Adoption of Quality Protein Maize Technology in Hai and Babati districts, Tanzania

Abstract

Technology adoption is a key driver of economic growth. The objective of the paper is to assess the acceptance of Quality Protein Maize (QPM) among farmers in the Hai and Babati districts, Tanzania. A random sample of 120 smallholder maize farmers in four villages was used to collect information regarding the adoption of QPM in the study area. The study employed descriptive statistics to analyze the data collected. Findings show that of the sampled farmers only 25% have adopted and continue to apply the technology which indicates a small adoption rate. In order to produce quality QPM, the study advised the government to guarantee input-output efficiency among farmers. The government should promote and support the promotion and dissemination activities of QPM in the country. Moreover, seed agents should ensure a sustainable supply and timely availability of seeds to farmers.

***Keywords**: QPM, non-adopters, promotion, dissemination*

INTRODUCTION

Many industrialized and developing nations around the world depend heavily on maize (Zea mays L.) for human and animal nourishment (FEW NET, 2018). According to estimates from the FAO food balance sheets, maize provides at least one-fifth of the continent's diurnal caloric intake and accounts for 17 to 60% of the daily protein requirements of people in 12 nations (Galani *et al.*, 2022).

Maize is the most significant staple food in Tanzania, with over 80% of the country's people depending on it for both food and income earning (URT, 2017; Barreiro-Hurle, 2012). In Tanzania, maize provides more than 35% of the population's usable protein and 60% of their daily calories (ANSAF and URT, 2017; URT, 2007). Additionally, maize is a component of animal feed used in the raising of cattle. More than 75% of the country's grain consumption is made up of maize, which accounts for 31% of the nation's overall food production (FAO, 2017).

Compared to regular maize, quality protein maize has almost twice as much useable protein. Some QPM hybrids have up to 13.5% protein content (Shawa *et al.*, 2020). The enhanced QPM populations were made available for direct field use as OPVs (open-pollinated varieties) or as bred lines for hybridization. Numerous cultivars with enhanced protein quality have therefore been made available for both sub-tropical and tropical lowland cultivation as well as temperate and tropical highland environments. In poor nations where maize is a staple food, QPM is widely used. In 18 developing nations, there were 750,000 hectares of cropland under cultivation (Asea *et al.*, 2014; Gregory and Sewando, 2014).

QPM is more valuable biologically and nutritionally than regular maize, and it may be grown similarly and has a similar kernel phenotype (Prasanna *et al.*, 2001). In comparison to regular maize, this kind has twice as much Lysine and Tryptophan as usual. QPM behaves and appears like regular maize. Since it is created using conventional breeding methods, it is not genetically altered and can only be accurately differentiated through scientific tests. In general, the QPM is

expected to increase household food security, generate income and minimize malnutrition problems, especially among children.

In Tanzania, the QPM technology was introduced in 2001 whereby three varieties which are Lishe H-1, Lishe H-2 Lishe K-1 were released. Two international organizations namely National Agricultural Research Systems (NARS) and CIMMYT contributed much to the introduction of these varieties in Tanzania, specifically the northern part of the country. These varieties were presented to the Variety Release Committee (VRC) for debate prior to their formal release, where the VRC reviewed the data from the advanced yield trials and the farmers' assessments that the Original Breeder had assembled (Twumasi-Afriyie, 2016). Later, the committee was convinced of the varieties' benefits and they were made public. Continuous seed certification for the released cultivars is done annually by the Tanzania Official Seed Certification Institute (TOSCI).

Technology adoption is crucial for economic growth, especially in emerging nations. Researchers must provide evidence that their investments have been competitive with alternatives in terms of research and technology distribution so as to draw attention to funding for agricultural research (Bjornlunda *et al.*, 2020; Mukasa, 2016). Thus, a study on the uptake of new technology is essential since it will yield significant indicators for evaluating the effects at the farm level and thereby enhancing farming operations (Lugamara *et al.*, 2021; Wordofa1 *et al.*, 2021).

There was a need to comprehend QPM's adoption status as well as the elements that influence it, given the significance of QPM which be cultivated and consumed by a large number of families as a nutritionally essential staple grain in the human diet like ordinary maize if they are produced and consumed in sufficient quantities (De Groote et al., 2010). Since the start of the QPM project in 2003, Tanzania Agricultural Research Institute (TARI) has been carrying out a number of QPM promotional activities in the Northern Zone of Tanzania, including field demonstrations, field days, the distribution of leaflets and brochures, the development of various recipes, and the production of QPM seeds (Misaki *et al.*, 2016). However, the adoption of QPM is not well established. Therefore, this paper filled the gap by establishing the adoption of QPM in Tanzania.

Materials and Methods

The study was conducted in Manyara and Kilimanjaro region where Babati and Hai districts were selected, respectively. The districts were sampled due to the fact that these districts were the first to receive the QPM technology in the country. These districts have favourable weather conditions for growing maize with a bimodal rain experience, which ranges from 500–1200 mm and 350–2000 mm, respectively. Normally, the short rainy season lasts from late October until December, whereas the long rainy season occurs from March to June. The soils range from sandy loam to clay alluvial soils and are of volcanic origin.

Cross-sectional study design was applied in a non-experimental fashion. Statistical Packages for Social Science (SPSS) software Version 20 was used to compile, code, and analyze the obtained data. Both comparative mean analysis and descriptive statistics, focusing on frequency distribution, were used.

Results and Discussion

Work-related qualities of the head of household

Among the factors influencing the use of technology are occupational characteristics such as farm size, off-farm activities, and animal ownership. Findings shows that households' average farms were 1.0 hectares (3.68 acres) which is 51% of which were planted in maize. (Table 1). In terms of total farm size, adopters had more acreage than non-adopters, however the difference was insignificant. The average amount of land used to grow maize by adopters and non-adopters was 0.8ha and 0.6ha, respectively. Maize, beans and sunflower are the most important crops grown. For both adopters and non-adopters, maize rated number one among the crops planted, followed by beans for Babati and beans for sunflower district.

Table 1: Farm qualities

	Adopters		Non-adopters	
Farm characteristics	**Mean**	**SD**	**Mean**	**SD**
Land owned	1	0.8	0.9	0.9
Area under maize	0.6	0.4	0.6	0.4

Off farm activities are sources of additional income which may encourage or discourage investment in new technologies. In this study the main off farm activities were casual labour, salary employment, carpentry and petty business. There was significant different ($p<0.01$) in number of adopters and non adopters involved in of farm activities. The results showed that adopters are less involved in off-farm activities than non-adopters of QPM technology (Table 2). Casual labour was the type of work mostly reported to be done by adopters (55.6%) and there was significant difference ($P<0.05$) between adopters and non-adopters. This indicates that the availability of labour in local markets would affect technology adoption. When there is local labour market, farmers can hire labour as needed. Members of farmers household may also sell labour to obtain cash as necessary.

Table 2: activities outside of agriculture

Item	**Adopters**	**Non-adopters**	**χ^2 statistic**
Involved in activities outside of agriculture	19 (36.7%)	51 (56.7%)	3.71*
activities outside of agriculture (Casual labour)	10 (55.6%)	15 (30.6%)	4.38**

**=Significant at 10% level, **=Significant at 5% level*

According to Farkas (2019) an institution is a system of behavioral norms that controls and shapes how people interact, in part through assisting individuals in developing expectations of what others will do. Thus extension services, research, seed/input provisional services (inputs stockists), and loan facilities are some of these institutions' supporting systems. As they are created to lessen risk and uncertainty in human exchange, institutions are seen as methods for structuring human relationships in the face of uncertainty. Institutions aid people in developing expectations of others' behavior (Martin, 2016).

Findings from Table 3 show that 54% of the adopters and 27% of the sampled non-adopter of QPM accessed agricultural extension services. This findings are similar to Lambert and Ozioma, (2011) who observed that adoption was higher for farmers having contact with extension agents working on agro-forestry technologies than farmers who have never experience any extension contacts.

Table 3: Distribution of sampled farmers' characteristics

Characteristics	Adopters %	Non-adopters %
Membership in farmers organization /group	70.0	33.3
Farmers access to extension	54.0	27
Participation in on farm demonstration trials	90.0	33.3
Attendance to farmers field days	63.7	3.3
Farmers access to credit	26.7	54.4

Around 26.7% of adopters and 54.4% of non-adopters claimed to have used local credit facilities. (Table 3). This demonstrates how existing credit facilities offer credits for other uses. The key difficulties that were raised concerning credit facilities that were provided include, extensive processes in acquiring credits, short repayment time and lack of information. Savings and Credit Co-Operative Societies (SACCOs) and Village Community Banks are two credit sources in the research region (VICOBA), Bangladesh Rural Advancement Committee (BRAC), Cooperative union and Vision Fund.

Knowledge about QPM technology

Farmers are unable to adopt a technology they are unfamiliar with. This implies that farmers must be aware of a new technology in their surroundings before any accumulation of knowledge and experiences can begin. Targeting farmers' ability to gather information is impossible without knowledge of the technology. So, we need at first step in any adoption process to impart knowledge to farmers. In other words, before using new innovations, farmers have to be aware of them. According to the study's findings, the respondents had a high level of knowledge about the QPM technology (Table 4).

Table 4: Knowledge about QPM

Knowledge about QPM	Adopters (n=30)		Non-adopters (n=90)		Total
	Number of respondents (%)		Number of respondents (%)		
	Babati	Hai	Babati	Hai	
Yes	14 (46.6)	16 (53.4)	24 (52.1)	31 (70.4)	85 (70.1)
No	0	0	22 (47.9)	13 (29.6)	35 (29.9)
Total	14	16	46	44	120

The level of knowledge about QPM technology among non-adopters from Hai district was 70.8% while that of Babati was 52.1% (Table 4). According to the findings, Hai District was better knowledgeable about QPM technology than Babati District. The marginally greater awareness rate in Hai District may be attributable to the fact that SARI has focused more of its efforts there than in Babati district on promoting and disseminating QPM technology, such as through QPM Field demonstrations at farmers' fields.

Source of QPM technology information

According to respondents, there are two main sources of information of the technology, namely researchers (37.7%) and farmers' field days (28.2%). TARI - Selian Centre was mentioned the

Centre of the agricultural researchers for the technology in these regions. Other sources included extension officers and farmers themselves

Table 5: Source of QPM technology information

Source of QPM information	Adopters (n=30)	Non-adopters	Total
	Frequency (%)	Frequency (%)	
Researchers	10 (11.8)	22 (25.9)	32 (37.7)
Farmers field days	13 (15.3)	11 (12.9)	24 (28.2)
Other farmer	4 (4.7)	14 (16.5)	18 (20.2)
Extension agents	3 (3.5)	3 (3.5)	6 (7.0)
Village leaders	-	2 (2.4)	2 (2.4)
Farmers group	-	3 (3.5)	3 (3.5)
Total	30 (35.3)	55 (64.7)	85 (100)

Rate of adoption

In this study, the adoption rate is calculated as the percentage of sample farmers who grow QPM. QPM has been in use in the examined region since 2001. In the study area, about 25% of the farmers who were surveyed cultivated QPM, while 75% did not (Table 6). The Lishe K1 QPM cultivar was grown by QPM adopters. Additionally, there were no appreciable differences in adoption rates between the surveyed districts. When compared to Babati district, Hai district had an adoption rate that was marginally higher (13.3%). This is likely due to QPM technology distribution operations that were carried out in Hai district.

Table 6: Adoption rate of QPM technology

District	Adopters (n=30)	Non adopters (n=90)	Total
Babati	14 (11.7%)	46 (38.3%)	60 (50%)
Hai	16 (13.3%)	44 (36.7%)	60 (50%)
Overall	30 (25.0%)	90 (75.0%	120 (100%)

Note: Values in the parentheses indicate percentage

Table 7 summarizes the major reason for not adopting QPM technology as given by the sampled non adopters. The major reason for low adoption as mentioned by respondents included non availability of QPM seeds as indicated by 45.6 % and25.7% of the respondents were not aware. These findings concur with that of Gregory and Sewando (2014) which revealed that the main reason of not adopting the technology was the problem of seed source. Other reasons mentioned by the sampled farmers were little knowledge about the technology, insignificant knowledge of QPM nutritional value, high price of seeds and land scarcity.

Table 7: Major reasons for not adopting (n=90)

Reason	Frequency	Percentage	Rank
No trustworthy QPM seed source	41	45.6	1
Little knowledge	23	25.7	2
Insignificant knowledge of QPM nutritional value	11	12.2	3
High price of QPM seeds	6	6.6	4
Scarcity of land for QPM	1	1.1	5

Adoption trend of QPM technology

The study examined the patterns of land use in the districts that were sampled. Based on Gregory's (2010) study adopters in Babati allocated an average of 2.2 acres while Hai allocated 1.8 acres for growing ordinary maize. However, it is only 15% and 34% of the total area is grown with QPM respectively.

Table 8: Area covered by QPM

District	Typical area in acreage			
	2004/05	2005/06	2006/07	2007/08
Babati	0.43	0.40	0.28	0.20
Hai	0.62	0.63	0.63	0.55

Source: Hai and District Agricultural and Livestock Department
Data from 2008/09 to 2021/22 were not available

The trend reveals that during the 2007–2008 growing season, the average amount of QPM-cultivated land decreased from 0.43 acres in 2004–2005 to 0.20 acres in 2007–2008 and from 0.62 acres to 0.55 acres for Babati and Hai, respectively. This signifies a decrease in QPM-cultivated areas of about 53.5% and 11.3%, respectively. (Table 8). The primary clarifications given for this pattern were; unavailability of QPM seeds, average yield potential for adopters, and little knowledge for non-adopters.

Conclusions and Recommendations

The QPM technology wasn't widely used. This is largely owing to the paucity of QPM seeds, financial facilities for maize/QPM production, and knowledge of QPM technology, its manufacturing, and marketing. Hence, it is advised that efforts to maintain QPM seed sources (public, private, and community-based organizations) at all levels, particularly at village levels to assure timely availability, be made in order to increase the success of the QPM adoption. Researchers and extension officers can raise awareness of QPM through promotion and dissemination initiatives (such field days and on-farm demonstrations), as well as by campaigning at all levels for partnerships and support. In order to raise QPM's output potentials, the government must enhance breeders' variety development efforts.

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