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Impact of agricultural input subsidy on productivity of small-scale maize farmers in the Hhohho Region of Eswatini

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Abstract

The Kingdom of Eswatini with partnership from India introduced an agricultural input subsidy programme in 2014 that was targeted to improve maize productivity among the small-scale maize farmers. However, there is very little emphasis that has been placed on the evaluation of the effectiveness of such programme. This study investigated the impacts of agricultural input subsidy on the productivity by small-scale maize farmers in the Hhohho region of Eswatini. Primary data was collected from sampled 224 farmers using structured questionnaire and interviews. The study employed the propensity score matching model that matched participants and non-participants based on observable covariates. The results revealed that the agricultural input subsidy programme in the Hhohho region have impacted on the productivity of small-scale maize farmers. The farmers' decision to participate in the agricultural input subsidy package programme were influenced by farm size and farm experience. The study then recommends that to increase the maize productivity among the smallholder farmers there is need to capitalized on the factors such as farm size and experience on agricultural activity to influence participation on the input subsidy programme.

Keywords: Propensity score matching; Subsidy; Productivity; Maize; Eswatini

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1. Introduction

Maize cultivation has spread across different countries of the world because it is one of the most cereal crops grown in total food grain production after wheat and rice (Anupama et al., 2005). In the Kingdom of Eswatini maize is one of the dominant crop that is mostly grown by the citizens both on Swazi Nation Land (SNL) and Title Deed Land (TDL) since it is the staple food. The traditional authority holds the land tenure system under SNL in trust for the people hence private companies as well as individuals owned the TDL (Magagula et al., 2007). Small-scale farmers mostly produce maize in the SNL and the maize that is grown on it accounts for 90% of Eswatini maize output. According to the National Maize Corporation (2016), in 2014/15 to 2015/16 the area under maize production dropped significantly by 47 percent that led to the drastic decline of production output by 59 percent, which then led to the decline in the country maize self-sufficiency from 62.2 percent to 25.2 percent within the same period. The most challenges faced by these smallholder farmers include increasing cost of buying farm inputs such as seeds, fertilizer, chemicals, hiring tractor for farm operations and the climate change effect, which has forced some farmers to halt maize production just to focus on food aid. The kingdom of Eswatini has four agro-climatic zones (Highveld, Middleveld, Lowveld and Lubombo Plateau) with only two (Highveld and Middleveld) being the only ones that produces the most maize in the country. The Highveld region normally records the highest maize yield followed by the Middleveld (Ministry of Agriculture, 2013).

In 2016 the Kingdom of Eswatini declared a state of emergency that led to extensive losses of crops and deaths of livestock due to climatic conditions (World Food Programme, 2016). Prior to this state of emergency the Kingdom of Eswatini with partnership with India introduced a farm input subsidy programme in 2014 for the maize small-scale farmers could not yielded the desired benefits. The main objective for the programme was to improve maize productivity among the SNL farmers as well as driving the economy. The programme was overseer by the Ministry of Agriculture for the past years. The term subsidy covers a broad range of governmental economic interventions and policies. It can be best defined as the financial assistance provided by government to farmers through government-sponsored price-support programs (Food and Agricultural Organization, 2015). The benefit generated by policy may take different forms such as an increase in output-price, reduction in input-price, tax rebate, interest rate concession and/or direct budgetary transfer. In order for developing countries to achieve productivity that are financially viable by the small-scale farmers there is need to have adequate inputs and proper technologies (Ajah and Nmadu, 2012; Wiggins and Brooks, 2010). Input subsidies are a way of helping farmers to meet the market price halfway since they do not pay the full price. Input subsidies could therefore; provide means for achieving higher agricultural productivity, improved food security and, through lower food prices, pro-poor economic growth.

The package of the Kingdom of Eswatini subsidy programme requires that the maize farmers should register and the registered farmers contributes by paying 50% of the cost for one 25 kg bag of maize seeds, four 50 kg bags of LAN fertilizer and six 50 kg bags of NPK fertilizer. (Food and Agricultural Organization, 2015). According to Food and Agricultural Organization (2015), there were only 3 723 small-scale farmers that benefited from the programme in the 2014/15 season because the programme was only implemented in just two agro-climatic zone and the aim is to reach 21 750 farmers. There is no doubt on the increasing global food

crisis, requiring nations and international organizations all over the globe to respond with strategies and long-term approach of combating it. Food production through the smallholder farmers who are the major producer of food has not been easy since most of these farmers are still using traditional method of farming with small size of farmland for cultivation. Low productivity in agriculture has been observed to be a problem contributing towards increased food insecurity. Increased agricultural productivity has been identified as a potential means for improving the food supply aspect of food insecurity, and agricultural inputs can help to increase productivity greatly (Gordon, 2000).

In order for the Kingdom of Eswatini to achieve food secured status there is a need to focus on the development of agricultural sector mainly on the maize production, hence the sector remains the first agenda for international donor agencies and the government of Eswatini hence it attracted the attention of the researchers. The objective of the paper is to estimate the impact of the agricultural farm input subsidy programme on the productivity of smallholder maize farmers in the Hhohho region of Eswatini. Based on the knowledge of the researchers there was no similar study in the Kingdom of Eswatini that was done after the implementation of the programme to estimate its impact on the maize productivity of the small-scale farmers. Thus, this paper will contributes by filling in the knowledge gap of existing literature on impact evaluation of fertilizer and input subsidy programme in order to help policy makers in adopting evidence-based programmes that will assist in the agricultural development matters. The remainder of the paper is organized as follows. Section 2 gives the methodology approach that was adopted by the study. Section 3 presents the results and their discussions and finally, Section 4 presents the conclusion that is drawn from the results as well as the recommendation.

2. Methodology

2.1. Study area

This study was conducted in the Hhohho region of Eswatini, which is located in the northwestern part of Eswatini within coordinates 26o00'S31o30'E. According to the Ministry of Tourism and Environment Affairs [MTEA] (2011), the Hhohho region has a population of 282,734 as per the 2007 census in an area of about 3,625.17 km^2. The Highveld and Middleveld geographic regions predominantly overlay the Hhohho region. The Highveld has the highest altitude of 900-1400 meters above sea level; the Middleveld ranges from 400-600 meters above sea level with an annual rainfall of between 500-1500 mm (MTEA, 2011). This makes the Hhohho region to be less prone to drought hence most rural communities still practice rain-fed subsistence agriculture alongside semi-commercial to purely commercial agriculture. According to the Ministry of Agriculture (2013), the most produce crop in the Hhohho region is maize and the highest yields are recorded in the Highveld followed by the Middleveld since there are the moist parts of the country. The Hhohho region is subdivided into fourteen (14) Constituencies (known as tikhundlas) that are used as local administrative centres as well as parliamentary centres that are further divided into chiefdoms.

2.2. Sampling and method of data collection

The study used a multi-stage sampling technique to select the respondents in the study area. In the first stage, 30% of the constituencies in the Hhohho region were purposively selected (4 out of 14 constituencies) that consisted of both beneficiaries (benefiting from 2017/2018 season) and non-beneficiaries of agricultural subsidy. In the second stage, 224 maize farmers were randomly selected from the 4 constituencies with 56 respondents from each constituency. A structured questionnaire was used to collect the data that was administered through a face-to-face interview.

2.3. Analytical framework

In order for the study to achieve its objectives of estimating the average impact of participating in the agricultural input subsidy programme by small-scale maize farmers in the Hhohho region on the productivity a Propensity Score Matching (PSM) technique was adopted. The PSM technique assists in controlling for the problem of selection bias that arises due to the use of treatments that are non-randomized by the programme. Based on literature most research studies on impact evaluation estimation focuses on the Average Treatment Effect (ATE) and the Average treatment effect on the treated (ATT). The ATE is commonly used to estimate impact of a programme that is selected randomly from the entire population, while the ATT estimates the average gain for those that have received the treatment. For this particular study the focus was on the use of ATT to estimate the level of benefits by the smallholder maize farmers that participated on the agricultural input subsidy programme in the 2017/18 cropping season compared to what would have happened without participating in the programme (counterfactual). According to Rosenbaum and Rubin (1983) they suggested that before the use of the ATT there is a need to significantly reduce the dimensional conditioning problems through the use of the use of balancing scores such as propensity score. Once the propensity score is known, then the ATT can be estimated as follows:

$$ATT = E[\rho(X)|D = 1][E(Y_1|D = 1, \rho(X)] - [E(Y_0|D = 0, \rho(X)] \quad (1)$$

Where $E[\rho(X)|D = 1]$ is the expected probability with respect to the distribution of the estimated propensity scores, Y_1 and Y_0 are the productivity variables for the smallholder maize farmers that participated in the agricultural input subsidy programme and non-participant respectively, D is participation taking the values 1 for the beneficiaries and 0 for the non-beneficiaries. The ATT shows the difference between the beneficiaries and non-beneficiaries based on the estimated propensity scores that were estimated on the observable covariates represented by the vector X. To ensure that the PSM estimates are robust enough three algorithms methods of the PSM methods were used (Nearest Neighbour, radius, and Kernel) were used. The probit regression estimation method was applied to analyze the determinants of participation in the agricultural input subsidy programme.

3. Results and discussion

3.1. Summary characteristics of the respondents

Table 1 reveals that the average age for the non-beneficiaries was 45 years and that of the beneficiaries was 42 years that implies that non-beneficiaries were older. The results also showed that the non-beneficiaries

spent more years in school (average of 9 years) compared to 8 years for the beneficiaries. The non-beneficiaries were highly experienced (21 years average experience) than the beneficiaries of subsidy who have 16 years of average experience on farming. There is no much difference in household size averages between the beneficiaries and non-beneficiaries. Also, the beneficiaries have a bigger farm size (2.8 hectares average) compared to (2.3 hectares average) for the non-beneficiaries of subsidy. Lastly, there is a difference in productivity between the farmers who collected subsidy and those who did not, as the mean average difference between the two were 0.01tonnes/hectare, beneficiaries being the better ones with the mean of 0.238 tonnes/hectare.

Table 1. Mean comparison of the socioeconomic characteristics of the respondents

Subsidy status	Sex	Married	Age	Education	Experience	Hhsize	Farmsize	Productivity
Non-beneficiaries	.4306	.4525	44.76	8.93	21.15	7.32	2.347	.2296
Beneficiaries	.4827	.3793	41.97	8.19	15.91	7.39	2.780	.2381
Total	.4508	.4241	43.68	8.64	19.11	7.34	2.520	.2329

Source: Field Survey, 2019

3.2. Impact of agricultural input subsidy programme on small-scale farm productivity

The first stage to evaluate the impact of the agricultural input subsidy programme was to estimate the propensity scores using probit model between the treated and the control groups in order to avoid the problem of selection biases. The propensity score are then matched to compare the mean outcome of the treatment and matched control groups based on pre-treatment covariate similarities. Table 2 shows the results of the probit regression model on the smallholder maize farmers' decision to participate in the agricultural input package programme. Table 2 revealed the the smallholder maize framers' decision to participation to the agricultural input subsidy programme is statistical influenced by farm size and the farm experience.

Accordingly, small-scale maize farmers that have bigger famrs have the highest probability of partcipating in the agricultural input subsidy programme and farm size is statistically significant at 5% level.These result agreed to the findings of (Gecaj, 2018) where the planted area was positively related to agricultural subsidy.

Table 2. Determinants of Small-scale maize farmers participation in the agricultural input subsidy programme

Variables	Coefficient	Std.Err	z	P>/z/
Sex	.1165589	.1811222	0.64	0.520
Marital status	-.0738899	.1859662	-0.40	0.691
Age	.0002169	.0108043	0.02	0.984

Years of education	-.021256	.0179792	-1.18	0.237
Farming experience	-.0247241**	.0095792	-2.58	0.010
Household size	.0093423	.0330393	0.28	0.777
Farm size	.1945935**	.0765004	2.54	0.011
Constant	-.2378464	.5381949	-0.44	0.659
Diagnostic				
Pseudo R^2 = 0.0662				
Log likelihood = -139.73333				
LR chi2(7) = 19.81				

*Note: Significance level: *** 1%, ** 5%, * 10%*
Source: Field Survey, 2019

Small-scale maize farmers that have more than 21 years of farming experience are less likely to participate in the agricultural input subsidy programme.

3.2.1. Choosing a matching algorithm

In order to check the robustness of the estimated average treatment effect on the treated (ATT) that was computed using the PSM method the following matching algoritms nearest neighbor, kernel matching and radius matching were evaluated to match particants and non-participants with atleast similar propensity score and the results are presented in Table 3.

Table 3. Estimating the average treatment Effect on the treated

Variable	Treated	Control	Difference
Nearest neighbour Unmatched	.238171624	.22966225	.008509374
ATT	.238171624	.121527776	.116643848
Kernel Unmatched	.238171624	.22966225	.008509374
ATT	.238171624	.22966225	.008509374
Radius Unmatched	.238171624	.22966225	.008509374
ATT	.238171624	.22966225	.008509374

Source: Field Survey, 2019

The result from the nearest neighbour Matching estimates showed that the Agricultural input subsidy programme has raised productivity slightly by 0.1 on the ATT. Whilst, the result showed that there was no differences on the maize productivity with Radius Unmatched Matching and Kernel Unmatched Matching.

3.2.2. Matching quality

The propensity scores that were estimated were validated by checking their matching quality that involves checking the common support region so that only participants and non-participants of similar characteristics are compared to each other when estimating the ATT.The results are presented in Figure 1.

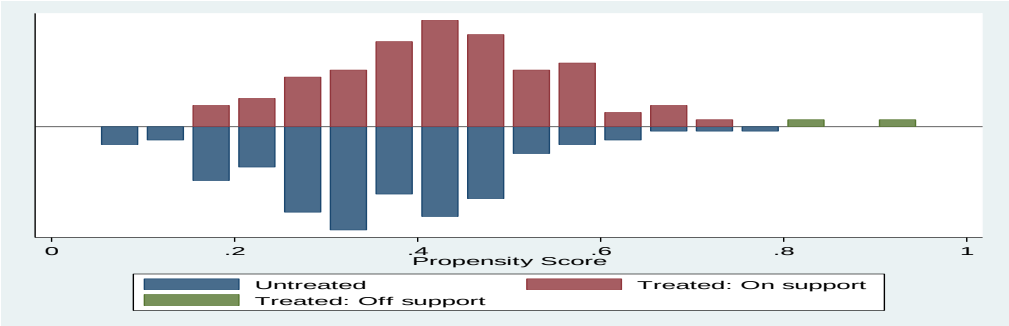

Figure 1. Matching quality

Figure 1 shows that the distribution of the propensity scores satsify the common support assumption that there is an overlap of the propensity scores of the participants and non-participants of subsidy. The overlap condition ensures that treatment observations have comparison observations 'nearby' in the propensity score distribution (Heckman et al., 2008). This implies that the effectiveness of propensity methods also depends on having a large number of non-beneficiaries so that a substantial region of common support is found. Due to the scale, it is difficult to discern in this graph that in each class of the "propensity score" there is a certain number of non-treated individuals as well. So we can assume that common support is given. This corroborates the findings of Lopez et al. (2017) which also complied with the assumption of common support.

3.2.3. Average treatment effects on the treated (ATT)

To proceed to the estimation of the average treatment effect on the treated (ATT) we checked if the important assumption of propensity score matching models of the common support condition has been achieved and the results are presented in Table 4.

Table 4. Estimating the propensity score

Variable	Obs	Mean	Std.Dev	Min	Max
Ps	224	0.2329672	0.0041566	0.2296622	0.2381716

Source: Authors Computation, 2019

Table 4 revealed that the average propensity score to participate in agricultural input subsidy programme is 0.23, which in line with the common support assumption that the propensity score lie strictly between 0 and 1 since it is probability. This means that the average probability or propensity score to participate in the agricultural input subsidy programme for the respondents was 23%. The findings are also similar to the discoveries of Preka (2014) on his work titled the impacts of in the agriculture sector in Albania,where the propensity score was also between 0 and 1 (0.45 precisely).

This stage involves the estimation of the impact of participating in the agricultural input subsidy programme on maize productivity between the ATT and the unmatched and the results are presented in Table 5.

Table 5. Impact of Agricultural input subsidy

Outcome	Sample	Treated	Controls	Difference
Productivity	Unmatched	.238171624	.22966225	.008509375
	ATT	.238171624	.121527776	.116643848

Source: Authors Computation, 2019

From Table 5, the results revealed that before matching was done, the average productivity of smallholder farmers that participated in the agricultural input subsidy programme was 0.24 tons/ha and that of non-participants was 0.23 tonnes/ha suggesting that before matching, on average the productivity for the participants was 0.01 more than those of non-participants. After matching and controlling for all factors, the difference between the average productivity of smallholder farmers that participated in the agricultural input subsidy programme and non-participate increased to 0.13 tons/ha. These results imply that participating in the agricultural input subsidy adoption in the 2017/18 cropping season has a positive effects on the maize productivity of smallholder farmers in the Hhohho region of Eswatini. These findings are in line with the findings of Oladejo (2018) who also discovered that agricultural subsidy had an impact on productivity.

4. Conclusion and recommendations

The Kingdom of Eswatini with partnership from the Republic of India introduced agricultural input subsidy programme in 2014 in order to improve maize productivity among the small-scale maize farmers. The area under maize production in Eswatini dropped significantly by 47 percent in the 2014/15 to 2015/16 cropping season that led to the drastic decline of production output by 59 percent. The objective of the paper is to estimate the impact of the agricultural farm input subsidy programme on the productivity of smallholder maize farmers in the Hhohho region of Eswatini. The study employed the PSM model that matched participants and non-participants based on observable covariates. The results revealed that participation in the agricultural input subsidy programme have positive impacted on the maize productivity by the smallholder farmers in the

study area. The smallholder farmers' decision to participate in the agricultural input subsidy package programme is positively influenced by farm size and negatively influenced by the farm experience. Based on the results of the study we can conclude that the agricultural input subsidy programme have a significant impact on the productivity of maize farmers in the Hhohho region of Eswatini. In as much as the agricultural input subsidy programme have impacted on the productivity of small-scale farmers, policy makers should therefore, come up with clear, open and transparent selection criteria that will be used for distributing the agricultural subsidies to the beneficiaries that are strongly in deep need, less experienced farmers as well as those who have more that 2.9 hectares of land will be keen to increase their productivity.

References

Anupama, J., Singh, R.P. and Kumar, R. (2005), "Technical efficiency in maize production in Madhya Pradesh: Estimation and implications", *Agricultural Economics Research Review*, Vol. 18 No. 2, pp. 305-315.

Ajah, J. and Nmadu, J.N. (2012), "Small-scale maize farmers access to farm inputs in Abuja, Nigeria", *Kasetsart Journal of Social Sciences*, Vol. 33 No. 3, pp. 499-505.

Food and Agriculture Organization, (2005), "FAO/WFP Crop and food supply assessment mission to Swaziland Special Report". Available at: http://www.fao.org/docrep/008/J5512e/J5512e00.htm. (Accessed 04 June 2019).

Gecaj, M., Shahu, E.O., Imami, D., Skreli, E. and Jambor, A. (2018), "Analysing the impact of subsidies in the Albanian agriculture sector – A comparative approach", Paper prepared for presentation for the 162nd EAAE seminar. The evaluation of new CAP instruments: Lessons Learned and the road ahead. Available at: https://econpapers.repec.org/scripts/redir.pf?u=http%3A%2F%2Fageconsearch.umn.edu%2Frecord%2F271964%2Ffiles%2FGecaj_Shahu_Imami_Skreli_Jambor.pdf;h=repec:ags:eaa162:271964 (Accessed 10 August 2019).

Gordon, A. (2000), "Improving Smallholder access to purchased inputs in Sub-Saharan Africa", Policy Series 7. Natural Resources Institute (NRI), Chatham, UK. 1 January.

Heckman, J., Ichimura, H., Smith, J. and Todd, P. (2008), "Characterizing Selection Bias Using Experimental Data", *Econometrica*, Vol. 66 No. 5, pp.1017-1098.

López, C.A., Salazar, L. and De Salvo, C.P. (2017), "Agricultural input subsidies and productivity: The case of Paraguayan farmers", IDB Working Paper Series No. IDB-WP-802. Inter-American development Bank Environment, Rural Development and Disaster Risk management Division, April 2017.

Magagula, S.D.M., Dlamini, E.V. and Mkhwanazi, E.M. (2007), Modern Agriculture for Swaziland (2nd edition). Oxford University Press Southern Africa, New York, United States of America.

Ministry of Agriculture (2013), Ministerial Annual Report 2012/13. Government of Swaziland, Mbabane, Swaziland.

Ministry of Tourism and Environment Affairs [MTEA] (2011), "Swaziland's Second National Communication to the United Nations Framework Convention for Climate Change Final Report". MoTEA, Government of Swaziland, Mbabane, Swaziland, Available from: www.unfccc.int/../swznc2.pdf (Accessed 10 August 2019).

National Maize Corporation (NMC) (2016), Annual Report 2015/16. The Corporate Gap, Matsapha, Swaziland

Oladejo, C.O. (2018), Impact of E-wallet fertilizer subsidy on productivity of maize-based smallholder farmers in Ogbomoso agricultural zone, Oyo State, Nigeria, Unpublished M.Sc. Thesis. Department of Agricultural Economics, Faculty of Agricultural Sciences, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Preka, O. (2014), The impact of grants in the agriculture sector in Albania: a counterfactual approach. Unpublished PhD Dissertation. University di Bologna. Department of Agrifood Economics and Statistics, Rome, Italy.

Rosenbaum, P.R. and Rubin, D.B. (1983), "The central role of the propensity scores in observational studies for causal effects", *Biometrika*, Vol. 70 No. 1, pp. 41–55.

Wiggins, S. and Brooks, J. (2010), "The Use of Input Subsidies in Developing Countries", Working Party on Agricultural Policy and markets, Organisation of Economic Co-operation and development, Paris, France, 15-17 November.

World Food Programme (WFP). (2016), Swaziland Country Brief for March 2016, World Food Programme, Rome, Italy.