

## Original Research Article

# Influence of Acquired Knowledge on Irrigation and Crop Management Technologies among Smallholders' Farmers of Oluch-Kimira, Homa Bay County, Kenya

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**Abstract:** This article aims to determine the level of retained knowledge acquired through trainings on Irrigation and crop management technologies among smallholder farmers in Oluch-Kimira irrigation schemes, Kenya. Farmers were trained and a common knowledge test was administered after sometime for both irrigation participant and non-participant of irrigation technology. The result was analyzed descriptively and inferentially and the findings recorded. Descriptively the result indicated that, the mean score for irrigation participants (IRRP) was 74.5% and 53% for non-irrigation participants (NIRRP). The result further indicated that the (IRRP) scored high in 17 statements than the (NIRRP) indicating that they had acquired higher knowledge than NIRRP. On the other hand the NIRRP scored high in statements 9 (Flooding can control pests in the field) and 15 (Intercropping beans with maize create unnecessary completion thus low yields) with a score of 54.3% for NIRRP against 44.7% for IRRP and 58.8% for NIRRP against 41.2% for IRRP respectively; whether this difference was significant or not it was determined by testing the hypothesis and concluded that, the difference in score for IRRP and NIRRP is significant. Hence we can infer that the training on irrigation and management technologies was effective.

**Keywords:** Acquired; Knowledge; Irrigation and Crop Management Technologies.

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## 1. INTRODUCTION

Training is meant to equip the farmers with knowledge and skills to enable them to manage and utilize water resources effectively and also to help them to make decisive decisions on the type of irrigation and crop management technology to apply and adapt. Research has shown that, the more farmers are trained on the subject matter, the better they will comprehend any technical problem and solve it with ease (Rockaway *et al.*, 2011). Farmers' level of education has a positive impact on irrigation and water utilization this therefore, promotes farmers adoption of cheaper and affordable irrigation technologies (Chebil *et al.*, 2012). According to Amao & Awoyemi (2008), trainings open farmers mind and increases the required agricultural skills and knowledge of the new technology package thus better understanding on how to apply them.

It is important that agricultural training and extension programmes be intensive enough to enhance

the adoption not only for yield improvement but also of fertility-restoring (Nkonya *et al.*, 2004). Synergies need to be created between government departments, non-governmental organizations, researchers, donors and local communities in implementing programs that promote smallholder farmers' adoption of technologies that increase agricultural productivity and reduce environmental degradation and the deterioration of soil quality (Rosegrant *et al.*, 2002; Nkonya *et al.*, 2004).

The contribution of agricultural extension towards boosting irrigation technology on the other hand cannot be underestimated. At no time in the history of the country has the requisite of training and improving the production volume of smallholder farmers through irrigation systems been of such important as it today. Increasing agricultural crop production not only relies upon the farmers' perception, attitude and cultural change but also technological embracement at the community level (Asiabaka *et al.* 2012). Smallholder's farmers enhance their living

standard by adopting such technologies by allowing for a more effective and efficient use of farm resources, such as fertilizer and irrigation water and by improving the quality and quantity of farm produce. In achieving this noble goals, decentralization, Pluralism, cost recovery, participatory, cost sharing, stakeholders' inclusivity, resources mobilization, decisions making and agricultural developmental approaches that closely affect them are also considered important (Owuoth, 2010).

For any country to achieve food security it means that, irrigation technologies must be given top priorities by its governments since no community or country can claim to walk the path of economic growth without technology in play. It is on this ground that agricultural extension officers have been acknowledged to link local smallholder farmers with proper training on irrigation technology to enhance agricultural crop productivity (Woods, 2012). For the case of the study areas, the extension services were well intergraded schemes to meet the demands of the farmers.

## **2. METHODS AND MATERIAL**

### **2.1. The Study Area**

This research was conducted in Homa Bay County, Homa Bay sub-county where Oluch scheme is found and Rachuonyo sub-county Kimira scheme is found. The county lies between a latitudes and longitudes of 0° 20' S and 0° 30' S and 34° 30' E and 34° 39' E respectively. In Kimira irrigation scheme only 808 hectares is used as arable land for irrigation out of a total area of 1,790 hectares whereas Oluch irrigation scheme only 666 hectares is used as arable land for irrigation out of a total area of 1,308 hectares.

### **2.2. Sampling and Sample Size Determination**

The study used simple random and purposive sampling methods to select respondents for interviews. Simple random sampling was used to select non-irrigation participants and participant of irrigation systems whereas purposive sampling was used to select agricultural extension officers. The study applied fisher formula by Mugenda & Mugenda, (2003) to achieve the required sample size of 340 respondents.

## **3. RESULT AND DISCUSSION**

### **3.1. Socio-Economic Characteristics**

#### **3.1.1. Gender of the Respondents**

The researcher believed that gender division in the family would significantly determine the roles played by the households, owing to the fact that engagement in any activity vary based on the sex of the respondents. Based on this fact the farmers were asked to state their gender for the purpose of categorizing them. Out of 340 respondents who were interviewed, 203 were male which translate to 59.7% while 137 representing 40.3% were female as indicated in Table 1A.

The findings revealed a low participation of female than male counterparts which contradicts GFRA, (2012) who claimed that, up to 80% of the farms labour is done by female in most of the African countries. The study also disagree with the findings of the study by Migika (2013) that, agricultural engagements is a preserve of women and in that regard, agriculture is practiced for subsistence with little attempt to raise the production levels to meet their economic challenges. Swanson (2005) in his study identified some of the factors that might limit female from engaging in agricultural activities this include but not limited to; the type of crops grown and the nature of training offered by the extension personnel which cannot accommodate them, also, women's daily domestic chores won't allow them attend or participate in most studies.

This study is in agreement with that of Suleiman & Saeed (2013) who found out that, Men do more agricultural activities than women and are better placed in taking the risk of trying new idea such as the recommended crop production technological packages, seemingly because they have some access to credit services and have larger farmland units for cultivation. The analysis revealed that, access to credit services can be determined by the size of the farmland owned, education level and level of adoption of the recommended crop and livestock production technological packages. The male farmers usually get higher scores on the latter variables than the female counterparts in the society. The result further showed that women have a high tendency to join groups dealing with an enterprise that gives high and quick returns. This bring the imbalance between male and female participation in socio-economic activities and this gender disparity affects female in terms of control, ownership and accessibility to productive resources and participation in decision making, making them vulnerable to food insecurity (Kisii County, 2013).

#### **3.1.2. Age of the Respondents**

The finding of the study as indicated in Table 2A revealed that, 50% of the respondents fall under the age bracket of 36-55 years, followed by youths of the age bracket of 18-35 years representing 37.4%, and between the age bracket of 56-69 years and 70 years and above represented by 8.5% and 4.1% respectively as indicated in Table 1B.

It is believed that the age factor can be a driving force in the farming community however, the research has shown that youths do not regard farming as economic gain therefore, they tend to look down upon any activities that go with manual work for white color jobs and also the activity that can give them a quick money. According to Obamiro *et al.* (2013) in his study he asserted that, many youths might have gone to look for jobs in urban areas leaving the elderly people to do

the farming which could be attributed to food insecurity in areas. In addition, the farmer's age affects the overall labour productivity and adoption of irrigation technologies which is critical in enhancing the overall water productivity. This study disagrees with the study by Sandile (2016), who revealed that, on average, the age of farmers was 45 years with the elderly farmers constituting 61% which was quite a significant proportion of farmers engaged in small-scale irrigation systems. This implied that, such households might solely depend on hired labour as an alternative, with a resulting effect of increased variable cost and thus reduced enterprise net revenue.

The current study has proved that, indeed age as been considered a key factor when it comes to quality of decisions and farmer's attitudes towards adopting the irrigation technologies and water use as stated by Ahmed *et al.*, (2012). According to Owilla (2010), in his study he noted that, there negative relationship between farmers' age and water utilization in Mwea irrigation scheme, where the old farmers tend to have less access to irrigation water as compared to younger people. However a study the current study disagrees with Adeoti (2009) who reported that, there is negative association between irrigation technology and age of farmers' effect on the water usage for irrigation farming.

The findings of this research also are in consistence with that of Migika, (2013) who found out that, more middle aged farmers than younger ones engage in agricultural activity. This was attributed to the fact that majority of the youths incline to a more competitive jobs in big cities or towns away from home as their parents resort to agricultural activity as the only alternatives of livelihood in the village.

### 3.1.3. Educational Level of the Respondents

The extent to which farmers acquire knowledge would determine their competence in agricultural crop productivity and improved farming systems in general. In the light of such assumption, the respondents were asked to state their academic qualifications as indicated in Table 1C. Out of 340 respondents who participated in this study, majority of them had secondary education level at a frequency of 137 representing 39.7%, followed by primary education level at frequency of 82 representing 24.1% where as 22.6% stated having attained Middle level colleges and those with University academic qualification and none educated/illiterate represented by 10% and 3.2% respectively. The implication of these findings did not demonstrate substantial education potential, given the fact that just 32.6% of the respondents had attained middle level colleges and University level of education which are considered as the pool of knowledge to change the farming systems. Addressing the challenges associated with crop productivity therefore would be a big problem since enhanced agricultural output

correspond purely with the extent to which farmers adopts to new and modern technologies which in itself, is a function of education.

The literature has shown that, education of an individual has direct influence to his income. According to Amao & Awoyemi (2008) they indicated that, education open farmers mind and increases the required agricultural skills and knowledge of the new technology package thus better understanding on how to apply them. In most individual's educational level can be determined in terms of the years he/she has spent in formal education which is negatively correlated with net farm income with an explanation that, educated farmers do farming as part time and only supplement farming to increase their salary income. However, it is not statistically significant (Oluwasola *et al.* (2008). Equally, the findings of this study were in agreement with that of Sandile (2016) who found out that the education level among the small scale irrigation farmers was very low with the highest being grade 5 at primary level. It is, therefore, expected that the adoption of irrigation technologies among farmers in the will be low.

The number of years when a person spent in formal education is one of the most important determinants of increased household food production and adoption of good agricultural practices. Further, education facilitates the process of information flow and leads persons to explore as wide as possible on the different pathways of acquiring information regarding agriculture, food security and crop diseases (Ersado, 2001). The level of education plays an important role in farmers' decision making especially in the adoption of new agricultural technologies. There is common perception that educated farmers usually have a better opportunity to access information on new technologies and are generally better able to assimilate, to process and to use this information (Taylor, 1997). According to Aksoy, Kulekcu and Yuvuz, (2011), also concluded that, the level of education can influence productivity performance since education can a key factor in facilitating knowledge, awareness, and adoption of new technologies and also enable one to access information faster and contribution in decision making. Farmers with high education should be aware of more sources of information, and be more efficient in evaluating and interpreting information about innovations than those with low education.

The study is also in consistence with a study by Kipkemei (2001) who found out that, farmers with secondary level of education and have knowledge in secondary school agriculture perform much better in almost all agricultural activities as compared to whose farmers without the agricultural knowledge of secondary school. This means that agricultural knowledge of secondary school not only widen farmers' ability but also makes them more self-reliant,

resourceful, effective and capable of solving many problems associated with farming. Evenson and Mwangi (1998) in their study found out that, there positive but statistically insignificant relationship between schooling and farm productivity. In measuring education level within the household, the large majority uses either the household head's education level or the mean education level of the family members within that household (Onphanhdala, 2009).

Relatively more educated smallholder farmers are more likely to receive new technologies quickly and apply as expected compared to those with low education or uneducated ones, and the more farmers are educated the more they become innovative and active in all agricultural matters (Musemwa & Mushunje, 2012). The study is in agreement with that of Rockaway *et al.*, (2011) that, more educated farmers will contribute towards water and irrigation system management thus sustainable of irrigation systems. In addition he concluded that, the level of education of the farmer has positive impact on irrigation water utilization efficiency in the farm, this therefore, promotes farmers adoption to cheaper and affordable irrigation technologies (Chebil *et al.*, 2012). Djauhari *et al.* (1987) in their study also noted that farmers with higher levels of education should appreciate the importance of new emerging technologies especially when farming is the only source of income. Farmers with more years of farming

experience and more years of education are most likely and ready to adopt the new innovations technology due to their ability to read and understand technical terms that may be found in any technological package a critical aspect of technology adoption (Bonabana-Wabbi, 2002).

Waithaka *et al.* (2007) conducted a research in Vihiga sub-county, Kenya and noted that by increasing the educational level of the household head enable the farmer to use the inputs such as fertilizer, seeds and agro-chemicals used per the recommendation thus better yields and better crop management. The same sediments were echoed by Ariga *et al.*, (2009) who asserted that the farmers' educational background has significant effect of fertilizer use i.e. low education farmers misuse fertilizer than farmers with basic secondary school education. This is due to different types of fertilizers require different mode of application to specific crops, however some farmers who don't know how to read manufacturers' instructions may use the fertilizer regardless the crop. Also, different type requires different application mode, rate of application and timing of application with education therefore errors that might be committed will be minimized. Adolwa *et al.* (2010) on his research noted that farmer's education level significant influence the uptake of Soil Fertility Integrated Management project in Western Kenya.

**Table-1: Respondent's Gender, Age and Education**

<b>Gender</b>	<b>Frequency</b>	<b>Valid Percent (%)</b>
Male	203	59.7
Female	137	40.3
<b>Total</b>	<b>340</b>	<b>100.0</b>
<b>Age bracket</b>	<b>Frequency</b>	<b>Valid Percent (%)</b>
18-35 years	127	37.4
36-55 years	170	50.0
56-69 years	29	8.5
Over 70 years	14	4.1
<b>Total</b>	<b>340</b>	<b>100.0</b>
<b>Education levels</b>	<b>Frequency</b>	<b>Valid Percent (%)</b>
None educated/illiterate	11	3.2
Primary Education	82	24.1
Secondary Education	135	39.7
Middle level colleges	77	22.6
University Education	34	10.0
Any other	1	0.3
<b>Total</b>	<b>340</b>	<b>100.0</b>

### 3.2. Agricultural Knowledge Test

#### 3.2.1. Common Agricultural Knowledge Test on Crop Management Practices for Irrigation Participants (IRR) and Non-irrigation Participants (NIRR)

Farmers of Oluch-Kimira were trained and taken through a common agricultural knowledge test on various irrigation and crop management technologies in order to determine the extent they had acquired knowledge through the trainings. The result of the test was tabulated in table 2.

**Table-2: Level of Common Agricultural Knowledge for IRR AND NIRR**



Statements/item on crop management practices	Scores in (%)	
	IRRP	NIRRP
Irrigation technology was meant for all farmers irrespective of gender, age, tribe and economic status	90.3	59.7
Irrigation systems is meant to supplement the rain water for crop use	82.1	47.9
Irrigation system was installed to provide water for domestic use	67.6	52.4
Contour farming, terracing, crop rotation, and cut-off-drain are all physical measure of soil conservation	92.4	74.6
Water is essential for plant to grow	95.6	46.4
High crop yields can be obtained regardless the weather conditions	84.1	43.9
Water and soil conservations increases agricultural productivity	92.1	73.9
Flooding can control weeds in the field	53.4	49.6
Flooding can control pests in the field	44.7	54.3
Flooding can cause crop diseases in the field	51.5	45.5
Uncontrolled water can cause destruction to crops	89.7	54.3
The irrigation method used in the area is the most effective and economical	70.9	29.1
Too much application of fertilizers is dangerous to both soils and crops	89.4	69.6
Trees are major source of rain formation	71.2	28.8
Intercropping beans with maize create unnecessary completion thus low yields	41.2	58.8
Crop rotation control pests and disease	93.2	59.8
Crop rotating between maize crop with wheat crop is good	67.1	52.9
Crop rotation between Maize and Irish potatoes is good	78.6	65.4
Intercropping maize and bean improves the yield of maize	60.6	39.4
<b>Mean Score</b>	<b>74.5</b>	<b>53.0</b>

**KEY: IRRP-Irrigation Participants and NIRRP- Non-Irrigation Participants**

Analysis of common knowledge test acquired as a result of training about irrigation technologies were based on the set objectives. This test aimed at determining the impact of irrigation and crop management technologies promoted through participatory project extension approaches on knowledge of farmers’ participant and non-participants. The test was administrated to all participants. The objective sought to gauge the knowledge gained as a result of trainings on irrigation technologies and find out if the knowledge gained, retained and utilized by all the respondents. The test consisted of nineteen (19) questions on crop management practices related to irrigation technologies disseminated in Oluch-Kimira irrigation scheme. The indicator on knowledge gained about irrigation technologies was measured through the level of knowledge acquired by the IRRP and NIRRP farmers in irrigation technologies as result of the irrigation project training and conventional extension training in Oluch-Kimira scheme in Homa Bay County, Kenya.

The result in Table 3 indicates that, the mean score for IRRP was 74.5 percent and 53 percent for NIRRP. The result further indicated that the IRRP scored high in 17 statements than the NIRRP an indication that they had acquired higher knowledge than NIRRP. On the other hand the NIRRP scored high in statements 9 (Flooding can control pests in the field) and 15 (Intercropping beans with maize create unnecessary completion thus low yields) with a score of 54.3% for NIRRP against 44.7% for IRRP and 58.8% for NIRRP against 41.2% for IRRP respectively. From

the test result it shows that even NIRRP also learned from the message and training packages disseminated through either conventional or learned from irrigation training from the project. From the results, IRRP seemed to have acquired higher knowledge; whether this different was significant or not it was determined by testing the hypothesis by using paired t-test to determine the mean difference between the two score for IRRP and NIRRP. IRRP was taken to be X while the score for NIRRP was taken to be Y and then by taking the null hypothesis that the mean difference between the two scores is zero, we can write:

$$H_0: \mu_1 = \mu_2 \text{ which is equivalent to test } H_0: D = 0$$

$$H_a: \mu_1 < \mu_2 \text{ (as we want to conclude that training on irrigation technology has been effective)}$$

Since we are having marched pairs, a paired t-test was used to work out test statistic as:

$$t = \frac{\bar{D} - 0}{\sigma_{diff} \sqrt{n}}$$

Where:

$\bar{D}$  = Mean of difference

$\sigma_{diff}$  = Standard deviation of difference

n = Number of matched pairs

To determine the value of t, first is to find out the mean and standard deviation of differences as shown in Table 4.

**Table-3: Testing of Hypothesis on Knowledge between IRRP and NIRRP**

Test Questions	Score for IRRP X <sub>1</sub>	Score for NIRRP Y <sub>1</sub>	Difference D <sub>1</sub> =(X <sub>1</sub> -Y <sub>1</sub> )	Difference squared D <sub>1</sub> <sup>2</sup>
	90.3	59.7	30.6	936.4
	82.1	47.9	34.2	1169.6
	67.6	52.4	15.2	231.0
	92.4	74.6	17.8	316.8
	95.6	46.4	49.2	2420.6
	84.1	43.9	40.2	1616.0
	92.1	73.9	18.2	331.2
	53.4	49.6	3.8	14.4
	44.7	54.3	-9.6	92.2
	51.5	45.5	6.0	36.0
	89.7	54.3	35.4	1253.2
	70.9	29.1	41.8	1747.2
	89.4	69.6	19.8	392.0
	71.2	28.8	42.4	1797.8
	41.2	58.8	-17.6	309.8
	93.2	59.8	33.4	1115.6
	67.1	52.9	14.2	201.6
	78.6	65.4	13.2	174.2
	60.6	39.4	21.2	449.4
n=19			Σ D <sub>1</sub> =409.4	Σ D <sub>1</sub> <sup>2</sup> = 14605.2

Therefore the mean difference  $\bar{D} = \frac{\sum D_1}{n} = \frac{409.4}{19}$

=21.5

$$\sigma_{diff} = \sqrt{\frac{\sum D_1^2 - (\bar{D})^2 * n}{n - 1}} = \sqrt{\frac{14605.2 - (21.5)^2 * 19}{19 - 1}}$$

$$= \sqrt{\frac{14605.2 - 8782.85}{18}}$$

$$= \sqrt{\frac{5822.45}{18}}$$

$$= \sqrt{323.47} = 17.98. \text{ Therefore } \sigma_{diff} = 17.98$$

To find t, by substituting the value into the following equation

$$t = \frac{\bar{D} - 0}{\sigma_{diff} \sqrt{n}}$$

$$\text{Hence the value of t is } = \frac{21.5 - 0}{17.98 / \sqrt{19}} = \frac{21.5}{78.37}$$

$$t = 0.274$$

Degrees of freedom =  $n - 1 = 19 - 1 = 18$ .

Since alternative (*H<sub>a</sub>*) is one-sided, a one-tailed test shall apply (in the left tail because *H<sub>a</sub>* is of less than type) for determining the rejection side at 5% level of significance which comes to as by, using the table of *t*-distribution for 18 degrees of freedom, to obtain *R*:  $t < -1.734$ .

Since the calculated value (observed value) of *t* is 0.274 which is in the rejection region and thus, we reject *H<sub>0</sub>* and conclude that the difference in score for IRRP and NIRRP is significant. Hence we can infer that the training on irrigation technologies was effective.

### 3.2.2. CONCLUSION AND RECOMMENDATIONS

From the findings it's clear that irrigation participants (IRRP) scored higher in knowledge test questions as opposed to non-irrigation participants (NIRRP). By subjecting the results of the common knowledge test to the t-test, the mean scores between the IRRP and NIRRP showed a significant difference. It was concluded that, farmers who were trained and exposed to irrigation and crop management technologies had acquired more knowledge than the non-irrigation participants (NIRRP). The IRRP were therefore better off in terms of knowledge acquired in irrigation and crop management technologies and had a higher level of understanding in these technologies than their counterparts (NIRRP). It was concluded that a greater impact of irrigation and crop management technologies on the farming system of the irrigation participants than that of the non-irrigation participants in the study areas of Oluch-Kimira, Homa Bay County, Kenya. It's recommended that, there is need to scale up the trainings not only on irrigation and crop management technology but also in any new technologies before its implemented to be able to see its benefits and values to the intended consumers. This can be achieved by the Ministry of Agriculture in collaboration with other research institutions such as Universities and private partners through public-private partnerships..

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