The Effect of Utilization of Cassava Solar Drying Technology on Small – Scale Cassava Farmers Incomes' in Teso-South Sub-Countyof Busia County, Kenya

Justus Bahati Wanzala, Fred K. Wamalwa
Jomo Kenyatta University of Agriculture and Technology, Kenya
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ABSTRACT

Cassava (with a Botanical name Manihot esculenta) is a perennial woody shrub with an edible root, which is grown in tropical and subtropical parts of the world, including sub-Saharan Africa. Cassava is grown in the former Western Province, which constitutes Kakamega, Bungoma, and Busia Counties, and has huge potential for food security. The challenges the farmers face is a lack of proper handling during harvesting which they spoil easily and hence sell it raw, making cultivation a business unsustainable due to heavy losses. This paper was on effect of utilization of cassava solar drying technology on small-scale cassava farmers' incomes' in Teso-South Sub-County of Busia County, Kenya. Primary data was collected using a structured questionnaire and analysis was done through SPSS where descriptive and inferential statistics. The findings showed that utilization of cassava solar drying technology ($\beta=0.137$, $p<0.05$) was a significant predictor of small-scale cassava farmers' incomes in Teso-South Sub County, Busia County, Kenya. The study recommends that government of Busia County should put in place and strengthen the adult literacy programs, invest in acquisition of solar dryers, and training on dryer usage among small-scale cassava in Busia County.

Key words: Solar Drying Technology, Farmer's income

INTRODUCTION

The positive and significant impact on crop income is consistent with the perceived role of new agricultural technologies in reducing rural poverty through increased farm household income (Djanibekov & Gaur, 2018). Over the years, there has been mounting recognition of the contribution that cassava solar drying technologies can make as a means of improving the economic well-being of the rural sector. The impacts of agricultural growth and development on poverty reduction and the promotion of food security may be at least three times greater than the combined impacts of other economic sectors within developing countries (Christiaensen & Martin, 2018). Cassava is one of Africa's most important food crops. It is the second most important staple food crop after maize in Sub-Saharan Africa, particularly in western, central and eastern Africa. This crop is widely consumed because of its high calorific value and because it is the cheapest source of energy (Kassie, Shiferaw & Muricho, 2011).

Some of the means to improve cassava processing include increasing the supply of cassava roots, making solar driers available and accessible, improvement of cassava processing technology and infrastructure, promotion, group processing of cassava roots, improvement of the quality of cassava roots and thus processed products (Peuo, Mimgratok, Chimliang, Yagura, Huon & Peuo, 2021). Cassava can thrive in areas characterized by poor rains, thus ideal for smallholder farmers with limited access to agricultural inputs in the tropics (Opondo, Dannenberg & Willkomm, 2017).

Drying is the oldest and simplest method of processing cassava and is the mode of preservation used in most African countries. It is sun dried on any flat surface and there are food safety concerns that need to be addressed to protect the consumers from hazards that may occur (Gacheru, 2015). Threats to food safety and quality include poor physical quality, chemical contamination, and bacterial or mycotoxin contamination.

Cassava products require drying below 12% moisture which is impossible with traditional sun drying method, resulting in mold growth, aflatoxin infestation, and fermentation since the drying process takes 1 to 2 weeks; hence compromising on the quality of the dried. During rainy season, when traditional sun drying processing method is used, it takes longer to dry the chips; leading to contamination and discoloration of the chips thus detracting their appearance and noxious odors and off-flavors that are unacceptable to the consumer are usually observed (FAO, 2010). Thus, solar drying is a more appropriate option than sun drying.

Sub-Saharan Africa produces more than half of the world's cassava (Vidigal, Romeiras & Monteiro, 2019) which is consumed by an estimated 500 million people daily. Accordingly, cassava is gaining recognition by smallholder farmers on the continent as a cash crop but there is still low commercialization of the crop at only 7% as 93% of the crop is consumed in households. Approximately, 38% of the cassava produced in the coastal lowlands of Kenya is consumed at household level and 51% of the farmers make chips for domestic use, sale to starch and feed factories, or as an intermediate for production of flour (Opondo & Owuor, 2018).

Onyango, Bii, Odhiambo, Kinyumu, Kirimi and Ayieko (2017) stated that Kenya is a food deficit country with much of its land being arid or semi-arid a situation which is suited for cassava since it is a drought resistant crop. Acheampong and Owusu (2015) noted that the cassava crop is resilient to adverse conditions, but the harvested cassava tubers are highly perishable and farmers suffer poor post-harvest loss due to storage. Thus, farmers have started utilizing cassava drying technology to help in storage of cassava (Onyango *et al.,* 2017). The technology involves use of a solar dryer, the dryer is ideal for small scale cassava farmers for higher cassava production, low cost of preparing safe cassava products leading to diversification in cassava products, and improved food security.

The challenges encountered in cassava farming commercialization range from freshly harvested Cassava being bulky and highly perishable, inadequate processing knowledge and skills, inadequate processing and value addition equipment, and poor marketing and unorganized marketing systems. The industrial potential of cassava has, however, not been tapped as most farmers use it mainly for subsistence. The crop is also bedeviled by postharvest losses that do not benefit the farmer or the market (Abdi, Jacob & Chesambu, 2017). Therefore, it is essential to develop low cost and energy effective processing technologies for industrial utilization of cassava.

Teso-South Sub-County is a leading cassava growing area in Busia County but the cassava farmers suffer from wasted yield due to poor drying mechanisms that cause contamination and discoloration that fetches lower prices in the market. Hence the focus on solar drying technologies which were initiated by Farm Concern, an International Non-governmental organization in collaboration with the Kenya Agricultural and Livestock Research Organization (KALRO). The utilization of solar drying technology was expected to improve income of the cassava farmers.

LITERATURE REVIEW

The High Payoff Input Model

The model postulates that the key to transforming a traditional agricultural sector in poor countries into a productive source of economic growth is investment designed to make modern, high-payoff inputs available to farmers in poor countries. At the core of this model is the view that peasants or smallholder traditional societies remained poor due to limited technical and economic opportunities. Acceptance of the high pay off input model hinges on growing studies revealing high rates of returns to public investment in agricultural research (Ruttan, 1988).

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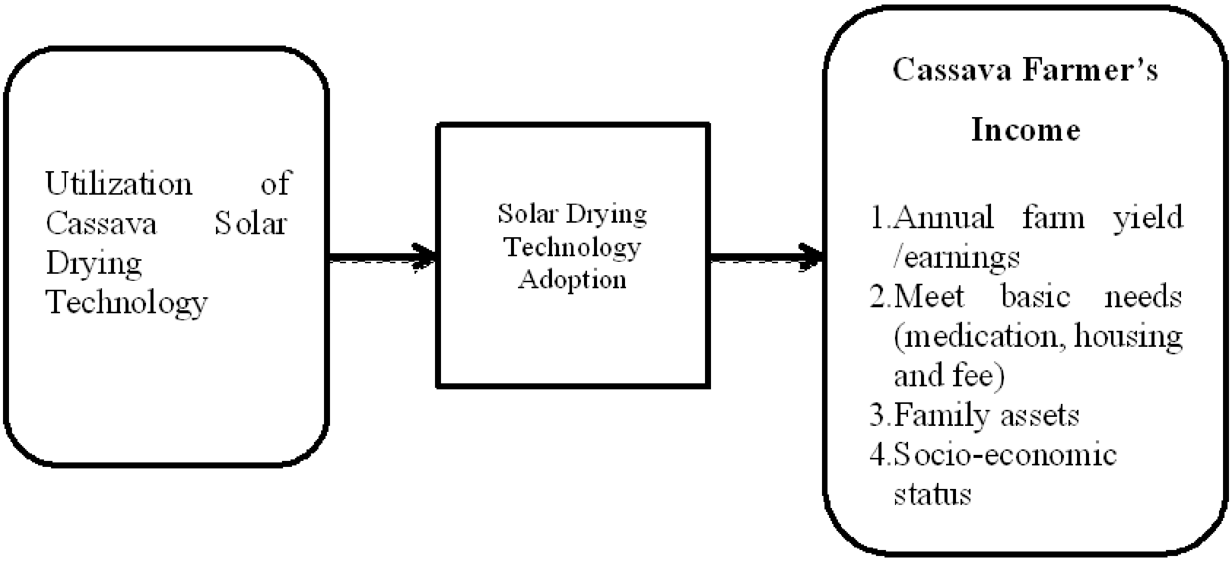
The model has weakness as noted by Ruttan and Hayam (1972) as it does not clearly explain how resources are to be allocated for initiatives such as research and public and private sector economic activities. Thus, investing in research is a source of new high-payoff technologies, but does not shed light on a link to how economic conditions spawn development and adaption of efficient technologies for any society. The model exhibits the value of using solar drying technologies that reflect increased productivity, cutting down post-harvest losses and wastes that improve economic earnings of the cassava farmers. They earn a high payoff through use of solar dryers that positively impact on economic well-being of the farmers.

Conceptual Framework

Figure 1: Conceptual Framework



Empirical literature

Cassava yields in Africa are small and it remains unclear which factors most limit yields. Using a series of farm surveys and on-farm and on-station trials in Uganda and western Kenya, we evaluated the importance of abiotic, biotic, and associated crop management constraints for cassava production in a range of socio-economic settings as found in smallholder farms in the region. To address the problem of sustainable increased cassava production and processing for both domestic purposes and then contain the problem posed by cassava mosaic diseases in Kenya several initiatives must be enacted by the government.

According to Von Braun (2008), agricultural growth via technological transformation leads to an expanded food supply which presupposes complementarity of production and processing operations in agriculture. To date, little evidence exists regarding the individual effect and productivity of certain improved farming technologies and practices on targeted respondents in Kenya. This describes socioeconomic characteristics of cassava farmers, determines the levels of awareness and adoption of cassava production technologies by farmers, determines the levels of awareness and adoption of cassava processing technologies by farmers, estimates the profitability of the cassava production technology, and estimates the poverty status of cassava farmers in areas and non-areas of cassava intervention programs and determine the factors influencing it.

Despite this development, the demand for cassava is mainly for food and domestic consumption; and opportunities for commercial development of various processed products. The absence of agro industrial markets remains the major constraint to further development of the crop. Cassava production exhibits high levels of variability and cyclical gluts, due mainly to the inability of markets to absorb supplies. As a result, prices of cassava roots decline sharply and production levels are reduced in succeeding years before picking up again. Such factors according to Von Braun (2010) cause price instability over the years and this significantly increases the income risk to producers. Insufficient processing options for storage of harvested cassava contribute to losses and lower prices.

RESEARCH METHODOLOGY

Research Design

This research used a descriptive survey research design as it described the characteristics and functions adopted in cassava drying technologies.

Target Population and Sample Size

The researcher targeted 1,247 cassava farmers from Teso South who grow cassava and dry their tubers using solar dryers. The sample size included 114 farmers who dry their cassava tubes using solar dryers. The response rate was 75.4% based on 86 out of the 114 administered questionnaires that were filled and returned for analysis.

Data Collection

Structured questionnaires were used in collecting primary data from the cassava farmers as the respondents. The researcher engaged five research assistants who self-administered the questionnaires to the farmers. The collected data was entered into SPSS version 23.0 for further analysis.

Data Analysis

The analysis included both descriptive and inferential statistics to interpret the data. The Multiple Regression Model followed the format shown below:

$$\mathbf{Y = \beta_0 + \beta_1 X_1 + \varepsilon}$$

Where:

Y = small scale cassava farmers' incomes

X_1= Utilization of Cassava Solar Drying Technology

ε = Error term

β_1 =Coefficient of solar drying technology

RESULTS AND DISCUSSION

Descriptive Statistics

Utilization of Cassava Solar Drying Technology by Small Scale Cassava Farmers in Teso South Sub-County, Busia County

The study set out to establish the adoption of cassava solar drying technology among small scale cassava farmers in Teso-South Sub-County of Busia County.

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Figure 4.1: Use of Solar Dryers

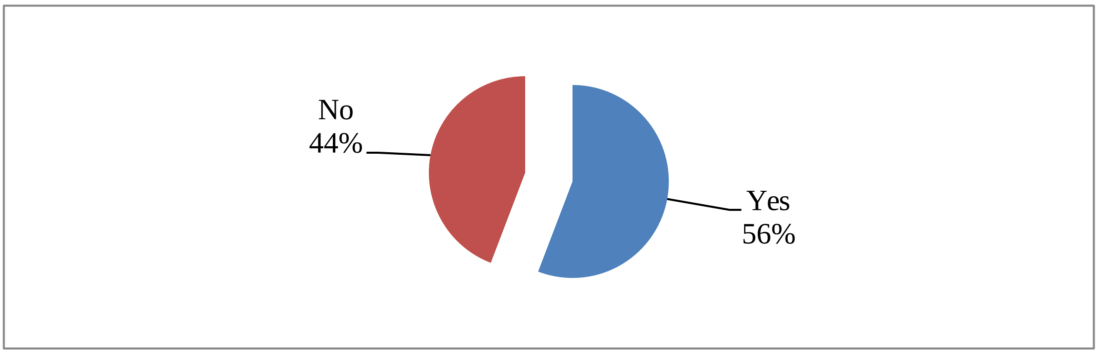

Figure 4.1 indicates that 56% of the respondents stated that they used solar dryers but 44% of the respondents shared that they did not use solar dryers, meaning that solar drying technology had been adopted by cassava farmers in Teso-South Sub County

The study sought to understand if the respondents used solar dryers they owned or they hired the same, findings are shown in Table 4.1

Table 4.1: Use of own dryer against hiring

	Frequency	**Percent**
Yes	36	41.9
No	44	51.2
System	6	7.0
Total	**43**	**100.0**

The findings in Table 4.1 indicate that while 51.2% of the respondents hired the cassava dryers, only 41.9% had their own, implying that those who did not own dryers could hire. This can explain why the proportion of farmers who used solar dryers was relatively high.

The researcher probed to understand the perception of respondents who owned their dryers, with results shown in Table 4.2

Table 4.2: Perceptions of Owning Solar Dryer

Category	**Classification**	**Frequency**	**Percentage**
If you own a dryer, is it easy to use the machine?	Yes	14	38.9%
	No	16	44.4%
	System	6	16.7%
If you own a solar dryer, how did you acquire funds to buy it?	NGO	10	27.8%
	Other	8	22.2%
	System	18	50.0%

The findings show that 44.4% of the respondents said that it was not easy to use the solar dryers against 38.9% who agreed. On access to funds to acquire the solar dryers, 27.8% were funded by NGOs while 22.2% had other sources of finances to fund the buying of the solar dryers.

Respondents were asked to indicate the number of kilograms of cassava that they dried using solar dryers; results were summarized as shown in Table 4.3

Table 4.3: Operating Capacity of the Solar Dryers

	Frequency	Per cent
100-1000	22	25.6
2001-5000	20	23.3
Over 5,000	10	11.6
System	34	39.5
Total	**86**	**100.0**

The findings in Table 4.3 indicate that 25.6% of the solar dryers dried 100-1000kgs of cassava in a day while 11.6% dried over 5000Kgs, an indication of the operational and production capacity of the solar dryers, which ranged from average to optimal.

The study sought to establish the frequency at which the solar dryers were used by farmers to dry cassavas and the findings are shown in Table 4.4

Table 4.4: Frequency of Using Solar Dryers

	Frequency	Percent
Daily	2	2.3
Weekly	16	18.6
Monthly	34	39.5
System	34	39.5
Total	**86**	**100.0**

Table 4.4 shows that while 39.5% of the farmers used solar dryers to dry cassava every month, 2.3% used it daily, implying that solar drying technology was not frequently used by the cassava farmers.

The study sought to establish the final product that was obtained after processing the cassava and Table 4.5 breaks down the findings.

Table 4.5: Final Product after Cassava Processing

	Frequency	Per cent
Cassava flour	44	51.2
Cassava chips	34	39.5
Cassava Starch	2	2.3
System	6	7.0
Total	**86**	**100.0**

The findings in Table 4.5 indicate that while 51.2% of the farmers shared that they obtained cassava flour after processing, 2.3% indicated cassava starch. This means that a wide variety of products was generated at the end of processing of cassava through solar dryers.

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The study sought to appreciate the perceptions of the use of solar dryers on the income of the farmers as shown in Table 4.6

Table 4.6: Perceived effect of use of dryer technology on income

	Frequency	Percent
Very great extent	18	20.9
Great extent	18	20.9
Moderate extent	8	9.3
No change	36	41.9
System	6	7.0
Total	**86**	**100.0**

Table 4.6 indicates that while 41.9% of the respondents perceived that the use of solar dryers had not changed their income, 9.3% indicated that there was a moderate change in their income after they had started using solar dryers.

The study sought to establish the accessibility to cassava chips dryers with the findings as summarized in Table 4.7

Table 4.7: Accessibility to cassava chips dryers

	Frequency	Percent
Yes	54	62.8
No	28	32.6
System	4	4.7
Total	**86**	**100.0**

The findings in Table 4.7 indicate that while 62.8% of the respondents agreed that cassava chips dryers were easily accessible, 32.6% disagreed. This finding could be the possible explanation for why 39.5% of the respondents reported processing cassava into chips as the final product.

Respondents were asked to share out the cassava drying method that offered them quality cassava products. Table 4.8 is an overview of the results.

Table 4.8: Cassava drying methods and quality

	Frequency	Percent
Direct drying in the sun	40	46.5
Use of solar dryers	42	48.8
System	4	4.7
Total	**86**	**100.0**

The findings in Table 4.8 indicate that while 48.8% of the respondents believed that solar dryers generated quality cassava products, 46.5% favored direct drying in sun. This means that the quality benefit motivated farmers to embrace solar technology in drying and processing of their cassava.

Respondents were asked to indicate if the use of solar dryers met their cassava needs. The results were established and summarized as indicated in Table 4.9.

Table 4.9: Use of solar dryers and cassava needs

	Frequency	Percent
Yes	48	55.8
No	20	23.3
System	18	20.9
Total	**86**	**100.0**

The findings indicate that 55.8% of the respondents noted that the use of solar dryers met their cassava needs, unlike 23.3% of the respondents who disagreed.

Respondents were asked to indicate whether they had a chance to use solar dryers and observe their performance before embracing them. Table 4.10 is a breakdown of the findings.

Table 4.10: Prior use and observation of performance of solar dryers

	Frequency	Per cent
Yes	40	46.5
No	42	48.8
System	4	4.7
Total	**86**	**100.0**

The findings in Table 4.10 show that while 48.8% of the respondents did not a chance to use solar dryers and observe their performance before embracing them, 46.5% had such a chance.

Small Scale Cassava Farmers' Incomes

The study sought to establish the small-scale cassava farmers' incomes in Teso-South Sub County, Busia County, Kenya. Table 4.11 is a breakdown of the findings after analysis was done.

Table 4.11: Small Scale Cassava Farmers' Incomes

Category	Classification	Frequency	Percentage
On average how much did you make selling solar dried cassava chips annually basis?	Kshs. 100-1000	19	22.1%
	1001-2000	21	24.4%
	2000-5000	29	33.7%
	Over 5000	17	19.8%
How much were you earning annually before using solar dryers	Below Ksh 30,000	46	53.5%
	Above Ksh. 30,000	40	46.5%
Has your household been able to meet its basic needs since you started processing your cassavas using solar dryers?	Yes	49	57.0%
	No	37	43.0%
In general, to what extent has use of solar dryer technology affected your household income?	No extent	9	10.5%
	Little extent	11	12.8%
	Moderate extent	13	15.1%

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	Great extent	27	31.4%
	Very great extent	26	30.2%

The findings in Table 4.11 indicate that on average per year, 33.7% of the studied farmers generated Kshs. 2000 – 5000 per year after processing chips from cassava dried through solar. Before this, 53.5% of the farmers reported that they were earning below Ksh 30,000 in a year. Encouragingly, an overwhelming 57% of cassava farmers shared that their household income was able to meet their basic needs since they started processing their cassavas using solar dryers. At the same time, 31.4% of the respondents noted that use of solar dryer technology had affected their household income to a great extent.

Regression Results

The researcher conducted a regression analysis to predict the effect of utilization of cassava solar drying technologies on economic wellbeing of small-scale cassava farmers in Teso-South Sub-County of Busia County.

Table 4.12: Model Summary

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.751	.565	.553	.02804

Table 4.12 shows that utilization of cassava solar drying technology was strongly correlated with economic wellbeing of small-scale cassava farmers in Teso-South Sub-County of Busia County (R=0.751). Furthermore, 55.3% variation in economic wellbeing of small-scale cassava farmers in Teso-South Sub-County of Busia County is explained utilization of cassava solar drying technology since Adj. $R^2 = 0.553$.

The ANOVA results of the study were determined and summarized as shown in Table 4.13

Table 4.13: Analysis of Variance (ANOVA)

	Sum of Squares	**Df.**	**Mean Square**	**F**	**Sig.**
Regression	.148	1	0.148	74.001	.000
Residual	.114	84	0.002		
Total	**.262**	**85**			

The findings in Table 4.13 indicate that the overall regression model that was adopted in this study was significant (F=74.001, P<0.05).

The findings on beta coefficients and significance are shown in Table 4.14

Table 4.14: Beta Coefficients and Significance

	Unstandardized Coefficients		**Standardized Coefficients**	**T**	**Sig.**
	B	**Std. Error**	**Beta**		
(Constant)	9.948	1.880		5.292	.000
Utilization of Cassava SolarDrying Technology	.137	.053	.127	2.585	.011

Based on the findings in Table 4.14, the following regression model is predicted:

$$\mathbf{Y = 9.948 + 0.137X_1 + \varepsilon}$$

Where:

Y = small-scale cassava farmers' incomes

X_1 = Utilization of Cassava Solar Drying Technology

The study set out to determine how utilization of cassava solar drying technology affects the economic well-being of small-scale cassava farmers' inTeso-South Sub-County of Busia County. The findings were ($\beta = 0.137$, $p<0.05$), which implies that the adoption of cassava solar drying technology had a significant effect on the economic well-being of small-scale cassava farmers.

CONCLUSION AND RECOMMENDATIONS

Cassava solar drying technology utilization by small scale cassava farmers in Teso South Sub-County, Busia County significantly predicted their economic wellbeing. The study also concluded that the solar dryers were mostly hired and those who owned obtained them from NGOs. The processing capacity was limited and accounted for little to no changes in terms of income earnings of the cassava farmers and most of the respondents did not get a chance to use solar dryers and observe their performance before embracing them. The study makes these recommendations:

1. The Government of Busia County together with non-governmental organisations should encourage small scale cassava farmers to organize themselves into self-help groups and community-based organizations (CBOs) where they can enjoy economies of scale or easily borrow money to acquire their own solar dryers or set up more aggregation centres with large scale solar driers and cassava products processing machinery.
2. When acquiring dryers for small scale cassava farmers more focus should be on their processing capacity and the farmers should be given a chance to use solar dryers and observe their performance before embracing them. Widespread use of dryers and large-scale processing of cassava products should be encouraged to enhance incomes of farmers and offer opportunities for diversification of cassava products.
3. There is a need for support from the county government, national government, Kenya Agricultural, and Livestock Research Organization, NGOs and farmers groups to commercialize the crop and focus on market-led production and processing activities. The farmer groups will give them the bargaining power and get strategically linked to buyers thus spurring rural development in Busia County in general and Teso South Sub-County in particular.

RESEARCH LIMITATION AND DIRECTION FOR FUTURE STUDIES

The study's geographical location was vast it needed help from research assistants. The low education level(illiterate and semi-literate) of the farmers meant the need for translation to the local language. Future studies can cover other regions such as coastal region where cassava is grown and consider additional factors that contribute to economic wellbeing of small-scale cassava farmers.

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