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Factors Affecting the Adoption of Chemical Use in Yam Storage among Farmers in Orire Local Government Area of Oyo-State, Nigeria

Enioluwa Jonathan Ijatuyi[1], Karabo Mabe[2] and Omotayo Abiodun Olusola[3]

[1, 2, 3]Department of Agricultural Economics and Extension, North-West University, Mafikeng Campus, Mmabatho 2735, South Africa
E-mail: [1]<ijatuyienioluwa@yahoo.com>, [2]<karabo.mabe@nwu.ac.za>, [3]<omotayoabiodun777@gmail.com>

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ABSTRACT Yam as a staple food in Nigeria has lot of importance, hence it has been imperative to know different ways of preserving this tuber. The study aimed at looking at the factors that affected the adoption of chemicals as a preservative in Orire local government area of Oyo-state in Nigeria. A sample size of 120 farmers was chosen and multi-stage sampling technique was employed. Majority of the farmers were male with ninety-three percent, married with seventy-five percent and with no form of education. Majority of the farmers had between 5-9 household members. The study discovered a positive significance between the adoption of the technology and the family size of the farmer. Majority still made below 20,000 NGN in sales annually. The welfare of the farmer contributed to the adoption of the technology significantly. The null hypothesis was rejected. The study recommends that the government should encourage more female farmers to cultivate yam tubers and also more financial assistance should be given to farmers in order to encourage production and this introduction should benefit the farmers and not the researchers' alone.

INTRODUCTION

In history, agriculture is known to be one of the oldest industries among humans and also it could be said that it remains one of the main pivots on which the human health stands (Ijatuyi et al. 2016). Agriculture constitutes the main source of employment and livelihood for the majority of the world's poor (Meijerink and Roza 2007). Therefore, the importance to invest more in the agricultural sector has been raised so as to raise productivity in agriculture. Agriculture is a major contributor to the growth of any given nation in all the main sectors of growth. It plays tremendous role in the nation's economic development, such roles includes; provision of food for the teeming population, provision of raw materials for industries (Adams et al. 1992). The importance of the agricultural sector to the Nigerian economy cannot be overemphasized as in recent times it contributes about twenty-six percent of the nation's GDP (Oluyole 2010). Anonymous (2017) discussed that the contribution to the economy of Nigeria from Agriculture increased to 5035069.07 NGN Million in the third quarter of 2016 from 3635533.14 NGN Million in the second quarter of 2016. It was further stated that Agriculture in Nigeria average about 3660608.78 NGN Million from 2010 until 2016 reaching an all-time high of 5035069.07 NGN Million in the third quarter of 2016 and a record low of 2594759.86 NGN Million in the first quarter of 2010.

Yam otherwise known scientifically as (*Dioscorea SPP)* is a climbing plant that produces large underground tubers. Otegbayo et al. (2011) discussed that yam is an integral part of food systems in the tropics and is estimated to be a source of calories for over 60 million people. Osunde and Orhevba (2011) stated that yams are the most important food crops in West Africa next to cereals and about 48.7 million tons are produced worldwide and Nigeria in West and Central Africa produces about ninety-four percent.

Address for correspondence:
Enioluwa Ijatuyi
Department of Agricultural Economics and Extension,
North West University,
Private Bag X 2046,
Mmabatho 2735, South Africa
Telephone: +27790476718,
E-mail: ijatuyienioluwa@yahoo.com

In the plight of obtaining fresh, edible and marketable yams, the freshly harvested tubers need to be stored and kept clean from excess temperature but good aeration must be provided. There are many causes that could lead to yam loss. These include sprouting, transpiration, respiration, rot due to mold, bacteria, insects and mammals (Osunde and Orhevba 2011). Andrew et al. (2002) established that yam is a principal source of nutrient calories for several millions of people. Yam provides over 200 dietary calories per capital daily for over 150 million people in West Africa while serving as a crucial source of income for the people (Babaleye 2003). Out of the numerous root tuber crops that we have in Nigeria, yam is greatly preferred because of its peculiar characteristics, which makes it attractive to smallholder farmers, it has numerous uses due to its richness in carbohydrate especially starch. As a major staple food in Nigeria, it can be turned into varieties in many household diets such as yam flour, boiled, fried, roasted or even pounded.

In some parts of Yoruba land especially among the Ijebu people, yam can be grated and fried before being eaten and also be consumed in form of yam porridge. Moreover, its availability in many parts of Nigeria and almost throughout the year makes it preferable to other seasonal crops like grains, peas, beans etc., for food security (Ayanwuyi et al. 2011). In Nigeria, food production awareness has expanded the need for adequate storage of agricultural produce so that food security can be achieved. Food storage became an imperative phenomenon, considering the immense contribution of agriculture to food and life security. According to World Bank (1998), food security is defined as access to enough food by all at all time for an active and healthy life. The food security programme of Nigeria centers on three strata of farm produce storage and these included strategic produce reserve, buffer stock, and the farm level storage. The programme mandated that farmers should store eighty-five percent of their farm produce (Olumeko 1999). Thus, food storage is the necessity for food security.

Yam is a widely consumed staple food consumed by both humans and animals. Over 600 species of this root tuber is known to be in existence but only six are relevant to these part of the world and especially Nigeria, these includes: white yam *(Dioscorea Rotundata)*, yellow yam *(Dioscorea Cayenensis)*, water yam *(Dioscorea Alata)*, Trifoliate yam *(Dioscorea Dumentorum)*, Aerial yam *(Dioscorea Bulifera)*, and Chinese yam *(Dioscorea Esculenta)*. All the six species account for over ninety percent of the entire food yam grown in the tropics. Hahn et al. (1987) identified the white yam as the most commonly grown, mostly used and with the highest value amongst all the species of yam. Yam storage facilities or structures in different parts of Nigeria are made from different locally sourced materials. Okoedo-Okojie and Onemolease (2009) reported that yam barn is a very common traditional storage structure across the yam growing states of Nigeria which are usually made of paddy straws, split or whole bamboo poles, reeds, ropes, mud bricks. Traditional storage methods have been used by yam farmers across the yam growing regions and are similar to those used in Oyo, Edo, Ondo, Ekiti, Kwara and Adamawa states. Traditional methods of storing yam in those states include; yam barns, heaping and covering of yam tubers, bare floor/ground, raised platform and pits or hole dug in the ground. The main purpose of storing yam or any other tuber is to retain and maintain the quality for a longer time, prevention of yam tubers from rodent attack and also to ensure the continuity of the yam tubers availability throughout the year.

Agbarevo and Benjamin (2014) stated that "the adoption of improved agricultural innovations is a means of improving farmers' yield but the low rate of adoption of extension packages of recommendations by farmers in Nigeria has been an obstacle to the realization of this goal." Agbarevo and Benjamin (2014) further stated that the low adoption of innovations by farmers cannot be attributed to just one reason but to several reasons which he attributed to the fact that due to the financial state of most of the rural farmers, they are not always able to purchase improved technological packages from extension workers. The importance of adoption of new and improved technologies by farmers has been made known by different agricultural economists and extensionists over the years. Some studies focused on the theory of adoption processes, some paid attention to identifying significant characteristics associated with adopters and non-adopters, some studies have taken new approach to delve into determinants of technol-

ogy adoption while some others investigated the rate of adoption of agricultural technologies (Rogers et al. 2005). The agricultural sector of Nigeria has been facing many challenges and problems of storage technology hence huge waste in agricultural outputs that has contributed a lot of loss to the economy. Natsa (2015) highlighted that in Nigeria, NGN 16 billion is needed to make up for the shortfall in production in the tomato industry. According to Adepoju (2014), poor post-harvesting handling of perishable farm produce by the farmers can be traced to the negligence on the part of some farmers. Olumeko (1999) showed that about 2.4 billion tons of food is lost per annum due to poor harvest and storage facilities in which the losses are mainly in grains, yam, cassava, plantain, and fruits. Olumeko (1999) further stated that about NGN 48 billion is lost annually on post-harvest of the farm produce, hence some improved yam storage technologies such as refrigeration and Gamma radiation requires the availability of some social infrastructures such as electricity. However, many of the rural communities in Nigeria still lack electricity or its regular supply thus making it impossible for the adoption of any storage technology that requires electricity as it may not be feasible in those communities. The importance of using chemicals as a storage innovation for yam is because it does not need electricity to operate which is cost effective. It prevents root rot and inhibits sprouting.

Given the above observations, the need for this study to communicate improved technology to farmers is imperative since food storage plays a vital role in food supply at household level. Hence, the objective of the study was to determine the factors affecting the use of chemicals as yam storage technology among farmers in Orire local government area of Oyo- state, Nigeria because farming is the predominant activity in this area and it is the major source of livelihood. Specifically, the paper examined respondents' personal characteristics in the study area, and the factors affecting the adoption of the use of chemicals for yam storage in the study area.

METHODOLOGY

The study was carried out in Orire local government area in Oyo state which is one of the 33 local governments in the state. The headquarters of the local government is situated at Ikoyi-ile and with an area of 1800.00 km^2, a plain of 79.00 km^2 and population of 103,611 (Oyo-State 1998-1999). It is bordered by local governments such as Atiba to the west, Ogbomosho north and Ogbomoso south, Ogo-oluwa, Surulere and Oyo to the south. Olorunsogo local government to the north and to the east is Ekiti state. Some of the communities in the study area include: Aaipon, Oja-tuntun, Tewure, Araromi, Ikoyi-alaropo, Esin-ele, Obamo, Fedegbo, Olotutu, Oloka, Oko-ilorin, Adekanbi, and Igbori-igbeti Some of the agricultural commodities found in the study area include tomato, maize, melon, cassava and some tree crops (cashew and mango).

Population, Sampling Size, and Sampling Technique

The northern ecological zone of Oyo-state in which Orire local government is located is characterized by savannah vegetation and lies within the northern agricultural zone of the state agricultural extension service. Farming is the predominant economic activity of the people, yam, maize, and cassava being the major crops grown. A sample size of 120 farmers was chosen from a population of 103,611 (Oyo-State 1998-1999) since it is not economical and practicable to study all the members of the population. The research design is a survey whereby administration of questionnaire was used to solicit information from the respondents. Multi-stage sampling technique was employed for the study. The first stage was to select Orire Local Government, second stage was the selection of the six villages in the local government and the third stage was random selection of farmers in Adekanbi, Aipo, Ikoyi-alaropo, Oja-tuntun, Oko-Ilorin and Igori-igbeti communities that 20 questionnaires was administered to.

Data Collection

Data were gathered from the respondents by means of a structured interview schedule. Only 100 of the expected 120 responses were found useful for data analysis. Analysis of data was done using frequency table, percentage, and mean.

The data collected from this study was analyzed using the descriptive method that includes the use of percentages, frequencies, and averages. Ordinary least square regression was used

to determine the factors affecting the adoption of chemical use for yam storage in the study area. The relationship between the adoption of chemical use for yam storage and the factors can be expressed as follows:

$Y=f(X_1+X_2+X_3+X_4+X_5+X_6+X_7+X_8+X_9+X_{10}+X_{11}+X_{12}+X_{13}+X_{14}+X_{15}+X_{16}+e)$

Where: Y = adoption of chemical use for yam storage

X_1 = Age, X_2 = Religion, X_3 = Gender, X_4 = Marital status, X_5 = Educational level, X_6 = Farm experience, X_7 = Farm size, X_8 = Household size, X_9 = Believe, X_{10} = Landownership, X_{11} = Welfare, X_{12} = Access to credit, X_{13} = Extension visit, X_{14} = Total farm revenue, X_{15} = Labour use, X_{16} = Yam variety, e = Error term

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

The result in Table 1 shows that majority (93%) of the respondents in the study area are male, Table 1 further showed that the marital status of the respondents in the study area is married with a majority percentage of seventy-five. Fifteen percent are single, seven percent are divorced while three percent of the respondents were widowed. The majority of the respondents interviewed had nothing more than the primary school education with thirty-four percent. The age range of the respondents varied from below 30 and over 51 years and the result from the table showed that fifty-three percent of the respondents fall in the range 41-50 in the study area indicating that most of the respondents were in the productive age group.

This is in agreement with the findings of Mohammed et al. (2014) that stated similar age bracket in their study that is 30-50 years which are an advantage since they are still in the age at which they are supposed to be energetic, more mentally alert in learning a new technology than the older farmers and hence can actively get involved in processing activities. Mohammed et al. (2014) in Lawal and Oluyole (2008) and Agwu (2004) posited that the finding is in line with their conclusion and also stated that age is a very important determinant of socio-economic status that individuals wear as they advance in age in respective to their energy which also confirms that age has a significant effect on the level of awareness and on agricultural production. The farming experience in years of the respondents shows that ten percent had 10 years and fewer, forty percent had between 11- 20 years, and fifty percent of the respondents had 21 years and above in the study area. The study shows that thirteen percent of the respondents had a household size of below 5, fifty-two percent had between 5-9 household size, twenty-two percent had between 10-14 household size and finally respondents that had greater than 14 household size were thirteen percent. The majority of the respondents recorded fell between the household size of 5-9.

The findings made by Giroh et al. (2011) reported a positive and significant relationship between family size and adoption of technology. This implies that family size as part of the

Table 1: Socio-economic characteristics of the respondents

Variable	*Frequency*	*Percentage*
Sex		
Male	93	93
Female	7	7
Marital Status		
Married	75	75
Single	15	15
Divorced	7	7
Widowed	3	3
Educational Level		
No formal	32	32
Primary school	34	34
Secondary school	24	24
Tertiary	10	10
Age		
30 and below	10	10
31- 40	20	20
41- 50	53	53
51 and above	17	17
Farming Experience (Years)		
10 and Fewer	10	10
11- 20	40	40
21 and above	50	50
Household Size		
Less than 5	13	13
5- 9	52	52
10- 14	22	22
More than 14	13	13
Farm Size (Hectares)		
1.0 and below	70	70
1.1- 2.0	20	20
2.1 and above	10	10
Annual Income (Naira)		
20,000 and below	45	45
20,001- 40,000	25	25
40,001- 60,000	20	20
More than 60,000	10	10
Total	100	100

Source: Field survey 2014

socio-economic characteristics of respondents is positively and strongly related to adoption. The farm sizes of the respondents were recorded with farmers that had 1.0 hectares and below having the majority with seventy percent, twenty percent of the respondents had between 1.1-2.0 hectares, and the least of farmers at ten percent having 2.1 hectares and above. This shows that the lower the size of the farm, the easier it is to adopt the use of chemicals for yam storage. The findings revealed that the majority of farmers with forty-five percent had an annual income of NGN 20,000 and below, twenty-five percent had between NGN 20,001- NGN 40,000, twenty percent had between NGN 40,001-NGN 60,000 and those with above NGN 60,000 were ten percent.

The results of the regression analysis in Table 2 revealed that the age of the respondents was significant negatively at five percent (P<0.05) to the adoption of the yam storage technique in the study area. This conforms Chi and Amanda (2002) that being young can trigger adoption of new technologies. The religion of the respondents had no significant effect on the adoption of the storage technology. The gender was noted to be significant negatively at ten percent (P<0.10) to the adoption of the yam storage technology. Simonyan and Obiakor (2012) stated that yam cultivation is male dominated practice because it involves the clearing of land, heaping, staking, and even digging during harvest, therefore requiring labour, more power, and efforts which a male will be able to cope with. Furthermore, the result also confirms the significance of respondent's marital status in the study area with it being negative at ten percent (P<0.10) in adopting the storage of yam with chemicals. Farmer's educational level also showed that it is very significant at five percent (P<0.05) in the adoption of chemical use. The apriori expectation of the study was that farming experience will be significant because it is expected that many years of farming experience can enhance productivity but this wasn't the case and also wasn't a factor that affected the adoption rate of the use of chemical usage for yam storage.

The farmer's farm size varied from respondent to respondent, and this was found significant negatively at one percent (P<0.01) to the adoption rate. This is similar to what Simonyan and Obiakor (2012) reported about their study area that was dominated by smallholder farmers. The household size of the respondents was also taken into consideration and it was found out that farmer's household contributes to the adoption of the technology that is being introduced with five percent (P<0.05). On the other hand, Wongnaa and Awunyo-Vitor (2013) stated that

Table 2: Ordinary least square regression analysis showing the factors affecting the adoption of the use of chemicals for yam storage

	Un-standardized coefficient		*Standardized coefficient*		
Model	*B*	*Std. error*	*Beta*	*t*	*Sig*
(Constant)	.054	.774		.070	.945
Age (X_1)	-.007	.012	-.047**	-.540	.593
Religion (X_2)	-.206	.264	-.135	-.738	.439
Gender (X_3)	-.104	.205	-.086***	-.505	.617
Marital status (X_4)	-.098	.226	-.082***	-.435	.666
Educational level (X_5)	.051	.343	.028**	.150	.882
Farming experience (X_6)	-.007	.016	-.126	-.435	.659
Farm size (X_7)	-5.289	.001	-.003*	-.009	.993
Household size (X_8)	.058	.284	.038**	.205	.839
Believe (X_9)	-.005	.011	-.115	-.488	.629
Land ownership (X_{10})	.268	.193	.228	1.387	.175
Welfare (X_{11})	-.110	.223	-.091***	-.494	.624
Access to credit (X_{12})	-.320	.320	-.226	-.999	.325
Extension visit (X_{13})	.517	.248	.411	2.089	.044
Total farm revenue (X_{14})	.013	.181	.011**	.074	.942
Labour-use (X_{15})	.135	.066	.420	2.037	.050
Yam variety (X_{16})	.003	.013	.055***	.272	.787

Source: Field survey 2014

Model = 1, R= 0.601, R^2 adj = 0.051, Standard error estimate (SeE) = 0.57741, 1 percent = *, 5 percent = **, 10 percent = ***.

there is the probability that family responsibility may take more of the annual income of the farmers. The result showed that the farmers belief was not significant which was thought that would have an effect on the adoption rate. Also, the ownership of farming land was also found not significant as a factor of the farmer's adoption rate. Respondent's welfare had a significant effect as one of the factors that affected farmer's adoption rate. The significance was negative at ten percent ($P<0.10$). Access to credit and the number of extension visits they get on their farms were not found to be significant for the adoption of the chemical use storage technique. The total farm revenue had a positive percentage with the adoption rate which was recorded at 5 ($P<0.05$). The labour-use was not significant on the respondent's adoption rate while the yam variety had a significant relationship between the farmers and the adoption of chemical use with a level of significance at ten percent ($P<0.10$).

CONCLUSION

The results of the regression analysis show that after inputting all the independent variables which had a significant correlation with the dependent variable, only the variables of facts with the chemical usage of storing yams remained. Furthermore, the findings in the study clearly show that new or improved technologies in agricultural development will remain in little value and effect until they are or can be put to use for the economic and social well-being, physical status of the people involved who are supposed to be the beneficiaries.

RECOMMENDATIONS

It is hereby with the above conclusions that the following are recommended: chemical usage for yam preservation should be introduced with the aim of benefiting yam cultivating farmers and not the researchers alone. The government of the day should encourage more female farmers to join in the cultivation of yam because the study discovered more male participation. The government should also assist farmers financially because the study highlighted through the annual income generated from sales, the majority still makes below NGN 20, 000. Finally, for further research, the effects of post-harvest losses or rural livelihood should be considered together with the effect on food security.

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