Determine the Influence of Farmer's Educational Level on Adoption of Agricultural Water Management Practices in Rongai Sub-county, Nakuru County, Kenya

ABSTRACT
Water is a critical input for agricultural production and therefore, plays an important role in food security. There are different practices that can aid in managing water used for agriculture. Some of these agricultural water management practices are; rain water harvesting, irrigation, organic farming, mulching and use of drought resistant crops among others. Farmer's decision to either adopt or reject these practices can be affected by several factors, some of which are socio-economic. Some of the socio-economic factors that may influence adoption of these practices include farmer's educational level, income level and farm size, among others. This research delve into the influence of farmer's educational level on adoption of agricultural water management practices. A cross-sectional survey design was adopted, while proportionate and simple random sampling technique was used to obtain the respondents. The accessible population was 6,230 smallholder farmers from the target population of 26,804 smallholder farmers in Rongai sub county Kenya. The study was done in August 2023 to November 2023.The study included 120 smallholder farmers in Rongai sub-county. The study used questionnaire to collect data while binary logistic regression was used to analyze the data. The*P* value calculated for the 120 smallholder farmers was *P*=.56 which is >than .05 concluding that in this study education level did not have an influence on adoption of agricultural water management practices. The findings of the study are useful and can encourage farmers to adopt agricultural technologies regardless of their formal education level. The findings may also guide agricultural extension officers to focus on training the farmers on the specific technologies without necessarily focusing on their level of education. Further, the government, through agricultural extension officers, and other policy makers in the agricultural sector, may use the findings of this study while promoting adoption of agricultural technologies, as well as in coming up with appropriate policies that can help improve adoption of agricultural technologies.

***Keywords**: Education level, agricultural water management practices,smallholder farmers. Rongai, Kenya*

INTRODUCTION
Adoption of agricultural technologies is defined as the degree of use of new technologies when the farmer is informed about the technology and it'spotential. Agricultural technologies are developed to increase farm yields, improve quality of farm produce, increase farmer's income, and ensure food security (Yigezu et al.,2018),[1].Agricultural water management practices are the activities that farmers undertake in order to conserve and manage water for high production especially during the dry seasons. Their adoption is critical since water is an indispensable ingredient for food production (Lutta etal., 2020),[2].Some of agricultural water management practices are ;capturing and storing water, drip irrigation, dry farming, use of drought tolerant crops and organic farming (Glória et al., 2020),[3].Despite the various advantages of using the agricultural water management practices, different communities and smallholder farmers consistently resist the use of agricultural water management practices, while others readily adopt them. Studies suggest that adoption of agricultural water management practices is largely dependent on socio-economic factors such as income level, farmsize, farming experience and education level (Veraart et al., 2017),[4].Education level of smallholder farmer is an important factor that explains farmer's agricultural adoption behavior. This is because education has the power to change knowledge, skills and attitudes of smallholder farmers, making them more likely to adopt new practices and ideas.Also, education enhances the ability of decision makers by enabling them to think critically and use information sources efficiently (Muriu-Ng'ang'a et al., 2017),[5].Research indicates that farmers with more education may be more aware of sources of information, and therefore, may be more efficient in evaluating and interpreting information about agricultural water management practices, than those with less education.Therefore, this suggests

that farmers with high levels of education are more likely to adopt new technologies than those with lower levels **(**Hoa le dang et al., 2019) [6].In contrast, a study done in China on “the Effect of channels of Knowledge Acquisition Affecting Farmer’s Adoption of Green Agricultural Technologies”, concluded that formal education does not necessarily influence farmer’s decision to adopt agricultural technologies.However, knowledge acquired from mass media such as radio, may affect farmer’s decision to adopt agricultural technologies (Wang et al., 2023**)** [7].Many parts of Rongai sub-county of Nakuru County in Kenya, receivesrainfall of 500-800mm per annum, which is below the average of 800-1000mm per annum in Nakuru county. This leads to scarcity of water for domestic and agricultural purposes. This necessitates the use of agricultural water management practices among farmers. However, despite their importance, these practices have not been fully adopted by smallholder farmers. This has resulted to low agricultural production in the area and consequently food insecurity.

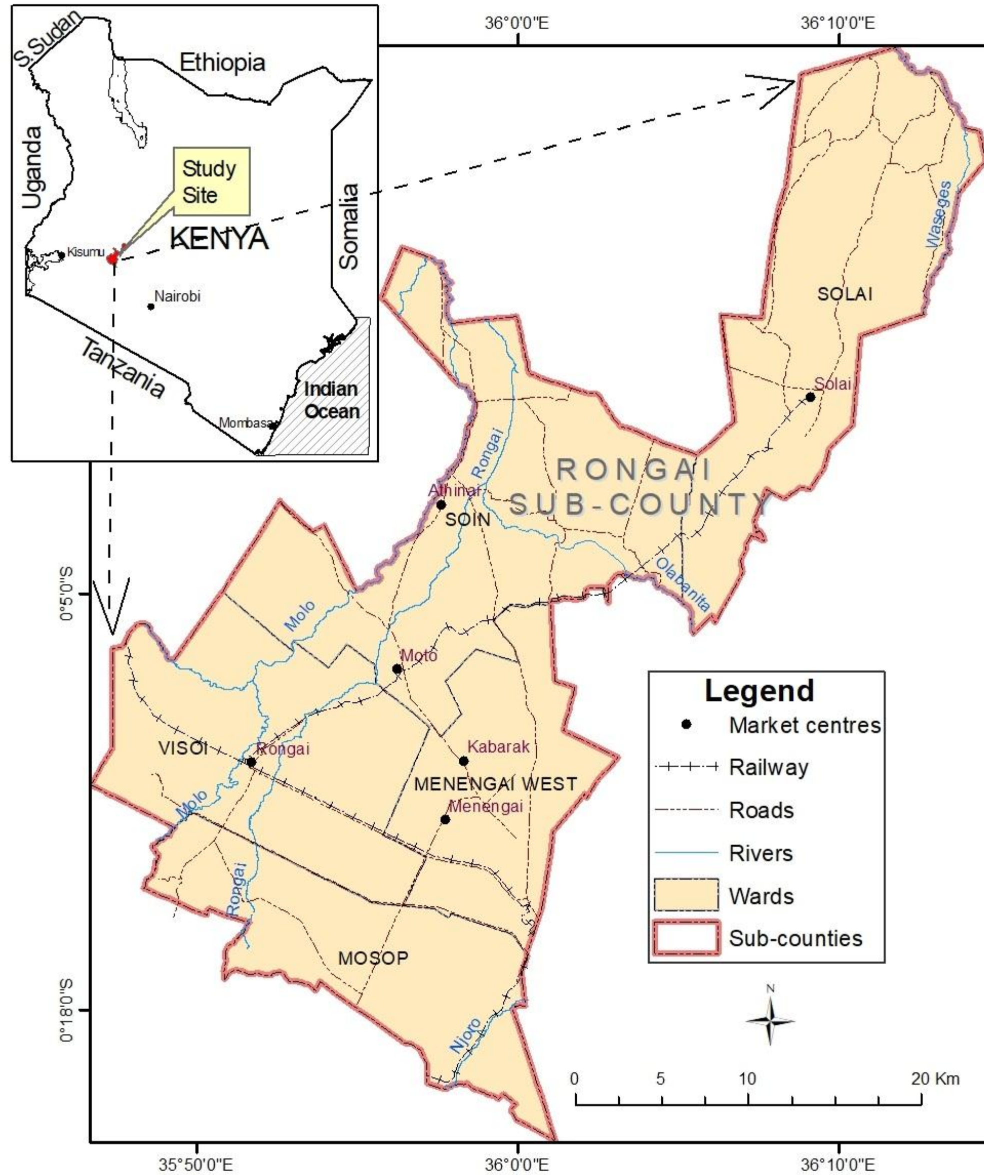
It was not clear about the factors that may have affected the adoption of agricultural water management practices and therefore the study sought to determine the influence of education level on adoption of agricultural water management practices in the area.

2. METHODOLOGY

2.1Study location

The study was carried out in Rongai sub-county, Nakuru County in Kenya.Rongai is made up of five wards namely, Soin, Solai, Mosop, Visoi and MenengaiWest.Rongai sub-county covers an area of 988.1 square kilometres, and has a population of 199,906 people with a population density of 202 per square kilometre. The major economic activities in Rongai include livestock production, crop farming and trade and investment (Gachie, 2020),[8].Rongai sub-county experiences variations in seasonal rainfall and is susceptible to droughts. The rainfall received is approximately 500-800mm per annum which is below the average rainfall of 800-1000mm per annum in Nakuru County. The Kenyan government through agricultural extension service providers, has made various efforts to control the effects of drought in the area. This has been done by creating awareness on the importance of water harvesting during rainy seasons especially construction of water pans and also use of drought resistant crops.However, despitethe efforts, the uptake of agricultural water management practices has been fairly low (Government of Kenya (GoK), 2018) [9].The study covered two wards, namely Soin and Visoi wards as they experience extreme variation in seasonal rainfall, of 400-600mm per annum (Gachie, 2020) [10]. (**See Figure 1**.).

Figure 1. Map of Rongai sub county



2.2 Sampling procedure and sample size

Out of the five wardscited,Visoi and Soin were purposively selected because of their low seasonal rainfall that leads to inadequate water in the areas (Karinga, 2021) [11].Proportionate sampling method was used to determine the number of respondents from the purposively sampled wards, while simple random sampling technique was used to obtain the respondents from the two wards. The study incorporatedone hundred and thirty (130) respondents.

The following formula by Nassiuma, (2000), was used to come up with an appropriate sample size for the study:

$$n = \frac{NC^2}{C^2 + (N-1)e^2}$$

$$\frac{6230x(0.21)^2}{(0.21)^2 + (6230-1)x(0.02)^2} = 108$$

Whereby:
n= the required sample size

N= the population within the study area,
C= Coefficient of variation
e= Standard error.
The sample was obtained using the coefficient of variation of 21%, a standard error of 2%.This meets Nassiuma's (2000) assertion that in most surveys a coefficient of variation occurs within the range of 21%≤C≤30% and that standard error occurs within the range of 2%≤e≤5%. The study expected 95% confidence (5% sampling error).
The sample size was108 but,the researcher revised the sample size to 130 by adding 20% of 108 as advised by Kaur, (2017) [12] in order to cater for non-responses and attrition. Therefore, the study incorporated 130 smallholder farmers.

Table 1: Summary of the distribution of sample size

Ward	Number of smallholder farmer	Proportion	Sample size
Visoi	3156	50.66	66
Soin	3074	49.34	64
Total	6230	100	130

2.3 Instrumentation
The study employed a semi-structured questionnaire. The questionnaire was chosen to collect data from the farmers because of its effectiveness, especially when used in a study with large samples.
2.4 Validity
The questionnaire's face and content validity were ascertained by experts from the Egerton University's Faculty of Education and Community Studies. Recommendations given were applied to enhance the instrument's validity.
2.5 Reliability
Piloting the questionnaire enabled the researcher to estimate its reliability. Piloting involved 30 smallholder farmers in Lare ward of Njoro sub-county in Nakuru County. Lare Ward has similar climatic and agricultural characteristic to Rongai sub county (Nassaji, 2015) [13].Cronbach Alpha Scale was used to estimate the reliability of the likert scale items. The reliability score was 0.50 which is less the required score and therefore, a further triangulation test was conducted among five smallholder farmers from the thirty smallholder farmers in Lare to ascertain the instrument's reliability This is because mmost of the items generated qualitative data.The instrument was thereafter, modified for data collection.
2.6 Data Collection
Rresearch authorization was given by the Research and Ethics Committee and the Board of Postgraduate Studies, both of Egerton University, while a research permit was got from the National Commission for Science, Technology and Innovations (NACOSTI). Further approval was got from the Agriculture extension officers, who also introduced the researcher to the farmers. The data was collected using a questionnaire.
2.7 Data Analysis
Data was cleaned, coded, scored and entered into the Statistical Packages of Social Sciences (SPSS) version 22.After cleaning out of the 130 questionnaires only 120 questionnaires were used in data analysis. Each score was assigned a specific weighting for meaningful interpretation for the hypothesis. Descriptive analysis was used to determine the frequency of level of education of smallholder farmers as well as the level of adoption of agricultural water management practices. Binary logistic regression test was used to predict the influence of education level on adoption of agricultural water management practices. The test of significance were computed at $\alpha=0.05$ significance level. The Binary Logistic regression model that was used is:
$y= ß0 + ß1X1 + \varepsilon$.
Where: y= Adoption of AWMP (Dependent variable)
Indicators: Low adoption, High adoption
ß0 = intercept, ß1, = coefficient of determination
Xn = X1 (Independent variable);
X1= Farmer's level of education
Indicator: Highest level of education attained

3. RESULTS AND DISCUSSION

The objective of the study was todetermine the influence of farmer's education level on adoption of agricultural water management practices among smallholder farmers in Rongai sub-county, Kenya*.* Education level refers to the status of learning that has been achieved by a student or group of students and is affected by the developmental difference of the students and how the learning environment are structured (Chuchird et al., 2017), [14].In the study education level was defined as highest level of education attained. The results obtained from this study were analyzed and discussed as follows:

3.1Frequency of Level of Education among Smallholder Farmers in Rongai Sub County in Nakuru County.

The indicator for determining the influence of education level was the highest level of education the farmer has attained. Frequencies and percentages were used to analyze level of education among smallholder farmers in Rongai sub-county in Nakuru County. The results are summarized in Table 2:

Table 2:Frequency of Level of Education among Smallholder Farmers in Rongai Sub-County

Education level	Frequency	Percent
No education	6	5.0
Primary school	50	41.7
Secondary school	40	33.3
University/college	24	20.0
Total	120	100.0

N=120 Source: Own computation of survey data, (2023)

From Table 2, it shows that majority of the farmers had primary school education as their highest level of education at 41.7%, followed by secondary school education at 33.3%. University/college had 20% while 5% had no education.

3.2 Frequency of Level of Adoption of Agricultural Water Management Practices in Rongai sub-county in Nakuru County.

Adoption of agricultural water management practices was measured in percentage and classified as low adoption, or high adoption. These percentages were calculated from the practices farmers have adopted from the three practices focused in the study (rain water harvesting, irrigation and use of drought resistant crops). From the scores of the three, agricultural water management practices, composite data wasgenerated for use in determining the adoption of agricultural water management practices. Composite data is the average data of the three practices to determine whether the farmer has adopted or not adopted the agriculture water management practices. If more than 50% the adoption level was considered high while less than 50% was considered low adoption. The results are shown in Table 3:

Table 3:Frequency of Level of Adoption of Agricultural Water Management Practices in Rongai sub-county

Use of Agricultural water management practices	Frequency	Percent
No	77	64.2
Yes	43	35.8
Total	120	100.0

N=120 .Source: Own computation of survey data, (2023)

Table 3, indicates that majority of the farmers did not use agricultural water management practices at 64.2% while only 35.8% adopted the practices. Therefore, the level of adoption of agricultural water management practices among smallholder farmers in Rongai Sub County is low.

3.3 Education Level and Adoption of Agricultural Technologies

Research has shown that level of education and adoption of agricultural technology are directly correlated (Feyisa, 2020), [15].In this study, majorityof the farmers were educated up to primary level. This suggests a high probability of them adopting agricultural water management practices. A study done on determinants of precision agriculture technology adoption in developing countries concluded that education level of the farmer influences adoption of technology. The study reports that early-adopters of technology tend to be better educated than late-adopters, and lack of education and knowledge tend to be considered as a barrier to adoption of agricultural technologies (Nguyen et al., 2023),[16].Additionally a study done in Ethiopia on determinants of agricultural technology adoption indicates that education level of the farmer has a positive association with farmers' decision to adopt agricultural technology (Adeagbo et al., 2023),[17].Research also shows that an increase in the years of formal education of farmers would increase their adoption of sustainable agricultural practices (Belayneh, 2023),[18].In contrast, a study done in China on how channels of knowledge acquisition affect farmers' adoption of green agricultural technologies concludes that formal education does not necessarily affect farmer's decision to adopt agricultural technology but rather the knowledge they acquire from the public and media concerning agricultural technologies (Wang et al., 2023),[19].Education level of the farmer is seen as an important factor in adoption of agricultural technology. However, adoption of agricultural technologies may be affected by other attributes such as farming experience, attitudes towards agriculture, extension services and farmer's income among others (Atube et al., 2021),[20].

3.4Regression analysis of the Influence of Education level on Adoption of Agricultural Water Management Practices.

The following null hypothesis was generated: Ho1:There is no statistically significant influence of farmer's education level on adoption of agricultural water management practices among smallholder farmers in Rongai sub-county Kenya. To test the hypothesis, the study analyzed and documented: Frequency of level of education on adoption of agricultural water management practices**.** Frequency of level of education was coded and analyzed as follows, 1 as No education, 2 as Primary education, 3 as Secondary level and 4 as University/college level. Adoption of agricultural water management practices was coded and analyzed as 1 Rain water harvesting, 2 Irrigation and 3 Use of drought resistant crops.For each agricultural water management practice, the options were scored as 1- adopted and 0- not adopted. Togetherwith the frequency of level of education, the average data of agricultural water management practices was used in the regression test to determine the influence of level of education on adoption of agricultural water management practices. Theresults of binary logistic test are presented in Table 4:

Test of Hypothesis

Table 4: Regression analysis between Level of Education and Adoption of Agricultural Water Management Practices

Summary of Binary Logistic Model							
Education Level		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	Education	.132	.225	.346	1	.557	1.141
	Constant	-.939	.639	2.161	1	.142	.391
a. Variable(s) entered on step 1: Education.							

N=120 *Source: Own computation of survey data, (2023)*

From Table 4 the analysis generated *P* =.56 therefore, the study failed to reject the null hypothesis, indicating that in this study, education level of smallholder farmers did not have a significant influence on adoption of agricultural water management practices. This finding can be associated with the fact that majority of the farmers in Rongai had primary education at 41.7 % which can be stated as low formal education. Formal education does not necessarily meet the skills required for use of agricultural technologies (Wang et al., 2023)[21].In this study, there is a possibility that smallholder farmers had basic knowledge of agriculture but lacked the skills which are associated with routine farming experiences, exposure to agricultural water management practices, access and training from extension services which may influence adoption of agricultural water management practices.

Further, other attributes may have influenced the findings of this study. This is because farmers stated that the cost of the practices affected their adoption without necessarily considering their formal education. The higher the cost of practice, the less likelihood of its adoption, and vice versa. Additionally, as indicated inTable 3, the adoption rate of agricultural practices is low since it is at 35.8%. This suggests that there could be other external factors that may affect adoption of agricultural water management practices regardless of the level of education of the smallholder farmers. Such factors may include; government policies,and terrain of Rongai sub county and particularly Soin and Visoiward. It was noted that the soil in Rongai is sandy and cannot hold water for long.These suggest that farmers need to buy dam liners for water pans as a way of harvesting rain water. The dam liners are expensive and regardless of the education level of the smallholders,not all farmers can afford and therefore, the terrain and cost of the practices may have discouraged the farmers from adopting the agricultural water management practices.

A study done in Northern Ghana on agricultural technologies adoption and smallholder farmers' welfare is in support of the result in Table 4, as it also concluded that education level of the farmer may not influence adoption of agricultural technologies.The study explains that some technologies require less skills to practice, while others come as a set, which encourages some farmers to adopt some aspects, and leave those which do not necessarily depend on the education level of the farmer (Adams & Jumpah, 2021),[22].

The other factors that could attribute to the lack of influence of educational level on adoption of water management practices in Rongai sub-county could be the training the farmer has had in agriculture, their age, and the experience the farmer has in agriculture. These factors can help the farmer decide either to adopt agricultural water management practices or not without necessarily being influenced by their education level.

4. CONCLUSION

This study failed to reject the null hypothesis, concluding that education level of the smallholder farmer in Rongai sub-county in Nakuru Kenya, did not have an influence on adoption of agricultural water management practices. These findings may guide agricultural extension officers to focus on training the farmers on the specific technologies without necessarily focusing on their education level. The findings of the study may also inform also policy makers in the agriculture sector, in coming up with appropriate policies that can helpto improve adoption of agricultural technologies and practices among smallholder farmers.

ETHICAL APPROVAL

Thestudy ensured numerous ethical considerations, which included attaining research authorization letter, research ethical approval and research permit. The research permit was thereafter presented to the Rongai sub-county agricultural office to seek approval for the same. The study was introduced to the farmers, and the principles of voluntary participation and confidentiality of participants were applied. The dignity, norms and culture of the farmers were respected at all times during the research process.

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