Research Article **AJAR (2017), 2:4**

American Journal of Agricultural Research
(ISSN:2475-2002)

Socio-Economic Factors Influencing Use of Improved Technologies by Smallholder Paddy Farmers in Kilombero District, Tanzania

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ABSTRACT

The study on which the paper is based was carried out in Kilombero district, Morogoro Region. Specifically it aimed at; identifying smallholder paddy farmers use of improved technologies (i.e. improved seeds and fertilizers) in their production; determining socio-economic factors influencing their use or none-use of the above, and identifying inputs access challenges faced by the farmers. To address the above a cross–sectional research design was adopted whereby data were collected only once. Simple random sampling was used to obtain 120 respondents, 40 from each of the selected villages. Data were collected using a structured questionnaire. Collected primary data was analyzed using the Statistical Package for Social Science (SPSS), whereby descriptive statistics such as frequencies and percentages were determined. In addition, a binary logistic regression model was used to determine association of some key socio-economic factors and farmers use of improved technologies. Generally, results from the logistic regression show that, availability of extension officers, involvement in other income generating activities, access to credit, household size, annual income, education level and farm size were significantly associated with the use of improved seeds and fertilizers. Results further show that, major technology use challenges faced by farmers were high inputs prices, poor availability of inputs, long distance to agro–input shops, lack of adequate input use knowledge and low quality inputs. Therefore, the paper recommends that, the Ministry of Agriculture, Local Government and other stakeholders work on ways to increase smallholder farmers' access and use of improved technologies hence improvement of their paddy productivity.

Key Words: Smallholder farmers, paddy, improved seeds, fertilizer

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How to cite this article:
Grace Makingi and Justin K. Urassa. Socio-Economic Factors Influencing Use of Improved Technologies by Smallholder Paddy Farmers in Kilombero District, Tanzania. American Journal of Agricultural Research, 2017, 2:4.

eSciencePublisher
eSciPub LLC, Houston, TX USA.
Website: http://escipub.com/

1.0 Introduction

Agriculture is the backbone of Africa's economy. According to [1], about 70% of Africans and roughly 80% of the continent's poor live in rural areas depending on agriculture for their livelihood. The sector accounts for about 20% of Africa's GDP, 60% of its labour force and 20% of all merchandise exports. However, food insecurity remains one of the main challenges facing many countries in Sub-Saharan Africa (SSA) despite the significant advancement in improving cereal grain yields especially for maize, wheat and rice [2][3].

Paddy is among the major cereals grown in Africa and its importance is rapidly increasing [4]. Its demand in SSA has doubled over the past few decades due to rapid urbanization and population growth [4] [5]. Generally, total milled rice production in SSA has increased from 2 million tons in 1961 to 16 million tons in 2009. At the same time, milled rice imports into SSA increased from 0.5 million tons in 1961 to 10 million tons in 2009 due to insufficient domestic production to meet the growing demand [6] [5]. So far, SSA's increase in paddy production has mainly been due to the expansion of cultivated areas. However, paddy yield in SSA has remained significantly lower than its consumption leading to a heavy reliance on imports which now constitute one-third of all rice traded in the world market [7]. Similarly, [8] has reported that, paddy yield in African countries has grown slowly from around 1.5 to 2.5 tons per hectare over a period of 50 years while in Southeast Asia rice production increased by almost 18 percent between 2000 and 2010, or 1.6 percent per year [9]. One of the main reasons for Africa's low productivity is the low level of inputs used (fertilizers and improved seeds); other reasons include, soil degradation, diverse agro-ecological system and policy distortion against agriculture [10]. Fertilizer use in SSA is 8 kg/ha, compared to 78 kg/ha in Latin America, 96 kg/ha in East and Southeast Asia, and 101 kg/ha in South Asia in 2002 [11].

In responding to the above-mentioned low paddy productivity, SSA came out with possible strategies for achieving productivity improvement. These strategies include; adoption of high-yielding modern varieties (HYMVs) and an increase in chemical fertilizer application [12] [10]. However, the mentioned strategies have not led to the desired changes in paddy production due to a multitude of factors such as inadequate investment in agriculture, limited access to credit by smallholder farmers, high cost of inputs and unavailability of inputs such as fertilizers and improved seeds, inadequate use of modern technologies, inefficient agricultural input markets, and the absence of a conducive policy environment [13].

Tanzania's agriculture like that of other SSA countries is still characterized by low input use. For example, Tanzania's 2007 Poverty and Human Development Report (PHDR) revealed that 87 percent of Tanzanian farmers were not using chemical fertilizers; 77 percent were not using improved seeds; 72 percent were not using pesticides, herbicides or insecticides due to high costs of agricultural inputs and services [14]. According to [15], the Post - Structural Adjustment Programs (Post–SAPs) period in SSA was marred by problems of accessing modern inputs. The above could be a result of farmers' prior experience whereby such inputs had been subsidized by the state, therefore paying the full price of the inputs for poor resource smallholder farmers may have been a problem in comparison to the pre SAP's period.

Paddy is Tanzania's second most important commercial and food crop, the first being maize. The crop is among the major sources of employment, income and food security for Tanzania farming households. In addition, Tanzania is the second largest producer of paddy in Southern Africa after Madagascar with a production level of 1,104, 890 Mt [16]. However, productivity (kg/ha) is low due to use of low-yielding varieties, low application of fertilizers, drought, low soil fertility and weed infestations. Other causes are prevalence of insect pests, diseases and birds. With a steadily growing demand due to increases in per capita consumption and population growth, the total area under rice cultivation has also increased substantially [16]. About 71 % of the rice grown in Tanzania is produced under rain fed conditions; irrigated land presents 29 % of the total with most of it in small village level traditional irrigation schemes. As a consequence of the above, the average yield is very low, 1-1.5 t per ha [17].

Around 90% of Tanzania's rice production is done by smallholders and production is concentrated in Mbeya, Morogoro, Shinyanga and Mwanza regions. Generally, paddy yield in Tanzania is stagnant while arable land per agricultural population is declining due to rapid population growth [18] [8].

Kilombero District is the largest paddy producing district in Morogoro Region and has a high potential for paddy production, more than 80% of the income of the people is obtained from selling paddy or rice [19]. However, yields are low on average about 2 towns per ha mostly due to dependence on rain-fed agriculture, low use of agricultural inputs such as fertilizer, poor farm inputs use; for example use of the hand hoe in land preparation and use of traditional seeds [20]. The above average is quite low when compared to the 3.1 to 4.3 tons per hectare expected under good management as reported in literature [21]. Kilombero district's production is also lower than those reported in other parts of the world. For example, according to [22] paddy productivity in Northern Africa, Asia, Eastern Europe, Southern America and Mexico between 2001 and 2005 stood at 9,539.98, 4,028.16, 3,728.36, 3,963.84 and 4,569.72 Kg/ha. The world's average during the same period stood at 3,966.76 kg/ha. The low paddy productivity reported in Tanzania and Kilombero district is difficult to explain based on the fact that, the Tanzanian government through the Ministry of Agriculture, Food Security and Cooperatives (MAFC) has been in the forefront to increase agricultural productivity for quite a long time. For example, '*siasa ni kilimo'* (politics is agriculture-1972), '*kilimo cha umwagiliaji'* (irrigated farming-1974), '*kilimo cha kufa na kupona'* (agriculture for life and death-1974/5) and '*mvua za kwanza ni za kupanda'* (first rains are for planting-1974), the current '*kilimo kwanza'* (Agriculture First Initiative) and 'The National Agricultural Input Voucher Scheme (NAIVS). The NAIVS aimed at promoting use of inputs through government subsidies especially in fertilizers for the purpose of increasing productivity. Despite all the above, low inputs use in paddy production is persistent.

Though several studies have been done on improved inputs use in agricultural production for example, [23] who focused on adoption of inputs in maize; [21] who focused on farmers adoption of selected recommended rice production practices in Kilombero district, and [24] who focused on assessment of paddy farmers information needs. Nonetheless, not much has been reported on the socio-economic factors responsible for the farmers use or non-use of the improved inputs. Therefore, the study on which this paper is based aimed at assessing Kilombero District's paddy producers' use of improved inputs (particularly, improved seeds and fertilizers), to determine social-economic factors influencing paddy producing households' use or none-use of the above, and identifying inputs access challenges faced by smallholder paddy farmers. The paper could be useful to policy makers and other stakeholders interested in coming up with strategies to raise smallholder farmers paddy productivity

1.2 Conceptual framework

The paper's conceptual framework is as shown in Figure 2. Generally, the framework is informed by the "Technology Diffusion Theory" which is based on farmers' decision to adopt new technologies [25]. Adoption means that a person does something differently than what they had previously (i.e., purchase or use a new product, acquire and perform a new behavior, etc.). Generally, the theory postulates that, farmers with more education and larger land will have more knowledge of improved farming systems and are more likely to adopt technologies more rapidly. According to the diffusion theory, inputs access by farmers is influenced by many factors as already pointed above. For example, presence of extension services can influence easy access to information on existence of agricultural inputs and improved technologies by farmers. Therefore, the more contact a farmer has with the extension services, the more will be the information/knowledge s/he has thus, the possibility of using the above [26]. In addition, personal factors such as age, gender, marital status and education may influence access and use of agricultural inputs. For example, [27] argue that, younger farmers are more likely and willing to spend more time to obtain information on improved technologies compared to older farmers hence a higher likelihood they could adopt new technologies. Situational factors such as infrastructure and distance to the nearest input center can influence farmer's access of inputs. Generally, shorter distances will mean that farmers can easily access improved technologies as for longer distance the reverse is true. In addition, involvement in other income generation activities and access to credit can provide money for the farmer to purchase agricultural inputs. Other factors that influence adoption of technologies include income, labour availability, and access to financial institutions, social capital, type and price of inputs, infrastructure, soil characteristics, and rainfall distribution [28].

2.0 Methodology

The study on which this paper is based was carried out in Kilombero District one of the six districts of Morogoro Region (location of the district is as shown in Figure 2). The district was purposively selected based on its high potential for paddy production and the fact that more than 80% of the district's residents income comes from paddy sales. In addition, paddy production is more pronounced in Kilombero district compared to the other districts in Morogoro region [19]. The district generally experiences high temperatures (26º to 32ºC) and has a bimodal rainfall pattern, the short rains begin towards the end of November and end in January or February, while the long rains usually start in March and end in May or June. Generally, the average rainfall ranges between 1200 to 1600 mm. The district's soil type is characterized by alluvial lowlands covered mostly by heavy clays as a result of periodical/permanent flooding. According to Tanzania's 2012 Population and Housing Census, Kilombero district had a total of 407 880 people whereby 202 789 were male and 205 091 were female. The main occupation of the people in Kilombero District is agriculture. About 80% of the population are engaged in Agricultural production, predominantly at the subsistence level.

The study adopted a cross-sectional research design whereby data were collected once using a pre-structured questionnaire. The design was thought to be suitable for the current study because it allows collection of data that can be used to determine relationship between variables. In addition, the design is suitable where time and resources are limited and offers quick results with low costs [29] [30] [31]. The population for the study on which the paper is based comprised all paddy farmers in Kilombero district. Multi-stage sampling was used to select 3 wards out of the 35 wards producing paddy in the district, it was important to use the above as it allows the use of multiple sampling techniques within a single study. In order to obtain representative villages' random sampling was employed to select 1 village from each of the 3 wards. Thereafter, a total of 120 respondents were randomly selected from three villages (i.e. Mkula, Mangula A and Kisawasawa for other details see Figure 1), 40 from each village. Simple random sampling was used because it allowed the possibility of every respondent to have a chance of being selected. The selection was guided by village registers.

Primary data were collected using a structured questionnaire with both open and close ended questions. Collected primary data was analyzed using the Statistical Package for Social Science (SPSS), whereby descriptive statistics such as frequencies and percentages were determined. In addition, a binary logistic regression model (as detailed below) was used to determine association of some key socio-economic factors and farmers use of improved technologies. The logistic regression model was chosen out of a range of alternative regression models such as probit because it accepts a mixture of continuous and categorical independent variables and for the current case the dependent variable was categorical (0 = non-use of improved seeds or fertilizer in paddy farming and 1 = use of improved seeds or fertilizer in paddy farming).

The likelihood of a farmer using agricultural inputs (improved seeds and fertilizers) was predicted using the following binary logistic model:

$$Lg\ (P/1\text{-}P) = \beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots \beta_n x_n + \varepsilon i \ldots\ldots\ldots\ldots\ (1)$$

Where P=Farmers use of improved agricultural inputs (1 = uses 0 = does not use)
1-P= Farmers none-use of improved agricultural inputs (i.e. seeds and fertilizers); X^1-X^8= Explanatory socio-economic predictor variables X1= Age of head of household X^2= Sex of head of household X^3= Marital status of the household head X^4= Education qualification

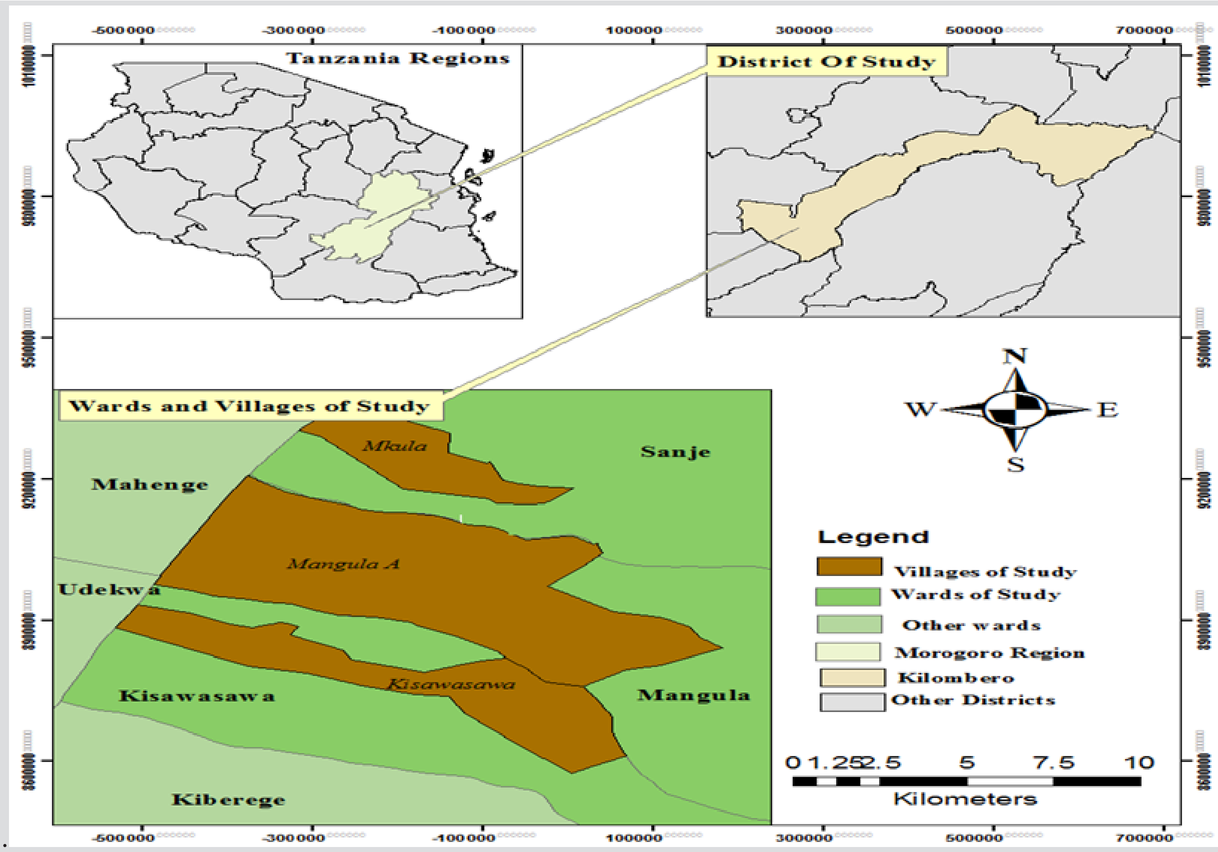

Figure 1: Map showing the study area

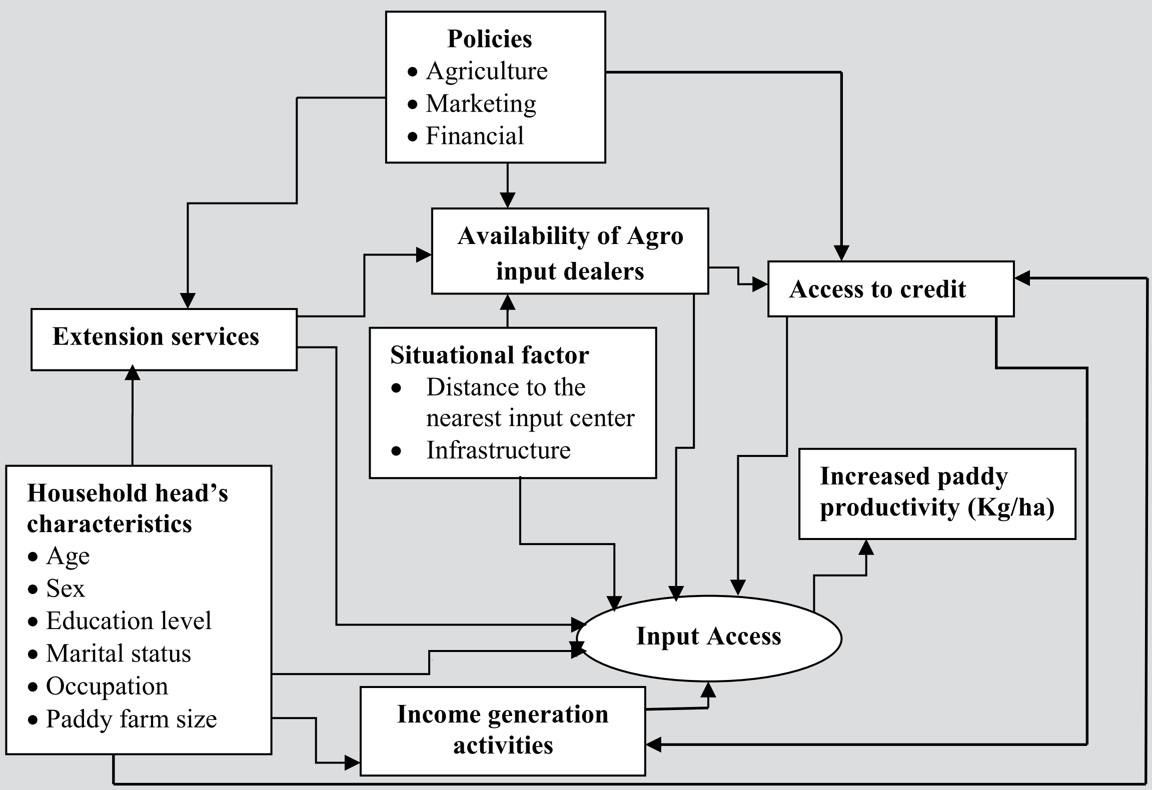

Figure 2: Conceptual Framework for farming households input access and paddy productivity

of household headX^5= Income (Estimation of household head's income) X^6= Household size X^7= Farm size (Number of acres cultivated)
X^8= Distance in kilometres from agro – inputs centres to farm X^9= Land ownership X^{10} = Availability of extension officer
X^{11} = Access to credit X^{12} = Group membership X^{13} = Involvement in other income generating activities (IGA's) (e.g. petty trade, livestock keeping, wage employment and carpentry)

3.0 Results and Discussion

3.1 Respondents Socio-demographic Characteristics and a household's use of improved technologies in paddy production

As pointed out in sub-section 1.0, socio-demographic characteristics can influence a household's adoption of improved technologies. Socio-demographic characteristics that have been taken into account in this paper include; age, sex, marital status, education level, and household size. The above characteristics according to literature can influence adoption of agricultural technologies [32] [33]. According to the study findings (Table 1) the age of respondents who are also referred to here as household heads ranged between 20 and 71 years with the average being of 40.2. Table 1 also shows that, those in the age group 20 - 40 years reported more use of improved technologies (i.e. improved seeds and fertilizers) in paddy production compared to households led by much older individuals. The current study is in agreement with the findings by [34] who reported that, adoption of genetically modified maize was adopted more by younger farmers and declined with age for those farmers closer to retirement in India.

Results in Table 1 also show that a majority of male headed households (MHHs) had relatively adopted more of the improved agricultural technologies in their paddy production compared to female headed households (FHHs). Generally, the above could be due to MHHs having more access to and control over vital production resources than FHHs due to socio-cultural values and norms. These results conform to the study in Nigeria by [35] which indicated male farmers adopted more organic fertilizers unlike their female counterparts. Results in Table 1 further show that households with married household heads relatively used more of the improved technologies in the paddy farming compared to those heads not in marriage. These results seem to imply that, married household heads had to adopt agricultural technologies so as to produce more to have a surplus to sell to enable them meet other household needs such as shelter and paying for other services. These results are similar to those by [28] who observed high adoption of improved maize technologies in married households in Ghana. Moreover, according to [36] marital status is an important social factor having a manifestation in the social standing and sense of responsibility of married individuals in the society.

Generally, education has been reported to be a means of liberation from ignorance, developing human skills and knowledge hence, empowering individuals and communities to participate in certain activities [37]. Results in Table 1 show that, the majority of respondents had attained primary education and above. The results suggest that most of the surveyed households had some literacy and numeracy skills which could enable them adopt agricultural technologies required for increased paddy productivity. According to Kiabaara (2005) as cited by [22], farmers in developing countries need at least five years of schooling to facilitate poverty reduction of their households due to education's influence on a household's choice and adoption of technologies. Moreover, some of the innovations can be introduced through posters, leaflets, and brochures which require literate individuals with some reading and numeracy skills. The study's observations generally conform to findings by [38] that, farmers who are better educated are generally more open to innovative ideas and new technologies that promote technical change. In addition, [39] have also pointed out that education facilitated the adoption of modern technologies and improved farm practices in Nigeria.

In addition to the above-mentioned household characteristics', household size is another important characteristic when examining issues of agricultural production and adoption of technologies. Generally, it is a measure of labour availability. According to [40] a household includes persons living together and sharing household resources such as accommodation, farmland and foodstuffs. Results in Table 1 generally show that, large sized (6 – 10 members) households reported relatively more use of improved technologies in their paddy compared to the small sized ones (1 – 5 members). The observed household size of above 5 members is considered to be large based on the 2012 Tanzania census whereby, the country's average household size was 4.8 [41]. The above observation may be due to the fact that, some agricultural activities are labour intensive therefore, households with more economically and physically able members could be better placed in adopting such technologies hence raising crop productivity. The above result is in agreement with the study conducted in Nigeria by [39] which showed that, household size was crucial to adoption of agricultural technologies especially, inorganic fertilizers which required the family as a source of labour. According to [42] small sized households with low level of income may not be able to hire required labour in case of labour intensive activities. Results in Table 1 further show that, farming was the main occupation of all the respondents. However, other income generating activities (IGA's) were also undertaken to supplement the main activity, the activities include, petty trade, livestock keeping, wage employment and carpentry. Generally, the results in Table 1 show that with the exception of livestock keeping 50% and above of the households engaged in the IGA's were using improved technologies (i.e. improved seeds and fertilizers) in their paddy production. These results conform to what was reported by [43], that income from off-farm sources is important in financing purchase of farm inputs (e.g. seeds, fertilizers, labour).

3.2 Socio – economic factors associated with a household's use of improved seeds and fertilizers in paddy farming

Binary logistic regression results for the factors associated with households use of improved seeds are shown in Table 2, the model's R^2 was 0.405 (Cox and Snell R^2), and 0.547 (Negelkerke R^2). This implies that independent variables were able to explain the dependent variable by 54% and the rest (46%) could not be explained by variables in the equation therefore. Based on the analysis four independent variables were significantly associated with a household's use of improved seeds and these are; household size, average annual income, farm size and education level. However, household size according to Table 2 was only slightly significant (p = 0.057). The observation nonetheless suggests that many larger households (i.e. those with more than five members as indicated in Table 1) were using improved seeds in their paddy production hence a possibility of high production and increased income may then enable such households to purchase improved seeds. The above observation is in line with what was reported by [44] who observed that adoption of new varieties requires more labour inputs. Generally, it is assumed that large households can easily provide the labour required for improved paddy production practices especially when endowed with physically able mature persons. On the other hand, a large household may encourage adoption of improved inputs such as fertilizers, improved seeds and pesticides whose application is labor-intensive [45]. Moreover, large households also have more needs which could be met by increasing production/productivity; one of the ways of doing the above is by use of improved technologies.

A household's average annual income was significantly (p = 0.05) associated with use of improved seeds in paddy production (Table 2). Generally, the observation is in line with the assumption that, a higher income level generally suggests that a farmer is more able to purchase improved seeds and other inputs. The above observation conforms to that by [46], who reported that a farmer's income was positively related to his/her uptake of farming technologies since any adoption/adaptation process requires a farmer to have sufficient financial resources. As expected farm size was significantly (p = 0.05) associated with a household's use of improved seeds (Table 2). According to the observation, farmers with large farms were more likely to adopt improved paddy seeds relative to those with small farms. The observation is in line with literature [28]; most often large farms are a sign of commercialization of production hence, the need to maximize productivity through use of improved technologies.

The binary logistic regression results (Table 2) further show that, education level of a household

Table 1: Socio-demographic characteristics of respondents and the surveyed households use of improved technologies in paddy production (n=120)

Characteristic		**n=120**	**Improved seeds**	**Fertilizer**
Age of household head	20 – 40	58 (48.3)	39 (32.5)	40 (33.3)
	41 – 60	33 (27.5)	16 (13.3)	22 (18.3)
	≥ 61	29 (24.2)	6 (5)	9 (7.5)
Sex of household head	Male	74 (61.7)	35 (29.2)	41 (34.2)
	Female	46 (38.3)	26 (21.7)	30 (25)
Marital Status of household head	Married	88 (73.3)	46 (38.3)	52 (43.3)
	Single	32 (26.7)	15 (12.5)	19 (15.8)
Education Level of household head	Primary and above	102 (85)	54 (45)	58 (48.3)
	No formal education	18 (15)	7 (5.8)	13 (10.8)
Household size	Small 1 – 5	59 (49.2)	17 (14.2)	19 (15.8)
	Large 6 – 10	61 (50.8)	44 (36.6)	52 (43.3)
Household head's main occupation	Paddy Farming (n =120)	120 (100)	61 (50.8)	71 (59.2)
Household's involvement in other income generating activities	Petty trade (n_P=42)	42 (35.0)	21 (50)	28 (67)
	Livestock keeping (n_L=40)	40 (33.3)	17 (43)	19 (48)
	Wage employment (n_W=24)	24 (20)	16 (67)	14 (58)
	Carpentry (n_C=14)	14 (11.7)	7 (50)	10 (71)

NB: Numbers in parenthesis indicates percentages, nP = number of households earning an income from petty trade, nL= number of households earning an income from livestock farming, nW = number of households earning an income from wage employment and nC = number of households earning an income from carpentry

Table 2: Binary logistic regression results for socio – economic factors associated with a household's use of improved seeds (n=120)

Variable	**Use of improved seeds**						**Use of fertilizers**					
	B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**
Age	.047	.239	.039	1	.843	1.048	.292	.238	1.504	1	.220	.746
Sex	.692	.623	1.237	1	.266	1.998	.409	.582	.494	1	.482	1.505
Marital status	.294	.650	.205	1	.650	.745	.160	.686	.055	1	.815	.852
Farmers association membership	.662	.383	2.790	1	.104	.516	.077	.355	.047	1	.829	.926
Household size	**1.143**	**.600**	**3.631**	**1**	**.057***	**3.137**	-.085	.579	.022	1	.883	.918
Access to credit	.000	.000	.646	1	.421	1.000	.000	.000	.540	1	.463	1.000
Other economic activities	.000	.000	.500	1	.479	1.000	**.000**	**.000**	**6.200**	**1**	**.013****	**1.000**
Farm ownership	.979	.612	2.558	1	.110	.376	.030	.603	.003	1	.960	1.031
Extension officer availability	.198	.590	.113	1	.737	1.219	**1.623**	**.664**	**5.969**	**1**	**.015****	**.197**
Distance to Input shop	-.056	.038	2.115	1	.146	1.058	**.054**	**.031**	**1.552**	**1**	**.078***	**.947**
Annual income	**1.650**	**.738**	**5.001**	**1**	**.025****	**5.209**	**2.109**	**.886**	**5.670**	**1**	**.017****	**.121**
Education level	**1.605**	**.701**	**5.243**	**1**	**.022****	**4.978**	.260	.739	.124	1	.725	.771
Farm size	**1.394**	**.452**	**9.532**	**1**	**.002****	**4.032**	-.238	.245	.939	1	.332	.789
Constant	6.394	2.518	6.448	1	.011	832.102	8.060	2.682	9.029	1	.003	3.1663

NB: Cox and Snell R^2 (Improved Seeds) = 0.405, Nagelkerke's R^2 (Improved Seeds) = 0.547: Cox and Snell R^2 (Fertilizer) 0.405, Nagelkerke's R^2 (Fertilizer) = 0.455 **Significant at p = 0.05 *Significant at p = 0.1

head was significantly ($p = 0.05$) associated with a household's use of improved seeds. This implies that an increase in the level of a household head's education also leads to increased adoption of improved agricultural practices and new technologies. The observation conforms to what has been reported in other studies. For example, according to [47] literacy level positively influenced the adoption of improved maize seeds and fertilizer use in Kenya.

Binary logistic regression results for factors associated with a household's use of fertilizers in paddy production are as presented in Table 2. The model's R^2 was 0.405 (Cox and Snell R^2) and 0.455 (Negelkerke R^2) implying that independent variables entered in the model were able to explain the dependent variable by 45%, the rest (55%) could not be explained by variables in the equation. Based on the analysis three independent variables were significantly associated with a household's use of fertilizers, these include; availability of an extension officer (extension services), access to credit and involvement in other income generating activities (IGA's) (petty trade, livestock keeping, wage employment and carpentry). Availability of an extension officer was significantly ($p = 0.015$) associated with a household's use of fertilizers. Generally, availability of an extension officer/ access to extension services is instrumental in influencing farmers use of fertilizers, Normally, this happens through provision of training on how to apply the same in their farms hence increased paddy production and productivity (kg/ha). These results conform to those reported by [48] that, the rate at which innovations are used by farmers is largely dependent on sensitization, mentoring and demonstration by extension agents.

The logistic results (Table 2) also show that, access to credit was significantly ($p = 0.05$) associated with the farmer's use of fertilizers. This is probably due to the fact that access to credit enables farmers to purchase fertilizers easily. The current study is in line with [47] who observed that access to credit enhanced farmers' capacity to adopt improved maize seeds and fertilizer use in Kenya which in turn increased their productivity. Generally, accessibility to credit reduces the level of risk associated with adoption of technologies on the side of a farmer, thereby increasing the likelihood of adoption. The logistic regression results (Table 2) further show that distance to an agro-input shop was associated with the farmer's use of fertilizers, however, this was only slightly significant ($p = 0.078$). Generally, being near to a particular service can enhance ones use of the same, for example, a short distance to agro-input shop could influence a farmer's use fertilizer because of reduced costs both in terms of time and transportation. These results conform to that reported by [49], that being near to agro-input centers positively influenced farmer's use agricultural inputs in Nigeria.

The logistic regression results (Table 2) further show that, involvement in other economic activities (petty trade, livestock keeping, wage employment and carpentry) was significantly ($p = 0.013$) associated with a farmer's use of fertilizers in paddy production. The observation suggests that farmers' involvement in other economic activities provides them with an extra income/capital which they can use to purchase fertilizers. The observation conforms to what was reported by [43] that, income from off-farm sources is important in financing purchase of farm inputs (e.g. seeds, fertilizers, labour).

Other variables such as age, education and annual income were positively associated with use of fertilizers in the surveyed households' paddy production as expected. However, the association was not statistically significant. For example, age of household head was hypothesized to have a positive influence on adoption of fertilizer. According to [34] age has a direct bearing on a farmer's approach, openness or conservativeness and level of exposure to new technologies. Generally, younger farmers are more interested in trying out new agricultural technologies because of their risk taking character. Farm size was also hypothesized to have a positive influence on adoption of agricultural technology. Small farms have been reported to have a greater likelihood of adopting recommended practices as they are more intensively managed. Household size was hypothesized to have a positive influence on adoption of agricultural technology. However, in the current case this showed a negative association. Generally, larger households i.e.

those with many able bodied persons can benefit from their numbers when they can actively participate in income generating activities. It is also believed that households with adequate and a readily accessible labour pool can affect the adoption decision and amount of technology adopted. On the other hand large households with many dependants could find themselves unable to invest in improved technologies as those who are economically inactive may be draining the meagre resources available.

3.3 Improved technologies access challenges faced by smallholder paddy producers in Kilombero District

Access and use of agricultural inputs among paddy farmers is important if farm productivity is to be increased. Results in the appended Table 3 show the five major challenges reported by surveyed households, these included; high input prices, poor availability of the inputs, long distance to agro-input shops/outlets, inadequate knowledge proper use of inputs, and low quality of the available inputs. These results are somewhat similar to observations from literature that, high costs of inputs have been reported as a major challenge in Kilombero District [50]. According to [44], timely availability of inputs was also reported to be a constraint to smallholder farmers in India. As regards the challenge of inadequate knowledge, this according to [51] has been observed to be one of the major factors holding back smallholder farmers when it comes to use of inputs and as a consequence low productivity which may result into food shortage. In addition to the above, persistence or lack of access to certified improved rice seeds can according to [46] jeopardize the efforts to achieve self-sufficiency in rice production.

4.0 Conclusions and Recommendations

The paper generally aimed at determining the socio-economic factors associated with a household's use of improved seeds and fertilizers in paddy production in Kilombero district. Based on the presented results it can be concluded that the following socio-economic factors; household size, average annual income, farm size and education level were significantly associated with a household's use of improved seeds. As regards use of fertilizers, it can be concluded that, a household's annual income, availability of extension staff (extension services), involvement in other income generating activities and distance to an agro-input shop were observed to significantly be associated with its use by households'. Lastly, it is concluded that, major improved inputs use challenges were, high prices, non-availability of inputs at the right time, and long distance to agriculture input centers. Nonetheless, high input price was high on the list.

Based on the above, it is recommended that farmers be encouraged to join Savings and Credit Cooperative Societies (SACCOs). Doing the above will enable them access affordable loans with which they can purchase the required inputs for increased paddy productivity. It is also recommended that, the government should promote the private sector's investment in agricultural inputs particularly in the rural areas, doing this will facilitate availability of agricultural inputs close to the farmers and at the right time. Lastly, it is recommended that, extension services need to be strengthened so as to reach more farmers thus enabling them to adopt improved technologies for increased paddy productivity for both poverty reduction and improved food security.

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Table 3: Inputs access challenges in the study area (n=120)

Inputs access challenge	Frequency	Percent
High price of inputs	69	57.5
Poor availability of inputs	32	26.7
Long distance to agro-inputs shops	11	9.2
Lack of knowledge on proper use of inputs	3	2.5
Low quality inputs	5	4.1