**z-value**
Sex	0.00	0.17	-0.03	0.70	2.68	0.26
Education Level	0.05	0.02	0.24	0.30	0.35	0.87
Age	0.01**	0.01	2.12	0.20**	0.09	2.26
Land Size	0.29***	0.08	3.8	3.2***	1.17	2.74
Access to Extension Services	2.43***	0.18	13.19	8.73*	5.39	1.66
Distance to Collection center	-0.14***	0.04	-3.27	0.55	0.707	0.79
Household Size	-0.10*	0.06	1.77	-1.53	1.20	-1.27
Non-farm Income	0.00***	0.00	3.12	0.00***	0.00	2.97
No. of Observation	384			196		
Wald chi2(8) =	312.30			297.43		
Prob > chi2	0.000			0.000		

Key: *, ** and *** = significant at 10%, 5%, and 1% level, respectively.

The results show that a significant number of farmers werenot accessing subsidized fertilizers. From the 384 farmers, only 196 respondents accessed the subsidized fertilizer leaving out 188 farmers. This might have been attributed to flaws in the design and implementation of the program, fraudulent behaviours such as soliciting bribes to provide the product or diversion away from the intended beneficiaries (Dorward and Chirwa 2011).

Distance to agricultural office had a negative outcome on subsidized fertilizer access as expected. This implied that increase in the distance to agricultural office was likely to decrease fertilizer access as distance has associated high costs of transport which might limit farmers from accessing the subsidized fertilizer and hence ultimately leading to low application of fertilizer. A 1 kilometer increase in the distance to the agricultural office leads to a 0.14 decreases in chances of accessing subsidized fertilizer. This results tally with Makau (2016) who found a negative relationship between distance and quantity of fertilizer used citing that longer distances attracted higher transport and transaction costs. However, contradictory results

were found by Martey et al. (2013) who reported a positive relationship between distance to agricultural office and fertilizer adoption and intensity of use. He argues that there was a likelihood of farmers depending more on neighbouring farmers for useful information on fertilizer use relative to most of the agricultural extension agents that are not accessible to farmers hence explaining the phenomenon.

Access to extension agents positively affected both the chances of accessing and the use intensity of subsidized fertilizer. This is due to the fact that extension services increases farmers' awareness on available subsidized fertilizers. These results tally with Cavane (2016) who found extension services being a significant factor for adoption of fertilizers where the probability of adoption of NPK and urea increased 5 and 3 times more through learning from extension officers than learning from neighbours.

Household Size was found to negatively affect the chances of accessing subsidized fertilizer although it didn't significantly affect the use intensity. A larger household comes with higher obligations in terms of meeting the basic needs of a household. This burden usually constrains the household and might prevent them from harnessing the available subsidized fertilizers. These results however contradict with Makau (2016) who reported a positive and significant relationship between household sizeand quantity of fertilizer purchased and used. She alludes this to the probability of a large household contributing to the labour during application hence acting as a motivation to access and use fertilizers.

4 CONCLUSION

A significant number of farmers were not accessing subsidized fertilizers. The findings showed that age, access to extension services, land size, distance to market, household size and non-farm income significantly affected the accessibility of subsidized fertilizer to the farmers while the use intensity of subsidized fertilizer was significantly determined by age, land size, access to extension services and non-farm income of household head.

This study recommends a collaborative approach where the government should consider socio economic factors of the farmers. The government should also target the smallholder farmers when formulating policies for distribution of subsidized fertilizers as they are the intended beneficiaries who used to receive insufficient or no fertilizer for their production. Institutional factors such as extension services and fertilizer dissemination points should be effective to access more farmers who are in need of the much desired fertilizer. Improvement in infrastructure such as road and lessening the distance and associated transport costs is crucial for successful adoption of subsidized fertilizer to farmers.

5. REFERENCES

Akudugu, M. A., Guo, E., & Dadzie, S. K. (2012). Adoption of modern agricultural production technologies by farm households in Ghana: What factors influence their decisions. *Journal of biology, agriculture and healthcare*, *2*(3).

Asante, B. O, Afari-Sefa V., & Sarpong, D. B (2011). Determinants of Small-Scale Farmers' Decision to Join Farmer Based Organizations in Ghana. *Afr. J. Agric. Res., 6*(10), 2273-2279.

Cavane, E. (2016). Farmers' attitude and adoption of improved maize varieties and chemical fertilizers in Mozambique. *Indian Research Journal of Extension Education*, *11*(21), 1-6.

Cochran, W. G. (2007). *Sampling techniques*. John Wiley & Sons.

Cragg, J. (1971). Some statistical models for limited dependent variables with application to the demand for durable goods.*Econometrica, 39*(5), 829-844.

Dorward, A., Chirwa, E., & Jayne, T. S. (2011). Malawi's Agricultural Input Subsidy Program Experience over 2005–09. *Yes Africa Can: Success Stories from a Dynamic Continent*, 289-317.

Druilhe, Z., & Barreiro-Hurlé, J. (2012). *Fertilizer subsidies in sub-Saharan Africa* (No. 12-04). ESA Working paper.

FAO. (2018) *Kenya at a glance | FAO in Kenya | Food and Agriculture Organization of the United Nations*. (2018). *Fao.org*. Retrieved from http://www.fao.org/ kenya/fao-in-kenya/kenya-at-a-glance/en/

Kothari, C.R. (2004). *Research Methodology. Methods and techniques*, 2nd Ed. New Delhi: New Age International (P) Ltd.

MAKAU, J. M. (2016). *An Assessment of The Effect of Subsidized Fertilizer on Farmer Participation in Commercial Fertilizer Markets in North Rift Region of Kenya* (Doctoral dissertation, University of Nairobi).

Mal, P., Anik, A.R., Bauer, S., and Schmitz, P.M., (2012), "Bt Cotton Adoption: A Double-hurdle Approach for North Indian Farmers", *AgBioForum, 15(3)*, 294-302

Martey, E., Wiredu, A. N., Etwire, P. M., Fosu, M., Buah, S. S. J., Bidzakin, J., & Kusi, F. (2013). Fertilizer adoption and use intensity among smallholder farmers in Northern Ghana: A case study of the AGRA soil health project. *Sustainable Agriculture Research*, *3*(1), 24.

Mathenge, M., Place, F., Olwande, J., & Mithoefer, D. (2010). Participation in agricultural markets among the Poor and marginalized: analysis of factors Influencing participation and impacts on income and Poverty in Kenya. *Unpublished Study Report Prepared for the FORD Foundation*.

Ng'ang'a, S. K., Notenbaert, A., Mwungu, C. M., Mwongera, C., & Girvetz, E. (2017). Cost and benefit analysis for climate-smart soil practices in Western Kenya.

Noltze, M., Schwarze, S., & Qaim, M. (2011, September). Understanding the adoption of systemic innovations in smallholder agriculture: the System of Rice Intensification (SRI) in Timor Leste. In *presentation at the EAAE 2011 Congress, August* (Vol. 30).

Ochola, R. O., & Fengying, N. I. E. (2015). Evaluating the effects of fertilizer subsidy programmes on vulnerable farmers in Kenya. *Journal of Agricultural Extension and Rural Development*, *7*(6), 192-201.

Odame H, Muange E (2012). Can Agro-dealers deliver the green revolution in Kenya? Future Agricultures Consortium DFID UK. Future Agricultures Policy Brief No. 45.

Vanlauwe, B., Kanampiu, F., Odhiambo, G. D., De Groote, H., Wadhams, L. J., & Khan, Z. R. (2008). Integrated management of Striga hermonthica, stem borers, and declining soil fertility in western Kenya. *Field Crops Research*, *107*(2), 102-115.