

# The Influence of Entrepreneurial Activities on Adoption of Tissue Culture Banana Seedlings in Tanzania.

Tumaini Steven, Prof Ghahula Raphael, Dr. Macha Salvio  
Open University of Tanzania (OUT) - Faculty of Business Management  
tumainisteve2018@gmail.com

## ABSTRACT

Banana is the world's most popular fruit, with an estimated global export value of 7 billion dollars per year; they are also one of the most domestic foods and are traded by Tanzania farmers. However, approximately 15% of the global banana production is involved in trade. The inadequate adoption of Tissue Banana Seedlings has led to the assessment of the Influence of Entrepreneurial Activities on the Adoption of Tissue Culture Banana Seedlings in Tanzania-Kilimanjaro particularly. The study adopted a positivism philosophy, a cross-sectional survey design, and purposive sampling techniques targeting 350 farmers. Questionnaires were used for data collection, Binary Logistic Regression was applied for data analysis, the results show Entrepreneurial significantly influenced the adoption of Tissue culture seedlings, and Tissue culture seedlings offer more business opportunities than local suckers. Therefore, the study recommends promoting Entrepreneurial activities towards the adoption of tissue culture banana seedlings in Tanzania and developing countries.

## Keywords: ←

Entrepreneurial;  
Banana; Seedling;  
Adoption;  
Tanzania.

## INTRODUCTION

Banana is a staple crop cultivated in 126 countries covering an area of 12.5 million acres throughout the tropics and sub-tropics. The annual production reported about 100 million tons, which ranks banana as the fourth most important crop in the world after rice, wheat, and maize and India is the largest producer of this crop (FAO, 2022). Bananas it is one of the main food crops and it is consumed across the world by about 400 million people Das, (2023). In Tanzania, the crop is the fourth most consumed crop for food and revenue generation for more than 30% of the total population Lucas, and Jomanga., (2021). In East Africa, Tanzania is the second banana producer after Uganda. The country has the highest world consumption rate between 280- 500 kg per person. Over the past half a century, developing countries, except Sub-Saharan Africa, have seen tissue culture Banana seedling technologies adopted at unmatched levels. Despite depending on agriculture, most sub-Saharan African countries are grappling with the challenge of food insecurity (Pinstrup-Andersen, and Cohen., (2000). The bottlenecks around the agriculture systems are associated with the lack of credit, limited access to quality seedlings, aversion to risk, inadequate farm size, inadequate incentives associated with farm tenure arrangements, insufficient human capital, absence of equipment to relieve labour shortages, chaotic supply of complementary inputs such as seed chemicals, and water, and inappropriate transport infrastructure (Feder et al., 2015).

The adoption of tissue culture banana seedlings in the agricultural systems in Asia and Latin America increased the production of bananas from 25,000 tonnes per hectare (ha) to 50,000 tonnes per hectare (Voora et al., 2020). Sub-Saharan Africa

continues to have very low levels of tissue culture Banana seedlings adoption and the available data indicate declining rather than increasing levels of adoption, even among the countries that were the early innovators, such as Kenya and Zimbabwe (Pingali, (2007); Thuo et al. (2017).

Although the horticulture industry in Tanzania contributes over 38% of foreign income earnings and is the fastest growing sector about 9-12% annually as a sub-sector within the agricultural sector (Lucas, and Jomanga., 2021). Smallholder farmers plant new fields with Banana suckers, and in turn, lower the adoption of tissue culture banana seedlings. In Tanzania like other developing countries in the world, farm entrepreneurs are confronted by several challenges that constrain the growth and development of the agriculture sector (Mbuga, 2019). As a result of the obstacles encountered by numerous developing nations, food that could be produced domestically is imported (URT, 2016; Mbuga, 2019; FAO, 2011).

In Tanzania, the propagation of the Banana seedlings system is characterised by both formal and informal plant material supply. Most small farmers engaging in growing bananas (*Musa* spp) get their seedlings from informal sources (Mavitiru, 2022). Consequently, the production of bananas dropped from 968,060 tonnes during the 2018/2019 season to 852,682 tonnes in the 2019/20 season. In the year, 2022 banana production in Kilimanjaro decreased to 732,662 tonnes from 968,060. The bananas are adversely affected by parasites and diseases particularly banana bunchy top disease (BBT), which is caused by a banana bunchy top virus and banana *Xanthomonas* Wilt (BXW). Banana diseases are transmitted by Banana suckers and it serves as vectors for the transmission of these diseases from one orchard to another (Tumaini et al., 2024; Joseph, 2022).

Banana bunchy top virus (BBTV, genus Babuvirus), an aphid-transmitted virus, was first reported in 2021 in the Buhingwe district in the Kigoma region of Tanzania. The virus is spread by banana aphid, *Pentalonia nigronervosa*, and through vegetative propagation from infected planting material. Following confirmation of the presence of the disease in Tanzania and evidence that the disease is spreading fast. Several measures have been taken by the Tanzania Horticulture Association (TAHA), The International Institute of Tropical Agriculture (IITA), the Tanzania Plant Health and Pesticides Authority (TPHPA), Tanzania Agricultural Research Institute (TARI) to inform the national and international community to appeal for collective actions to contain and combat BBTV in Tanzania (Shimwela, et al. 2022). The disease caused by this virus infection is termed a banana bunchy top disease (BBTD). The BBTV has no effective solutions. Preventing the virus has spreading and eradicating infected seedlings is the best strategy. The intervention against this challenge is the adoption of tissue culture Banana seedlings (Joseph, 2022).

The Tissue culture banana seedlings, in conjunction with other contemporary agricultural inputs and effective crop management techniques, have the potential to substantially augment crop yields and consequently stimulate the growth of banana productivity (Olumba & Onunka, 2020; Voora et al., 2020). Despite the significant nutritional and fruit value of bananas in Tanzania, the cultivation of banana fields by smallholder farmers in Kilimanjaro is limited to indigenous seedlings called suckers (Tumaini et al., 2024).

Nevertheless, it is a rare occurrence for farmers to embrace a specific technological advancement before completely comprehending the advantages it provides, according to analysts (Muyanga, 2019; Birch, 2018). While there are

producers who hold the view that tissue culture seedlings are not advantageous, there are others who consider them to be so for various reasons that require investigation and resolution. The significance of tissue culture in the banana field is contingent on several of the variables that affect producers' adoption of new technologies. Certain farmers exhibited a lack of enthusiasm toward implementing banana tissue culture (TC) due to their preference for planting indigenous suckers. Furthermore, farmers with a limited understanding of the introduced technology cited various reasons for their reluctance to plant TC (Kirimu et al., 2023).

While adopting Banana tissue culture seedlings is not the only component in a far-sighted banana yield increase strategy in Tanzania, it is often presented as the best solution and easily measurable its impact at the small-scale farmers level, and directly attributable interventions that many developing countries can readily follow. Therefore, private sectors, the International Institute of Tropical Agriculture (IITA), Tanzania Plant Health and Pesticides Authority (TPHPA), the Tanzania Agricultural Research Institute (TARI), Tanzania Horticulture Association (TAHA), international research centers, and non-governmental organizations throughout the developing world often prioritise the promotion of diseases free Banana seedlings.

However, the reality underlying the adoption of tissue culture Banana seedlings is far more complicated. There is a significant lack of entrepreneurial mindset in establishing a seedlings marketing system that continuously supplies improved Banana seedlings to small-scale farmers across diverse agro-ecologies and fragmented markets (Donovan et al., 2021). The Banana seedlings supply system needs long-term investments, in research culture laboratory and agronomy practice and the breeding systems for seed multiplication that supply affordable quantities of high-quality quality Banana seedlings to plant.

Policy decisions on how to build a modern Banana tissue culture seedlings industry and the science- the business of a seed system—must balance a complex set of societal and the country's economic balances. This includes allocating appropriate roles for the public and private sectors in the business, defining optimal levels of regulation, and distributing the gains from innovation across different actors in the value chain (Donovan et al., 2021). As a country's Banana seedlings system grows and values, these businesses become increasingly important to all industry actors. Tissue culture laboratories, entrepreneurs, seedlings companies, public research organizations, regulators, state extension services, farmers' organisations, and consumers are all needed in different stages in the value chain.

In recent years, some thought has been given to the Banana tissue culture seedlings business considering rapid changes in the fields of both technology and industry. These issues are raised in a series of studies on topics such as seed regulations and Seed Industry Analysis in Asia (Donovan et al., 2021). An Optimal Approach to Enhancing Banana Tissue Culture Amen et al. (2023). Quality Production of Planting Materials in Banana for Sustainable Food Production and the Alleviation of Malnutrition (Das, 2023). Income-Generating Macropropagation and Micropropagation of Plants (Preetha & Hemanthakumar, 2023). The Status, Challenges, and Opportunities of Plant Tissue Culture in Sri Lanka, Padukkage et al., (2023), among others. Every point illustrated in this discourse can be applied to ensure the consistent provision of superior banana seedlings and to determine the extent of interventions required to expand the banana seedling system in Tanzania.

The lack of clean sources of planting materials and the low involvement of entrepreneurs in the banana value chain affect the seedling's system. The Banana seedlings must be obtained from a reliable source. Enterprise will supply the registered seedlings to farmers with a higher class than the class the farmer has been growing from unreliable sources. Entrepreneurship theories have established different attributes that relate to the adoption of new technology by smallholder farmers, and they relate to Entrepreneurial activities and factors that influence farmers to adopt or not to adopt all new technologies (Schumpeter, 1934).

There is scholarly interest in identifying the influence of Entrepreneurial activities in the field of Agriculture He, (2022), among others, has discussed the importance of identifying the influence of entrepreneurial activity that adds value to the agriculture economy at the regional and national levels. By involving entrepreneurs, they will work and keep pace with seed demand in both the present and future in terms of quantity and quality, price, place and time, and other factors. Therefore, we propose a solution to these problems by involving various institutions and organisations.

The list includes Government institutions; Public sector organizations, Research and academic laboratories, and Institutions and Private sectors that can provide clean Banana seedlings. This method would uncover new ways that tap the full potential of tissue culture banana seedlings and increase the seedling's availability and yield, alleviating all the challenges that hinder the growth of the Banana sectors in the country. Therefore, this paper combs the concept of entrepreneurship influence in the adoption of tissue culture banana seedlings in Tanzania.

Previous literature argues that tissue culture banana seedlings are widely used in banana-growing countries to facilitate banana growers' targeting of commercial and domestic growers in low- and middle-income countries. The level of risk that farmers are willing and able to take when they use tissue-culture banana seedlings in developing countries is a big factor in whether they use them or not especially when the farmers are not aware of the newly introduced seedlings (Kirimi et al., 2023).

Schumpeter, theory has given a very fresh and unseen aspect of entrepreneurship and the core reasons or characteristics of entrepreneurs (Kurz, 2008). The term "innovation" can be defined simply as a new idea, device, or method Innovation is often viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs (Schumpeter, 1934). This is done by giving markets and society access to products, processes, and ways to get products, services, technologies, and business models that are more efficient.

On the other hand, the innovator uses those discoveries and creates something new, whether it be a product or service. However, in some cases, an inventor might turn out to be an innovator. An innovator is more valuable than an inventor it is because he or she does not just create or find something new but also makes money from it. There is a need to stabilise the tissue culture banana seedlings adoption. This is done by giving markets and society access to seedlings, supply through entrepreneurs, and ways to get products, services, or market system models that are more efficient. Strengthening producer systems and connecting them to farmers through promoting entrepreneurs' engagement in the seed system. With that note, this study adopted the Schumpeter, (1934) theory of entrepreneurs from which entrepreneur variables were derived to answer research questions.

The theory of entrepreneurship innovation adoption has been extensively used in both agricultural Lechterbeck et al., (2024); Juma, (2014); Spielman, (2005); Potts.,

& Kastle, (2017); Kurz, (2008) and non-agricultural studies Henrekson et al., (2024); Ortiz-Villajos., (2024) & Lazzarotti et al., (2011). Meanwhile, some studies examining the impact of the entrepreneurship of farmers on agriculture and rural economic growth have been carried out by Pan et al., (2024). Previous indication of tissue culture banana seedlings' low adoption suggests that there is a need for insights elaboration on issues that are still not fully resolved in the banana tissue culture seedlings innovation diffusion. The objective of the present paper is to examine the influence of entrepreneurship on the adoption of tissue culture banana seedling innovation by farmers.

This paper contributes to extending the discussion on the adoption theory by focusing on the entrepreneur's role in the seedling system. This research contributes to the entrepreneurship literature by suggesting that the Banana tissue culture seedlings provide more business opportunities to entrepreneurs through selling seedlings. The overall purpose of this paper is to address the influence of entrepreneurial activities and their contribution to the adoption of Tissue Culture banana seedlings in the Kilimanjaro region of Tanzania.

## METHOD

The study adopted an explanatory where cross-section design was employed at different stages. The study used a population of Banana farmers in Kilimanjaro region from Rombo district, Hai district, Moshi Rural, and Moshi municipal. Structured questionnaires were used to collect data from 350 smallholder farmers who have been in banana farming for at least 3 years. The study used a multistage sampling technique; farmers were purposively selected randomly and proportionally surveyed from 36 villages. Descriptive analysis was utilised to examine quantitative data, while inference about the responses of the target population was conducted using binary logistic regression by establishing a framework defining the influence of entrepreneurship on the adoption of tissue culture banana seedlings in the Kilimanjaro region. The dependent variable of this study was measured on a dichotomous scale. This means 0-No (farmers not adopted tissue culture banana seedlings) and 1- Yes (farmers adopted tissue culture banana seedlings) (Das, 2021; Tumaini et al., 2024).

## RESULTS AND DISCUSSION

### 1. Descriptive Statistics Results

Descriptive statistics were calculated to measure the perceptions of respondents regarding the entrepreneurial of tissue culture banana seedlings over local seedlings known as suckers. Mean scores and standard deviation were observed to measure the variability of the responses. Based on the Nagelkerke value, the model explains approximately 62.6% of the variability in the outcome variable. The results from the model summary stipulate the full model accounts for 62.6% of the explainable variance in the adoption of banana tissue culture. This suggests that the independent variables included as explanatory variables – Entrepreneur captures over half of the factors that influence adoption.



**Table 1: Model Summary**

-2 Log-likelihood	Cox & Snell R Square	Nagelkerke R Square
163.102	0.385	0.626

**Source:** Field Data, (2022)

In accomplishing the reliability of the data, the findings were experimented with by applying Cronbach's alpha. The technique involved separating the farmers into four equal halves responding to the same set of research tools. The score for each set was computed and the relationship between the two sets of scores was examined to see whether the measure of reliability was used to evaluate the degree to the different respondent's data tests that probed the same hypothesis Tumaini et al., (2024).

The consistency of results across items was measured with Cronbach's alpha of more than 0.871 value. Since Cronbach's alpha coefficient aimed to measure internal consistency reliability for a set of items. In this study, the items on a scale are interrelated and measure the same underlying construct. A Cronbach's alpha coefficient of 0.871 suggests a moderate level of internal consistency. This means the items are related and measure the adoption of banana tissue culture seedlings with the same constructs item and the implication was internally consistent Greco et al., (2018). The consistency of results across items in the current study is within the acceptable level of 0.7 Sekaran, describing the reliability of multi-item scale tools used in the current study (Bryman., (2006); Bell., (2015).

## **2. The influence of entrepreneur activities on the adoption of Tissue Culture Seedlings**

The findings in Table 2 show that respondents perceive tissue culture banana seedlings as providing moderately high business opportunities compared to the local banana suckers. Specifically, the mean scores range from 3.74 to 3.80 for the four business opportunity factors, with standard deviations between .783 and .829. This indicates most responses clustered around the mean, agreeing that tissue culture seedlings provide business opportunities for selling seedlings ( $M = 3.74$ ), selling food ( $M = 3.76$ ), in transport ( $M = 3.80$ ), and providing inputs ( $M = 3.75$ ). With means above the midpoint of 3, respondents generally perceive that tissue culture banana seedlings offer more business opportunities than local suckers across the four areas examined.

**Table 2:** Mean Score for Entrepreneurial Activities Response (n =350)

Items	Mean	SD
Banana tissue culture seedlings provide more business opportunities in selling the seedling compared to Banana local suckers	3.74	0.829
Banana tissue culture seedlings provide more business opportunities in selling food compared to Banana local suckers	3.76	0.783
Banana tissue culture seedlings provide more business opportunities in the transport sector compared to Banana local suckers	3.8	0.79
Banana tissue culture seedlings provide more business opportunities in the provision of inputs compared to Banana local suckers	3.75	0.804

**Source:** Field Data, (2022): Cronbach's Alpha = 0.871; Number of items (n=4)

### 3. Binary Logistics Regression Analysis

This section presents the results of Binary Logistic Regression demonstrating factors affecting the adoption of tissue culture banana seedlings. Binary logistic regression is a statistical method employed to analyse the association between a dichotomous categorical outcome variable and one or multiple independent predictor variables (Das, (2021). This technique assumes independence of errors, absence of outliers, and multicollinearity to estimate the significance of the effect size and model variation.

### 4. Multicollinearity Test

The test for multicollinearity suggests that the independent variables exhibit Variance Inflation Factors (VIF) below 10 and tolerance values exceeding 0.1, satisfying typical threshold standards. The VIF spans of 1.460 and the tolerance results of .685 for Entrepreneur these values remain well within acceptable ranges as indicated in Table 3.

**Table 3:** Test of multicollinearity

Variable	Tolerance	VIF
Entrepreneur	0.685	1.46

**Source:** Field Data, (2022)

### 5. Test of outliers

Bootstrap percentiles were utilised to assess potential outliers. The descriptive statistics show that the 95% confidence intervals for the means range from about 0.09 points for Adoption. The confidence interval for, Entrepreneur is 0.1485 points range (from 3.6836 to 3.8321). The variable with the narrowest confidence interval is Adoption, with an interval of 0.09 points (from 0.14 to 0.23). This suggests a lack of extreme outliers that are skewing the distributions. Additionally, the standard deviations remain relatively small with a value of 0.68226. The small standard deviations, along with the narrow confidence intervals, provide evidence that there are no significant outliers across all these metric variables. The data appear centered and not heavily skewed in either direction as indicated in Table 4.

**Table 4:** Bootstrap Percentile Results for Outliers Test (n=350)

Variable			Bias	Std. Error	95% CI	
					Lower	Upper
Entrepreneur	Mean	3.7614	-0.0002	0.0374	3.6836	3.8321
	SD	0.6823	-0.0018	0.03901	0.6022	0.7589
Entrepreneur Adoption	Mean	0.18	0	0.02	0.14	0.23
	SD	0.387	-0.001	0.017	0.35	0.419

**Source:** Field Data, (2022); CI= **Confidence Interval**

## 6. Logistic Regression Analysis

After successfully testing of assumptions, binary logistic regression analysis was carried out to measure the relationship of the variables. The baseline model was tested before including variables in the equation as shown in Table 5. The Wald test for the constant was statistically significant ( $p < .000$ ), indicating that including the constant is useful for the model fit. The exponentiated coefficient for the constant was .224, meaning that the baseline probability of the outcome occurring when all predictor values are zero is estimated to be .224.

**Table 5:** Baseline model summary

	B	S.E.	Wald	df
Constant	-1.497	0.138	117.215	1

**Source:** Field Data, (2022)

## 7. Omnibus test

The Omnibus Test provides an overall statistical assessment of the improvement in model fit by adding the set of predictors to the logistic regression model. It compares the constant-only model containing no independent variables to the model with all the current predictors included. The null hypothesis is that the coefficients for all predictors equal zero, meaning none are useful for prediction. However, the model chi-square test  $X(104, 350) = 169,887$ , was highly significant,  $p < .000$ . This provides clear evidence to reject the null hypothesis. Since the Step, Block, and Model chi-square tests all give the same conclusion; results suggest that adding the full set of predictors significantly enhances the logistic model's ability to explain the outcome compared to the baseline as indicated in Table 6.

**Table 6:** Omnibus Tests of Model Coefficients

Step 1	Chi-square	df	Sig.
Step	169.887	104	0
Block	169.887	104	0
Model	169.887	104	0

**Source:** Field Data, (2022)

## 8. Logistic model summary

Table 7. Provides indicators of the logistic regression model's goodness-of-fit and explanatory power. Specifically, it reports the -2 Log Likelihood along with two pseudo-*R*-squared measures: Cox & Snell *R* Square and Nagelkerke *R* Square. Cox & Snell is .385 while Nagelkerke is .626. Based on the Nagelkerke value, the model explains approximately 62.6% of the variability in the outcome variable. The results



from the model summary indicate that the full model accounts for 62.6% of the explainable variance in the adoption of banana tissue culture. This suggests that the independent variables included as predictors –Entrepreneur - capture over half the influence over adoption.

**Table 7: Model Summary**

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
163.102	0.385	0.626

**Source:** Field Data, (2022)

## 9. Hosmer and Lemeshow Test

The Hosmer-Lemeshow goodness-of-fit test evaluates how accurately the logistic regression model can predict the observed outcomes in the adoption of tissue culture banana seedlings data. The test yielded a chi-square,  $X^2(350,8) = 5.123$ ,  $p = .744$ . Since the  $p$ -value exceeds the .05 threshold, we fail to reject the null hypothesis of no difference between the expected and observed adoption outcomes. This indicates that the model-estimated probabilities match closely with the actual distribution of outcomes seen in the banana seedling data. Specifically, there is adequate model fit and reliable calibration between the predicted adoptions and farmers' realized technology adoption decisions. Given satisfactory model performance, it can be affirmed that the logistic model with the current set of predictors demonstrates a good fit with the observed tissue culture banana seedling adoption outcomes as depicted in Table 8.

**Table 8: Hosmer and Lemeshow Test**

Chi-square	df	Sig.
5.123	8	0.744

**Source:** Field Data, (2022)

## 10. Classification between adopters and non-adopters of TCBS

The classification table evaluates the performance of the logistic regression model by comparing its predicted outcomes of adopting banana tissue culture seedlings to the actual observed outcomes in the dataset. Table 9 indicates that the model accurately predicted 98.6% of non-adopters and 59.4% of adopters, resulting in an overall predictive accuracy rate of 91.4%. However, the emphasis is on distinguishing adopters from non-adopters, and the relatively lower sensitivity of 59.4% for those adopting tissue culture indicates a lack of high accuracy in classifying banana seedling adoption. Notably, 26 adopters were incorrectly classified as non-adopters among 64 adopters, highlighting a significant limitation.

**Table 9: Classification Table**

Observed	Predicted - Adoption		% Correct
	Non- Adopters	Adopters	
Non- Adopters	282	4	98.6
Adopters	26	38	59.4
Overall Percentage			91.4

**Source:** Field Data, (2022)

## 11. Logistic coefficients' Results

The inspection of each predictor contribution in the model was calculated as shown in Table 10. Specifically, Entrepreneurship ( $B = 107.041$ ,  $p < .001$ ) significantly

influenced the likelihood of adopting banana tissue culture. These findings underscore the multifaceted nature of factors contributing to adoption decisions, emphasizing the importance of considering entrepreneurial characteristics in promoting the adoption of banana tissue culture.

**Table 10:** Logistic Regression Coefficients' Summary

Variable	B	Sig.	Exp(B)	95% C.I. for EXP(B)
Entrepreneurship	107.041	0	3.072	(2.002, 4.719)
Constant	-188.7	0	0	(0.000, 0.000)

**Source:** Field Data, (2022)

## DISCUSSION

The variable “entrepreneurial activities” had four items of measurement applied to test the adoption of the tissue culture banana seedlings. These factors are Banana tissue culture provides more business opportunities in selling seedlings, provides more business opportunities in selling food, provides more business opportunities in the transport sector, and provides more business opportunities in the provision of inputs. Altogether, these items significantly influenced the likelihood of farmers adopting banana tissue culture.

Thus, the results suggest that the decision to adopt tissue culture banana seedlings is driven by entrepreneurial endeavour since these seedlings offer greater potential for economic opportunities in comparison to traditional banana suckers. Some producers chose to use tissue culture banana seedlings instead of local banana suckers because they offer greater potential for commercial options. These data suggest that when tissue culture banana seedlings provide more financial prospects compared to local banana suckers, banana producers are more inclined to embrace them.

Farmers hypothesized the influence of entrepreneurial activities towards the adoption of tissue culture banana seedlings positively, and directly influence the adoption of tissue culture banana seedlings. The findings revealed that there were positive respondents who perceived tissue culture banana seedlings as providing moderately high business opportunities compared to local banana suckers. Precisely, the mean scores range from 3.74 to 3.80 for the four business opportunity factors, with standard deviations between .783 and .829. This indicates most responses gathered around the mean, asserting that tissue culture seedlings provide business opportunities for selling seedlings ( $M = 3.74$ ), selling food ( $M = 3.76$ ), in transport ( $M = 3.80$ ), and providing inputs ( $M = 3.75$ ). With means above the midpoint of 3, respondents generally observe that tissue culture banana seedlings offer more business prospects than local suckers across the four areas examined.

Furthermore, the findings indicate that entrepreneurial activities were statistically significant. This is evident from the average scores for entrepreneurial prospects, which include many characteristics such as selling seedlings, food, transport, and inputs, which fell within the range of 3.74 to 3.80. These figures suggest a moderately favorable outlook, implying that tissue-cultured seedlings are perceived to offer greater business potential across various domains compared to local banana suckers. These findings correspond to previous studies for example the study by Wanyama, (2015) on innovation, demonstrating that commercialisation and livelihood opportunities serve as driving factors for adoption among smallholder farmers. These findings differ from those of Thuo et al., (2017) in Kenya, who found the influence of

tissue culture adoption is the conservation measures and the use of water boreholes for irrigation. In addition, Thorne, et al., (2022) assert that there was limited access to the new technology the avocado plants. Such accessibility was prominent on the most unfavorable point in access to the tree quality; access to the cultivars; and the cost of tree cultivars. Therefore, the involvement of entrepreneurs in the seedling system will provide more business opportunities and bridge the gap for farmers to adopt innovation.

Nevertheless, the broad confidence interval of 2.002 to 4.719 for the odds ratio related to entrepreneurship shows uncertainty about the magnitude of this impact within different segments of adopters. This is likely indicative of the diversity in commercialisation approaches among smallholder farmers. Findings also demonstrate that farmers view tissue-culture banana seedlings as presenting reasonably high business prospects versus local banana suckers. The mean values, going from 3.74 to 3.80, imply that the respondents largely agree tissue cultured seedlings offer greater commercial potential for selling plantlets, selling food products, participating in transportation, and supplying agricultural inputs over local varieties.

These findings align with Mwirigi et al., (2015) on the concept that there is a shared positive perspective among the farmers concerning the entrepreneurial opportunities offered by tissue-culture banana seedlings across the surveyed domains compared to what local suckers can provide. That means farmers need awareness of the entrepreneurial advantages offered by the tissue culture seedling to adopt and use the innovation, this fact means that understanding the advantages of new technology can change the attitude of stakeholders' decisions to adopt the new technology. In making, these comments I agree with Schumpeter's theory of innovation he argues that; the basic nature and scope of innovation by entrepreneurs do not necessarily mean the introduction of newer products, but sometimes it means more than that. According to theory newly introduced products or services, innovation should also open new markets either by developing a brand-new market or by revamping the old market with huge potential opportunities for entrepreneurs to prompt the adoption (Schumpeter., 1934).

Although these findings of the current study are like some other studies on technology adoption for farmers and other members of the public and private sectors including the development organisations and research institutes. To the best of our knowledge, the current study has helped to fill the knowledge gap left in terms of research level; most existing studies only focus on the macroeconomic level, which does not pay more attention to the underlying effects of the role of entrepreneur on the adoption of agriculture technology Pan et al., (2024). The entrepreneur activities as added knowledge in the empirical literature as the factor that influences new technologies adoption by farmers in the agriculture seedlings sector. Therefore, this study has contributed new knowledge in the literature about the influence of entrepreneurs on seedling adoption from two perspectives; farmers and the private sector investing in tissue culture seedling production of which the existing theories and empirical studies are informative and inconclusive.

## **CONCLUSION**

The study findings have revealed that the adoption of tissue culture banana seedlings is a collaborative process that involves individual farmers and many stakeholders in the value chain that possess diverse expertise within a specific

community. Tissue culture banana seedlings are not much of an issue in the technology adoption, but seed information is much more challenging. Different Interventions in the seed system tend to create alternative delivery systems, avoiding local markets and entrepreneurs. Such contexts are increasingly discussed with different scholars in terms of being innovative. The study has endeavored to comprehend the impact of entrepreneurs on the adoption of Banana tissue culture by farmers while acknowledging their intellectual contributions to the existing literature. We have contributed novel perspectives and further empirical data regarding the factors influencing farmers' decision to cultivate banana tissue culture seedlings. We investigate the extent to which entrepreneurship influences the adoption of Banana tissue culture seedlings in Tanzania and examine the specific ways in which this influence manifests.

While previous research has focused on Rogers's diffusion theory of innovation Rogers, (2004); Rezaei-Moghaddam & Saleh., (2010) the current research results have added new knowledge by demonstrating that entrepreneurial activities provide more business opportunities if added significantly to the literature will provide new insight into the adoption of new seedlings by farmers (Śledzik, 2013; Schumpeter, 1934). Some farmers may perceive tissue culture banana seedlings as not being beneficial, while others do perceive it as beneficial for several reasons. However, more work must be done to see smallholder farmers' needs for new technology, to involve existing seed markets in interventions, and to understand the roles of different stakeholders when proposing an intervention in a tissue culture banana seedlings system.

Considering the importance of agricultural extension systems, Government and Non-Government organisations in Tanzania have initiated various approaches and models of agricultural extension to promote the adoption of tissue culture seedlings. However, most existing promotion approaches have not been particularly effective. It appears that current promotion strategies and penetration plans have not adequately delivered the seedlings services to the small farmers in rural areas of Kilimanjaro. Furthermore, the introduction of quality seedlings alone does not appear to influence banana tissue culture seedlings adoption in the study area with a significant percentage of interviewed farmers about the influence of entrepreneurs in tissue culture seedling adoption. Considering the above, the study recommends that the government, private sectors, and development partners focus on the awareness creation of farmers on better seeds to plant to increase farm yields.

The study suggests that farmers should select to adopt for many reasons, and the process can follow multiple paths once initiated. Like any human situation, there will inevitably be challenges that must be acknowledged and resolved as agricultural innovation is introduced to the market until the farmers' system gradually embraces the innovation over time. Nevertheless, by acquiring knowledge, demonstrating their abilities, developing entrepreneurial skills, engaging in advertising, and possessing a strong desire, farmers successfully navigate the extensive process and ultimately fulfill their long-held aspiration of being brand ambassadors.

Hence, it is imperative for Tanzania's Ministry of Agriculture and regional extension systems, in collaboration with development organisations and private sectors, to prioritise the adoption of innovative systems approaches. This will facilitate the development and widespread distribution of new tissue culture seedlings to banana farmers, thereby creating lucrative business prospects. Ultimately, this

initiative will contribute to enhancing crop yields and attaining household food security. Furthermore, the results indicate that establishing connections between farmers and a broader range of individuals, such as suppliers of agricultural inputs and marketing services, is crucial for the successful transformation of seedlings into a more commercially oriented venture. In addition, Banana Seedling's business should adopt a market system that utilises local networks to distribute seedlings and services and collaborate with tissue culture laboratories and the commercial sector to promote the growth of the banana seedlings business. One additional suggestion is to enhance the availability of extension services in local areas, promote the cultivation of high-quality local banana varieties, and facilitate the distribution of Tissue Culture banana seedlings to farmers. It is also important to implement a policy that subsidises the price of banana seedlings and provides education and training to farmers on Tissue Culture banana cultivation to improve their knowledge and skills. Based on statistical analysis, it can be stated that the highlighted limitations in the adoption of tissue culture banana seedlings by entrepreneurs have been addressed. This has important consequences in terms of theory, empirical evidence, and practical applications.

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### **Reference**

- Amen, H., Taha, R. A., Moselhy, M. A., Gohar, M. R., Abdelalim, M., & Elsayed, T. (2023). Rhizobacterial Culture Supernatant As A Promising Strategy For Banana Tissue Culture Improvement. *Egyptian Journal of Chemistry*, 66(1), 99-112.
- Birch, I. (2018). Agricultural productivity in Kenya: barriers and opportunities.
- Das, A. B. (2023, March). Quality Planting Material Production in Bananas for Sustainable Food Production in Alleviating Malnutrition. In *National Seminar on Improvement of Tribal Through Sustainable Agriculture (LITTSA-2023)* (p. 36).
- Das, A. (2021). Logistic regression. In *Encyclopedia of Quality of Life and Well-Being Research* (pp. 1-2). Cham: Springer International Publishing.
- Donovan, J., Rutsaert, P., Spielman, D., Shikuku, K. M., & Demont, M. (2021). Seed value chain development in the Global South: Key issues and new directions for public breeding programs. *Outlook on Agriculture*, 50(4), 366-377.
- FAO, (2020) Banana Market Review: Preliminary Results 2019. Rome
- He, M. (2022). Literature Review on Entrepreneurship Practice in Agriculture, Rural and Farmers under the Background of Rural Revitalization. *Open Access Library Journal*, 9(5), 1-13.
- Hemanthakumar, A. S., & Preetha, T. S. (2023). Macro-and Micropropagation of Plants for Income Generation. In *Conservation and Sustainable Utilization of Bioresources* (pp. 409-450). Singapore: Springer Nature Singapore.
- Henrekson, M., Johansson, D., & Karlsson, J. (2024). To Be or Not to Be the Entrepreneur in Neo-Schumpeterian Growth Theory. *Entrepreneurship Theory and Practice*, 48(1), 104-140.



- Joseph, J., (2022). Why the Future is Bright for Banana Farming  
<https://www.thecitizen.co.tz/tanzania/news/why-the-future-is-bright-for-banana-farming-3722610>(Accessed 24 Aug 2022)Kau Agri infotech portal  
<http://celkau.in/Agrienterprises/enerprise/21.%20Seed%20and%20Seedling/3.%20Requirements%20for%20Entrepreneurship%20in%20Seed%20Production.pdf> (accessed 2023 Aug 22)
- Juma, C. (2014). Complexity, innovation, and development: Schumpeter revisited. *Policy and Complex System*, 1(1).
- Kirimi, F. K., Onyari, C. N., Njeru, L. K., & Mogaka, H. R. (2023). Effect of on-farm testing on the adoption of banana production technologies among smallholder farmers in the Meru region, Kenya. *Journal of Agribusiness in Developing and Emerging Economies*, 13(1), 90-105.
- Kurz, H. D. (2008). Innovations and profits: Schumpeter and the classical heritage. *Journal of Economic Behavior & Organization*, 67(1), 263-278.
- Lazzarotti, F., Samir Dalfovo, M., & Emil Hoffmann, V. (2011). A bibliometric study of innovation based on Schumpeter. *Journal of technology management & innovation*, 6(4), 121-135.
- Lechterbeck, J., & Kerig, T. (2024). Inventions, innovations, and the origins of spelt. wheat. *Vegetation History and Archaeobotany*, 1-11.
- Lucas, S., & Jomanga, K. (2021). The status of banana production in Tanzania; a review of threats and opportunities. *Int. J. Curr. Sci. Res. Rev*, 4, 1260-1275.
- Padukkage, D., Nanayakkara, C. M., & Padmini, C. (2023). Plant Tissue Culture In Sri Lanka: Current Status, Challenges, and Opportunities.
- Maviritu, C. A. (2022). *Project Management Practices and Performance of Tissue Culture Banana Project: A Case of National Agricultural Rural Inclusive Growth Project in Hamisi Sub- County, Vihiga County, Kenya* (Doctoral dissertation, University of Nairobi).
- Mbuga, S. (2019). Credit financing challenges on farm entrepreneurship in Tanzania: Empirical evidence from smallholder paddy farmers at Dakawa ward in Mvomero district.
- Muyanga, M. (2019). Smallholder adoption and economic impacts of tissue culture
- Njuguna, M., Wambugu, F., Acharya, S. and Mackey, M. (2013) Socio-economic impact of tissue culture banana (Mus a spp.) in Kenya through the whole value chain approach. *Act Horticulture* 879, 77-86.
- Olumba, C. C., & Onunka, C. N. (2020). Banana and plantain in West Africa: Production and marketing. *African Journal of Food, Agriculture, Nutrition and Development*, 20(2), 15474-15489.
- Ortiz-Villajos, J. M. (2024). Dynamics of innovation over time: Evidence from the Spanish business elite. *Structural Change and Economic Dynamics*.
- Pan, Y., Zhang, S., & Zhang, M. (2024). The impact of entrepreneurship of farmers on agriculture and rural economic growth: Innovation-driven perspective. *Innovation and Green Development*, 3(1), 100093.
- Pingali, P. (2007). Agricultural mechanization: adoption patterns and economic impact. *Handbook of agricultural economics*, 3, 2779-2805.
- Pinstrup-Andersen, P., & Cohen, M. J. (2000). Asian food security and the potential role of modern agricultural biotechnology. Asian Institute of Technology.
- Potts, J., & Kastle, T. (2017). Economics of innovation in Australian agricultural economics and policy. *Economic Analysis and Policy*, 54, 96-104.

- Rezaei-Moghaddam, K., & Salehi, S. (2010). Agricultural specialists' intention toward Precision agriculture technologies: Integrating innovation characteristics to technology acceptance model. *African Journal of Agricultural Research*, 5(11), 1191-1199.
- Rogers, E. M. (2004). A prospective and retrospective look at the diffusion Model. *Journal of Health Communication*, 9(S1), 13-19.
- Schumpeter, J.A. (1934), *The theory of economic development: an inquiry into profits, capital, credit, interest and the business cycle*, Harvard Economic Studies, Vol. 46, Harvard College, Cambridge, MA.
- Shimwela, M. M., Mahuku, G., Mbanzibwa, D. R., Mkamilo, G., Mark, D., Mosha, H. I., ... & Kumar, P. L. (2022). First report of banana bunchy top virus in banana and plantain (*Musa* spp.) in Tanzania. *Plant Disease*, 106(4), 1312.
- Śledzik, K. (2013). Schumpeter's view on innovation and entrepreneurship. *Management Trends in Theory and Practice*, (ed.) Stefan Hittmar, Faculty of Management Science and Informatics, University of Zilina & Institute of Management by University of Zilina.
- Spielman, D. J. (2005). Innovation systems perspectives on developing-country agriculture: A critical review.
- Thuo, C.N.; Nguluu, S. & Kisangau, P. (2017). Factors Affecting Adoption of Tissue Culture Bananas in the Semi-Arid Areas of the Lower Eastern Region of Kenya. *International Journal of Recent Research in Life Sciences (IJRRLS)*, Vol. 4 (3), pp1-26
- Tumaini, S., Gwahula, R. ., & Macha, S. (2024). The Influence of Complexity on the Adoption of Tissue Culture Banana Seedlings in Tanzania. *International Journal of Business, Law, and Education*, 5(1), 148 - 157.  
<https://doi.org/10.56442/ijble.v5i1.254>
- Voora, V., Bermúdez, S., Farrell, J. J., Larrea, C., & Luna, E. (2023). Banana prices and sustainability.