Improved Potato Variety Analysis in Malawi: An Evaluation of Farmers Seed Demand

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ABSTRACT

Inefficient potato seed system in multiplication and distribution has been one of the major challenge facing potato production in Malawi. As a result, small farmers recycle traditional potato varieties that attracts many problems at the market. Government of Malawi and International Potato Center introduced new potato varieties in 2012-2013 winter season with the hope to improve the problem. However there a need to evaluate farmer's preference and analyses seed demand in order to coordinate multiplication and distribution of these potato varieties. Thus, the study carried out sensitivity analysis on changes in seed demand with the changes in output and input prices using a derived demand function. The second objective was to assess which of the improved potato variety, small farmers prefer. Cross sectional data was collected on an aggregated total of 168 potato small farmers in 2016 in Dedza and Ntcheu districts. Study results indicated that market price, output and labor cost were significant and positively contributing to farmer's choice to produce improved potato varieties. On farmer's seed preference, *Chuma* variety was more preferred followed by *Mwai* and *Thandizo* varieties.

Keywords: *Potato varieties, Malawi, Seed demand.*

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1. INTRODUCTION

Sustainability of crop production in most developing countries lies in a proper seed system that ensures availability of products of modern plant breeding and local farmer ingenuity Tripp [1]. Musa and Mheen-Sluijer [2] defined seed system as range of activities starting from seed selection, breeding, distribution, and use while Morris [3] defined seed as one of the most fundamental inputs in agriculture, that has the ability to affect production. Quality of the seed has a vital impact on the increment of yield per production as improved seed can make contribution to productivity dependent of other inputs.

Malawi is one of the countries that lacks efficient potato seed system in multiplication and distribution unlike grain crops [4]. Potatoes are important to small farmers in Malawi as they provide fast cash as well as provide nutrients to consumers as potatoes are ranked fourth in terms of major food crops after maize, cassava and sweet potato [5]. Malawi is one of the biggest potato producer country in sub-Saharan region as it is ranked second after South Africa [6]. As much as Malawi is one of the biggest potato producing country, lack of availability of quality planting material remains a challenge in potato production.

Potato seed system in Malawi is characterized into formal and informal systems. In the formal seed system, there is breeding of modern varieties by agricultural research institutions, varietal testing, seed multiplication, release and distribution to farmers [4]. While informal seed system is where traditional varieties used by farmers are multiplied and checked for pests and diseases before distributing to farmers. As much as there is formal seed system in Irish potato production, seed saving or recycling is a common means of farmers accessing potato seed.

Lack of proper seed multiplication and distribution has resulted in inadequate supply of high quality potato seed leading to most Malawian small potato farmers recycling traditional seed. Demo, et al. [7] added that, lack of improved potato varieties has led to over 80 percent of the potato smallholder farmers still cultivating traditional varieties. With the challenge mentioned above, Government of Malawi in collaboration with International Potato Center released in 2012-2013 winter season, new and improved potato varieties in order to improve yield and also provide quality potatoes. Varieties released are *Bembeke* (800946) with yield of 41 tons per ha, *Njuli* (CIP 396027.205) with yield of 36 tons per ha, *Chuma* (CIP 395015.6) with yield of 32 tons per ha, *Thandizo* (CIP 381381.13) with yield of 35 tons per ha, *Zikomo* (CIP 381381.20) with yield of 34 tons per ha and *Mwai* (CIP 396036.201) with yield of 41 tons per ha [8].

After the improved potato varieties were introduced, distribution was in a form of pass on program. Meaning to say; once a farmer received improved seed, then has to pass on seed, after harvest, to another farmer. The pass on program is evident by Phiri [4] who indicated that, 55% of planting seed in Malawi is recycled from previous harvest through a process of selection in the fields. Given the importance of improved seed, the question could be how sensitive are the improved potato varieties to output and input prices to motivate small farmers to decrease producing traditional potato varieties and demand more of the improved potato varieties. According to micro-economic theory that treats a person as a maximizing agent, it is expected that a farmer will chose the low cost seed source in order to maximize profit [9]. Therefore, a farmer will only choose improved potato varieties if output is higher and input prices is lower than traditional varieties.

As much as there are so many stages in analyzing seed system, the current study evaluated seed demand of improved potato varieties and assessed potato varieties mostly preferred by small farmers. The objective of the study, was to test the extent of sensitivity of potato seed demand (*Thandizo*, *Chuma*, *Mwai* and *Zikomo*) given input price (seed, fertilizer and pesticides), labor cost, market price and output. the second objective was to identifying potato variety preferred by farmers. The hypothesis under the study was output, input prices and market prices of *Thandizo*, *Chuma*, *Mwai* and *Zikomo* varieties are inelastic.

2. DATA, VARIABLE AND EMPERICAL MODEL

2.1. Data and Variable

Data used in this study was from a survey on 168 farmers in Dedza and Ntcheu districts in Malawi as the districts contribute to about 69 percent of potatoes produced in the country [5]. But also Dedza and Ntcheu districts were selected because were beneficiaries of improved potato pass on program. The survey was conducted by the authors as part of master's research using a semi-structured questionnaire that contains data on potato production and marketing of improved varieties in 2014-2015 agricultural growing season. A two stage sampling technique was used to select represented sample. In the first stage, purposive sampling was used to select Extension Planning Areas (EPA) and later simple random sampling was used to select villages and small farmers.

Total sampled farmers in two districts and 4 EPAs aggregated to 168 respondents all producing improved potato varieties amongst other varieties. A questionnaire was formulated to obtain information on potato production, price, plot size, challenges faced in producing improved varieties, labor, output, fertilizer and pesticide cost. The study only concentrated on four improved potato varieties (*Thandizo*, *Chuma*, *Mwai* and *Zikomo*) as there were varieties present to farmers at the time of study.

2.2. Economic Model

Monares [10] indicated that, the fundamental factor for increasing productivity in developing countries is the constant supply of good quality seed. A rational farmer will only use improved potato seed varieties if output is substantially higher than output from traditional seed varieties. Since seed is one of the fundamental inputs in the potato production, analyzing farmer's seed demand is important in coordinating seed supply. Seed demand was derived from a production function. The study used Cobb Douglas production function as it clearly stipulates the relationship between inputs and outputs of any crop. The importance of the model is its simplicity to solve and interpret elasticity coefficients.

Production function of the model shows the economic relationship between the inputs (land, labor and capital) and output. Michael, et al. [11] indicated that, it is simpler to analyze demand function for all inputs from a cost function as opposed to production function. The simplicity comes in from shepherd's lemma given by partial derivation of total-cost function with respect to input's costs. A cost function is presented in equation 1 below:

$$C(v,w,q) = vk + wl = Bq^{\frac{1}{\alpha+\beta}} v^{\frac{\alpha}{\alpha+\beta}} w^{\frac{\beta}{\alpha+\beta}} \quad (1)$$

Where B is a constant parameter as indicated in equation 2

$$B = (\alpha+\beta)\alpha^{\frac{-\alpha}{\alpha+\beta}} \beta^{\frac{-\beta}{\alpha+\beta}} \quad (2)$$

Taking partial derivatives of the cost function (1) with respect to capital (k), labor (l) and their prices, results in equations 3 and 4

$$k^c(v,w,q) = \frac{\partial c}{\partial v} = \frac{\alpha}{\alpha+\beta} * q^{\frac{1}{\alpha+\beta}} B v^{\frac{-\beta}{\alpha+\beta}} w^{\frac{\beta}{\alpha+\beta}} \quad (3)$$

$$l^c(v,w,q) = \frac{\partial c}{\partial w} = \frac{\beta}{\alpha+\beta} * Bq^{\frac{1}{\alpha+\beta}} v^{\frac{\alpha}{\alpha+\beta}} w^{\frac{-\alpha}{\alpha+\beta}} \quad (4)$$

Applying natural logarithm to both side of equation 3 and 4 result in equations 5 and 6

$$ln\, k(v,w,q) = ln\frac{\alpha}{\alpha+\beta} + \frac{1}{\alpha+\beta} ln\, q + lnB - \frac{\beta}{\alpha+\beta} ln\, v + \frac{\beta}{\alpha+\beta} ln\, w \quad (5)$$

$$ln\, l(v,w,q) = ln\frac{\beta}{\beta+\alpha} + \frac{1}{\alpha+\beta} ln\, q + ln\, B + \frac{\alpha}{\alpha+\beta} ln\, v - \frac{\alpha}{\alpha+\beta} ln\, w \qquad 6$$

Therefore, input demand production function for labor is linear in logarithms form after generalizing equations 6 as shown in equation 7

$$ln\, l(v,w,q) = ln\, A + a\, ln\, q + b\, ln\, v + c\, ln\, w \qquad 7$$

Where a is the elasticity of seed given changes in output quantity, b is seed price elasticity while c is cross price elasticity of seed chosen.

2.3. Empirical Model

Farmer's seed demand was derived from the assumption of production function. Improved potato seed varieties demand by farmers was specified using seed demand as a function of output quantity, input prices and costs. Using the input demand function derived above (equation 6), farmer's seed demand function for the improved potato seed was given by:

$$lnD_{seed} = \beta_0 + \beta_1 lnseed_{price} + \beta_2\, lnfertilizer_{cost} + \beta_3 lnlabor_{cost} + \beta_4\, ln\, pest_{cost} + \beta_5 lnQ + \beta_6 lnQ_{price} + \varepsilon$$

Input variables used in the model were fertilizer, pesticide and labor costs while the parameter variables assumed to be exogenous to any farmer are output and seed prices. The input prices were seed price and market prices of *Thandizo*, *Mwai*, *Chuma* and *Zikomo*. Improved potato seed demanded lnD_{seed} in kilogram is a vector of input costs used in potato production. Fertilizer cost (Mk/planted area); pesticide cost (Mk/planted area); labor cost (MK/planted area) and seed price per kilogram. lnQ is quantity harvested (kg) while lnQ_{price} is the market price of *Thandizo*, *Mwai*, *Chuma* and *Zikomo*.

3. RESULTS

Ramsey RESET test was carried out to test the functional form of seed demand for *Thandizo*, *Chuma*, *Mwai* and *Zikomo* varieties. Ramsey RESET tests whether non-linear combinations of the fitted values help explain the response variable. The null hypothesis was that; the quadratic variables are not significant. From the P-value of 0.000 in table 1, we fail to reject the null hypothesis and conclude that the functional form specified is correct.

Breusch-Pagan test was also carried out to test for the presence of Heteroscedasticity under the null hypothesis that variance in error term is constant or "homoscedasticity". After we failed to reject the null hypothesis that there was Heteroscedasticity in the data, the problem was corrected by robust standard errors after re-running the model. Knowing that Heteroscedasticity does not affect the unbiasedness of the estimator, the parameter estimates are the same after robust command. Adjusted R squared of 0.61 in table 1 means that 61 percent of variations in seed choice for improved potato varieties are explained by the model.

Table-1. Regression results on derived seed demand analysis

Dependent variable was lnD_{seed}		
Independent variables	**Coefficient**	**Stand. error**
β_0	-0.683	0.406
$lnseed_{price-Thandizo}$	0.052	0.211
$lnseed_{price-Chuma}$	-0.083	0.218
$lnseed_{price-Mwai}$	0.062	0.054
lnf_p	0.034	0.029
lnp_p	0.003	0.029
lnl_c	0.068*	0.026
lnQ_h	0.499*	0.075
$lnMarket_{price-Thandizo}$	0.097**	0.057
$lnMarket_{price-Chuma}$	0.031	0.057
$lnMarket_{price-Mwai}$	0.148*	0.051
$lnMarket_{price-Zikomo}$	-0.024	0.099
Observations	168	
R-squared	0.61	
Ramsay RESET test	F (3, 153) = 9.03	
	Prob F = 0.0000	

Source: Field Survey (2016), N=168

Estimated coefficient on seed price for all varieties were not significantly contributing to a farmer's decision to demand these improved potato varieties as indicated in table 1. The study results are in contrary with literature that indicate seed price to be significantly affecting farmers seed demand. The reason for contrary in result is explained by the free potato seed distribution. Potato seed pass on program resulted in most small farms incurring no cost on seed hence seed price not significantly contributing to improved potato seed demand. Considering that not all the farmers received the improved varieties, farmers who bought the varieties from fellow farmers were not enough to have an impact on the results.

Regression results from table 1 shows that fertilizer and pesticides cost were not significantly affecting seed demand for *Thandizo*, *Chuma*, *Mwai* and *Zikomo* varieties. Study results implies that; farmers do not react more to the changes in input prices in determining how much seed to demand or use. Results are in line with findings by Ogola, et al. [9] who indicated that, changes in input price are not a major significant factor in determining potato seed choice or demand unlike output prices.

Market price coefficient estimates of *Thandizo* and *Mwai* varieties showed a positive and significant contribution to farmers demanding improved potato varieties at 1 and 10 percent respectively. Market price coefficient estimate of 0.097 on*Thandizo* variety in table 1 implies that, as market price increases by 1 percent, farmer's seed choice for *Thandizo* will increase by 0.097 percent. While on mwai variety, a 1 percent increase in market price of *Mwai* variety increases farmer's demand by 0.148 percent as shown in table 1. This is in line with literature [9, 12] that potato seed demand or choice by farmers is more responsive to output market price than input price.

Literature indicate that, when estimated coefficients is less than one, then low sensitivity to changes in the variable. Despite low sensitivity in market price for *Thandizo* and *Mwai* varieties sensitive, *Mwai* variety is slightly responsive to changes in market price than *Thandizo* variety. This means, farmers are little more responsive to changes in *Mwai* market price than for *Thandizo* variety. One reason could be, *Mwai* variety is a red skinned variety good for French fries (chips) and processed into crisps which attracts more customers unlike *Thandizo* variety

which is a white tuber variety commonly consumed as boiled [8]. Therefore, the study fails to reject the null hypothesis and conclude that market prices are inelastic to changes in farmer seed demand for improved potato varieties. Considering that market price was one of the major impact on farmer's seed demand or choice, *Mwai* variety is a better choice for the farmers followed by *Thandizo* variety.

Farmer's Seed demand for *Thandizo*, *Chuma*, *Mwai* and *Zikomo* was positive and significantly related to output and labor cost. Output harvested was significant at 1 percent with an estimated coefficient of 0.499. This implies that, as output harvested increases by 1 percent, the decision of a farmer to choose improved potato varieties also increases by 0.50 percent. The increase in output harvested for these improved potato varieties affects farmer seed choice positively hence a shift from producing traditional varieties to demanding more of the new improved varieties.

Potatoes in Malawi are produced twice a year on average which involves a lot of labor. Labor cost was positive and significant at 1 percent with an estimated coefficient of 0.068. This implies that a 1 percent increase in labor cost increases a chance of a farmer choosing improved potato varieties by 0.068 percent. A positive sign on labor cost means that availability of farm labor encourages farmers to produce more than one variety. The other reason why labor cost was significant is that potato production is labor intense as a result availability of farm labor encourages farmers to produce more potatoes.

The study also analyzed farmer's preference on the improved potato varieties. The farmers were asked during the field survey on which of the variety they prefer and why. Table 2 shows the characteristics used to indicate the preferred variety. These characteristics were; easy to produce, Taste, easy to market, Tuber size, resistant to pest and diseases, early maturity, easy to store and resistance to dry spell. The improved variety that was mostly preferred by the farmers was *Chuma* variety followed by *Mwai* and *Thandizo* varieties respectively as indicated in table 2. The Characteristics that farmers use to choose their favorite variety were; easy to produce, high yield, tuber size and resistant to pest and diseases.

Table-2. Evaluation of farmer's preference on improved potato seed varieties

Characteristic	Thandizo	Chuma	Mwai	Zikomo	Total
Easy to produce	15	38	17	1	71
Taste	4	2	3	3	11
Easy to market	3	5	5	0	13
Big tubers	7	9	11	0	27
High yield	7	16	12	2	37
Resistance to pest and diseases	0	4	1	0	5
Early maturity	0	0	1	0	1
Easy to store	0	1	0	0	1
Resist to dry spell	0	2	0	0	2
Total	**36**	**77**	**50**	**5**	**168**

Source: Field Survey(2016), N=168

4. CONCLUSION

With the introduction of improved potato varieties, the study assessed the changes in farmer's seed demand with the changes in output, labor and input costs on 168 farmers in Dedza and Ntcheu districts in Malawi. The main results, showed that quantity harvested was positive and significantly influencing farmers choosing improved varieties. Reason being, farmers concentrate more on output and market price in determining which variety to produce. *Mwai* variety showed little sensitivity to changes in market price than *Thandizo* variety even though both were inelastic while in contrary, Chuma variety was more preferred by the farmers followed by *Mwai* and *Thandizo*

varieties. As a matter of policy recommendation, major concentration should be on making these improved potato varieties available to farmers with much emphasis on *Chuma*, *Mwai* and *Thandizo*.

REFERENCES

[1] R. Tripp, "How to cultivate a commercial seed sector?," presented at the Symposium "Sustainable Agriculture in the Sahel," Bamako, Mall, 2003.

[2] T. M. Musa and V. D. J. Mheen-Sluijer, *Review of state of art in the field of local seed supply systems*. Harare: Southern Africa and Development Community /GTZ, 1998.

[3] M. Morris, *Maize seed industries in developing countries*. Lynne Rienner Publishers, Inc. and International Maize and Wheat Improvement Center (CIMMYT), 1998.

[4] M. A. Phiri, "A scoping study on the status of the seed industry in Malawi- gaps challenges and opportunities," Draft Report on Seed Industry Coping Study. Department of Agricultural & Applied Economics, Lilongwe University of Agriculture and Natural Resources, Malawi2017.

[5] P. Demo, P. Pankomera, T. Connell, and K. Khumar, "Potential of potato farming in improving the livelihoods of small scale farmers in Malawi," presented at the African Crop Science Conference Proceedings. International Potato Center, Malawi, 2009.

[6] Food and Agriculture Organization of the United Nations (FAO), " Irish potato database. Irish Potato production, yield, seed and acreage for Malawi." Available at http://www.fao.org/faostat/en/#data, 2014.

[7] P. Demo, M. Soko, P. Pankomera, O. Mwenye, J. Mangisoni, J. Kagona, and I. Saini, "Survey of baseline information on seed and table potato production and marketing in Malawi," Annual Report-Horticulture Commodity Group, 2008.

[8] P. J. Z. Mviha, A. P. Mtukuso, M. H. P. Banda, and B. F. Chisama, *A catalogue of agricultural technologies released by the ministry of agriculture and food security: 2004-2011. Crop varieties, crop and livestock production technologies and agricultural processing and utilization technologies*. Malawi: Ministry of Agriculture, 2011.

[9] J. Ogola, A. Orawo, and M. Ayieko, "Assessment of factors affecting the farmer demand for seed potato in Nakuru District, Kenya," *African Journal of Agricultural Research*, vol. 7, pp. 4151-4157, 2012.

[10] A. Monares, *Agro-economic evaluation of highland seed in the carete vally; results from two experiments at two locations. Social science unit working paper series No 1979-3*. Peru: International Potato Center, 1976.

[11] A. Michael, D. Kuznetsov, and S. Mirau, "Analysis of the irrigation water price in rice production Tanzania," *Applied and Computational Mathematics*, vol. 3, pp. 177-185, 2014.Available at: https://doi.org/10.11648/j.acm.20140304.19.

[12] D. Horton, *Potatoes: Production, marketing, and programs for developing countries* vol. 243. Boulder CO: Westview Press, 1987.