Factors that affect adoption of Hybrid Maize in Mwanga District: Implications for Continuing Education

C. P. Msuya_Bengesi[7]

ABSTRACT

This study investigated factors that influence the adoption of hybrid maize in Mwanga district and the implications for continuing education. Data for the study was collected from ninety randomly selected farmers in two villages. Field observation was also used for data collection. The data was analyzed using the Statistical package for Social Sciences (SPSS), employing cross tabs and chi square techniques. Findings show that adoption was significantly associated with gender, income, farm size, and cost of inputs and complexity of growing hybrid maize. In addition factors such as the presence of coffee, inte-cropping system and the de-braning quality of hybrid maize also affected the adoption rate. Based on the findings training is still required to ensure that farmers adopt the technology correctly, which includes buying fresh supplies of hybrid maize seed every season. It is also recommended that farmers should find alternative arable areas in the lowland areas of Mwanga district to cultivate more maize so as to offset food shortages. At the policy level, reintroducing subsidies and is recommended as an option that should be considered.

Key words; Adoption, Hybrid maize, Mwanga district

Introduction

Maize is the most important cereal food crop in Tanzania. It is grown in 13 agro-ecological zones of Tanzania mainland (Haule, 1988 and Mbwaga, 1988). Major maize producing regions include Iringa, Mbeya, Rukwa and Ruvuma in the Southern Highlands, and Arusha and Kilimanjaro in the North of the country. Other regions include Kigoma, Morogoro, Mwanza, Tabora and Tanga. Maize is produced mostly by smallholder farmers whose farms average between 0.4 and 3 ha, and contribute about 80 percent of the total estimated national production. Maize is also produced by public institutions and private farmers with farm sizes of over 100 hectares, contributing 5 percent of the total national production (Semguruka, 1988). The remaining 15 percent is produced by medium scale farmers.

The national objective of attaining self-sufficiency in food production depends to a greater extent on the improvement of maize production. Since 1971 when food shortages became a frequent occurrence the government embarked on an ambitious maize production programmes aimed at increasing maize yields per unit area. Such

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[7] Lecturer, Sokoine University of Agriculture

programmes included the National Maize Project of 1974 and the National Food Crops Credit Programme of 1975 (Mlay, 1988).

The programmes aimed at assisting smallholder farmers to adopt improved production technologies and practices through provision of farm inputs on credit basis. Despite all these efforts, average yield per hectare is still low compared to neighboring countries. For example in 1985 the average yield of maize was 1218 kg/ha in Tanzania while in Kenya and Zimbabwe maize yield was 1782 kg/ha and 1736 kg/ha respectively (FAO, 1985). Low adoption of improved seed, fertilizers and other agro-chemicals coupled with inefficient extension systems are among reasons that have been attributed to low production for most food crops in the country (Marandu *et al.*, 1988). Constraints to non-adoption of innovations involve factors such as lack of credits, limited access to information, aversion to risk, inadequate farm size and inadequate incentives associated with farm tenure arrangements. Other factors include insufficient human capital, absence of equipment to relieve labor shortage, inappropriate transport infrastructure, and poor organization of input (seed, fertilizer, chemicals and water) supply (Feder *et al.*, 1985).

The introduction of hybrid maize varieties in Tanzania during the mid 1960s introduced a shift in maize production in Tanzania (James, 1989). However, the local varieties are often preferred by consumers because of their taste. Moreover, farmers like these varieties due to their resistance to pests and diseases and to low input requirement. According to a study by Hella (1992), about 95 percent of the people in Iringa region were aware of the existence of high yielding maize varieties at the time of the survey, but only 53 percent used hybrid maize seed.

In Mwanga District (Kilimanjaro region) fewer farmers adopted the use of hybrid maize and their yield was far below the optimum level. In 1994 about 60 percent of the households in the district harvested between 400kg and 600kg of maize per hectare (Msuya, 1995). Since many of the households (62%) in the sample had large families of 7 to 10 children, they could not meet household food needs from on farm production. These factors explain why Maghimbi (1995) found that the majority of households in Mwanga district have to buy maize from Tanga region and Moshi district virtually every year, as illustrated by the frequent food deficits that the district experiences.

A study by Ikeno (1995) established that in September, 1992 about 68,726 people or 70 percent of the total population in Mwanga district experienced food shortages. Again in 1994 about 54,570 people or 55 percent of the population experienced food shortages, which constituted about one third (34%) of all the people who were affected by food shortage in Kilimanjaro region during that year. The same study found that some 64,259 people in Kilimanjaro region could not afford to buy food,

of these about 74 percent were residents of Mwanga district. These data reflect the magnitude of the food situation in the district during the 1990s.

The climate of Mwanga district varies depending on the altitude. The highlands, which lie at an altitude of about 1,200 – 2000 meters has rainfall ranging from 800 – 1,200 mm per year. While the lowlands receives only 400 – 600 mm or rainfall, which is poorly distributed. In this area drought resistant seed cultivation is recommended. Some parts of the highlands are well suited for the production of hybrid maize and other improved maize varieties. However, their adoption rate remains very low despite serious food shortages facing the district as alluded to above. The purpose of this study therefore is to assess factors that influence the adoption of hybrid maize in Mwanga district, with the view of proposing policy implications in order to change the precarious situation regarding food security.

Methodology

The population of the study was farmers who grew maize at Masumbeni and Kisanjuni villages in Mwanga District. In each village, a random sample of 45 respondents was systematically picked, thus making a total sample size of 90 respondents. Structured questionnaires were used for data collection.

The other source of data collected was through direct observations. The data collected were coded and analyzed using the Statistical Package for Social Sciences (SPSS) computer programme. From the analysis, descriptive statistics such as frequencies and percentages were determined. Cross- tabulation analysis was used to determine how different factors affected the adoption of hybrid maize.

Results and Discussion

Farmers' Characteristics

A total of 90 respondents were interviewed. Of these 45 were males and 45 females. Their ages ranged from 31 to over 50 years with the majority being in the 31 to 50 years. Traditionally, young men below 30 years of age do not own land. In fact, there were very few young men who were engaged in farming. Most of the respondents, (84%) had completed primary level education. Although this level of education enabled them to read and write, it was probably not facilitative enough in the adoption of technologies and practices that required comprehension of technical extension leaflets and/or handbooks. The other 12 farmers or 13 percent had attended adult education classes and only 2 people or 2 percent had no formal education.

Farm size was measured in total hectares currently under production, owned or rented by farmers. Most farmers (69%) had farm sizes ranging from one to three hectares. The majority practiced mixed cropping consisting of maize, beans, plantains and cassava, others mixed food crops with cash crop (coffee). Regarding source of labor, all respondents reported that family members were an important

source of farm labor. Only about 18 percent of the respondents had an annual income of over Tshs. 110,000 and about 80 percent of the respondents spent their money to buy food for their families, while 18 respondents or 20 percent spent more of their annual income to pay for their children's school fees.

This reflects a low level of income for the majority of people. On average the per capita expenditure on food in Tanzania stand at around 70 percent. This implied that most farmers in the study area did not enough income to even consider buying farm inputs like improved seeds as a priority.

Level of adoption of Hybrid Maize

All 90 respondents had heard about hybrid maize but only 59 percent had planted hybrid maize immediately after hearing about it. Twenty-four respondents or 45 percent of those who grew hybrid maize have been growing it for 4 to 7 years while the rest had grown hybrid maize for 8 to 11 years. Only 17 respondents or 32 percent of those who grew hybrid maize said that they bought new hybrid maize seed every season while 68 percent selected good seed hybrid seed from the previous harvest. Scientifically, hybrid maize loses its vigor and the crop lacks uniformity when seed are selected by the farmer from their second and subsequent generations (TARO, 1987). Nevertheless, farmers continue to select from their own harvest due to ignorance or they cannot afford to purchase new seed each year.

Factors affecting the adoption of Hybrid Maize

The adoption rate of technology can be assessed by studying the impact or influence of a number of factors. In this study the factors identified and investigated included farmers characteristics, technical, institutional and other factors. In this study, cross tabulation was used to determine how different factors affected the adoption rate of hybrid maize.

Relationship between Farmers Characteristics and Adoption of Hybrid Maize

Farmers' characteristics which were identified included: Education level, gender, age, farm size and level of income. Data contained in Table 1 shows that about 77 percent of the 53 farmers who grew hybrid maize had completed primary level education, 10 or 19 percent had attended adult education classes and only about 4 percent had no formal education.

Table 1: Adoption of hybrid Maize and Education level (N=90)

Education Level	Adopted		Not adopted	
	N	%	N	%
No education	2	3.8	0	0.0
Adult education	10	18.9	2	5.4
Primary education	41	77.3	35	94.6
Total	**53**	**100.**	**37**	**100**

Chi –square test = 5.123 DF= 2 Significance = 0.077

Source: Survey data (1997)

The chi-square test on this variable was not statistically significant at P>0.05 implying that association between adoption of hybrid maize and the level of education was weak at best. Isinika (1995) also found a weak positive relationship between farmers' education and productivity gains in crop production. Apparently, these results do not confirm what was reported by Levinger and Drahman (1980) who reported that there is a relationship between the adoption of technology and level of education. This could however, be explained by the highest level of education attained was primary education which does not give then much advantage over their colleagues who did not have any formal education, especially where technical recommendations are presented in terms of practical skills, which require little formal schooling. Thus the adoption of a new variety among farmers may not depend at all on their level of education.

Table 2: Relationship between Sex and Adoption of Hybrid Maize N=90)

Gender	Adopted		Not adapted	
	N	%	N	%
Female	18	34.0	27	72.8
Male	35	66.0	10	27.2
Total	**53**	**100**	**37**	**100**

Chi-square test = 13.264 DF = 1 Significance = 0.0003

Source: Survey data (1997)

Of the 53 interviewees who grew hybrid maize, 66 percent were male and 18 or 34 percent were female. The results of chi-square test on the relationship between respondents' sex and adoption of hybrid maize was statistically significant at P<0.05 (Table 2). However, more male farmers adopted hybrid maize than females. Some other factor must account for the difference in adoption rate, since the education level was not significantly different between male and females.

Table 3: Farmers Age and Adoption of Hybrid maize (N = 90)

	Adopted		Not Adopted	
Age group	N	%	N	%
31- 37	10	18.9	9	24.3
38 -44	14	26.4	8	21.6
45-50	21	39.6	12	32.5
>50	8	15.1	8	21.6
Total	**53**	**100**	**37**	**100**

Chi- square test = 1.342 DF = 2 Significance = 0.72

Source: Survey data (1997)

The study examined the association between adoption rate and age of respondents as a reflection of characteristics of the farm household that includes access to resources, labor availability and sources of income. Data contained in Table 3 show that about 40 percent of the respondents who adopted hybrid maize were in the age group of 45 to 50 years, 26 percent were in the 38 to 44 years age group and only 18 percent were in the 31 to 37 years age group.

The Chi-square test on this variable shows no strong association between farmers' age and the adoption rate of hybrid maize, being not statistically significant at P>0.05. However, the results suggest that farmers within the 45 to 50 years age group had higher adoption rates, which can be due to having more experience and resources which enabled them to try new technologies and practices.

Table 4: Adoption of Hybrid Maize and Farm Size (N = 90)

Farm size (ha)	Adopted		Not Adopted	
	N	%	N	%
< 1	3	5.7	12	32.4
1 – 3	37	69.8	25	67.6
4 – 6	13	24.5	0	0.0
Total	**53**	**100.0**	**37**	**100.0**

Chi-square test= 18.46 DF = 2 Significance = 0.0001

Source: Survey data (1997)

Farm size is a common variable that is examined in adoption studies, and is often a good indicator of wealth. It is often assumed that large-scale farmers will be more likely to adopt a technology even if the innovation requires extra cash investment because they can afford it. Of the 53 respondents who grew hybrid maize, about 70 percent had farm size ranging between 1 to 3 hectares and about 25 percent had 4 to

6 hectares (Table 4). This variable was statistically significant at P<0.05, implying that there was an association between farm size and the adoption of hybrid maize.

These results could be attributed to the fact that smaller farms belonged to farmers who were less wealthy and hence more risk averse, especially on using resources that required cash outlays. The findings are consistent with similar results, which have established a strong relationship between the adoption of new technologies and farm size Polson & Spencer (1991).

Table 5: Adoption of Hybrid Maize and Estimated levels of Annual Income (N=90)

	Adoption		Not adopted	
Level of Income (Tshs)	**N**	**%**	**N**	**%**
60,000 – 70,000	7	13.2	17	46.0
70,001 – 80,000	2	3.8	4	10.8
80,001 – 90,000	4	7.6	1	2.7
90,001 – 100,000	6	11.3	3	8.1
100,001 – 110,000	22	41.5	8	21.6
> 110,000	12	22.6	4	10.8
Total	**53**	**100**	**37**	**100**

Chi-square test = 15.822 DF =5 Significance = 0.01

Source: Survey data (1997)

Data contained in Table 5 show that of the 53 respondents who grew hybrid maize, 42 percent had income levels ranging from Tshs. 100,001 to Tshs 110,000 and 23 percent had income levels above Tsh 110,000. The difference in income levels was statistically significant at P<0.05 implying that there was an association between adoption of hybrid maize and farmers' annual income. Farmers with high income adopted hybrid maize more easily than those with low-income levels because they could afford to buy hybrid maize seed and the inputs needed. Farmers in the low-income bracket find it difficult to buy the inputs needed in growing hybrid maize.

Relationship between Technical Factors and Adoption of Hybrid Maize

All respondents who grew hybrid maize agreed that the enterprise was profitable. However, the chi-square test on this variable showed no statistical significance at P>0.05, which means association between adoption of hybrid maize and its profitability was not significantly strong. The respondents mentioned a number of factors that influenced their decision to adopt hybrid maize. They included labor input, low or no profit, the technology being perceived as being complex and the high related cost.

Of the 53 respondents who grew hybrid maize, about 64 percent agreed that although they had adopted hybrid maize, they were aware that the technology required more labor.

Table 6: Technical Factors and Adoption of Hybrid Maize (N =90)

	Agree		Uncertain		Disagree		Significance
Variable	**N**	**%**	**N**	**%**	**N**	**%**	
High labour							
Adopted	34	64.2	0	0.0	19	35.9	
Not adopted	25	67.6	0	0.0	12	32.4	0.75
No profit							
Adopted	0	0.0	0	0.0	53	100	
Not adopted	0	0.0	0	0.0	37	100	0.95
Complex							
Adopted	27	50.9	2	3.8	24	45.3	
Not adopted	27	73.0	0	0.0	10	27.0	0.02
High cost							
Adopted	41	77.4	0	0.0	12	22.6	
Not adopted	37	100.0	0	0.0	0	00.0	0.0001

Source: Survey data (1997)

This however did not deter them from adopting hybrid maize. Feder *et al* (1985) likewise assert that higher yielding varieties generally require more labor input. In the case of Mwanga district, family labor is used to offset the explicit high cost of hired labor, thereby enabling many of them to afford adopting the technology.

The remaining 37 or 41 percent of the respondents who did not adopt hybrid maize reported that it was too costly. Chi-square test results showed that there was a statistical significance at $P<0.05$, implying that there was an association between non-adoption of hybrid maize and the costs involved (Table 6). Of the 37 non-adopters, about 73 percent agreed that adopting hybrid maize was complex and the chi-square test on this variable was statistically significant at $P<0.05$, implying that there was an association between non-adoption of hybrid maize and the perceived complexity of the technology. This would have implications on the design of extension programmes that aim at improving the knowledge and skills of farmers on this technology as well as others. These results are similar to findings by Rogers (1983) who reported that some innovations are readily understood by members of a social system and so are adopted readily and others are more complicated and their adoption rate is slow.

Table 7: Institutional Factors and Adoption of Hybrid Maize (N=90)

	Agree		Uncertain		Disagree		
Variable	**N**	**%**	**N**	**%**	**N**	**%**	**Significance**
No credit:							
Adopted	49	92.5	3	5.7	1	1.9	
Not adopted	30	81.1	7	18.9	0	0.0	0.11
No extension agents							
Adopted	24	45.3	0	0.0	29	54.7	
Not adopted	22	59.5	0	0.0	15	40.5	0.29

Source: Survey data (1997)

Relationship between Hybrid Maize Adoption and Institutional Factors

Institutional characteristics include publicly and privately operated systems for providing support services such as extension, research, credit and inputs supply. Out of 53 respondents who had adopted hybrid maize 92.5 percent stated that there were no credit facilities to motivate them to adopt hybrid maize. However, the chi-square test showed an insignificant coefficient at $P>0.05$, implying that there was no strong statistically significant association between adoption of hybrid maize and absence of credit facilities.

Likewise, although 45.3 percent of the non-adopting respondents said there were no extension agents to advice them on how to grow hybrid maize, the chi square test on this variable was not significant at $p>0.05$ (Table 7). Apparently, most of these respondents came from Masumbeni Village, which had no extension agent. So the response should not be generalized to the whole sample. Lugeye (1994) who observed that information from extension agents is important to enable farmers to adopt new innovations. However, being able to afford those technologies is another factor. Farmers in this study observed that one might have an extension agent to offer advice, but then no cash to buy farm inputs like seed, fertilizers and insecticides to implement the technology effectively.

Relationship between Adoption of Hybrid Maize and other Factors

There are several other factors, which had an influence on the adoption of hybrid maize. About 41.1 percent (37) of all the respondents said they had not adopted this technology because the maize had poor de-braning quality, an aspect that was important for the preparation of Kande, a popular local dish. In addition, more than 92% of the 37 non adopting respondents believed that a given volume of hybrid maize produced less flour compared to local maize varieties.

Table 8: Other Factors affecting the Adoption of Hybrid Maize (N=90)

	Agree		Uncertain		Disagree		
Variable	**N**	**%**	**N**	**%**	**N**	**%**	**Significance**
Presence of Coffee							
Adopted	32	60.4	0	0.0	21	39.6	
Not adopted	36	97.3	0	0.0	1	2.7	0.0005
Inter-cropping	36	67.9	0	0.0	17	32.1	
Adopted	31	83.8	0	0.0	6	16.2	0.05
Not adopted							
Presence of banana	39	73.6	0	0.0	14	26.4	
Adopted	33	89.2	0	0.0	4	10.8	0.31
Not adopted							
Poor-de-braning	44	83.1	0	0.0	9	16.9	
Adopted	37	100.0	0	0.0	0	0.0	0.004

Variable	Agree N	Agree %	Uncertain N	Uncertain %	Disagree N	Disagree %	Significance
Not adopted							
Less flour	42	79.2	3	5.7	8	15.1	
Adopted	34	91.9	0	0.0	3	8.1	0.39
Not adopted							
Failure to plough	48	90.6	0	0.0	5	9.4	
Adopted	34	91.9	0	0.0	3	8.1	0.63
Not adopted							

Source: Survey data (1997)

However, results of the chi square test showed that there was no statistical significance $p>0.05$ between the milling volume of the two varieties. Additional factors that seem to influence the adoption of hybrid maize include; the presence of coffee and intercropping with other annual crops, as stated by 97.3 percent and 83.8 percent of the 37 non-adopting respondents respectively. The chi square test for both was significant at $p>0.05$. Coffee provides an alternative source of cash income, which farmers then use to by food depending on their need. Other crops that are intercropped with maize serve as food and cash crops, This was confirmed by 89.2 percent of the non-adopting respondents stated that the presence of plantain (cooking bananas) as an alternative food and cash crop influenced their decision not to adopt hybrid maize. Meanwhile, 92% of the same category of farmers attributed non-adoption to lack of tractors for land preparation as another reason. Apparently, most farmers had fields on very steep slopes, which made it impossible to use tractors for field operations.

Conclusions and Recommendations

Based on these results it is obvious that all 90 respondents were aware of the existence of hybrid maize although only 58.9 percent had adopted hybrid maize. Of the 53 respondents who had adopted hybrid maize only 32.1 percent bought new hybrid maize seed every season. Those who did not buy new seed every season obtained their seed from maize harvested from previous seasons. This contributed to low yields that farmers obtained due to genetic segregation. This reflects a deficiency in the level of knowledge that the farmers have regarding the technology, which calls for appropriate extension programmes and demonstrations to impress upon farmers on the economic implications of their practice.

These findings also show that adoption of hybrid maize in Mwanga district was significantly associated with gender, farm size, income, cost of inputs and complexity of growing hybrid maize. Moreover, the presence of coffee, practicing inter-cropping system in the area and de-braning quality of hybrid maize, affected its adoption.

On the basis of these findings it is recommended that:

- Concerted efforts should be made to educate farmers on the need to ensure that they buy fresh supplies of hybrid maize seed every season because hybrid maize looses its yielding ability and uniformity when grown in the second and subsequent years due to genetic segregation.
- Effort should be made to revise existing policies with a view to re-introduce subsidies for agricultural inputs to make them affordable by many farmers.
- Policies governing credit facilitation should be reviewed to enable smallholder farmers to get credits for buying agricultural inputs.
- Women should be involved in household decision-making process so that they can have input in choosing agricultural activities.

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