

# Evaluation of Effects of Value Addition in Sweet Potatoes on Farm Income in Homa Bay County, Kenya

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## Abstract

Sweet potato value addition has become an increasingly important aspect in improving the diversification in its production and expanding the unexploited market amongst consumers. Homa Bay County is among the leading areas of production in Kenya due to its favorable land conditions and rainfall patterns that enables sweet potato to thrive well in the region. Value addition has been introduced in the County mainly by Non-Governmental organizations that work together with the public sector. However some small scale farmers do not practice value addition, partially because little has been done empirically to measure the impact that value addition has on farm income. This study focused on filling in this gap in the existing knowledge on sweet potato value addition. The study was conducted in Homa Bay County and the study sites selected included three sub counties namely Kasipul, Kabondo Kasipul and Ndhiwa. Multi stage sampling technique was used in selecting the study sites and the required sample size determined by proportionate to size sampling method. Interview schedules and observation were used to collect primary data. Multiple regressions were used to analyze the effect of different value addition activities on Income received solely from sweet potatoes. In addition marginal effects were obtained to analyze the effect of each independent variable separately on income. Findings revealed that the more value a farmer added to raw tuber, the better the income obtained from the market. In addition, farmer marketing groups had a stronger bargaining power in the market compared to farmers selling individually. The study therefore recommended that the County government should work closely with the non-governmental organizations to enlighten farmers on the importance of forming farmer groups since most training on value addition, information on prices and market opportunities can be easily disseminated through farmer groups. It is through these trainings that farmers would be able to make rational decisions with regard to production and adding value to get higher incomes.

**Keywords:** Value Addition techniques, Smallholder farmer, Farm income.

## 1. Introduction

Sweet potato is among the world's most important, versatile, and underexploited food crops. It currently ranks as the world's sixth most important food crop on a fresh weight basis. More than 105 million metric tons are produced globally each year; 95 % of which is grown in developing countries (FAOSTAT 2009). In these developing countries it ranks as the fifth most important food crop after rice, wheat, maize and cassava (*ibid*). Globally it is cultivated mostly in Asia Pacific countries such as China, Papua New Guinea, and Vietnam among other areas. In Africa it is produced in countries such as Angola, Madagascar, Malawi, Mozambique, Nigeria, Zambia, Uganda and Kenya. Sweet potato is one of the most widely grown root crops in Sub Saharan Africa covering around 2.9 million hectares with an estimated production of 12.6 million tons of roots in 2007 (FAOSTAT, 2008). It is predominantly grown in small plots by poorer farmers' hence it is known as the 'poor man's food' (Woolfe, 1992). Yields of sweet potato per unit of land vary widely, from over twenty-five tons per hectare in high-input agricultural systems to below three tons per hectare where sweet potato is grown as a subsistence crop with minimal use of fertilizers or other inputs, mostly in Africa.

In Kenya sweet potato is mostly grown in Kakamega, Bungoma, Busia, Homa Bay and Kisii Counties. The potential of sweet potato contribution to food security, increased incomes and reduction of nutritional deficit is considerable and is yet to be fully exploited in developing countries (Woolfe, 1992). The crop has a relatively high yield potential that may be realized within a short growing season of between three to five months. It is a drought tolerant crop and has a wide ecological adaptation. Most sweet potato varieties require low or non-use of external inputs. Moreover, the ability of the crop to establish ground cover fast enables suppression of weeds, control of soil erosion and maintenance of soil fertility. As such, it is an attractive crop for Kenya's farming systems. The production of sweet potatoes in Homa Bay County is greatly enhanced by conducive conditions including sandy loam soil, and an abundant almost continuous rainfall pattern. Farmers are therefore able to realize two to three crops per year. The crop is either planted as pure stand or relay cropped with maize.

Many raw commodities have intrinsic value in their original state. Value addition is the process of changing or transforming a commodity from its original state to a more valuable product. The uses of sweet potatoes have been diversified considerably over the last four decades, having great potential as a source of local value-added products and as ingredients in other production processes. Value addition may take various forms that could be summarized in three levels that include:

Level 1 - Post-harvest level/primary processing: this includes proper cleaning, sorting, grading and packing sweet potato raw tubers for sale. This is the most common type of value addition practiced by farmers.

Level 2 – Secondary/ basic processing: This includes steaming, boiling or roasting the raw tubers. In addition it can also take the form of grinding sweet potatoes into flour and packing the flour into different respective sizes.

Level 3 - High end processing; involves activities such as frying sliced root tubers to obtain potato chips, noodles, candy, desserts. In addition, it involves baking breads, buns, cakes and doughnuts using sweet potato flour, preparing *mandazi* and *chapatti* using the same grinded flour or making sweet potato juice. This level also involves actual packaging of processed sweet potato products, branding, and marketing.

Sweet potato (*Ipomea batatas*) can be consumed in its basic processed form which includes being steamed, boiled or grilled. It can as well be processed into chip or 'kolak' (traditional food). Intermediate products of sweet potato such as flour, paste and puree are produced by the food industry in developed countries and used as export commodity. Sweet potato has complex carbohydrate therefore its energy is released gradually. Consumed with its peel, steamed or boiled tuber contains higher fiber than oatmeal therefore it is suitable for diet and can substitute rice, potato or boiled corn. With low glycemic index (GI), sweet potato is suitable for people with diabetic, (ISFA, 2014).

The tuber could be roasted, fried, creamed or baked in their skins (Tewe *et al.*, 2003). They are combined with both sweet and savory dishes. In developing countries, the tubers can be grinded into flour which can be mixed with sorghum to make porridge. Mild alcoholic beverages can be made from peeled, chopped, pounded and fermented sweet potato. Such processing is only done when there is a surplus. In many areas of the county, sweet potato flour is used in making *chapatti*, *mandazi*, crisps and in making different types of baked food such as breads, cookies and muffins. Sweet potato flour can also be fermented to make products like soy sauce and alcohol. If immediately cooked, it can be processed further into wine, vinegar and nata de coco, or "on-the-go," a dessert popular in the Philippines and in Japan. Unprocessed sweet potatoes do not have an extremely long shelf life compared to other vegetables like carrots or potatoes. For this reason, drying, freezing or processing sweet potatoes into a frozen prepared food may benefit producers or processors by extending shelf life and gaining increased market visibility, (USDA, 2013). In addition other products such as sweet potato vine can be a valuable source of green fodder and lasts throughout the off-season. The tubers as well form an industrial raw material for the production of starch, alcohol, and pectin.

On-farm processing of sweet potato in Homa Bay has picked up with a majority of the processors being members of women groups. These groups have been trained on the processing technologies by specialist in home economics. Examples include the Kinda Women Group with a processing site in Rangwe and the Allendu Women group, (Owuor, 1996). ADS-Nyanza is a faith- based organization working in six counties in Nyanza region to implement a sweet potato value chain upgrading project. The aim is to increase farmers' income levels from sweet potatoes by improving production and marketing of the product in Kabondo area of Homa Bay County,(ADS-Nyanza, 2002).

## 2. Methodology

### 2.1 Study Area

The study was conducted in Homa Bay County located in the Nyanza region, along the south shore of Lake Victoria's Winam Gulf lying at latitude of 0.6833° S and longitude of 34.4500° E. The county covers an area of 3,183.3 sq km with a population of about 963,794 (male - 48% and female - 52%), according to the 2009 National Census. It has semi-arid climatic conditions with daily temperatures ranging between 26°C during the coldest months (April and November) and 34°C during the hottest months (January to March). The county receives between 250mm and 1200mm of rainfall annually, with the average annual rainfall estimated at 1,100mm. It has two rainy seasons; March-April-May (long rains) and September to November (short rains). The target population of the study consisted of smallholder farmers in the three sub- counties namely Kasipul, Kabondo and Ndihiwa in Homa Bay County. The sampling unit of the study was made up of smallholder sweet potato farmers. Proportionate to size sampling methodology (Anderson *et al.*, 2007) was used to arrive at the surveyed sample size of 174 farmers.

### 2.2 Methods of Data Analysis

STATA computer program was used to analyze data. Multiple regression models were used to determine the effect of activities at different levels of value addition on net farm income from sweet potatoes. In addition, the study analyzed the effect of key socio economic and institutional factors on income received from value added sweet potatoes. Marginal effects were also calculated.

The model was specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + v \dots \dots \dots (1)$$

$$Y = \beta_0 + \beta_1 Acrgswtpot + \beta_2 schlnyrs + \beta_3 lvl1valueaddtn + \beta_4 lvl2valueaddtn + \beta_5 lvl3valueaddtn + \beta_6 hhsiz +$$

$$\beta_8 \text{transportncosts} + \beta_9 \text{extnacc} + \beta_{10} \text{attendtraing} + \varepsilon \dots \dots \dots (2)$$

Table 1: Description of variables used in the regression model

Variable code	Variable	Measurement of the variable	Expected Sign
Net Incm (Y)	Net income	Net income from sweet potatoes solely	+
Acrgswtpot	Acreage under sweet potatoes	Total Acreage(continuous)	+
Nschlnyrs	Schooling years	Number of schooling years(continuous)	+
Lvl1valuaddtn	Level One value addition	Level One(Yes=1, No=0)	+
Lvl2valuaddtn	Level Two value addition	Level Two( Yes=1, No=0)	+
Lvl3valuaddtn	Level Three value addition	Level Three( Yes=1, No=0)	+
Hhsize	Household size	Total number of household members(continuous)	+
Transportncosts	Total transportation costs	Total transport costs incurred to the market(continuous)	+
Extnaccs	Access to extension services	Access to extension(Yes=1, No=0)	+
Attendtraing	Attend training	Attend trainings(Yes=1, No=0)	+

### 3. Results and Discussion

The econometric results of factors that influenced the level of income that farmers obtained from the sale of raw and value added sweet potatoes are presented in Table 2. Of all the factors that were considered in the multiple-regression model, 6 were found to have a significant effect on the farmers' level of income derived from the sale of sweet potatoes.

Table 2: Marginal effect results of factors affecting farmers' income.

Variable	dy/dx	Std. Err.	z	P>z
Household size	0.014	0.019	0.740	0.461
Schooling years	-0.007	0.024	-0.280	0.782
Acreage under sweet potatoes	0.161**	0.064	2.520	0.012
Extension access	0.041	0.192	0.220	0.829
Level 1 value addition	0.610*	0.316	1.930	0.054
Level 2 value addition	1.317***	0.345	3.810	0.000
Level 3 value addition	1.893***	0.349	5.430	0.000
Attend Training	0.257*	0.150	1.720	0.086
Transportation costs	0.346***	0.054	6.460	0.000

(\*significant at 10%, \*\*significant at 5%, \*\*\*significant at 1%)

The adjusted R<sup>2</sup> signifies the percentage of variation in the dependent variable explained by the independent variables. The Adjusted R-square in the regression was 58% which implied fifty eight percent of the variation in household revenue from sweet potatoes is explained by the independent variables.

Marginal effect indicates the effect of one unit change in an independent variable on household revenue. From the estimated marginal effect results, six variables were found to be significant at different confidence levels.

The acreage under which sweet potato is cultivated was statistically significant at 5% implying a unit change in the acreage cultivated led to an increase in income (Table 2). The corresponding marginal effect showed that one unit increase in the acreage under sweet potato cultivation led to the household income increasing by 16.1%. A greater acreage under sweet potato could translate to a greater output. Large scale production enables farmers to channel resources towards adding value at different levels while comparing prices in the market across the value addition levels. This result was consistent with that of Akteruzzaman and Parvin, (2012) who used multiple regressions to analyze factors affecting farm and non-farm income of Haor Inhabitants of Bangladesh and found out that farm size had a significant effect on farm income.

Level one value addition was statistically significant at 10%. This implied an extra effort of activity under this level increased the household income by 60% compared to farmers who were not doing any value addition at all. The difference in prices among these two groups could have been attributed to the actual activities of sorting, grading, cleaning and packing done by farmers carrying out level one value addition.

Level two value addition was statistically significant at 1%. This form of value addition had a positive effect on income. The more value a farmer added, the better the income. This implied farmers who were adding value at level two improved their incomes by 132%. The diversified range of products due to value addition reaches a larger market segment. This result was consistent with that of Umeh, (2013) which found that cassava value addition had a positive influence on the income generated and specifically raised income level of cassava flour by 80%.

Farmers carrying out activities in the highest level of value addition recorded highest improvement in

their income. Level three value addition was statistically significant at 1%. This implied the more the value added to the raw tubers at this level, the higher the household income by almost thrice the current income. Hagenimana, *et al.* (1999) revealed that substituting sweet potato flour for wheat flour in *mandazis* made the product more profitable for market vendors.

Transportation costs were found to be statistically significant at 1%. Costs are known to have a negative impact on income. These results however, were contradicting this fact. The higher the transport costs incurred by a farmer, the higher the household income from sweet potato. The explanation for this was that the transportation cost was being charged per sack hence the more the output the more the sacks and consequently the higher the transportation cost. More output when sold was translating to higher income. These results contradicted that of World Bank (2004) which revealed that high transaction costs increased the poverty level in the rural areas as a result of reduced farmer incomes.

Impact of attending training seemed to determine the extent of involvement of value addition activities. From table 2, the results showed that training was statistically significant at 10%. Farmers who had attended some form of training improved their incomes by up to 26% compared to those who had no training at all.

#### 4. Conclusion and Recommendation

The findings of the study showed that the key factors that influenced farm income from sweet potatoes were the actual levels of value addition, the acreage under which the sweet potato was being cultivated, access to training and the transportation costs. Based on these results, it is recommended that the non-governmental organizations' should work more closely with the county government to create awareness to farmers on the benefits of forming more farmer groups or joining existing ones. This is because through groups, there is ease dissemination of information regarding organized trainings on new vine varieties, value addition, prices and market opportunities. Farmer groups and especially marketing groups raise bargaining power for individuals. This could assist in reducing losses incurred by farmers selling individually at the prevailing market prices during excess supply of raw tubers. In addition, since non-governmental organizations' supports the already existing Kabondo Sweet Potato SACCO in terms of putting up operating machinery such as chippers, electric driers, milling machines for value addition purposes, the study recommended formation of more SACCOs to open up more market opportunities especially for farmers cultivating new sweet potato varieties for value addition.

#### References

- Aniedu, C., Aniedu, O. C., and Nwakor, N. (2012). Impact and Adoption of Value Added Innovations in Root and Tuber Crops among Farmers in Imo State, Nigeria. *Global Journal of Science Frontier Research Agriculture and Veterinary Sciences*, 12: 1-7
- Ememwa, L., Nungo, R. A., Obiero, H. M., and Ndolo, P. J. (2008). Challenges and Experiences in Transfer of post harvest Technologies to Farming Communities in western Kenya: A case of cassava and sweet potato processing. *Biennial scientific conference and 3rd agricultural forum, 10th- 13th November*.
- Fawzia, A., Karuri, E. G., and Hagenimana, V. (2000). Sweet Potato Ketchup: Feasibility, Acceptability and Production costs in Kenya. *Journal of Food technology in Africa*. 5: 14-18.
- Hagenimana, V., and Owori, C. (1997) Feasibility, acceptability, and production costs of sweet potato-based products in Uganda: *The International Potato Center (CIP) Program Report 1995-1996*. Lima, Peru. Pp: 276-281
- Hagenimana, V., Carey, E., Oyunga, M., and Gichuki, T. (1999). 'Carotenoid contents in fresh, dried and processed sweet potato products. *Journal of Ecology of food and Nutrition* , 37: 455 – 473.
- Hagenimana, V., Karuri, E. G., and Oyunga, M. A. (1998a). Oil content in fried processed sweet potato products. *Journal of Food Processing and Preservation* 22: 123-137.
- Nungo, R. A., Ndolo, P. J., Kapinga, R., and Agili, S. (2007). Development and promotion of sweet potato products in Western Kenya. *Proceedings of the 13TH ISTRC symposium, UK*.
- Omosa, M. (1997). Current and Potential Demand for Fresh and Processed sweet potato products in Nairobi and Kisumu, Kenya. *International Potato Centre (CIP) 88p. Working Paper (CIP). No 1997-1*.
- Singh, S., Riar, C. S., and Saxena, D. C. (2008). Effect of incorporating sweetpotato flour to wheat flour on the quality characteristics of cookies. *African Journal of Food Science* 2 : 065-072.
- Westby, A., Tomlins, K., Ndunguru, G., Burnett, D., Ngendello, T., Rwiza, E. (2003). Maximizing incomes from sweet potato production as a contribution to rural livelihoods: *Project report: (1999-2003), Tanzania*.