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Comparative Analysis of the Profitability of Adopters and Non-adopters of Quality Protein Maize (QPM) in Akinyele Local Government Area, Oyo State, Nigeria

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Abstract
The paper compares the profitability of adoption of Quality Protein Maize (QPM) with the Local/conventional Maize (LM). The gross margin of QPM farm is N12,557.46 per ha, while the gross margin of LM farm is N4,608.75 per ha. The test of comparison of means gross margin reveals that, the gross margin of adopters is significantly greater than that of the non-adopters. The study also reveals that 59 percent of the farmers have adopted the QPM owing to information they have known about it. This result implies that maize farmers in the study area are at the stage of late majority in line with Roger's 1995 classification of adoption. It also shows that about 41percent of maize farmers could adopt if there is an appropriate information service about the QPM. Therefore the study recommends to policy makers to emphasize on the sensitization of farmers in the study area.

Keywords: Profitability; Adopters; Non-adopters; Quality Protein Maize

Introduction
Maize (*Zea mays* L., Poaceae) is the most important cereal in the world after wheat and rice in terms of area cultivation and total production (Purseglove, 1992; Osagie and Eka, 1998). It is mainly used as staple food and animal feed in most developing countries (Olakojo *et al.,* 2007; Mboya *et al.,* 2011) and an important source of protein accounting for up to 60% of the daily human protein supply (Mbuya *et al.,* 2011, Musila *et al.,* 2010). While the average yield of maize in developed countries can reach up to 8.6 tonnes per hectare, production per hectare in many Sub-Sahara Africa (SSA) countries is still very low (1.3 tonnes per hectare) (IITA, 2007). Normal maize varieties are observed to be deficient to two amino acids, lysine and tryptophan that are nutritionally essential for humans (Gaziola *et al.,* 1999; Sofi *et al.,* 2009; Azevedo and Arruda, 2010; Mbuya *et al.,* 2011) and maize mutants for high lysine and tryptophan have been reported in several studies (Mbuya *et al.,* 2012). Likewise, lysine metabolism and endosperm protein synthesis in maize mutants are well documented in various reports (Azevedo *et al.,* 2003; Azevedo *et al.,* 2004). The plant and grain of QPM is similar in appearance and are difficult to distinguish from normal maize. Although similar phenotypically to normal maize, nutritionally, QPM grains contains approximately 55% and 30% more tryptophan and lysine respectively compared to normal maize varieties. The lysine and tryptophan content in normal maize varieties is less than a half of the recommended rate for human nutrition (FAO/WHO, 1990). This problem has been addressed through research breakthroughs by the International Maize and Wheat Improvement Centre (CIMMYT) in the late 1990's leading to the development of Quality Protein Maize (QPM) which contains twice

the amount of lysine and tryptophan (Krivanek *et al.,* 2007). Since then over 20 African countries have adopted and promoted QPM in their agricultural development plan (Mbuya *et al.,* 2010). In Nigeria, the collaborative research efforts by maize scientists from international and national research thrusts including International Tropical Agriculture (IITA), Institute of Agricultural Research and Training (IAR & T), Ibadan, and Institute for Agricultural Research (IAR), Samaru, Zaria, are focused on improvement in maize grain quality characteristics of organoleptic and nutritional properties.

QPM has similar qualities as normal maize regarding grain texture, taste, colour, tolerance to biotic and abiotic stresses as well as high yield (Sofi *et al.,* 2009; Olawuyi *et al.*, 2013). QPM also looks like normal maize, but can only be reliably differentiated through laboratory tests (Ganesan *et al.,* 2004; Srinivasan *et al.,* 2004). These varieties must possess traits acceptable to farmers. Modern QPM varieties are currently being actively disseminated, particularly in Sub-Saharan Africa (Krivanek *et al.,* 2007). Little is known about the adoption rate and the profitability of growing this variety by farmers. Adoption of QPM by farmers' has therefore being of interest to agricultural economists, extension agents and rural sociologists. It is believed that an effective way to increase productivity is broad based adoption of new farming technologies (Mitten and Barret, 2008). For instance, a study in Mexico showed that adoption of improved maize varieties improves household welfare (Beceril and Abdullah, 2010). Similarly, in SSA, adoption of improved maize was indicated to have positive outcomes (Alene *et al.*, 2009).

Maize is widely fed to weaning children without a protein supplement such as milk, meat, or beans in many African countries. This had led to diseases such as kwashiorkor from protein deficiency. This had also prompted the development of Quality Protein Maize (QPM), such as Obatanpa, which has gone a long way in West and Central Africa (WCA) to reduce protein deficiency problems. Varieties of QPM have also made significant contributions to the food and livestock industries (Dankyi *et al;* 2005). They are easily adopted because of their high yield and nitrogen use efficiency. Farmers prefer the taste of QPM in the various recipes they prepared. The SG2000 effort in research and extension of QPM resulted in the registration and release of SAMMAZ-14 (Ado *et al;* 2005).

However, very low adoption of productivity enhancing technologies has dwarfed efforts to reduce rural poverty (World Bank, 2008). The slow rate of adoption of improved agricultural technologies could be due to low expected benefits from the new variety or could be due to other factors such as farmers' attitude or institutional factors which may not encourage the adoption of technologies by farmers (Seyoum *et al.* 1998). Assessing adoption and profitability of QPM is therefore very essential to know whether it cultivation is more profitable than the traditional maize.

The main objective of this research is to compare the gross margin of adopters and non-adopters of QPM in Akinyele Local Government area of Oyo State, Nigeria.
The specific objectives are to:

1. describe the socio-economic characteristics of maize farmers by adoption of QPM in the study area;

2. estimate, and compare the gross margin of adopters and non-adopters of QPM in the study area;

Hypothesis

The following tentative hypothesis was also tested in the study

H_o: The gross margin of adopters is not significantly different to the gross margin of non-adopters

Literature review on adoption

Technology is the systematic application of scientific or other organized body of knowledge to practical purposes (Akubuilo *et al.,* 2007). This includes new ideas, inventions, innovations, techniques, methods and materials.

Agricultural technology adoption study has many policy implications in agricultural development (Fadare *et al.,* 2014). It serves as a tool for evaluating the distributional impacts of new innovations, for documenting the impact of an innovation or extension effort, for identifying and reducing the constraints to adoption, and as a research guide to focusing innovation priority (Feder and Slade, 1984; Adesina and Zinnah, 1993; Green and Ng'ong'ola, 1993; Doss, 2003; Langyintuo and Mungoma, 2008; Fadare *et al.,* 2014).

According to Rogers (1995), adoption is one important component within the innovation-decision process. He defines the innovation-decision process as "the process through which an individual passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation and use of the new idea, and to confirmation of this decision". For Van den Ban and Hawkins (1996), adoption of innovation is the decision of an individual or group to use or apply an innovation. Adoption is defined a as a decision made by an individual or group to use an innovation in a continuous manner; the technology is the systematic application of scientific or other organized body of knowledge to practical purposes (Akubuilo *et al.,* 2007). This includes new ideas, inventions, innovations, techniques, methods and materials (Olumba and Rahji, 2014). However, farmers' adoption of a new technology, such as improved maize seeds, is a choice between traditional and new technology (Aloyce *et al.,* 2000).

According to Rogers (1995), the innovation-decision process is composed of five main steps:

1. Knowledge is being aware of the existence of an innovation.
2. Persuasion is the process of forming a favorable or unfavourable attitude towards the innovation.
3. Decision means making a choice whether to adopt or reject the innovation.
4. Implementation is the logic consequence of the adoption and means putting an innovation into use.
5. Confirmation involves the re-enforcement or the reversing of a previous innovation-decision.

The Institut National de la Recherche Agricole du Bénin (INRAB) (1996; Adekambi 2005), made a distinction between adopters and non-adopters of an innovation or technology. An innovation is adopted when it is integrated by the user. In this study, adopters of QPM are maize farmers who grow this improved variety of maize; while the non-adopters are those who

do not cultivate this variety of maize. Rogers (1983) identified five categories of adopters as shown in Table 1.

In the literature, many studies have pointed out the importance of the gross margin in the farmer's decision to adopt a particular technology. INRAB (1996) has identified the gross margin as a factor that influences the decision to adopt a particular technology. According to Aloyce *et al.* (2000) farmers' decision to adopt or not to adopt is usually based on the profitability and risk associated with the new technology. According to Kenya Agricultural Research Institute (KARI, 2010), farmers often cite the high cost of improved seed as a constraint to adoption. The high seed price results both from high cost of developing and producing improved seeds and from high transportation cost (Morris, 2002). In particular, Hassan *et al;* (1998) found that improved maize seed is not economically profitable for resource-poor farmers when the seed-to-grain price ratio is unfavourable.

Materials and Methods

Study Area

The study area of this research work was Akinyele Local Government Area in Oyo State, Nigeria, with the headquarters in Moniya and shares boundary with Ibadan North Local Government area to the South; Afijio Local Government area to the North; Ido Local Government area to the West and Lagelu Local Government area to the East. The major occupations of the people residing in the area are farming, carpentry, trading, marketing, food processing as well as carving work. The crops grown in the area include maize, cassava, banana, plantain, and cocoyam.

Sources of Data

This study was mainly based on primary data, collected by administering well-structured questionnaires among small scale maize-based farmers. The data collected includes the socio-economic factors like age, household size, maize farming

Table 1: Different types of adopters

Category of adopters	Proportion of adopters	Characteristics	Cumulative Percentage
Innovators	2.5%	They are venturesome.	2.5%
Early adopters (after the innovators)	13.5%	They are considered as solid, responsible, local opinion leaders, higher social status, financial liquidity, advanced education, and more socially.	16%
Early majority (after the early adopters)	34%	They have the above social status contact with early adopters and seldom hold position leadership in a system (Rogers 1962).	50%
Late majority (after the early majority)	34%	They are typically sceptical about an innovation. They have below average social status, little financial liquidity, and little opinion leadership.	84%
Laggards and leapfrogs	The bottom 16%	They are the last to adopt an innovation; they have aversion to change and tend to be focus on the tradition being conservative, oldest among adopters, lowest social status and financial liquidity. Leapfrogs often skip several generations in order to reach the most recent technology when resistors upgrade.	100%

Source: Adapted from the classification of Rogers (1995).

experience, educational level, and farm size, adoption of improved seed, and usage of land management practices, input use and output.

Sample Selection and Size

A multi-stage sampling procedure was used for this study with the first stage which involved the purposive selection of ten villages (Ikereku, Oboda, Arulogun, Onidundu, Moniya, Akinyele, Talonta, Ojoo, Ijaye and Iroko) based on the intensity of maize production in the villages. The selection was done to reflect the most typical situation for maize-based farming systems. The second stage involved a simple random sampling 10 maize-based farmers in each of the 10 villages. Leading to a total of 100 respondents used for the study.

Analytical Techniques

Descriptive statistics such as frequency tables, percentage, mean were used to analyse socio-economic characteristics and level of adoption of QPM variety.

Gross margin analysis was used to estimate the cost and returns in production of the quality protein maize variety and also to determine whether quality protein maize is profitable. The Average Gross margin per hectare is the difference between total revenue and the total variable cost incurred. It can be expressed as

GM/ha = TR-TVC, (1)

Where,

GM/ha = Gross Margin Per hectare

TR = Total Revenue (Quantity of output x Market price) per ha

TVC = Total Variable Costs

Total Variable Cost includes the various cost of the quality protein maize that varies with the level of the production like labour, seed and fertilizer per ha.

Limitation of Data Collection

Certain problems were encountered in the course of the study, these includes:

- Apathy on the part of some respondents, probably due to their experience with researchers in the past.
- The inability of the farmers to keep adequate records and give exact data as they depend on memory recall which permits a wide range of errors.
- Unwillingness of some respondents to reveal the financial position of the business.

Results and Discussion

Socioeconomic Characteristic of Respondents

Table 2 presents the distribution of adopters and non-adopters by sex, age, marital status, educational level, maize farm size household size and years of farming experience. Only 59% of the farmers have adopted the QPM due to proper information they have received on QPM. The frequency analysis reveals that about 95% of the adopters are male and they have an average maize farm of 2.1ha. Also, 83% of non-adopters are male cultivating about 1.9ha of maize. The maize farmers in the study area have an average of 16 years of farming experience with a maximum of 30 years and a minimum of 2.5 years and 7 years for adopters and non-adopters respectively. This result reveal that adopters and non-adopters although have similar farming experience, the proportion of adopters with former education is less than the non-adopters contrary to our expectation.

Only 61% of the adopters have a formal education against 78% of non-adopters.

Adopters and non-adopters have an average age of 54 years old each, majority are married with an average household size of 5. When this was compared with Rogers' classification (Table 1), it was concluded that, farmers in the study area are late adopters of QPM. These may be due to lack of information on the profitability of this maize variety by government extension agents. This finding is however contrary to Kari (2010), who observed that farmers often cite the high cost of improved seed as a constraint to adoption**.**

Profitability analysis

The result of the profitability analysis in Table 3 reveals that the production of QPM is profitable in the study area.

The mean gross margin of non-adopters is N4,608.8 per ha and N12,557.5 per ha for adopters. This shows that it is profitable for a maize farmer to cultivate QPM variety.

Test of null hypothesis that says that the gross margin of adopters is not significantly different to the gross margin of non-adopters

The test of null hypothesis that the gross margin of adopters is not significantly different from the gross margin of non-adopters' is rejected (Table 4). This means that QPM is significantly more profitable than local maize (LM) at 5% of level of significance.

Table 2: Distribution of adopters and non-adopters by socioeconomic and demographic variables

Variables	Items	Frequencies	Percentage of adopters	Frequencies	Percentage of non-adopters
Number	Adopters	59	59	41	41
Sex	Male	56	94.9	34	83
	Female	3	5.08	7	17
Age	less than 50	11	19	6	24.4
	50 to 60	29	67	30	68.3
	Greater than 60	9	14	5	7.3
	Min	38		38	
	Mean	54.3		54	
	Max	62		62	
	Std	5.814		5.586	
Marital Status	Married	58	98.30	41	100
	Divorced	1	1.70	0	0
Education Level	No formal	23	39	9	22
	Primary	23	39	11	26.8
	Secondary	13	22	21	51.2
Maize farm size	Less than 2 ha	15	25.4	14	34.1
	Equal to or greater than 2 ha	44	74.6	27	65.9
	Min	1.5		1.5	
	Mean	2.1		1.9	
	Max	3		3	
	Std	0.4224		0.3574	
Household size	3-5	22	37.3	14	34.1
	5-7	37	67.7	27	65.9
	Min	3		3	
	Mean	4.9		4.68	
	Max	8		7	
	Std	1.029		0.907	
Number of years of farming experience	Less than 7	2	3.4	0	0
	7-15	16	27.1	16	19.5
	15-30	41	72.9	25	80.5
	Min	2.5		7	
	Mean	15.98		15.54	
	Max	30		30	
	Std	4.2820		3.450	
Major reason for adoption	Proper information on QPM	59	100	-	-
Major reason for non-adoption	Lack of information on QPM	-		41	100

Source: Field survey 2014

Table 3: Profitability analysis

Designation	Adopters		Non Adopters	
	Mean	Std. Deviation	Mean	Std. Deviation
Number valid data	57.00		40.00	
Total output (Kg)	168.08	36.08	144.48	31.679
Output price (₦)	178.97	4.47	150.00	0.000
Total Revenue (Naira/ha)	29,610.34	7,693.12	21,671.25	4,751.92
maize land (ha)	2.05	0.222	16.50	7.47
Cost of labour	13.78	5.26	2.00	0.00
Cost of seed	5730.00	1807.535	4705.00	880.47
Cost of fertilizer	11758.98	1426.32	12357.50	1059.48
Total variable Cost/ha	17346.90	2411.13	17062.50	1456.72
Gross Margin/ha	12,557.46	8,343.84	4,608.75	4,985.40

Source: Estimates from data collected.

Table 4: Test of hypothesis

Variable	Observations	Mean Gross Margin	Difference in Gross Margin	Std. Dev.	Z value
Non-adopters	41	12557.5	7948.7	8343.8	5.388**
Adopters	59	4608.8		4985.4	

Note: ** Significance at P<0.05

Conclusion and Recommendations

The study compares the profitability of adoption and non-adoption of QPM in Akinleye Local Government Area of Oyo State using a multi-stage sampling technique. It administered a questionnaire on 100 farmers selected by simple random sampling. The descriptive analysis reveals that 59% of the farmers have adopted the QPM owing to the level of information they have known about this variety. In addition, the result of the gross margin analysis reveals that adoption of QPM is significantly more profitable than the Local Maize (LM). About 41% of the sampled respondents did not adopt as a result of lack of information about the QPM variety. The extension agents should therefore sensitize maize farmers the more on QPM, and let them know that this variety of maize if planted on the same size of plot with the local maize variety is more profitable using the case of this study area (Akinyele Local Government Area).

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