Vol. 17(4), pp. 690-696, April, 2021
DOI: 10.5897/AJAR2021.15477
Article Number: 0C1DD6966679
ISSN: 1991-637X

http://www.academicjournals.org/AJAR

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African Journal of Agricultural Research

Full Length Research Paper

Extension training for banana value addition among smallholder farmers in Meru and Tharaka-Nithi counties, Kenya

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Received 26 January, 2021; Accepted 6 April, 2021

Extension training is intended to increase the efficiency and performance of the human resource that acts responsibly in a society based on a communication interaction with knowledge sources. The main objective of this study was to assess the effect of training farmers on banana value addition among smallholder farmers in Meru and Tharaka-Nithi counties. The study adopted a pragmatic paradigm and a cross-sectional survey design and sampled 370 and 30 farmers proportionately obtained from 269,499 and 19,303 smallholder banana farmers in Meru and Tharaka-Nithi counties, respectively. Structured and semi-structured questionnaires were used to collect primary data from the respondents. Secondary data were obtained from official extension and production records in the two counties as well as related literature. Data was analysed using descriptive statistics to determine frequencies, percentages and means. Regression analysis was conducted to examine relationships between the study variables. The results revealed that there was an association between training farmers on the various method of banana value addition and adoption of selected banana value addition technologies was statistically significant at 1% level of significance (p-value = 0.000<0.01, χ^2=156.391, df 1). The study concludes that farmers having a preferred facilitator in training positively influenced the adoption of banana value addition technologies. The study recommends the government should create and implement policies such as collaborating with high learning institution like universities and set days where they will be training farmers on various methods of banana value addition.

Key words: Extension training, banana value addition, small holder farmers.

INTRODUCTION

Generally, banana production occurs in tropical countries with India, China, the Philippines, Ecuador and Brazil being the biggest producers where the majority of farmers serve the domestic market (Shaibu et al., 2012). In sub-Saharan Africa (SSA), low agricultural productivity has been the world's foremost global challenge (United Nations, 2013). Eastern and Southern Africa produce over 20 million tonnes of bananas annually which

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accounts for 26% of total world output. In Kenya, the banana is the most popular fruit (Joachim et al., 2018). In 2017 Meru county banana production was 210,450 tonnes, down from 276,919 tonnes in 2016 and 251,132 tonnes in 2015 (Horticultural Validated Report, 2014; Meru County Integrated Development Plan, 2018-2022). In 2016, Tharaka-Nithi county banana production was 76,633 tonnes down from 79,823 tonnes in 2014 (Tharaka-Nithi County Integrated Development Plan, 2018-2022). This decline in banana production could be attributed to several challenges including climate change, diseases and quality of extension service provision.

Lack of adequate training in good agricultural practices results in farmers learning their vocations from relatives and neighbours with little exposure to successful agricultural training. Consequently, they rely on instead of on good agricultural practices, which increase yields and sustain their farms, on inefficient agriculture with declining yields (FAO, 2018).

In a study on factors that impact agricultural extension training programs for smallholder women farmers in Njombe district, Tanzania, Gwivaha (2015) found that very few woman farmers were interested in preparation for agricultural extension. The findings also showed that many other factors interfered with their involvement in agricultural training: women farmers have less access to and ownership of land, and very few are members of farmers' groups/associations. In Meru county, Mbuthia Kayi and Wambugu (2018) found that banana farmers face many interdependent limitations, such as insufficient know-how on banana management, high-cost plantlets, and amplifying pests and diseases with partial efforts to resolve them.

In addition to field management issues, post-harvest management of banana products is still a challenge and farmers incur losses. Around 90% of the bananas produced are consumed as fresh fruits domestically. Just 5% of the processed products are consumed and provide a strong potential for future processing. But processed banana products are becoming very popular in our daily lives and can limit the disaster (Dhake et al., 2019). Approximately, 2.5% are only processed as bananas and the remainder are used as food ingredients. Around seventeen kinds of banana, products can be prepared. The key product on the banana market is fried chips (Dhake et al., 2019). Unfortunately, even though some farmers are aware of the pre- and post-harvesting technologies and practices, they rarely practice such technologies in production and value addition (Bonabana-wabbi et al., 2015). Therefore, there
is a need to build farmer capacity on access and application of value addition technologies to bridge the gap between awareness and practical utilization of these technologies to sustain livelihood (Bonabana-Wabbi et al., 2015; Makini et al., 2017). This paper, therefore, investigates training for banana production value addition among smallholder farmers in Meru and Tharaka-Nithi counties.

MATERIALS AND METHODS

Research design

This study adopted a cross-sectional survey research design. Data was collected to make inferences about a population of interest (universe) at one point in time thereby taking care of attrition according to Cooper and Schindler (2003). In this research design, data was collected on one occasion and represents a snapshot of the respondents' responses at that specific point in time. Therefore, this design was used for the study to seek information on the effect of extension training on the adoption of banana production technologies among smallholder farmers in Meru and Tharaka-Nithi counties.

Target population

The study targeted 19,303 and 269,499 smallholder banana farmer's households in Tharaka-Nithi and Meru counties, respectively (Table 1).

Sampling and sample size

The sub-county from each of the two counties formed a stratum. Based on the sampling formula provided by Yamane (1967) and adopted by Israel (1992), a total sample size of 400 farmers for Meru and Tharaka-Nithi counties was used:

$$= \frac{N}{1+N(e)^2} \quad (1)$$

where n is the sample size, N is the population size, e is the level of precision or the significance level.
Therefore,

$$\text{Sample size} = \frac{288,802}{1+288,802(0.05)^2} = 400$$

The suitable sample size for farmers in each sub-county was arrived at, first by calculating the proportional percentage of farmers in every sub-county and then calculating the actual sample size for farmers.

Data collection instrument

Questionnaires were administered to proportionate samples of 370 and 30 banana farmers in Meru and Tharaka-Nithi counties, respectively.

The study used a structured and semi-structured questionnaire. The selection of tools was guided by the nature of the data that was collected as well as the objectives of the study. The questionnaires were used to solicit information on the view, opinion and perception of the farmers on the adoption of tissue culture and macro propagation since they are the most suitable tool for survey research (Oso and Onen, 2008).

Data analysis

Descriptive and inferential statistics were used to analyse data. The Statistical Package for Social Science programme (SPSS) was used to analyse collected data. Descriptive statistics were used to summarize the data in form of frequencies and percentages. The

Table 1. Population.

County	Target population	Sample size
Meru county	269,499	370
Tharaka-Nithi county	19,303	30
Total	288,802	400

Source: Tharaka-Nithi County Integrated Development Programme, 2018- 2022; Meru County Integrated Development Programme, 2018- 2022

binary logistic regression model was used as the following.

Banana value addition was measured as a binary variable taking values 1 for adopters (farmers who have adopted banana value addition) and 0 for non-adopters (those farmers who have not adopted banana value addition). The effect of farmers training on the adoption of banana value addition was analysed using a binary logistic regression model which can be represented as follows:

$$P_i = F(Z_i) = 1/1 + e^{-(\alpha + \Sigma \beta_i X_i)} \quad (2)$$

where P_i is the likelihood of adoption of banana value addition, X_i represents i^t predictor variable, α and β_i are the parameter estimates and *e* is the base of the natural logarithm. The equation can further be represented in terms of odds ratios and the log of odds as:

$$\frac{P_i}{1 - P_i} = e_i^Z \quad (3)$$

$1 - P_i$ is the probability of farmers not adopting banana value addition. Taking the natural log of the equation gives:

$$ln\left(\frac{P_i}{1 - P_i}\right) = Z_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_n X_n + U_i \quad (4)$$

where U_i is the error term?

RESULTS AND DISCUSSION

A total of 400 household questionnaires were distributed and 400 questionnaires were returned giving a response rate of 100%.

Description of the study area

The study included two counties in Kenya, Tharaka Nithi and Meru. The two countries are well acquainted with the production of bananas. Tharaka Nithi county borders the counties of Embu, Meru and Kitui. It covers an area of 2,662.1 km^2, including 360 km^2 of forest covered by Mt Kenya. The county is subdivided administratively into five sub-counties: Tharaka North, Tharaka South, Chuka, Igambango'mbe and Maara (Tharaka Nithi, 2021).

Meru county is one of the 47 counties of Kenya, located in the former eastern province. The county lies between 0°6' North and 0°1' South and between latitudes 37° West and 38° East. It borders Isiolo county to the north, Tharaka/Nithi county to the east, Nyeri county to the south west and Laikipia county to the west. It covers a total area of 7,006 km^2 out of which with part of it 972.3 km^2 being gazetted as forest. It has a population of 1.55 million people (Meru County Government, 2019).

Variety of banana commonly grown

The study sought to find out the varieties of bananas that the farmers commonly grow (Table 2). The findings revealed that the most popular variety was William Hybrid (32.5%) followed by Grand Nain (22.5%), Giant Cavendish (21.3%) and the local or traditional type (20.5%). This shows that the preference for the latter three is relatively similar among the farmers although about one third grow more of the William Hybrids due to market demand. The findings are in agreement with those of Meru County Banana Stakeholder Forum (2019) which found out that Meru county is known for the production of different varieties of banana, such as the William Hybrid, Gross Mitchel (Kampala), Fhia 17, Giant Carendash, Uganda Green (Kiganda) and plantains which are commonly known as Gichagara, among others, making Meru the leading banana producer of the country, with an estimated value of over Ksh. 6B as per the research done in 2016 (Meru County Banana Stakeholder Forum, 2019).

Farmer training and use of selected banana value addition technologies

The study sought to find out the level of training and adoption of selected banana value addition technologies among the farmers in the area (Table 3). The findings show that several variables influenced the level of adoption of the selected banana value addition technologies by the farmers. The association between being trained on the various method of banana value addition and adoption of selected banana value addition technologies was statistically significant at 1% level of significance (p-value = 0.000 < 0.01, χ^2 =156.391, df 1),

Table 2. Variety of banana commonly grown.

Variety	%
William Hybrids	32.8
Grands Nain	22.5
Giant Cavendish	21.3
Traditional	20.5
Others	3.0
Total	100

implying that training on the various method of banana value addition can influence a decision to adopt banana value addition technologies. Farmers participation in a field trip to learn about value addition technologies and use of selected banana value addition technologies was statistically significant at 1% level of significance (p value=0.000<0.05, χ^2 =41.086, df 1), showing that learning about value addition of banana technologies positively influences the farmer's use of selected banana value addition technologies. The findings are in line with those of Wanyama (2015) who found out that training of farmers on Tissue Culture Banana (TCB) benefits and management of banana orchards might enhance the likelihood and intensity of TCB adoption and reduce negative perceptions about the technology. Wanyama (2015) also found out that farmers also need to be sensitized on the importance of seeking extension services regularly for technical support and use productivity-enhancing technological components like the application of farmyard manure, effective pest/disease management.

The relationship between preferred facilitator in banana value addition training and use of selected banana value addition technologies was found to be statistically significant at 1% level of significance (p value= 0.000<0.01, χ^2 =34.081, df 1), revealing that a farmer having a preferred facilitator in banana value addition training positively influences farmers to use of selected banana value addition technologies. The study observed that the frequency in which banana value addition training was organized and use of selected banana value addition technologies was statistically significant at 5% level of significance (p value= 0.001<0.05, χ^2 =22.030, df 5), showing that repeated training of farmers with preferred facilitators determines farmers use of selected banana value addition technologies. The association between challenges that farmers experienced in adopting banana value addition was statistically significant at 1% level of significance (p value=0.000<0.05, X2 =24.547, df 5). This implies that the challenges that farmers go through in banana production determine the use of selected banana value addition technologies. The findings are in line with those of Tarekegn et al. (2020) who conducted a study on "Value chain analysis of banana in bench Maji and Sheka zones of Southern Ethiopia". The study found out that extension contact, type of varieties utilized, the area allocated for banana production, distance to the nearest market, total income and education level were significantly determining factors of banana market participation. Also, lack of an organized market, low demand during the production season, expensiveness of improved varieties and disease were top identified problems by banana producers.

Binary logistic regression of farmer training and use of selected banana value addition technologies

The study sought to test a null hypothesis that there is no relationship between farmer training and the use of selected banana value addition technologies (Table 4). The study evaluated the individual effects of the independent sub-variables and the overall effect of the independent variable. In testing the hypothesis, binary logistic regression equation was used. The variables of the study were X1 = training on the various method of value addition, X2 = participated in a trip to learn about value addition technology, X3 = preferred facilitator in banana value addition training, X4 = frequency in organizing banana value addition training, and X5= challenges in the adoption of banana value addition technology.

The binary logistic regression results showed that predicted: Logit of (use of selected banana value addition technologies) = -7.967+ (3.214) × trained on various method of value addition + (0.954) × participated in a trip to learn about value addition technology + (0.341) × preferred facilitator in banana value addition training + (0.372) × frequency in organizing banana value addition training + (-0.181) challenges in adoption of banana value addition technology.

The positive B coefficients for predictor variables predictor variables score is associated with increased odds of adopting banana production technologies.

Logit of (use of selected banana value addition technologies) = $3.214X_1 + 0.954X2 + 0.341X_3 + 0.372X_4 – 0.181X_5 – 7.967$

The B coefficients for predictor variables (trained on the various method of value addition, participated in a trip to learn about value addition technology, preferred facilitator in banana value addition training, frequency in organizing banana value addition training) were positive indicating that increasing predictor variables score is associated with increased odds of use of selected banana value addition technologies.

From the results, being trained on various methods of banana value addition was statistically significant in predicting whether a farmer will use the selected banana value addition technologies or not if trained, with the overall effect being Wald 71.415, df=1, p=0.000. The odds ratio was 24.870, implying that the farmers who have been trained on various methods of banana value addition are 25 times likely to use selected banana value

Table 3. Farmer training and use of selected banana value addition technologies.

Variable (Farmer training)		Adoption of banana technology		Statistical significance		
		Yes [N (%)]	No [N (%)]	P-value	χ^2	df
Trained on the various method of banana value addition	Yes	193 (73.4)	70 (26.6)	0.000	156.391[a]	1
	No	10 (7.4)	126 (92.6)			
Participated in a trip to learn about value addition technology	Yes	119 (69.6)	52 (30.4)	0.000	41.086[a]	1
	No	83 (37.1)	141 (62.9)			
Preferred facilitator in banana value addition training	Extension officers	107 (60.5)	70 (39.5)	0.000	34.081[a]	1
	Contact farmers	19 (59.4)	13 (40.6)			
	Researchers	27 (36.5)	47 (63.5)			
	CBO or NGOs	30 (68.2)	14 (31.8)			
	Fellow Farmers	8 (28.6)	20 (71.4)			
	Expert in the industry	6 (21.4)	22 (78.6)			
Frequency in organizing banana value addition training	Weekly			0.001	22.030[a]	5
	Fortnightly	6 (42.9)	8 (57.1)			
	Monthly	1 (10.0)	9 (90.0)			
	Half-yearly	4 (66.7)	2 (33.3)			
	Annually	128 (60.7)	83 (39.3)			
	After one year	21 (50.0)	21 (50.0)			
	Others	36 (37.9)	59 (62.1)			
Challenges in adoption of banana value addition technology	Lack of equipment	38 (50.7)	37 (49.3)	0.000	24.547[a]	5
	Inadequate skills	55 (53.9)	47 (46.1)			
	Lack of ready market	42 (39.6)	64 (60.4)			
	Limited Banana produce	0 (0.00)	4 (100.0)			
	Fear of due to failure	7 (41.2)	10 (58.8)			
	Inadequate capital	60 (71.4)	24 (28.6)			

addition technologies than farmers who are not trained. Farmers being trained on the various method of value addition had the most positive overall effect on the use of selected banana value addition technologies. The findings are in line with those of Nakano et al. (2018) conducted a study on the impact of training on technology adoption and rice farming productivity in Tanzania and found that farmers' technology adoption rates rose immediately after the training, those of the non-trained ordinary farmers caught up belatedly. As the technologies disseminated, the paddy yield of the key farmers increased from 3.1 to 5.3 tons/ha, while the yield of the ordinary farmers increased from 2.6 to 3.7 tons/ha.

The study revealed that participation in a trip to learn about banana value addition technologies had a positive influence on the use of selected

Table 4. Binary logistic regression of farmer training and use of selected banana value addition technologies.

Variables in the equation		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1[a]	Trained on various method of value addition	3.214	0.380	71.415	1	0.000	24.870	11.803	52.404
	Participated in a trip to learn about value addition technology	0.954	0.288	10.985	1	0.001	2.596	1.477	4.563
	Preferred facilitator in banana value addition training	0.341	0.094	13.111	1	0.000	1.406	1.169	1.692
	Frequency in organizing Banana value addition training	0.372	0.119	9.806	1	0.002	1.450	1.149	1.830
	Challenges in the adoption of banana value addition technology	-0.181	0.111	2.635	1	0.105	0.834	0.671	1.038
	Constant	-7.967	1.099	52.548	1	0.000	0.000	-	-

a. Variable(s) entered on step 1: Trained on the various method of value addition, Have you participated in a trip about value addition, Who are your preferred facilitators in the training, How often the training is organized, What challenges you face in adopting the value addition technology learnt.

banana value addition technologies with the overall effect of Wald 10.985, df=1, p=0.001. The odds ratio was 2.596; this implies that the farmers who participated in a trip to learn about value addition technologies are 3 more times likely to use selected banana value addition technologies than those who did not participate in a trip. It was noted that farmers with preferred facilitators in a banana value addition training had a positive influence on the use of selected banana value addition technologies with the overall effect of Wald 13.111, df=1, p=0.000. The odds ratio was 1.460, this implies that the farmers who had preferred facilitators during training are about 1.5 (one and a half) times more likely to use selected banana value addition technologies than those who did not have preferred facilitators. The findings are in agreement with those of Ndungu Nguluu and Kisangau (2017) who found out that the availability of extension services (public or private) had an association with the adoption of tissues culture banana technology (p=0.0001).

The study results showed that frequency in organizing banana value addition training had a positive influence on the use of selected banana value addition technologies with the overall effect of Wald 9.806, df=1, p=0.002. The odds ratio was 1.450, this implies that the farmers who frequently attended the banana value addition training are equally likely to use selected banana value addition technologies as findings are in agreement with those of Ndungu et al. (2017) who found out that training farmers on tissue culture influenced the adoption of tissue culture.

The study found out that challenges in the use of banana value addition technologies had a negative influence with a β coefficient of (-0.181) on the use of selected banana value addition technologies with the overall effect of Wald 2.635, df=1, p=0.105. The odds ratio was 0.834, this implies that the more the farmers are experiencing challenges the lesser the use of selected banana value addition technologies. The option of adopting the banana value addition technologies was thus less palatable compared to failure to adopt the technologies under stressful conditions. The findings are in agreement with those of research done by Farm Management Community (2019) who found that a small-scale farmer faces both internal and external challenges as far as the adoption of modern agricultural technologies is concerned. This aspect accounts for the slow rate at which such technologies are adopted. The land size, cost and benefits of technology, are some of the economic factors that determine the rate of agricultural technology adoption. Farmers' education level, age, social groupings, and gender are some of the social factors that influence the probability of a farmer to adopt modern agricultural technologies.

RECOMMENDATIONS

It is recommended that the government creates and implement policies such as collaborating with high learning institution like universities and set days where they will be training farmers on banana value addition. This empowers farmers economically since they may have the right knowledge and skills needed for banana production and value addition. The study also recommends the government and other non-governmental organization to be innovative when it comes to training farmers. Innovations like mobile application technology that will provide training online or via SMS will target a wide population of farmers and facilitate access to

information since most people in Kenya own smartphones.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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