

The Effect of Banana Value Addition on Food Security and Household Income among Banana Farmers in Bubare Sub-County, Mbarara District.

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Abstract

Background

This study examined the effect of banana value addition on food security and household income among banana farmers in Bubare Sub-County, Mbarara District.

Methods

The study employed a mixed-methods design. A sample size of 162 respondents selected from banana-farming households was selected using the formula of Kish and Leslie (1965). Data were collected through the use of questionnaires and key informant interviews. Quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS), and qualitative data were analyzed thematically.

Results

The majority of the respondents were male (57.4%) and female (42.6%); most 22.8% of respondents had primary level of education, followed by 18.5% who had completed ordinary level of education, and the least completed post-secondary education (5.6%). The results further revealed that 50.0% of farmers engaged in banana value addition, mainly through production of local banana beer (29.6%), flour (16.0%), wine (12.3%), and juice (11.1%). Other practices included drying, biscuit production, and animal feed preparation. Regression analysis indicated that households practicing value addition were 4.8 times more likely to achieve food security than non-adopters (OR = 4.812, $p < 0.001$).

Conclusion

The study concludes that banana value addition contributes significantly to household food security, but its income effect remains transitional, as raw banana sales continue to yield higher median incomes for non-adopters.

Recommendation

The study recommends that extension services should be reoriented toward post-harvest processing, with gender-sensitive approaches to address disparities in adoption.

Keywords: Banana Value Addition, Adoption, Food Security, Household income

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Introduction

From a global perspective, bananas are indeed a global commodity, with significant economic and nutritional importance (FAO, 2020). According to the Food and Agriculture Organization (FAO), bananas are the fourth most important food crop in the world, with over 150 million tons produced annually (FAO, 2020). However, despite their widespread consumption, smallholder farmers, particularly in the Global South, often face challenges such as low income and limited market access. Value addition initiatives have been implemented globally to address these challenges and improve food security and income generation among farmers (FAO, 2020). For example, in countries like India and Ecuador, banana processing industries have emerged, producing a wide range of products such as banana chips, juices, and purees (Dev &

Pandey, 2019; FAO, 2020). These value-added products not only fetch higher prices in the market but also contribute to reducing post-harvest losses and creating employment opportunities along the value chain.

On a continental perspective, in continents like Africa, Asia, and Latin America, where bananas are staple crops, value addition initiatives are gaining momentum as a means to enhance food security and income generation. For instance, in East Africa, the East African Community (EAC) has prioritized regional cooperation in the banana sector to promote value addition and trade (EAC, 2021). Through initiatives like the East African Community Trade Development Program, countries such as Uganda and Tanzania are working together to address common challenges and unlock the potential of the banana value chain. Similarly, in Latin America, countries like Costa Rica

and Ecuador have made significant investments in banana processing and value addition technologies (Herrera & Bertrand, 2019).

From a regional perspective, within specific regions like East Africa and Central America, regional collaboration is essential for maximizing the benefits of value addition in the banana sector. For example, in Central America, the Central American Agricultural Council (CAC) has supported initiatives to strengthen the banana value chain and promote regional trade (CAC, 2020). Through programs like the Regional Plan for Sustainable Agriculture, countries such as Honduras and Guatemala are working together to improve productivity, quality, and market access for bananas.

From a national perspective, Uganda is a major producer of bananas in Africa, with bananas being a staple crop and a significant source of income for millions of smallholder farmers across the country (FAO, 2020). Uganda's government plays a crucial role in promoting value addition in the banana sector through supportive policies and investments. For instance, in Uganda, the government has established the Presidential Initiative on Banana Industrial Development (PIBID) to promote value addition and increase income for banana farmers (Nampala et al., 2019). Through initiatives like the Banana Livelihoods Diversification Project, Uganda aims to enhance the competitiveness of its banana sector and improve food security for rural communities (Kasenge et al., 2020). Despite the importance of bananas in Uganda's agricultural sector, farmers face various challenges that hinder their productivity and profitability. These challenges include low market prices for raw bananas, high post-harvest losses, limited market access, and food insecurity (Kasozi, 2019).

Bubare sub-county, located in Mbarara district, banana farming is a primary livelihood activity, contributing to food security and income generation for many smallholder banana farmers (Kasozi, 2019). Bananas are a staple crop in the local diet and a significant source of income for households in the area (Nakazibwe et al., 2021). The sub-county's economy is predominantly agrarian, with agriculture being the mainstay of livelihoods for the majority of the population. The study aimed to investigate the effectiveness of banana value addition on food security and income generation among banana farming households.

Research objective.

To analyse the perceived effect of banana value addition on food security and household income generation among farmers in Bubare sub-county, Mbarara district. The study specifically focused on banana value addition practices and products produced to improve food security and household income generation among farmers in the study area.

Materials and methods

Study area

The study was conducted in Bubare sub-county in Mbarara City. The study was conducted in Mbarara City, located in the western region of Uganda. Mbarara City is located in

southwestern Uganda, serving as one of the country's prominent urban centers. The city is strategically positioned along the major highway that connects Uganda to Rwanda, making it a key commercial and transportation hub in the region. Geographical Coordinates include: Latitude: 0.6077° S and Longitude: 30.6582° E. Mbarara City is surrounded by several districts that contribute to its regional importance. It neighbours Isingiro District to the southeast, Kiruhura District to the northeast, which is a key area for dairy farming and cattle rearing, Ibanda District to the northwest, Sheema District to the west, and Rwampara District to the southwest.

Mbarara District is located in southwestern Uganda and has historically been one of the country's major agricultural districts, with a rural economy largely dependent on crop and livestock farming. The district had a high population engaged in agriculture, with a significant proportion of households relying on farming as their primary source of livelihood (UBOS, 2019). Agriculture contributed substantially to household incomes and local economic development, with both subsistence and commercial farming systems being practiced.

Study design

The study adopted a mixed-methods research design, combining both quantitative and qualitative approaches. The quantitative component involved the use of structured questionnaires administered to respondents in order to collect numerical data on banana value addition practices, income generation, and food security. The qualitative component involved focus group discussions, which provided in-depth insights into farmers' experiences, perceptions, and challenges related to banana value addition. This design was considered appropriate because it allowed the researcher to collect and analyze both numerical and descriptive data, thereby providing a more comprehensive understanding of the study problem. The integration of quantitative and qualitative data enhanced triangulation, improved the validity of findings, and enabled the study to capture both the extent of value addition practices and the contextual factors influencing their adoption among banana farmers.

Study setting

The study started on 5th March, 2025 and ended on 29th July, 2026.

Participants

Inclusion criteria

Households or individual farmers who were permanent residents and actively engaged in banana farming in Bubare Sub-County, Mbarara District. Participants who were active smallholder or commercial banana growers were included in the study.

The farmer or household either practiced or had basic awareness of and involvement in banana value-addition activities (such as ripening, sun-drying, flour milling, juice,

or wine processing). Participants who gave formal or verbal informed consent to take part in the survey or interviews were included in the study.

Exclusion criteria

Farmers who own banana plantations or process products outside Bubare Sub-County. Residents who engaged in general crop agriculture (such as cassava or maize) or livestock keeping but do not grow bananas. Farmers who were incapacitated, mentally unfit, or unwilling to provide informed consent. Temporary farm workers or non-resident landowners who do not manage or make decisions regarding the local household's food security and farm income.

Bias

Several safeguards were applied to minimize potential sources of bias. Selection bias was minimized through stratified and purposive sampling, ensuring proportional representation across the sampled population. Response and social desirability bias were mitigated by assuring respondents of anonymity and confidentiality, using standardized, pre-tested items, and triangulating quantitative data with qualitative accounts from key informants. Instrument bias was addressed through expert panel review (Content Validity Index = 0.92) and a Cronbach's Alpha reliability check prior to administration. The questionnaire was also pilot-tested to refine ambiguous items, and data collection followed a standardized drop-and-pick procedure to minimize interviewer-related variation.

Variables

Banana value addition is the process of changing raw bananas or banana plant parts into new, higher-value products to increase profits, extend shelf life, and reduce waste.

Household food security means every person in a home has continuous physical, social, and economic access to enough safe, nutritious food that fits their dietary needs.

Household income refers to the total monetary and in-kind earnings received by all members of a household over a specific period. This includes wages from jobs, profits from small businesses, earnings from farming (on-farm income), or remittances and aid (off-farm income).

Source of Data and Measurement of Study Variables

The study used both primary and secondary sources of data. Primary data were obtained directly from banana farmers in Bubare Sub-County, Mbarara District, using a structured questionnaire. The questionnaire collected information on banana value-addition practices, household food security, household income, and the socio-economic characteristics of the respondents. Secondary data were obtained from relevant reports, publications, and records from institutions such as the Uganda Bureau of Statistics (UBOS), Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), and Mbarara District Local Government. These sources

provided supplementary information concerning banana production, agricultural activities, household livelihoods, and food security.

The main independent variable of the study was banana value addition. This was measured based on the different activities undertaken by farmers to increase the value of bananas before consumption or sale. The activities considered included ripening, drying, processing bananas into flour, making banana chips, juice, or other products, grading, packaging, and improved storage. Information was obtained from farmers through the questionnaire.

Food security was one of the main dependent variables. It was measured using household-level indicators obtained from the respondents. These included the number of meals consumed by household members per day, availability of food, occurrence of food shortages, ability of the household to obtain sufficient food, and the period for which the household had adequate food supplies. Responses to these indicators were used to establish the food-security status of the households. A food-security score was developed from the responses, with higher scores indicating better household food security.

The second dependent variable was household income. This was measured by determining the income earned by the household from banana farming and other household economic activities. Particular attention was given to income obtained from the sale of fresh bananas and value-added banana products.

Study population

These included banana farmers, extension workers, community stakeholders, and other banana value-adding actors.

Sample determination and size

The sample size was determined using the standard statistical formula by Kish and Leslie (1965) at a 95% confidence level and a 5% margin of error. The use of a 95% confidence level ensured that the results of the study were reliable and could be generalized to the broader population with an acceptable level of certainty, while the 5% margin of error minimized sampling bias and improved precision of the estimates as follows as shown in equation (1);

$$n = \frac{Z^2 pq}{d^2} \quad \text{.....(1)}$$

where $N > 10,000$

$$\begin{aligned} n &= 1.96^2 \times 0.12 \times 0.88 / 0.05^2 \\ &= 3.8416 \times 0.1 \times 0.9 / 0.0025 \\ &= 0.4345 / 0.0025 \end{aligned}$$

$$n = 162 \text{ respondents.}$$

n - The sample size

Z- Constant value (1.96)

d - Degree of accuracy 0.05

p - Estimated number of value addition actors 12%

(0.12)

q – Non- value addition actors/utilizers 88% (0.88)
 α – 0.05 (level of significance)

Sampling techniques

Stratified random sampling was used to select respondents in Bubare Sub-county, Mbarara District. The population of banana farmers was first grouped into distinct strata based on relevant characteristics to ensure adequate representation of different categories of farmers in the study.

The first stratification was based on parish, where banana farming households were distributed across the parishes within Bubare Sub-county. The number of respondents selected from each parish was made proportional to the total number of banana farmers in that parish. For example, parishes with a higher proportion of banana farming households contributed a larger share of respondents compared to those with fewer farmers, ensuring proportional representation across the sub-county.

The second stratification was based on farm size, where farmers were categorized into small-scale, medium-scale, and large-scale banana producers depending on the size of their banana plantations.

A further stratification was based on engagement in value addition practices, where farmers were grouped into those who did not engage in value addition, those involved in basic processing (such as drying and flour production), and those engaged in more advanced processing activities such as packaging and branding. After determining the number of respondents required from each stratum, simple random sampling was applied within each group. Household lists obtained from local leaders and farmer associations were used as sampling frames. Respondents were then randomly selected to ensure that each eligible farmer within a stratum had an equal chance of being included in the study.

Purposive sampling was used to select key informants who possessed specific knowledge and experience relevant to banana value addition in Bubare Sub-county, Mbarara District. The researcher deliberately identified and included individuals such as agricultural extension officers, local leaders, and selected officials from farmer organizations because of their direct involvement in agricultural service delivery and knowledge of banana production systems. These respondents were selected based on their ability to provide detailed and reliable information regarding existing value addition practices, institutional support, challenges faced by farmers, and potential interventions for improving banana-based livelihoods.

Research instruments

A structured questionnaire was used to collect quantitative data from banana farming households in Bubare Sub-county, Mbarara District. The tool was designed in line with the study objectives and was administered to systematically capture information on banana production, value addition practices, and their implications for food security and household income. The questionnaire captured data on respondents' socio-demographic characteristics such as age, gender, and education level, as well as farm characteristics

including farm size and banana varieties grown. It also gathered information on the types of value addition practices undertaken by farmers, including processing activities, products produced, and methods used.

An interview guide was used to collect qualitative data from key informants in Bubare Sub-county, Mbarara District. Face-to-face interviews were conducted with selected respondents, including extension officers and local leaders, to obtain in-depth information on banana value addition practices, challenges faced by farmers, and possible improvement strategies. The interviews enabled the researcher to gather detailed and context-specific insights that complemented the quantitative data collected through questionnaires. They also provided an opportunity to obtain first-hand information from knowledgeable stakeholders involved in agricultural service delivery and rural development. Where respondents did not provide immediate or complete responses, probing questions were used to clarify issues and obtain more detailed and accurate information relevant to the study objectives.

Quantitative variables

Quantitative data in this study were analyzed using descriptive statistics to establish patterns and determine relationships.

Means and Standard Deviations were used to present continuous variables.

Frequencies and percentages were used for categorical data (for example, the proportion of farmers participating in value addition versus those selling raw bananas).

Ethical considerations

Ethical clearance was sought from the Bishop Stuart University Research Ethics Committee. Free and informed consent of each individual participant was obtained at the start of the study. Respondents read an informed consent form explaining the purpose of the study, what participation in the study involves, how confidentiality and anonymity would be maintained, the right to refuse to participate in the study or to withdraw from the study without any penalty, and the benefits and risks of participating in the study.

Respondents had the right to make autonomous decisions about their participation in research, and their dignity and rights should be respected throughout the research process. The researcher conducted research with honesty, integrity, and transparency, accurately reporting findings and acknowledging any conflicts of interest or biases.

The researcher recognized and respected cultural diversity, values, beliefs, and practices, ensuring that research activities are conducted in a culturally sensitive and inclusive manner. The researcher should be aware of and respect local customs, values, and norms in Mbarara District. This may involve adjusting the language or approach used in questionnaires and interviews to ensure they are culturally appropriate.

The researcher carefully considered any potential risks to participants, particularly when discussing sensitive issues

such as pollution levels, regulatory compliance, or environmental practices. These discussions could lead to discomfort or anxiety, especially if participants fear repercussions. The researcher ensured that the potential benefits of the study outweigh any risks to participants.

Qualitative responses captured using the interview guide were presented by reporting results in the form of verbatim statements.

Quantitative analysis was done using the Statistical Package for the Social Sciences version 22.0 (SPSS), which involves a series of steps to manipulate data, run statistical tests, and interpret results; results were presented in tables and figures.

Data analysis

Qualitative data were analysed through the use of content analysis, which involves systematically examining data to identify patterns, themes, and meanings within the content.

Study results

Table 1. Descriptive Statistics for Age and Other Continuous Variables

Variable	N	Minimum	Maximum	Mean	Std. Dev.	Median
Age (years)	162	19	73	41.87	11.50	42.50
Education (years)	162	0	17	8.77	4.00	9.00
Household Size	162	2	9	6.17	1.81	6.00
Banana Acreage (acres)	162	0.25	4.52	1.79	0.86	1.85
Distance to Market (km)	162	0.30	12.00	3.59	2.45	3.20

Source: Primary Data, 2026

The age of the participants ranged from 19 to 73 years, with a median age of 42.50 years and a mean age of 41.87 years (SD = 11.50) (Table 1). The majority of respondents were in the economically successful adult age range, as indicated by an interquartile range which ranged from 34.25 to 49.00 years.

The educational achievement of the participants was measured in completed years of formal schooling. The average level of education was 8.77 years (SD = 4.00), roughly equivalent to finishing primary school. Nine years was the median. Nine of the participants (5.6%) had completed 17 years of post-secondary education, whereas 7 participants (4.3%) had no formal education. The modal group was 7 years of schooling (22.8%), which is equivalent to finishing primary school, followed by 9 years (18.5%)

and 11 years (18.5%), which are equivalent to finishing the O-level.

With a range of two to nine individuals, the average household size was 6.17 (SD = 1.81). The median household size was 6 persons. More food demand and more job opportunities for value-adding activities may result from larger households, putting pressure on banana production and marketing.

With a minimum of 0.25 acres and a maximum of 4.52 acres, banana farming occupied an average of 1.79 acres per family (SD = 0.86). The median acreage was 1.85 acres. Although a significant amount of output seemed to enter both raw and processed commodities markets, these smallholder farm sizes suggested that banana cultivation was primarily focused on sustenance.

Table 2. Banana Value Addition Practices Most Frequently Adopted

Value addition Practice	Frequency (n=81)	Percentage (%)
Tonto/local beer	24	29.6
Banana flour production	13	16.0
Wine processing	10	12.3
Juice production	9	11.1
Animal feed preparation	8	9.9
Banana drying	7	8.6
Chips making	4	4.9
Banana biscuits	4	4.9
Banana crisps	2	2.5
Total	81	100.0

Source: Primary Data

The study results reveal that 81 farmers reported participating in value addition; the most commonly carried out value addition activity was the processing of tonto (local

banana beer), which was reported by 24 participants (29.6% of value adders) (Table 4.4). The processing of banana flour (16.0%), wine processing (12.3%), juice (11.1%), animal

feed preparation (n = 8, 9.9%), banana drying (8.6%), chips (4.9%), banana biscuits (4.9%), and banana crisps (2.5%) came next. The predominance of “tonto” production was a result of both the inexpensive capital requirements for this

business compared to more scientifically demanding operations like flour milling or juice extraction, as well as the cultural entrenchment of local banana alcoholic beverages in the area.

Table 3. Value-Added Banana Products Currently Produced

Product	Frequency (n=81)	Percentage (%)
Banana-based animal feed	23	28.4
Dried banana	18	22.2
Banana wine	16	19.8
Banana crisps	10	12.3
Banana juice	9	11.1
Banana flour	5	6.2
Total	81	100.0

Source: Primary Data, 2026

The value-added banana goods that respondents were currently manufacturing were another question posed to them. The most processed product was animal feed made from bananas (28.4%), which was followed by dried bananas (22.2%), banana wine (19.8%), banana crisps (12.3%), banana juice (11.1%), and banana flour (6.2%). The prevalence of animal feed production indicated that many producers had embraced value enhancement as a by-product feed system rather than for direct human consumption or financial markets, perhaps combining the processing of bananas with livestock raising operations. Dried bananas and banana wine were also significant, indicating that practicing farmers are diversifying their product mix.

Discussion

The findings demonstrate that banana value addition among the farmers was dominated by traditional and relatively accessible processing activities, particularly tonto production. The finding is consistent with MAAIF (2020) in Uganda, that identify brewing as an important form of banana value addition among smallholder farmers. However, the proportion of farmers involved in tonto processing in the present study (29.6%) was higher than the 12% reported by previous research, suggesting that the practice may be particularly important in the study area. Rietveld (2013) similarly observed that banana beer and spirit production constitutes an important livelihood activity within Uganda's smallholder farming systems and that the associated value chain is largely local.

The relatively lower participation in flour, juice, wine, chips, biscuits and crisps may reflect greater requirements for capital, processing equipment, technical skills, food-safety compliance and access to formal markets. This interpretation is supported by Natukwatsa (2021), who identified inadequate capital and limited extension services as major constraints to banana value-addition adoption among smallholder farmers in Bushenyi District.

The 9.9% involvement in animal-feed preparation is also important because it demonstrates that farmers are finding

alternative uses for bananas and banana residues. This has implications for reducing post-harvest losses, which are a major problem in banana production because of the crop's perishability. This finding is in agreement with Nalunga et al. (2015), who identified high post-harvest losses as an important challenge in Uganda's cooking-banana value chain and highlighted value addition as an opportunity for reducing physical and economic losses. Similarly, FAO (2022) notes that in western Uganda farmers may discard bananas or feed them to animals during periods of market oversupply and emphasizes value addition as a means of extending shelf life and increasing farmer incomes.

Generalizability of the Study

The study findings are expected to have moderate generalizability, particularly to banana-growing households in Mbarara District and other parts of southwestern Uganda where farmers operate under comparable production and marketing conditions.

The study is likely to provide useful insights into how banana value addition activities, such as processing bananas into products such as banana flour, chips, juice, wine, or other marketable products, influence household income and food security. Farmers in other banana-producing areas who have similar access to markets, agricultural extension services, processing technologies, credit facilities, and labour may experience effects comparable to those observed in Bubare Sub-County. Therefore, the findings may provide a useful basis for understanding the potential contribution of banana value addition to food security and income.

However, generalization should be made with caution because the study is geographically limited to Bubare Sub-County, Mbarara District, and the characteristics of farmers in this area may differ from those in other districts. Differences in soil conditions, banana varieties, production levels, market access, household characteristics, infrastructure, access to finance, technology, and government support may influence the effectiveness of value addition. Consequently, the findings should not

automatically be generalized to all banana farmers in Uganda without considering these contextual differences.

Conclusion

The study demonstrates that banana value addition practices contribute significantly to food security, with value-added households more likely to achieve year-round sufficiency. This confirms the role of processing in mitigating seasonal shortages and price fluctuations. However, the income effect remains ambiguous. Farmers who did not engage in value addition reported higher median incomes from raw banana sales, suggesting that value addition has not yet reliably outperformed raw sales returns.

Study limitations

Access to respondents was a limitation, as some key informants such as extension officers and local leaders were not readily available during the data collection period. Similar challenges were reported by Kasozi et al. (2019) in studies on agricultural extension access in Uganda. Response bias was another limitation, where some respondents tended to provide socially desirable answers rather than accurate information, a challenge also noted by Tourangeau and Yan (2007) in survey-based agricultural studies. Language barriers were also experienced, particularly among older farmers who were more comfortable in the local language.

Recommendations

Extension services should be reoriented toward post-harvest processing, with practical, product-specific training in juice extraction, flour milling, drying, and packaging. Institutions such as the Uganda Industrial Research Institute should provide specialized training at sub-county level. Subsidized machinery provision and cooperative equipment-sharing programs should be promoted, focusing on technologies aligned with high-revenue products such as drying, fermentation, and juice extraction. Market linkage programs should connect farmers to urban traders and institutional buyers, while cooperative advertising contracts can reduce price volatility. Government frameworks for banana value addition should be strengthened through designated financing for processing infrastructure, decentralized implementation, and systematic farmer awareness campaigns. Policies should prioritize post-harvest conversion alongside production growth, given the observed negative relationship between acreage and adoption.

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Declaration of conflict of interest

The authors declare no conflict of interest during the research process.

List of Abbreviations

Dr:	Doctor
EAC:	East African Community
FAO:	Food Agricultural Organization
MAAIF:	Ministry of Agriculture, Animal Industry and Fisheries
PIBID:	Presidential Initiative on Banana Industrial Development (PIBID)
Prof:	Professor
SD:	Standard Deviation
SPSS:	Statistical Package for the Social Sciences
UBOS:	Uganda Bureau of Statistics

Author biography

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Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Author contributions

Tukundane Grolious: Conceptualization, Investigation, Data collection, Formal Analysis, Writing Original draft, Visualization.

Prof. Edward Ssemakula: Supervision, Validation, Review & Editing.

DR. Stephen Lwasa: Supervision, Writing – Review & Editing

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