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FACTORS INFLUENCING THE USE OF LOCAL RICE VARIETIES AND ITS INFLUENCE ON PRODUCTIVITY IN THE LWAFI-KATONGOLO IRRIGATION SCHEME, NKASI DISTRICT, TANZANIA

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ABSTRACT

Performance of rice production in the Lwafi-Katongolo Irrigation Scheme is influenced by both environmental and non-environmental factors. Despite introduction of improved rice varieties in irrigation schemes for increased production, farmers still choose to use local rice varieties. The factors that determine farmers' choice of local and improved varieties have not been studied and used as a basis to improve productivity in the scheme. Such an analysis has wider implications on improvement of performance of rice irrigation schemes. This study was done to determine: (1) socio-economic factors influencing use of local rice varieties (2) other non-socio-economic factors influencing rice production (3) factors influencing productivity in the scheme. A sample of 120 farmers from 4 purposely selected villages of Katongolo, Masolo, Kamwanda and Mpata were surveyed using standard socio-economic survey approaches. Data on soil chemical and nutrient characteristics for the irrigation scheme were obtained from ARI- Uyole database. Quantitative data were analyzed using SPSS and Stata computer programs. Qualitative data were analyzed by content analysis. Multinomial Logistic Regression model was used to determine factors influencing the adoption of different rice varieties. The results show that education level had significant positive influence on the use of local varieties ($p<0.1$). Other major economic activities influence use of local varieties for farmers who grow both varieties ($p = 0.05$). For most farmers prior experience on growing local varieties and investment capital greatly influenced adoption of new rice varieties. Constraints of using local rice varieties are poor appearance, poor taste and low production with implications on markets, economic performance and consumer preferences. Understanding farmer preferences based on quality of rice is prerequisite in introducing new rice varieties for improvement of productivity in irrigation schemes. Research on the most favorable rice varieties especially from socio economic and soil condition points of view is imperative. Concerted extension education to promote the use of improved rice varieties and measures to ameliorate possible saline condition of the soil will augment productivity.

Keywords: Local rice varieties; Multinomial logistic regression; Lwafi-Katongolo irrigation scheme and Productivity.

Abbreviation: ARI=Agriculture Research Institute

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1. INTRODUCTION

Globally, rice is one of the most important crops and it represents a staple food for over half of the world's population, with a wide production of more than 700 million tons per year and a harvested area reaching 165 million ha with Italy being the preeminent rice producer (Hassen *et al.,* 2017). Most of the increase in production of rice can be tagged on the introduction of improved irrigation technologies and rice varieties globally. Due to prevalence of poverty and liquidity constraints, smallholder farmers tend to rely on less productive traditional farming methods characterized by dependence on weather conditions, low adoption of improved technology and low use of capital inputs hence productivity among farmers remain as one of the challenges in many developing countries (Anang, 2019). The farming system being characterized by rain fed and irrigation, rice production tends to differ based on innovations of rice growing hence yield difference per unit area of production. According to Anang, (2019), farmers consider different factors before deciding the best innovation for rice production like profitability of innovation, risk of adoption, the capital of the farmers, government policies relating to agriculture and socio-economics of the farmers.

In Tanzania rice has been one of the important crops that contributed immensely to food and nutrition security, socio-economic development and country's foreign exchange. Rice is the second most important staple grain crop after maize (URT, 2019). Under optimum condition potential yield of rice range from 4 to 6 t/ha for upland and 6 to 10 t/ha for lowland of irrigated areas, though this always depends on varieties of rice grown and management level (Ngailo, 2017). Meanwhile rice growing in Tanzania face different challenges like poor availability of improved and quality seed varieties, insect pest and disease, poor adoption of improved seed varieties among farmers, and lack of sufficient funds for breeding suitable varieties (URT, 2019). Moreover Tanzania has thirteen improved rice varieties released for multiplication and subsequent use by smallholder farmers (Republic *et al.,* 2014). These are grown, however, on less than 15 percent of the total area cropped to rice. Most rice growers are still planting low yielding varieties, and have yet to be introduced to the improved varieties (Republic *et al.,* 2014).

Tanzania has developed and implementing several initiatives for improving agricultural development. Such initiatives include but not limited to establishment of irrigation schemes and the development of agriculture development strategies such as National Agriculture Policy (2013), Kilimo Kwanza (2009), Agricultural Sector Development Strategy (2001), National Rice Development Strategy (2009), Agricultural Sector Development Programme (2006-2016), Tanzania Agriculture and Food Security Investment Plan (2011/12-2020/21) and Southern Agricultural Growth Corridor of Tanzania (2011) (Oates *et al*., 2017) .With recent to the Climate Smart Agriculture Strategy to mainstream climate change mitigation in agriculture production, the major agriculture production related slogans such as the poverty reduction strategy (MKUKUTA) and Big Result Now (BRN) (Leyaro & Morrissey, 2013), it has taken time for farmers to pace with such initiatives. The cultural, tradition and socio-economic constraints associated with such initiatives has led into poor adoption of different technologies meant to improve productivity in irrigation schemes. Consequently, some farmers in the Lwafi-Katongolo irrigation scheme continue using traditional rice varieties in production.

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The reasons for such a practice of continued use of traditional rice varieties and its influence on productivity are not well analysed. This study was a prerequisite in addressing the factors influencing the use of local rice varieties in Lwafi-Katongolo irrigation scheme and implications on production among small holder farmers. The study uses Lwafi-Katongolo irrigation scheme as a case with implications on other rice irrigation schemes in different geographic, socio-economic and cultural setting in Tanzania. The study is based on three key questions: What are factors that influence the use of local rice varieties in Lwafi-Katongolo irrigation scheme? How does this constrain/favor productivity of the scheme? What are the most plausible reasons of using traditional rice varieties?

2. METHODOLOGY

2.1 Description of the study area

The study was done in Nkasi District, found in Rukwa Region, as it is located on the South West Part of Tanzania between Lake Tanganyika and Lake Rukwa which lies between longitude 30º 20'and -31º 30' East and Latitude 6º 58'and -8º 17" South (Figure). The Lwafi-Katongolo Irrigation Scheme is located in Masolo and Katongolo village bounded by Kipili, Kirando and Itete wards. The Scheme site is about 60Km from Namanyere Town, lies at latitude 07º 26' S and longitude 30º 43' E. Though the soil of the irrigation scheme is sand clay loam with a bulk density of 1.28 g/cc while the average rainfall distribution in the entire district ranges from 800-1400mm.

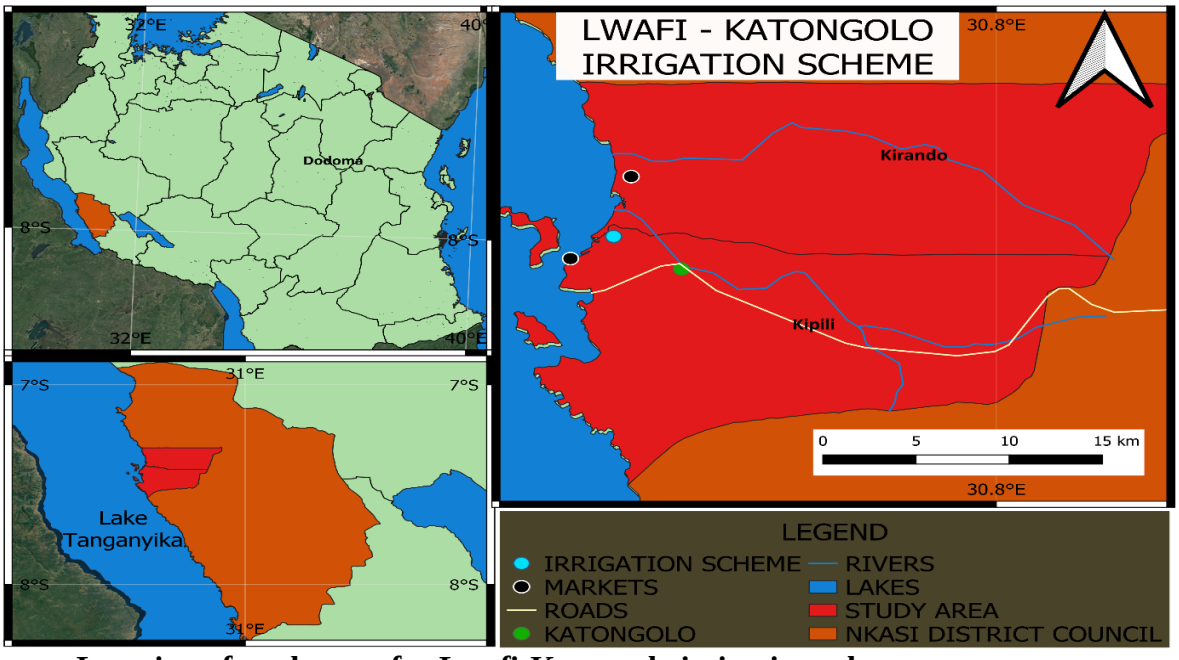

Figure: Location of study area for Lwafi-Katongolo irrigation scheme

2.2 Research design

The study used cross-section design under which data were collected at one point in a time using questionnaire survey and supplemented by field observation.

2.3 Study population and Sampling Procedure

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A multi stage sampling procedure was used, where 2 wards (Kipili and kirando) were purposely selected based on their involvement in the irrigation schemes. Four village with highly practicing irrigation which were Katongolo, Masolo, Kamwanda and Mpata village were selected randomly for the survey at which two village from each ward were selected, Using the list of house hold practicing irrigation from each village as the sampling frame 120 house hold were randomly selected from each village (30 households per village) for the survey.

2.4 Data collection

In this study both primary and secondary data were collected. Primary data involved both quantitative and qualitative, and these were collected using a mixed method approach including interview guide like Focus Group Discussion (FGD) and Structured questionnaire. On the other hand, data on age, education level, experience in farming, economic practices, extension services, capital, market accessibility, land ownership, reasons for using traditional varieties, constrains of using local varieties and Soil characteristics from ARI-Uyole data base were collected. Though the study was conducted from November 2021 up to February 2022.

2.5 Data analysis

Collected data were coded and analyzed using Statistical Package for Social Sciences (SPSS) and Stata computer programs. Quantitative data were analysed using descriptive statistics where percentages and frequencies were computed, though analysed soil sample were collected from ARI-Uyole for productivity assessment of the land in the scheme. Multinomial logistic regression model was used to identify factors that influence the use of local rice variety in the scheme., Qualitative data were analysed through content analysis whereby information from FGD and KII were used to identify, quantify, analyze and describe the presence, meanings, and relationships of the themes, or concepts within the gathered information as relates to choices in the use of different rice varieties.

The Multinomial Logistic Regression Model as a statistical technique that assess the relationship between one dependent variable and several predictors (Alexopoulos, 2010). .A multinomial logistic regression model as characterized by multiple explanatory variable follow the general formula (El-Habil, 2012).

$$\text{Logit(Y)} = \beta o + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_z X_z + \varepsilon$$

Where;

- Y is the dependent variable (Rice variety) with category of hybrid varieties (Saro 5 and Wahiwahi), local varieties (Geha, Supa-kyela, Malamata, Makoti, and Supa kikwakwa) and mixed varieties (Hybrid and local varieties).
- βo ……Is the intercept
- X_1, X_2……. X_z are explanatory independent variables (age, education, experience in farming, major economic practices, extension services, capital (income), market accessibility, information accessibility and land ownership).
- β_1, β_2……...βk are known as the model parameters (Beta coefficients), and "z*"* is the number of observations which is equivalent to the number of independent variables.
- ε is the random error as assumed to be independent random variable with mean 0 and variance ($\sigma 2$), however it was assumed as constant for this study.

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3. RESULT AND DISCUSSION

3.1 Factors influencing the use of local rice varieties in the irrigation scheme

The identified multinomial logistic regression model fits well the data as measured by Pseudo R^2 (0.5470=54.7%), observation=120, Log likelihood=-18.640083 and LRchi ^{2}(18) =45.02. These values suggest a good predictive ability of the model implying that explanatory/independent variables included in the model explain well the variation in the dependent variable and goodness of model fitness.

The nine explanatory variables of age, education, experience in farming, major economic activity, extension services, capital (income), market accessibility, information accessibility and land ownership thus explain well the choices made by the farmers on the rice varieties to grow. Among of the nine explanatory variables education level and major economic practiced significantly influence the use of local varieties for rice production. Education level was more influential for farmers who use local/traditional rice varieties. On the other hand, both education level and major economic activity had more influence on farmers who use both local (traditional) and improved varieties.

3.1.1 Education level

Education level (Table 1), had a statistically positive influence on the use of local rice varieties in the Lwafi-Katongolo irrigation scheme for farmers using local varieties ($p < 0.1$) and both local and improved varieties ($p< 0.05$). For farmers using traditional varieties one unit change in education level will lead to 2.343631 unit increase in use of local varieties for rice production. For farmers using both traditional and improved varieties, one unit change in education level will lead to 3.827078 unit increase in using local varieties for rice production in the scheme (Table 1). This means that education level is more forceful in influencing the use of local varieties especially with farmers who grow and/or use both varieties.

These finding compare well with a study conducted in eastern India which showed that age, education, land size, resistant to diseases influence positively the decision of adoption while variable like household size, experience of farmers, cost of seeds, insecticide and fertilizer influence negatively the decision of adoption (Bannor *et al.*, 2020)**.**

3.1.2 Major Economic activity

The major economic activity had statistically significant negative influence ($p <0.05$) on the use of local varieties for farmers who use both local (traditional) and improved varieties in the Lwafi-Katongolo Irrigation Scheme (Table 1). A unit change in Major economic activity by a farmer who uses both local and improved rice varieties will decrease the odd in use of local varieties for rice production by -2.617929 when another factor are held constant. This implies that Major economic activities of farmers like different businesses, fishing, other farming practices, livestock keeping and salaried employment have no influence on the use of local rice varieties by farmers who use both varieties in the scheme.

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Table 1: Multinomial logistic regression on factors influencing the use of rice varieties in the Lwafi-Katongolo irrigation Scheme, Nkasi District

Rice Variety	**Coef.**	**Std Err**	**Z**	**P>IZI**	**[95%Conf-Interval]**	
Hybrid (Improved) variety				(Base outcome)		
Use local (traditional) variety						
Age	1.008354	1.15694	0.87	0.383	-1.259206	3.275914
Education level	**2.343631**	**1.2611**	**1.86**	**0.063****	**-.1280799**	**4.815341**
Experience in farming	-.1957702	.2959976	-0.66	0.508	-.7759149	.3843745
Major Economic activity	-.2607936	.8209225	-0.32	0.751	-1.869772	1.348185
Extension services	-18.81829	8133.125	-0.00	0.998	-15959.45	15921.81
Capital (Income)	-1.476768	2.240562	-0.66	0.510	-5.868189	2.914653
Market accessibility	2.062959	1.884964	1.09	0.274	-1.631502	5.757419
Information accessibility	-22.93244	3635.066	-0.01	0.995	-7147.53	7101.665
Land ownership (land size)	.6657765	1.061188	0.63	0.530	-1.414113	2.745666
Constant	32.26684	8908.504	0.00	0.997	-17428.08	17492.61
Use both local and improved variety						
Age	.8333883	.936615	0.89	0.374	-1.002343	2.66912
Education level	**3.827078**	**1.652706**	**2.32**	**0.021***	**.5878342**	**7.066322**
Experience in farming	.0298397	.1970656	0.15	0.880	-.3564019	.4160812
Major Economic activity	**-2.617929**	**1.287139**	**-2.03**	**0.042***	**-5.140675**	**-.0951832**
Extension services	-18.53692	4714.764	-0.00	0.997	-9259.304	9222.23
Capital (Income)	-2.218663	2.207626	-1.00	0.315	-6.54553	2.108204
Market accessibility	-20.55197	11874.02	-0.00	0.999	-23293.19	23252.09
Information accessibility	-21.25359	4107.341	-0.01	0.996	-8071.495	8028.98
Land ownership (land size)	-1.904073	1.166524	-1.63	0.103	-4.190419	.3822728
Constant	68.85853	13419.83	0.01	0.996	-26233.52	26371.23

Note: *, and **, are significant at 95% and 90% levels respectively

3.2 Non-socio-economic factors that may influence rice production in the irrigation scheme

3.2.1 Nature and characteristics of the land

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Table 2, shows the soil properties that may influence rice production in the Lwafi-Katongolo Rice Irrigation Scheme. Except for exchangeable potassium, exchangeable magnesium, iron and manganese which seem high and total nitrogen, boron, and zinc other properties of the soil seem to be conducive for rice growth. The soil pH in the scheme (6.5-7.4) is optimal range for different rice varieties to grow if nitrogen and phosphorus-based fertilizers will be used to promote rice production. Limitations from saline conditions in the scheme and high percent of sand (53.23%) may ensue limiting the growth of some rice varieties. This implies that not all rice variety will be favorable and produce good yield in the Lwafi-Katongolo irrigation scheme under the existing conditions and a choice of the most appropriate rice variety is imperative to rectify any anomalies. The choice of local rice varieties by farmers may also be influenced by these conditions due to the fact that such varieties may have been adapted to the conditions over time.

Table 2: Soil characteristics of the scheme that influence productivity of the Lwafi-Katongolo Irrigation scheme, Nkasi District

Parameter	Result	Guideline	Interpretation	Comments
pH (water)	6.5-7.4	5.5-6.8	optimal	Optimal for many crops to grow
Organic carbon (%)	2.34-5.78	>1.5	Medium/Moderate	Continuously application, Stover is necessary
Total nitrogen (%)	0.56-1.35	>1.5	Low	Application of N-source, Fertilizer is required, preferably blended with zinc
Available P(ppm)	16.89-22.41	>15	Medium	Application of P-source, fertilizer is required, preferably due to high

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				fixation of Ca.
Exchangeable potassium(ppm)	258.1-278.4	241	High	Can be applied in some spots eg.low land fields
Exchangeable Ca(ppm)	2115.40-2379.59	1600	Moderate	Can be applied in some spots eg.CAN
Exchangeable Mg(ppm)	78.5-111.09	50	High	Nil
Sulphur (ppm)	7.99-12.6	10	Medium	Application of S-source is required to improve yield of paddy
Effective CEC (mol/kg)	19.30-24.67	15	Medium	Indicate moderate nutrient holding capacity
Boron(ppm)	0.03-0.98	1.6	Low	Application of B-source, fertilizer is required, especially foliar or blended B fertilizer
Zinc (ppm)	0.19-1.87	4.1	Very low	Priority for application of Zn source fertilizer, foliar fertilizer or blended Zn fertilizer
Iron (ppm)	27.46	>2	Very high	Adequate
Manganese (ppm)	6.32	5	Very high	Adequate
Electrical conductivity(mS/cm)	2.31-2.42	4	None saline	Preparation of controlling salts should be observed.
% Sand	53.23	<50		
%Silt	21.13	<20		
%Clay	25.65	<30		
Bulk density (g/cc)	1.28	1.35		

Source: ARI -Uyole (2021)

3.2.2 Reasons and Constraints of using local/traditional rice varieties

The major reasons for using local rice varieties in the scheme from farmer perspectives (Table 3a) are experienced/consumer preference (34.1%) followed by inadequate capital for investment (20%), accessibility of seeds (15%), (which may indicate capital) and a combination of the factors (2.5% – 5%). This implies that for most farmers experience on use of traditional/local varieties and capital greatly influenced their adoption of new rice varieties.

The constraints of using local rice varieties (Table 3 b) are poor appearance in maturity with implications on markets (27.5%), poor taste with implications on consumer preference (15.8%), low production per area (12.5%) and (11.7%) poor germination. Others include combination of

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the factors (0.8% – 9.2%). This indicates that with respect to the choice of seeds poor appearance of the rice at maturity and taste with their potential effect and implications on marketing are important considerations in designing and implementing rice irrigation schemes. The finding compares the same with FGD, the reasons for using local varieties were due to its accessibility, tolerant in water, consumer preference, and poor capital among farmers.

Table 3. Reasons and Constraints of using traditional rice varieties in the Lwafi- Katongolo Irrigation Scheme, Nkasi District

Variables	Frequency	Percent
(a) Reasons for using local varieties		
Low capital	24	20.0
Mostly experienced/consumer preference	41	34.1
Very tolerant in water	6	5.0
Very accessible	18	15.0
Poor capital and mostly experienced	1	.8
Poor capital and very tolerant in water	1	.8
Poor capital and very accessible	3	2.5
Poor capital, mostly experienced and very tolerant in water	1	.8
very tolerant in water and very accessible	3	2.5
Poor capital, mostly experienced and very accessible	1	.8
Mostly experienced and very accessible	14	11.7
Mostly experienced and very tolerant in water	6	5.0
Mostly experienced, very tolerant in water and very accessible	1	.8
Total	120	100.0
(b) Constraints of Using Local Varieties		
Poor appearance in maturity	2	1.7
Poor preference test	2	1.6
Low production per area	4	3.3
Poor germination and poor preference test	3	2.5
Poor germination and local production per area	9	7.5
Poor germination and low production per area	1	.8
Poor appearance in maturity and low production per area	11	9.2
Poor germination, poor appearance in maturity and low production per area	2	1.7
Poor germination, poor preference test and low production per area	14	11.7
Poor appearance in maturity, poor preference test and low production per area	33	27.5
Poor germination, poor appearance in maturity and poor preference test	1	.8
Poor appearance in maturity and poor preference test	1	.8
Poor preference taste and low production per area	19	15.8
Poor appearance in maturity and poor preferred test	3	2.5
Poor appearance in maturity and low production per area	15	12.5
Total	120	100.0

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4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Though education level and major economic practiced are the major factors that influence adoption of local rice varieties in the Lwafi-Katongolo Irrigation Scheme, education level is more forceful in influencing the use of local varieties especially for farmers who grow and/or use both varieties. Other major economic activities (different businesses, fishing, other farming practices, livestock keeping and salaried employment) have no influence on the use of local varieties by farmers who use both local (traditional) and improved varieties. Among the reasons that influence use of different rice varieties for most farmers, prior experience on use of traditional/local varieties and capital are the major reasons. The constraints of using local rice varieties are poor appearance on maturity and poor taste with implications on markets, consumer preference and low production per unit area with implications economic performance of the irrigation scheme.

4.2 Recommendations

i. Understanding the differential productivity and farmer preferences based on quality of rice is prerequisite in introduction of new rice varieties for improvement of productivity in irrigation schemes.
ii. Research on the most favorable rice varieties especially from socio economic and soil condition points of view is imperative
iii. Concerted extension education to promote the use of improved rice varieties and measures to ameliorate possible saline condition of the soil will augment productivity

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