S.Afr. Tydskr. Landbouvoorl./S. Afr. J. Agric. Ext., Mligo & Msuya
Vol. 43, No. 1, 2015: 41 - 56
ISSN 0301-603X (Copyright)

# FARMERS ADOPTION OF RECOMMENDED RICE VARIETIES: A CASE OF KILOMBERO DISTRICT OF MOROGORO REGION, TANZANIA

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***ABSTRACT***

*Kilombero is one of the Districts in Tanzania that is famous in rice production and several practices have been introduced in order to improve production like improved rice seed varieties. Despite this adoption of recommended practices has not been convincing. A study was conducted to assess the current level of adoption and factors influencing adoption of recommended rice varieties. A cross - sectional research design was used where data were collected at a single point in time. A pre- tested questionnaire was used to collect data from 120 respondents from six villages, namely Mang'ula A and Mang'ula B from Mang'ula Ward and Kisawasawa and Ichonde villages from Kisawasawa Ward. Other villages were Mkula and Sonjo from Mkula Ward. The collected data were analysed by using a Statistical Package for Social Sciences (SPSS) Computer Program. Chi-square was used to test whether there is significant difference between the two variables under investigation while correlation was used to test whether there is any relationship between the same variables. The study findings reveal low adoption of recommended rice varieties where by only* 43.3% *planted TXD 306 which is a recommended rice variety. Most of the investigated intervening factors like Efficiency misperception, Need tension and Prominence seemed to influence the adoption of recommended rice varieties while the independent variables had no influence in the adoption behaviour. This calls the need to address the factors that influence adoption in order to address the problem of low adoption in the study area and hence improve rice yield.*

## 1. INTRODUCTION

Rice is the second most important food and commercial crop grown in Tanzania after maize (Relief web report, 2010). It is a major source of employment, income and food security for many rural households. Rice accounts for about 13% of all cereals produced and consumed as food in Tanzania (Investment Potential in the Grain Industry, n.d). The major rice growing regions include Shinyanga, Morogoro, Mbeya, Mwanza and Rukwa (United Republic of Tanzania, 2011).

Over the years rice production in Tanzania has not been promising. This is partly attributed by the low or non adoption of recommended agricultural production practices, like recommended varieties and fertilizers. Farmers use local varieties that are planted in same land without adding fertilizer. This practice has resulted into low soil fertility in most parts of the country. Literature shows that less than 30 % of the land in Tanzania is planted to new varieties of rice, sorghum and pearl millet, and less than 10 % of farmers have ready access to seed of new varieties (Rohrbach, Mtenga, Kiriwaggulu, Monyo, Mwaisela, & Saadan, 2002). This means that more than 90% of farmers in Tanzania use local seeds, including those of rice, the situation that culminates inadequate food production for the rapid growing population. For example, the average national rice yield is as low as 1 to 1.5 tons per hectare instead of 3.1 to 4.3 tons per hectare expected under good management practices (URT,

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2009; Kato, 2007; RLDC, 2009; Match Maker Associates, 2010). In Kilombero District where this study was conducted, an average rice production is about 1.3 tons per hectare (URT, 2002/03).

Much effort has been undertaken by the government of Tanzania in order to achieve sufficiency in food production (Kimaro, 2003). For example during the 1970s and 1980s, the government of Tanzania used to import and manufacture fertilizer. It was distributed free of charge, or at heavily subsidized prices, an attempt to boost agricultural production (Jayne, Govereh, Mwanaumo, Nyoro, & Chapoto, 2002). In 2003/07 the government reintroduced subsidies for transport of fertilizer, the objective was to facilitate fertilizer use in remote areas and in 2005 the government decided to expand the fertilizer subsidy program to all regions including Morogoro.

In 2008 to date the government introduced the National Agricultural Input Voucher Scheme (NAIV) in order to facilitate fertilizer use in high-potential areas, offset rising cost of fertilizer, stimulate production to reduce food prices, stimulate (rather than displace) private distribution network to selected farmers in selected districts. In this scheme farmers are given three input vouchers for one acre (Minot, 2009). One voucher is for 15 kg rice seed or 10 kg improved maize seeds and second voucher is for 1 bag of DAP of 50 kg or 2 bags of Minjingu Rock Phosphate (MRP) of 50 kg each for planting. Third voucher is for 1 bag of urea of 50 kg for top dressing. The subsidy from the government for each voucher worth an average of 50% of prevailing market price, so remained cost which is normally the market price of inputs is co-financed by farmers.

Despite all the efforts done by the government of Tanzania adoption of recommended agricultural production practices like recommended seed varieties in order to increase average production of major food crops like rice is very low. Several factors have been associated with the adoption behaviour. These are the independent factors like personal, institution, environmental and socio – economic factors (Matata, Anandajayasekarani, Kiriro, Wandera, & Dixon (2001); Mtenga, 1999 and Nanai, 1993). Other studies (Düvel, 1991; Koch, 1987; Düvel & Botha, 1999; Msuya, 2007) argue that the intervening variables like needs, perception and knowledge are the key determinants of the adoption behaviour. However, very few studies have been conducted to investigate the influence of intervening factors on the adoption behaviour. Considering poor adoption of the recommended rice varieties in Kilombero District, this study intends to determine the intervening and independent factors that influence the adoption of recommended rice varieties in Kilombero District.

The results of this study will provide in depth information to all stakeholders, namely farmers, researchers, extensionists and policy makers on the current level of adoption of recommended rice varieties and the factors that influence their adoption. These will form the basis for recommending measures to be taken in order to facilitate farmers' adoption of recommended rice varieties and ultimately increased rice production, improved food security and income in Kilombero District.

## 2. METHODOLOGY

The study was done in Kilombero District of Morogoro Region located in Tanzania. Six villages famous in rice production were involved in this study, namely Mang'ula A and Mang'ula B from Mang'ula Ward and Kisawasawa and Ichonde villages from Kisawasawa

Ward. Other villages were Mkula and Sonjo from Mkula Ward. Kilombero District was chosen due to the fact that it is famous in rice production (Wikipedia, 2015) and is one of the areas that the country mainly depends on for supplying food grains like rice. In addition it is one of the districts where the recommended rice production practices like improved varieties have been introduced.

The study employed a cross-sectional research design that allows collection of information at a single point in time from a sample selected to represent the large population (Creswell, 1994; Babbie, 2010). A pre-tested questionnaire supported by personal observations was used to collect data from 120 respondents selected by using a simple random sampling technique, from the population of the small holder rice growers in selected villages. According to Matata *et al*., (2001) a sample of 80 - 120 respondents is adequate for most socio-economic studies in Sub-Saharan Africa household. A sample of 120 was also regarded desirable in this study due to limited time, financial constraints and is enough for statistical analysis such as descriptive, correlation and chi – square test (Mandenhall, 1982).

The collected data were coded, entered, cleansed, and analyzed using the Statistical Package for Social Science (SPSS) version 16, computer programme. Descriptive statistics such as frequency and percentage were calculated to determine distribution of the study variables. Correlation was used to determine relationship between the independent and dependent variables, while the Chi – square was used to test the significance difference between variables under investigation. The significant level of 0.05 (95%) was selected as a criterion for determining significances.

## 3. RESULTS AND DISCUSSION

### 3.1 Level of adoption of recommended rice seed varieties

Varieties characteristics play a vital role in influencing farmer's adoption behaviour. If the characteristics satisfy the need and interest of the farmers they will adopt (Tadesse, 2008). The experience show that farmers in Kilombero District grow different varieties such as, TXD 306, Kilombero, Kihoko, Local variety and Super India, but the recommended rice variety is TXD 306. During data collection respondents were requested to indicate rice varieties they grew in 2010/11 cropping season. Table 1 show the distribution of respondents according to type of rice varieties planted.

**Table 1: Distribution of respondents according to rice seed varieties planted in 2010/11 season (N=120)**

| Scale | Rice seed varieties | Frequency | Percent |
|---|---|---|---|
| 1 | Local varieties | 54 | 45.0 |
| 2 | Improved but not recommended | 14 | 11.7 |
| 3 | Recommended Variety | 52 | 43.3 |
| | Total | 120 | 100.0 |

Out of 120 respondents 45.0% planted local rice seed varieties (*Afaa Mwanza, Tule na bwana, Moshi wa sigara, Shingo ya mwali, Kalimata, Zambia, Mbawambili, Kisegese, Mwarabu, Rangi mbili, Dunduli, Kalinang'aula, Likanyaga and Ngome*), 43.3% planted recommended rice varieties that is TXD 306 rice seed variety. Others, 11.7% planted varieties which are improved but not recommended for Kilombero District, which are TXD

88, super India, Kilombero and Kihoko red (*Sindano*) rice seed varieties. This implies that large number of respondents (56.7%) did not plant the recommended rice seed variety which is TXD 306. The study went further to investigate the independent and intervening factors affecting adoption of recommended rice seed variety in the study area as explained below.

### 3.2 The Influence of Independent Variables on Adoption of Recommended Rice Variety

Gender difference is found to be one of the factors influencing adoption of new technologies. Due to many socio-cultural values and norms males have freedom of mobility and participation in different meetings and consequently have greater access to information (Tadesse, 2008). So in this study gender is hypothesized to influence adoption in favour of males. The findings regarding gender and adoption of recommended rice seed variety are summarized in Table 2.

**Table 2: Distribution of respondents according to their gender and adoption of recommended rice seed variety (N=120)**

| Sex | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Male | 21 | 38.9 | 7 | 13.0 | 26 | 48.1 | 54 | 45.0 |
| Female | 33 | 50.0 | 7 | 10.6 | 26 | 39.4 | 66 | 55.0 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2 = 1.481$; df = 2; p = 0.477; r = - 0.105; p = 0.253

The study results in Table 2 show that the adoption of recommended rice seed variety is high in male (48.1%) while in female it is only 39.4%. High percentage of female (50.0%) used local seed varieties as compared to male (38.9%). The differences between gender categories are not significant as proved by chi-square test results. Also there is no correlation between gender of the respondents and adoption of recommended rice seed variety (r = - 0.105; p = 0.253). However the negative correlation (r = - 0.105) implies that female respondents are less inclined than the male respondents to adopt the recommended rice seed variety.

Age of a farmer can generate or erode confidence on technologies. In other words, older farmers are in a position to experience much with their traditional farming practices. With age a farmer can become more risk averse to new technologies and are expected to be less responsive to newly introduced agricultural technologies. However there are mixed results as to the direction of influence. For example Rahmeto (2006) contends that younger farmers have higher probability of adopting improved rice varieties technologies than older farmers. Study results showing the relationship between age and adoption of recommended rice seed variety are presented in Table 3.

**Table 3: Distribution of respondents according to their age and adoption of recommended rice seed variety (N=120)**

| | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| < 36 | 24 | 61.5 | 4 | 10.3 | 11 | 28.2 | 39 | 32.5 |
| 36 – 56 | 23 | 33.8 | 9 | 13.2 | 36 | 52.9 | 68 | 56.7 |
| > 56 | 7 | 53.8 | 1 | 7.7 | 5 | 38.5 | 13 | 10.8 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2 = 8.450$; df = 4; p = 0.076; r = 0.151; p = 0.100

The results as presented in Table 3 show that a high percentage of youth (61.5%) with less than 36 years used local rice seed varieties, while 52.9% of the adult (36 to 56 years) respondents adopted the recommended rice seed variety. The results also show that there is no significant difference between age groups in terms of adoption of recommended rice seed variety ($\chi 2 = 8.450$; df = 4; p = 0.076). This concludes that the adoption of recommended rice seed varieties is not determined by age difference in the study area. Also the results from correlation indicates that there is no significant relationship (r = 0.151 p = 0.100) between age and adoption of recommended rice seed varieties. The findings are supported by CIMMYT (1993) which contends that adoption of a given innovation may not be strictly correlated with age.

Level of education increases farmers' ability to obtain, process, and use information relevant to adoption of improved technologies (Rahmeto, 2006). Education is therefore expected to increase the probability of adoption of improved rice seed varieties in the study area. An overview of respondent's education with respect to adoption is shown in Table 4.

**Table 4: Distribution of respondents according to their education and adoption of recommended rice seed variety (N=120)**

| Level of education | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| No formal education | 4 | 57.1 | 1 | 14.3 | 2 | 28.6 | 7 | 5.8 |
| Primary education | 46 | 45.1 | 13 | 12.7 | 43 | 42.2 | 102 | 85.0 |
| Secondary education | 4 | 36.4 | 0 | 0.0 | 7 | 63.6 | 11 | 9.2 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2=3.269$; df = 4; p = 0.514; r = 0.116; p = 0.205

As far as education is concerned very few (5.8%) of the respondents have no formal education and the majority 85.0% have primary education, which is common in Tanzania, the rest 9.2% have attained secondary education (Table 4). High percentage of respondents (57.1%) with no formal education planted local varieties while 36.4 with secondary education fall under the same category. The largest percentage (63.6%) of respondents with secondary education level adopted the recommended rice seed variety compared with other percentages in the same category. The chi-square test results ($\chi 2=3.269$; df = 4; p = 0.514) indicate that

there is no significant difference between education level and the adoption of recommended rice seed variety. This implies that different education levels do not differ in their levels of adopting recommended rice seed varieties. The results from correlation also indicate that there is no relationship (r = 0.116; p = 0.205) between education and adoption of recommended rice seed variety. These findings are in contrary with Crook, T. R., Tood, S.Y., Combs, J. G., Woehr, D. J. & Ketchen, D. J. (2011) and Amir (2006) who contends that better-educated farmers have enhanced information processing abilities allowing them to make better adoption decisions.

Marital status is an important social factor having manifestation in the social standing and the sense of responsibility of married individuals in society (Samson, 2007). It is assumed that in the study area married couples share experience in adoption of recommended rice variety. Table 5 summarizes the study results.

**Table 5: Distribution of respondents according to their marital status and adoption of recommended rice seed variety (N=120)**

| Marital status | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Married | 41 | 43.2 | 11 | 11.6 | 43 | 45.3 | 95 | 79.2 |
| Single | 2 | 25.0 | 1 | 12.5 | 5 | 62.5 | 8 | 6.7 |
| Divorce | 6 | 66.7 | 0 | 0.0 | 3 | 33.3 | 9 | 7.5 |
| Widowed | 5 | 62.5 | 2 | 25.0 | 1 | 12.5 | 8 | 6.7 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2$ =7.263; df = 6; p = 0.297; r = - 0.141; p = 0.124

High percentage of single respondents (62.5%) adopted the recommended rice seed variety as compared to 43 married couples (45.3%), although married couples were expected to have high adoption due to shared experience on rice production. Divorced is the only category with high percentage (66.7%) of respondents (6) who used local seed varieties as compared to other categories. The results of the chi – square ($\chi 2$ =7.263; df = 6; p = 0.297) shows that there is no significant difference (p > 0.05) between marital status and the adoption of recommended rice seed variety. Further the correlation findings reveals that there is no significant relationship (r = - 0.141; p = 0.124) between marital status and adoption of recommended rice seed variety. This implies that adoption of recommended rice seed variety is not determined by marital status in the study area.

Income has a direct correlation with adoption of technologies (Roger, 2003). Farmers who are well off can afford the prices of new improved technology than low income farmers. Rahmeto (2006) adds that farm income is the main source of capital to purchase farm inputs and other household consumable goods. Thus, those households with a relatively higher level of farm income are likely to purchase improved technologies or other essential agricultural inputs. The findings regarding income and adoption of recommended rice seed variety are summarized in Table 6.

**Table 6: Distribution of respondents according to their income and adoption of recommended rice seed variety (N=120)**

| Annual income (TSh*) | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Less than 500 000 | 14 | 60.9 | 3 | 13.0 | 6 | 26.1 | 23 | 19.2 |
| 500 001 – 1 million | 14 | 37.8 | 5 | 13.5 | 18 | 48.6 | 37 | 30.8 |
| 1 000 001-1 500 000 | 4 | 21.1 | 2 | 10.5 | 13 | 68.4 | 19 | 15.8 |
| 1 500 001- 2 million | 4 | 36.4 | 1 | 9.1 | 6 | 54.5 | 11 | 9.2 |
| More than 2 million | 18 | 60.0 | 3 | 10.0 | 9 | 30.0 | 30 | 25.0 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2$=12.243; df = 8; p = 0.141; r = - 0.025; p = 0.783
* USD 1 is equivalent to TSh. 2000

The results indicated in Table 6 show that low a percentage (30.0%) of the respondents (9) with high income of more than TSh. 2 million adopted the recommended rice seed variety, contrary to the expectations. The chi – square ($\chi 2$=12.243; df = 8; p = 0.141) reveals that there is no significant difference between income and adoption of recommended rice seed variety. The correlation test results (r = - 0.025; p = 0.783) indicates no relationship between adoption of recommended rice seed variety and annual income. This might be attributed by the fact that a high percentage of respondents with high income more than 2 million had not adopted the recommended rice seed variety similar to low income earners.

Number of people in a household is another independent variable assumed to have influence on adoption of recommended rice varieties. In this study number of people in the household is considered as the number of individuals who resides in the respondent's household. Large family size is assumed as an indicator of labour availability in the family (Tadesse, 2008). A household with large working labour force will be in a position to manage the labour intensive agricultural activities. Moreover, large working labour force in a family means, the household may not need to hire more additional labour and the money saved due to use of own labour force could be used for purchasing other crop production inputs. This will increase household's possibility to adopt improved rice varieties production package (Rahmeto, 2006). The results regarding the relationship between number of people in the household and adoption are as presented in Table 7.

**Table 7: Distribution of respondents according to their number of people in the household (hh) and adoption of recommended rice seed variety (N=120)**

| No. of people in hh | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| 1 - 3 | 10 | 55.6 | 2 | 11.1 | 6 | 33.3 | 18 | 15.0 |
| 4 - 6 | 20 | 42.6 | 3 | 6.4 | 24 | 51.1 | 47 | 39.2 |
| More than 6 | 24 | 43.6 | 9 | 16.4 | 22 | 40.0 | 55 | 45.8 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2$ = 3.905; df = 4; p = 0.419; r = 0.032; p = 0.725

The results presented in Table 7 indicate that a high percentage (55.6%) of respondents with 1 to 3 numbers of people used local varieties as compared to 43.6% with more than 6 number of people in their household. At the same time 51.1% from the household with 4 to 6 number of people used recommended rice seed variety as compared to 40.0% with more than 6 numbers of people in their household. According to chi - square results, there is no significant difference ($\chi 2 = 3.905$; df = 4; p = 0.419) between household size and the adoption of recommended rice seed variety. This implies that in this study adoption of recommended rice seed variety does not differ with the number of people in a household. The findings also reveal that, there is no significant correlation (r = 0.032; p = 0.725) between household size and the adoption of recommended rice seed variety. This implies that the adoption of recommended rice seed variety might be influenced by other factors such as needs and perception towards recommended rice seed variety.

Empirical studies show that land is one of the factors that affect adoption of recommended technologies among farmers. Those farmers who have land are likely to adopt new technologies than the landless farmers (Samson, 2007). Hence, land holding was hypothesized to have positive and significant relationship with adoption of recommended rice seed variety in the study area. Table 8 summarizes the results.

**Table 8: Distribution of respondents according to their farm size and adoption of recommended rice seed variety (N=120)**

| Farm size category (Acres) | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| 1 - 3 | 28 | 37.8 | 9 | 12.2 | 37 | 50.0 | 74 | 61.7 |
| 4 - 6 | 17 | 53.1 | 3 | 9.4 | 12 | 37.5 | 32 | 26.7 |
| More than 6 | 9 | 64.3 | 2 | 14.3 | 3 | 21.4 | 14 | 11.7 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2 = 5.273$; df = 4; p = 0.260; r = - 0.204; p = 0.025

Although it was expected that farmers with large farm size (more than 6 acres) have high chance to adopt recommended rice seed variety, the findings show that a high percentage (64.3%) of respondents (9) from this category used local varieties. Only 21.4% respondents (3) in the same category had adopted recommended rice seed variety as compared to 50.0% and 37.5% for those owning 1 to 3 acres and 4 to 6 acres, respectively in the same category. Adoption of recommended rice seed variety seems to be higher among small holder farmers with a farm size ranging between 1 to 3 acres. The correlation results show that there is a negative relationship between farm size and adoption (r = - 0.204; p = 0.025). The negative sign indicates that the adoption is higher among small farm holders than among large farm holders. These findings are contrary to Samson (2007) observations.

The survey went further to assess the influence of area under rice on adoption of recommended rice seed variety and the results obtained are presented in Table 9. Results show high adoption of recommended rice seed varieties (58.8%) among respondents with small area under rice production (below 1 acre). On the other hand the findings reveal that high percentage (66.7%) of respondents owning more than 3 acres used local rice varieties than it was expected. Only 20.5% respondents owned more than 3 acres adopted the

recommended rice variety. These findings are supported by the correlation results that show negative relationship (r = - 0.332; p = 0.000) between area under rice and the adoption of recommended rice seed variety. This implies that the smaller the area under rice is, the higher the adoption tends to be, which is contrary to other research findings which indicate existence of a positive relationship between farm size and adoption of recommended practices (Oluwasola (2010); Kalineza (2000); Senkondo; Mdoe; Hatibu; Mahoo; & Gowing (1998); Hussain; Byerlee; & Heisey, 1994).

**Table 9: Distribution of respondents according to their area under rice and adoption of recommended rice seed variety (N=120)**

| Area under rice (Acres) | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Less than 1 | 16 | 31.4 | 5 | 9.8 | 30 | 58.8 | 51 | 42.5 |
| 1 - 3 | 12 | 40.0 | 4 | 13.3 | 14 | 46.7 | 30 | 25.0 |
| More than 3 | 26 | 66.7 | 5 | 12.8 | 8 | 20.5 | 39 | 32.5 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2$=14.195; df = 4; p = 0.007; r = - 0.332; p = 0.000

Generally all investigated independent variables in this study except farm size and area under rice production seemed to have no significant association with the adoption of recommended rice seed variety. However, the two variables have negative influence on the adoption of recommended rice varieties as it was expected. This is in line with Düvel (1991) and Düvel and Botha (1999) who observed an inconsistency influence of independent variables on the adoption behaviour and suggested the intervening variables namely needs, perception and knowledge as the important predictors of the adoption behaviour. The following section examines the influence of intervening variables on the adoption of recommended rice seed variety in the study area.

### 3.3 The Influence of Intervening variables on Adoption of Recommended Rice Variety

The intervening variables considered in this study include various aspects of needs (Efficiency misperception, need tension), perception (prominence, advantages and disadvantages) and knowledge. Each intervening variable relationship with adoption of recommended rice seed variety is analyzed separately in this section.

Efficiency misperception (EM) is one of the intervening variables that Düvel (1991) identified to be one of the behaviour determinants. There is a tendency for individual to overrate their production and or practice adoption efficiency. This is bound to have significant effect on adoption due to the fact that the more the efficiency is overrated, the smaller the problem scope or need tension becomes and thus the smaller the incentive to adopt the recommended innovation. Table 10 summarizes the relationship between the efficiency misperception and adoption of recommended rice seed variety.

**Table 10: Distribution of respondents according to their efficiency misperception (EM) and adoption of recommended rice seed variety (N=120)**

| Efficiency misperception | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Underrate | 0 | 0.0 | 7 | 58.3 | 5 | 41.7 | 12 | 10.0 |
| Slightly underrate | 0 | 0.0 | 2 | 18.2 | 9 | 81.8 | 11 | 9.2 |
| Asses correct | 17 | 29.3 | 5 | 8.6 | 36 | 62.1 | 58 | 48.3 |
| Slightly overrate | 8 | 88.9 | 0 | 0.0 | 1 | 11.1 | 9 | 7.5 |
| Overrate | 29 | 96.7 | 0 | 0.0 | 1 | 3.3 | 30 | 25.0 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2 = 84.682$; df = 8; p = 0.000; r = - 0.592; p = 0.000

According to the findings shown in Table 10, about 19% of respondents underrated their EM, 48.3% assessed it correct, while 32.5% overrated it. The results further reveal that, high percentages of respondents 96.7% who overrate and 88.9% of respondents who slightly overrate their rice varieties adoption used local seed varieties, while not a single respondent who underrate did so. On the other hand a high percentage of respondents (81.8%) who slightly underrate and who assessed correctly (62.1%), adopted the recommended rice seed variety, while a small percentage (14.4%) of respondents (2) who overrated did so. The reason for this is their high assessment (overrating), and consequent they are satisfied with their current choice and thus the little or no need to change. This significant relationship between efficiency misperception and adoption of recommended rice seed variety is reflected in the highly significant negative correlation (r = - 0.592; p = 0.000). The negative correlation coefficient implies that the adoption rate decreases as the current efficiency of recommended rice seed variety is overrated and vice versa. The chi – square findings further reveal that, there is a significant difference ($\chi 2 = 84.682$; df = 8; p = 0.000) between various categories of efficiency misperception (EM) and adoption of recommended rice seed variety in the study area. The findings are in line with Mlyuka, 2011; Habtemarium, 2004; Düvel, 1991; Düvel 2004) who found a negative relationship between need tension and adoption of recommended technologies.

Need tension is another key intervening variable that is expected to have influence on adoption behaviour. Düvel (1991) defines need tension as problem scope or perceived discrepancy between the current and desired or potential situation. This is assumed to be positively related with adoption of recommended rice seed variety. Table 11 summarizes the survey results.

**Table 11: Distribution of respondents according to their need tension and adoption of recommended rice seed variety (N=120)**

| Need Tension | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Low | 24 | 29.3 | 6 | 7.3 | 52 | 63.4 | 82 | 68.3 |
| Medium | 2 | 20.0 | 8 | 80.0 | 0 | 0.0 | 10 | 8.3 |
| High | 28 | 100.0 | 0 | 0.0 | 0 | 0.0 | 28 | 23.3 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2 = 93.439$; df = 4; p = 0.000; r = - 0.597; p = 0.000

The results presented in Table 11, show that 68.3% of the respondent indicated a low need tension (NT), 8.3% a medium need tension and 23.3% a high need tension. The results show that all respondents 100% from high need tension planted local varieties. On the other hand, none of the respondents from high and medium need tension adopted the recommended rice seed variety, while 63.4 % of respondents with low need tension adopted the recommended rice seed variety. The findings are supported by a negative correlation (r = - 0.597; p = 0.000) which indicates that there is negative significant relationship between NT and adoption of recommended rice varieties against what is expected. According to Habtemariam and Düvel (2004) negative correlations in the case of several variables related with the perceived problem discrepancy (need tension) between the current and desired situation can be attributed to especially the less effective respondents over-rating their own efficiency and/or need satisfaction. The results also show that there is a significant difference ($\chi 2 = 93.439$; df = 4; p = 0.000) between different need tension categories and adoption of recommended rice variety.

Prominence is synonymous with Rodgers (1983) concept of relative advantage, which he defines as the degree to which an innovation is perceived as being better than the idea it supersedes. It is another intervening variable which was used to determine the adoption behaviour of the recommended rice seed varieties in the study area. Table 12 summarizes the survey results.

**Table 12: Distribution of respondents according to their prominence and adoption of recommended rice seed variety (N=120)**

| Prominence | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Low | 10 | 83.3 | 0 | 0.0 | 2 | 16.7 | 12 | 10.0 |
| Medium | 2 | 66.7 | 1 | 33.3 | 0 | 0.0 | 3 | 2.5 |
| High | 42 | 40.0 | 13 | 12.4 | 50 | 47.6 | 105 | 87.5 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100.0 |

$\chi 2 = 11.182$; df = 4; p = 0.025; r = 0.254; p = 0.005

The summarized survey results show that, the majority (87.5%) of respondents perceived the recommended rice seed variety to have high prominence relative to their own practices, while 10.0% perceive it to have low prominence and the rest (2.5%) perceive to have medium

prominence. High percentage (83.3%) of respondents (10) from low prominence planted local seed varieties as compared to low percentage of respondents with medium and high prominence who also planted local varieties. On the other hand 47.6% of the respondents (50) with high prominence adopted the recommended rice seed variety, while 16.7% (2) with low prominence and none from medium prominence adopted the recommended rice seed variety. This is supported by positive significant correlation ($r = 0.254$; $p = 0.005$) implying that the adoption of recommended rice seed variety in the study area is influenced by perceived prominence. The chi – square ($\chi 2 = 11.182$; $df = 4$; $p = 0.025$) also indicates significant difference between different prominence categories and adoption of recommended rice seed variety. The findings are in line with Habtemarium (2004) who reported a positive relationship between prominence and adoption of recommended technologies.

Awareness is another intervening variable that have been found to have positive influence on adoption behaviour (Düvel, 2004). This is defined as the awareness of the recommended solution or optimum level that is achievable in terms of efficiency. The respondents were asked to indicate their awareness of recommended rice seed varieties production in their area. The findings show that the majority of respondents are aware as summarized in Table 13.

**Table 13: Distribution of respondents according to their awareness and adoption of recommended rice seed variety (N=120)**

| Awareness | Local | | Improved but not recommended | | Recommended | | Total | |
|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | n | % | n | % |
| Not aware | 3 | 100 | 0 | 0.0 | 0 | 0.0 | 3 | 2.5 |
| Aware | 51 | 43.6 | 14 | 12.0 | 52 | 44.4 | 117 | 97.5 |
| Total | 54 | 45.0 | 14 | 11.7 | 52 | 43.3 | 120 | 100 |

$\chi 2=3.761$; $df =2$; $p = 0.153$; $r = 0.168$; $p = 0.067$

The results in Table 13 show that, majority (97.5%) of respondents were aware of recommended rice seed variety. The results further show that all respondents (100.0%) who were not aware of recommended rice seed variety used local seed varieties, compared to those who were aware 43.6%. On the other hand about 44.0% of the respondents who were aware adopted the recommended rice seed variety while not a single respondent from those who were not aware did so. The chi - square indicates that there is no significant difference ($\chi 2=3.761$; $df =2$; $p = 0.153$) between awareness and adoption of recommended rice seed variety. The correlation results also show that there is no significant relationship ($r = 0.168$; $p = 0.067$) between awareness and adoption of recommended rice seed variety at 0.05 significant level. The significance is albeit at 0.06 level.

Perceived advantages and disadvantages of recommended rice seed variety are the other intervening variables assumed to have influence on adoption of recommended rice seed variety in the study area. The perceived advantages are discussed first followed by perceived disadvantages.

Respondents were asked to mention the advantages of planting recommended rice seed variety in their fields. The advantages mentioned were high yield, many tillers, resistance to water logging, early maturing, Good market and good milling quality as indicated in Table 14.

**Table 14: Distribution of respondents according to their awareness of advantages on recommended rice seed variety (N=120)**

| Advantage | Frequency | Percentage |
|---|---|---|
| High yield | 118 | 98.3 |
| Many tillers | 18 | 15.0 |
| Resistance to water logging | 15 | 12.5 |
| Early maturing | 61 | 50.8 |
| Good market | 23 | 19.2 |
| Good milling | 10 | 8.3 |
| Ratoon crop | 18 | 15.0 |

According to the findings in Table 14, majority of respondents (98.3%) mentioned high yield as the main advantage of using recommended rice seed variety. The survey went further to investigate the disadvantages of recommended rice varieties they were aware of. The disadvantages mentioned were poor taste and aroma, high management costs, susceptibility to diseases, low yield, poor market, logging; too much water requirements, sinks in flooding plain. The most important advantage which was mentioned by many of the respondents is susceptible to diseases as shown in Table 15.

**Table 15: Distribution of respondents according to their awareness of disadvantages on recommended rice seed variety (N=120)**

| Advantage | Frequency | Percentage |
|---|---|---|
| Great care is needed | 36 | 30.0 |
| Susceptible to diseases | 76 | 63.3 |
| Low yield | 1 | 0.8 |
| Poor market | 22 | 18.8 |
| Logging | 1 | 0.8 |
| Too much water requirements | 22 | 18.3 |
| Sinks in flooding plain | 7 | 5.8 |
| Poor taste | 2 | 1.7 |
| Poor aroma | 2 | 1.7 |

The results in Table 15 indicate that most of the respondents (63.3%) were aware that recommended rice seed variety (TXD 306) is susceptible to diseases; other disadvantages that were mentioned were high management costs (30.0%), low yield (0.8%), poor marketability (18.3%), logging (0.8%), too much water requirements (18.3%), poor taste (1.7%) and poor aroma (1.7%). It was also mentioned by other respondents (5.8%) that TXD 306 is a short variety, which sinks in flooding plain. This implies that awareness of disadvantages associated to recommended rice varieties is one of the reasons for its none or low adoption by farmers.

## 4. CONCLUSIONS

The study assessed the level of adoption of recommended rice variety and the independent and intervening factors that influence their adoption in the study area. The following are the major conclusions drawn from the findings of this study: The level of adoption of the recommended rice seed variety in the study area is low. Most of investigated intervening variables have influenced the adoption of recommended rice varieties as expected while it

was not in the case for independent variables. The intervening variables that seemed to mostly influence adoption of recommended rice varieties are efficiency misperception, need tension and prominence. The independent variables investigated, which are gender, income, age, marital status, number of people in a household and farm size are not important in determining the adoption of recommended rice variety in Kilombero District. Farm size and area under maize production influenced adoption negatively which is contrary to the expectations. Generally this study concludes that in the Kilombero District intervening variables are more important in determining the adoption of recommended rice variety than the independent variables. It is therefore recommended to policy makers, administrators, agricultural researchers and extension officers that more emphasis should be on the intervening factors in order to address the problem of none or low adoption in the study area.

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