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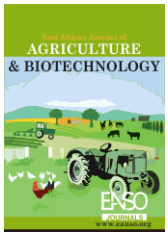

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Original Article

Assessment of the Economic Suitability of Indoor Storage for White-Coloured Sweet Potatoes Roots Under Tanzania Conditions

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Cost, Indoor Storage, Net Profit, Sales, Sweet Potato Roots.

ABSTRACT

The study aimed to reduce sweet potato postharvest losses while increasing income from sweet potato-based products in Morogoro, Tanzania. The economic suitability of indoor storage technologies for the storage of white-coloured sweet potato roots under Tanzania conditions was assessed. The sample was composed of sweet potato marketers and traders in Morogoro, Tanzania. They were selected after an extensive sampling procedure done step-wise. The first step involved using Kothari's recommended purposive sampling method to select wards. Simple random sampling was used in the second step to choose the markets, and the snowballing sampling approach was used in the third stage to choose the respondents. A total of 160 sweet potato vendors (from four markets in four wards) were selected. Data collected were the cost of labour, cost of purchasing and transportation of white-coloured sweet potato roots and the selling price of white-coloured sweet potato roots to determine net income. Data were analysed using cost-benefit analysis. Results indicate that traders' source of funding for their sweet potato selling activity was own/self-financing, estimated at 70%, loans estimated at 19.37%, and remittances estimated at 10.63%. Also, the study's findings demonstrate that the single and multi-stage channel systems are the two main sweet potato marketing channels. Retailers constitute 57.5% of respondents, wholesalers 27.5%, and other trades (Middlemen/SMEs processors) 15%. Furthermore, a study indicated that 21% of traders produce sweet potatoes on their farms, and 97% of merchants purchase sweet potatoes directly from farmers. Also, 42% purchase sweet potatoes through wholesalers/aggregators. Results continued to reveal that by using ventilated bags storage technology, farmers and traders could earn higher profits which were Tsh 19,000/= more than other storage technologies (improved traditional raised bamboo buckets and woven Polypropylene Bags. Cost-benefit analysis showed that farmers and traders could earn a net profit of Tsh 13,000/= after selling sweet potato roots stored in woven polypropylene Bags. Selling the roots, which were stored using bamboo buckets for 60 days, the net profit was Tsh 7,000/=. Also, farmers and traders incurred a net loss of Tsh 35,000/= for sweet potatoes for 60 days in improved traditional raised platforms. Therefore, the study recommended that ventilated bags are proper storage technologies for white-coloured sweet potato root. Their use will assist farmers and traders to reduce losses and hence improve profitability.

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INTRODUCTION

Sweet potatoes are grown for both subsistence and commercial purposes (Foley *et al.*, 2021). The majority of Tanzanians grow and consume sweet potatoes as one of their main staple food crops (United Republic of Tanzania [URT], 2021). Tanzania is the fifth-largest producer of sweet potatoes in the world (Jones *et al*., 2012), with a total of 1,076,320 farmers engaged in production, out of which 1,040,772 (96.7%) are in the mainland and 35,549 (3.3%) in Zanzibar islands (United Republic of Tanzania [URT], 2017). Sweet potato roots contain vitamins A, C and minerals but are also a good source of calories that benefit human health (Senthilkumar *et al*., 2020).

Sweet potato is one of Tanzania's major crops with good export potential if postharvest degradation and storage losses are effectively controlled. Besides, sweet potato marketing opportunities abound and demand for sweet potato roots, particularly in urban areas, is high (Nabay *et al.*, 2020). However, farmers, traders, and consumers in Tanzania remain confronted with major challenges such as soft rot and physiological changes (reduction of starch and increase in sugars and dextrin) in extending the shelf life of the roots (Jones *et al*., 2012). Furthermore, improper produce handling contributes significantly to sweet potato postharvest losses (Okoth, 2021). Processing and appropriate storage constitute some of the measures to minimise postharvest losses, including decay. To minimise decay losses, traders and farmers frequently sell their sweet potato produce within 1-2 weeks of harvesting as the only solution and hence avoid investment in storage (Sugri, Kusi, *et al*., 2017). The adoption of good storage technology has generated promising results in terms of extending the shelf life of sweet potatoes and as a result increasing the profit of roots after product sales (Nabay *et al.*, 2020). The study is set to assess the economic suitability of indoor storage technologies for storing white-coloured sweet potato roots under Tanzania conditions to reduce postharvest losses and increase profitability. The results will be used to assist farmers and traders in selecting proper indoor storage technology for reducing losses and hence profitability.

MATERIALS AND METHODS

Study Locations

The four main markets in Morogoro, Tanzania, are representative of other markets. The markets that were included in the study are Mawenzi Market from the Uwanja wa Taifa ward, Mji mpya Market from Mji mpya ward, Mazimbu Market from the Mazimbu ward and Chief Kingalu Market from the Sultan area ward. High sales of sweet potato roots served as the basis for choosing those markets.

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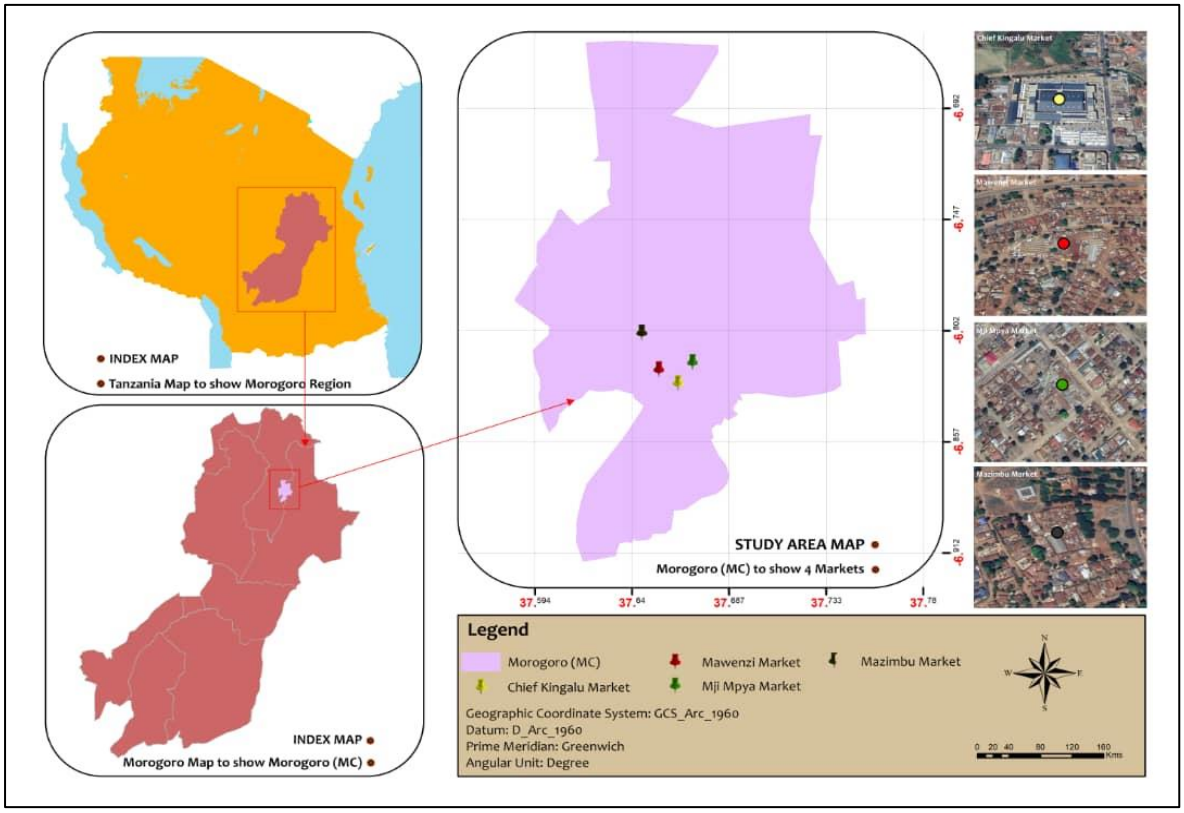
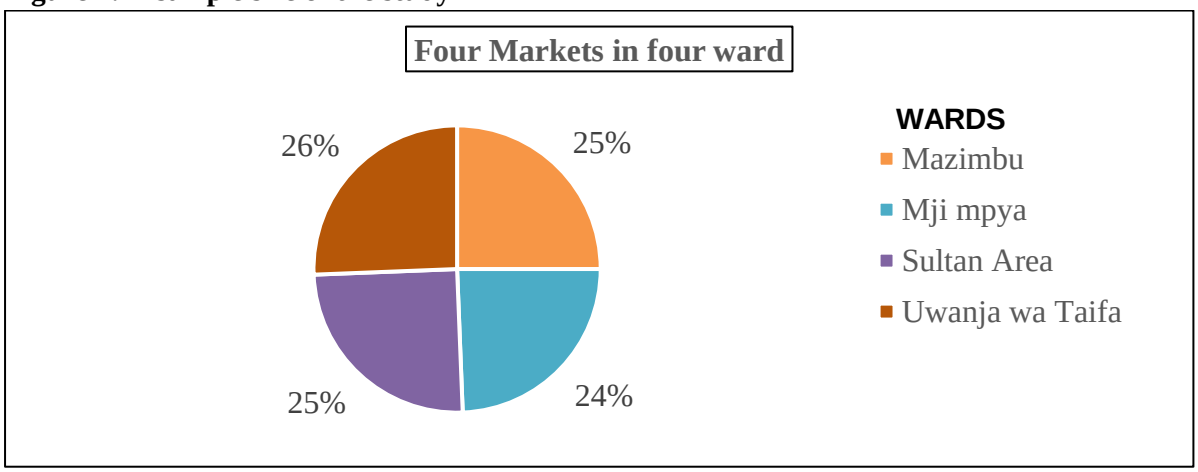
Figure 1: Morogoro Municipal map showing four markets



Sampling Frame, Selection Procedure and Size

The sample was composed of sweet potato marketers and traders in Morogoro, Tanzania. They were selected after an extensive sampling procedure done step-wise. The first step involved using Kothari's recommended purposive sampling method to select wards. Simple random sampling was used in the second step to choose the markets, and the snowballing sampling approach was used in the third stage to choose the respondents. In addition, market chairpersons participated in the suggestions of traders of sweet potatoes and their locations. The snowball sampling technique is frequently utilised in populations that are difficult for scientists to approach and are disguised populations (Atkinson & Flint, 2015). While there were a few dispersed sweet potato traders in Morogoro, Tanzania, the majority of those who were traders throughout the data-collecting period were included in the research. A total of 160 sweet potato vendors (from four markets in four wards) were selected.

Figure 2: A sample size of the study



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Data Collection

To gather adequate and accurate information from traders, both primary and secondary data were collected for this study. Secondary data were collected through scientific evidence and statistical abstracts utilised as supplementary data sources, while primary data included both qualitative and quantitative acquired through individual interviews (140 sweet potato vendors) and personal observation (20 sweet potato vendors). The Census and Survey Processing System (CSPro 6.3) software program was used to conduct the one-on-one interviews on an Android smartphone. General trading activities, distributional market channels, and profitability coefficients were among the several types of information gathered.

Data Analysis

Statistical Analysis Systems (SAS 9.3), Microsoft Excel 2010, and Statistical Package for the Social Sciences (IBM SPSS Statistics 21) were used to analyse collected data from each marketer's interview for analysis using analytical tools. The study also calculated Net profit using straightforward budgeting approaches**.** Total sales were obtained by multiplying the number of packed white-coloured sweet potato roots in storage technology and the market price at the time of selling. The net profit was obtained by deducting the total cost from the total sales of white-coloured sweet potato roots at the market.

NET PROFIT=Sales- (fixed cost +operation cost)

RESULTS

Source of Funds in Sweet Potato Trading Activities

During the baseline survey, it was observed that traders in Morogoro Municipality were getting funds from different sources. Results indicate that trader's source of funding for their sweet potato selling activity was own/self-financing, estimated at 70%, loans estimated at 19.37%, and remittances estimated at 10.63%

Table 1: Traders' source of funds in sweet potato trading activities in Morogoro municipality

Source	Market				Total	%	chi-square	p-value
	Mazimbu	Mji Mpya	Chief Kingalu	Mawenzi				
Loan	10	6	8	7	31	19.37	1.3568	0.716
Own/Self-finance	26	30	30	26	112	70	2.6892	0.442
Remittance	4	3	2	8	17	10.63	5.1126	0.164

From Chi-square (Pearson value) statistical analysis, *Table 1* above shows there were significant differences ($p<0.01$) in traders' source of funds in sweet potato trading activities between own/self-finance and remittances. Also, results show that there were no significant differences in the case of loans as Traders' source of funds in sweet potato trading activities.

Sweet Potato Roots Distributional Channels in Morogoro Municipal, Tanzania

Table 2 depicts the sweet potato marketing channels. In both rural and urban markets, sweet potatoes are distributed or marketed via the actions of several players. The study's findings demonstrated that the single and multi-stage channel systems were the two main sweet potato marketing channels. Retailers constitute 57.5% of respondents, wholesalers 27.5%, and other trades (Middlemen/SMEs processors) 15%.

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Table 2: Sweet potato roots distributional channels in Morogoro, Tanzania

Source	Market				Total	%	chi-square	p-value
	Mazimbu	Mji Mpya	Chief Kingalu	Mawenzi				
Other traders (Middlemen/ SMEs processors)	5	7	3	9	24	15	3.7805	0.286
Retailers	24	21	27	20	92	57.5	3.2278	0.358
Wholesalers	11	11	10	12	44	27.5	0.1994	0.978

From the Chi-Square Test, the results show that there were no significant differences (P>0.01) in sweet potato roots distribution channels (Other traders (Middlemen/SMEs processors and Retailers). For the case of Wholesalers, there are no significant differences (*Table 2*).

Traders' Source of Bought Sweet Potato

In this study, traders' source of bought sweet potatoes is described in *Table 3*, indicating that 21% of traders produce sweet potatoes on their farms. Furthermore, 97% of merchants purchase sweet potatoes directly from farmers. Also, 42% purchase sweet potatoes through wholesalers/aggregators.

Table 3: Sweet potato roots traders' source of bought in Morogoro, Tanzania

Source	Market				Total	chi-square	p-value
	Mazimbu	Mji Mpya	Chief Kingalu	Mawenzi			
Direct from farmer	24	21	29	23	97	3.4723	0.324
Wholesaler/Aggregator	10	13	11	8	42	2.0368	0.565
Own farm	6	5	0	10	21	10.7329	0.013

Cost-Benefit Analysis

The cost-benefit analysis was done, and the economic aspects of proper postharvest storage technology were justified/ presented. *Tables 4, 5, 6* and *7* show the fixed cost, operation cost, sales and net profit generated from the sale of sweet potato roots. Using ventilated bags storage technology, farmers and traders can earn more profit compared with other storage technologies, estimated at Tsh 19,000/= (*Table 3, 4, 5* and *6*).

Cost-benefit analysis has shown that farmers and traders get a net profit of Tsh 13,000/= after selling sweet potato roots when storing roots using woven Polypropylene Bags. Furthermore, when selling the roots, which were stored using bamboo buckets for 60 days, the net profit was Tsh 7,000/=. Also, farmers and traders get a loss of Tsh -35,000/= when selling the roots after 77 days of storage on improved traditional raised structure as a storage technology.

Table 4: Cost-benefit analysis of using improved traditional raised

S/N	Item	Quantity	Unit	Price (TZS)	Total (TZS)
A	FIXED COST				
	sweet potato roots	3	Tin	14,000	42,000
	Sub Total				42,000
B	OPERATION COST				
	Transport cost	3	Tin	4,000	12,000
	Storage equipment cost	3	Pc	10,000	30,000
	Labour cost	1	Person	2,000.00	2,000
	Sub Total				44,000

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S/N	Item	Quantity	Unit	Price (TZS)	Total (TZS)
C	SALES				
	Sales of sweet potato roots after storage	3	Tin	17,000	51,000
	Sub Total				51,000
D	NET PROFIT	on cost)			
	Sales- (fixed cost + operation cost)				-35,000

Table 5: Cost-benefit analysis of using bamboo buckets

S/N	Item	Quantity	Unit	Price (TZS)	Total (TZS)
A	FIXED COST				
	sweet potato roots	3	Tin	14,000	42,000
	Sub Total				42,000
B	OPERATION COST				
	Transport cost	3	Tin	4,000	12,000
	Storage equipment cost	3	Pc	1,000	3,000
	Labour cost	1	Person	2,000	2,000
	Sub Total				17,000
C	SALES				
	Sales of sweet potato roots after storage	3	Tin	22,000	66,000
	Sub Total				66,000
D	NET PROFIT	on cost)			
	Sales- (fixed cost + operation cost)				7,000

Table 6: Cost-benefit analysis of using woven Polypropylene Bags

S/N	Item	Quantity	Unit	Price (TZS)	Total (TZS)
A	FIXED COST				
	sweet potato roots	3	Tin	14,000	42,000
	Sub Total				42,000
B	OPERATION COST				
	Transport cost	3	Tin	4,000	12,000
	Storage equipment cost	3	Bags	1,000	3,000
	Labour cost	1	Person	2,000.00	2,000
	Sub Total				17,000
C	SALES				
	Sales of sweet potato roots after storage	3	Tin	24,000	72,000
	Sub Total				72,000
D	NET PROFIT	on cost)			
	Sales- (fixed cost + operation cost)				13,000

Table 7: Cost-benefit analysis of using ventilated bags

S/N	Item	Quantity	Unit	Price (TZS)	Total (TZS)
A	FIXED COST				
	sweet potato roots	3	Tin	14,000	42,000
	Sub Total				42,000
B	OPERATION COST				
	Transport cost	3	Tin	4,000	12,000
	Storage equipment cost	3	Bags	1,000	3,000
	Labour cost	1	Person	2,000.00	2,000
	Sub Total				17,000

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S/N	Item	Quantity	Unit	Price (TZS)	Total (TZS)
C	SALES				
	Sales of sweet potato roots after storage	3	Tin	26,000	78,000
	Sub Total				78,000
D	NET PROFIT	on cost)			
	Sales- (fixed cost + operation cost)				19,000

DISCUSSION

Source of Funds in Sweet Potato Trading Activities

The origin of sweet potato traders' funds at the beginning of a business transaction is regarded as the source of funds. The majority (70%) of the sweet potato traders depended on their own funding/Self-finance as the source of trading funds. This result agrees with the prior findings by Nabay *et al*. (2020) in Sierra Leone, which shows that the majority of sweet potato traders own the trading fund

Sweet Potato Roots Distributional Channels in Morogoro Municipal, Tanzania

The sweet potato's several (alternative) pathways from the producer to the buyer are depicted in *Table 2* (marketing channel). There are both single-stage and multi-stage sweet potato marketing channels in the study area. The movement of sweet potato goods from the producer directly to the customer, without the use of intermediaries, constitutes a single channel. Before reaching the end user, the multi-stage channel system goes via middlemen (intermediaries). This is similar to the findings of Tewe *et al.* (2003) in Nigeria, which indicate that in sweet potato producers' option to sell directly to wholesalers and retailers, all three kinds of intermediaries have mutually agreed upon their usage.

Cost-Benefit Analysis

The value of ventilated bags using CBA in the storage of sweet potatoes emanates confidence in recommending that farmers use this method rather than other methods and their CBA values obtained in research. It was evident that using ventilated bags during storage loss can be reduced compared with other storage techniques and the roots are safe for selling and hence profit maximisation. This is similar to the findings of Chakraborty *et al.* (2017) in India, which show that maintaining root quality and ensuring an adequate quantity throughout the year is the main objective of proper storage, which is accomplished by reducing losses. When losses reduce, profits may also be created. Also, findings showed that when using an improved raised platform for storage of white-coloured sweet potato roots causes a reduction in quality hence a loss of profit. This is consistent with the findings of Mpagalile *et al.* (2007) in Tanzania, which indicated that raised platform was unsuitable for storing sweet potato roots for a long time since it causes storage losses and tends to make it unprofitable. Similarly, the findings of Sugri *et al.* (2017) in Ghana showed that improved-traditional methods of storage are practised, including raised platform results but caused extreme losses and hence unprofitable. Net profit per selling of a 50 kg bag of sweet potato roots (shown in *Tables 4, 5, 6* and *7*) is higher than others. This demonstrates how profitable and lucrative sweet potato trading is. This is in line with the findings of Amengor *et al*. (2017) in Ghana, Nyiatagher and Monica (2017) in Nigeria and Nabay *et al*., (2020) in Sierra Leone who state that sweet potato root trading is a commercially viable and financially beneficial business venture worth investing in.

CONCLUSION

This study summarised the assessment of the economic suitability of indoor storage technologies for the storage of white-coloured sweet potato roots under Tanzania conditions where practicable and profitable storage technology procedures for farmers and traders were identified. In the cost-benefit analysis, the net profit of ventilated bags storage technology was higher than other storage technologies

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(improved traditional raised bamboo buckets and woven Polypropylene), indicating that the sweet potato root trading business is profitable. The adoption of good storage technology has generated promising results in terms of prolonging the shelf life of sweet potatoes and as a result, increasing sweet potato root's profit after product sales. The results will be used to assist farmers and traders in selecting proper indoor storage technology for reducing losses and hence profitability**.**

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