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Nerica Rice Technology Acquisition through Community Agriculture Development Project in Semi Arid Lands (CADSAL) of Kerio Valley, Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. Author RJL designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors RJL, DB and NR managed the analyses of the study. Author RJL managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The aim of Community Agriculture Development Project in Semi-Arid Lands (CADSAL) in Kerio valley was to increase agricultural production in the project area and it used Community Participatory Extension (CPE) approach. A survey methodology was utilized in the study with target population of 480 small-scale farmers who interacted with the project in Kerio valley locations. The objective of the study was to determine and compare the level of performance between the CADSAL participants and non-CADSAL participants in knowledge acquired in NERICA technologies in Kerio Valley of Elgeyo Marakwet County, Kenya. A sample of 160 comprising 80 CADSAL-Participants and 80 Non-CADSAL participants was chosen using simple random sampling. A structured questionnaire was administered through personal interviews to the respondents at their homes. Descriptive statistics was used to compute percentages, means and standard deviations. Inferential statistics was used which included multiple linear regression and t-test to test the hypothesis at α = 0.05. Data was analyzed using Statistical Package for

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SocialSciences (SPSS) Version 24.0. The result indicated positive acquisition of NERICA technologies by the community using community participatory extension approach. The t-test *p*-value of less than 0.05 was achieved upon analysis of data which led to rejection of all the null hypothesis. This means further that community extension approach was key in enhancing the level of acquisition of technology by the farmers and hence extension agents need to utilize participatory approach. The study outcome therefore encourages Community participation in the projects meant to increase knowledge of food production in order to increase food production, accessibility and income both in productivity and diversity of production hence sustainability.

Keywords: Agriculture extension; adoption; household; knowledge; rice.

1. INTRODUCTION

Agriculture extension is an educational service for advising, training and informing the farmers concerning practical and scientific matters relating to farming business and in influencing them to use improved techniques in their farming operations. The aim of extension exercise is to improve farmer livelihood through improved production and income [1-3].

Globally, technological change has been the major driving force for increasing agricultural productivity and promoting agriculture development in several countries. Promotion of agricultural technologies is done through extension, which is meant to deliver technology messages from research to the farmer. Participatory extension approach has been utilized in many countries including India, Nigeria and Kenya [4]. An extension approach is a method and way of delivery of technology information to the intended farmer. In the past, the choice of technologies and their adoption was to increase production, productivity and farm incomes. Over many decades, policies for agriculture, trade, education, training, research and development have been strong influencers on the choice of technology, the level of agricultural production and farm practices [5]. Success is measured in the adoption rate of recommendations and increase in national production [6]. Community participatory extension approach often focuses on the expressed needs of farmers' groups and its goal in increased production and an improved quality of rural life [4].

Community Agriculture Development Project in Semi-arid Lands (CADSAL) used two extension approaches in promotion of agricultural technologies, the Community Participatory Technology Development (CPTD) and Community Initiated Project (CIP). The CADSAL Project promoted new agricultural technologies such as the New Rice for Africa (NERICA) which is basically upland rice varieties (CADSAL 2010). According toAtera, Onyancha and Majiwa [7], average adoption rates of improved crop varieties and inorganic fertilizer of 65 percent and 76 percent, respectively, appear impressive, great variations exist across regions and agro-ecological zones. Given the link between technology dissemination, adoption and productivity, it is the desire of many Governments to promote development and adoption of agricultural technologies.Understanding the factors that influence adoption of new and/improved technologies across households and communities is of urgent interest [6].

Rice is the third most important cereal crop after maize and wheat. However, the demand for rice has been increasing steadily among the youthful and urban population in Kenya [8]. The country produces rice mainly under irrigation systems requiring large investments in water infrastructure. Introduction of the New Rice for Africa (NERICA) which is suitable for upland conditions without flooding has improved the level of production of rice to meet the ever increasing demand [8]. The Community Agricultural Development project in Semi Arid Lands (CADSAL) introduced the New Rice for Africa (NERICA) on trial basis in 2007 with the purpose of increasing agricultural production and ensuring food security for the communities living in Kerio Valley [7]. Since the phase out of the project, there has been no research to establish the level of knowledge acquisition through comparison of participants and non-participants in the project.Therefore, the purpose of the research was to establish NERICA rice technology knowledge acquisition level through Community Agriculture Development Project in Semi Arid Lands (CADSAL) of Kerio Valley, Kenya.

2. METHODOLOGY

The research adopted descriptive approach and employed a survey research methodology with ex post facto research design. The research process utilized both quantitative and qualitative approach using the structured closed and open-ended questionnaire and interview schedules. The achieved data was analyzed using t-test and multiple linear regression analysis. The questionnaire validity was achieved through expert analysis by the supervisors. The data was further treated based on 95% confidence level.

The study was carried out in Kerio Valley in Elgeyo- Marakwet County. Kerio valley lies in the basin of Elgeyo-Marakwet County and cuts across Keiyo South, Keiyo North, Marakwet East and Marakwet West. The four Sub Counties of Keiyo South, Keiyo North, Marakwet Westand Marakwet East have conducive characteristics of soil, rainfall and temperaturefor upland rice production. This are the sub counties that CADSAL project focused on in upland rice technology transfer. A total of 160 respondents were targeted with 80 of them having participated in the NERICA rice technology. The target population of the research was 480 farmers who participated in the NERICA growing technology adaptability trials and demonstrations in Elgeyo Marakwet County as shown in Table 1.

Table 1. Study area, population and proportionate sample size

Sub county	Population	Sample
Keiyo South	108	36
Keiyo North	99	33
Marakwet West	147	49
Marakwet East	126	42
Total	480	160

Source: CADSAL manual

The research process employedpurposive sampling technique to identify NERICA technology participants and non-participants and then used stratified sampling. Stratification came about through the Sub Counties they come from and the groups they are affiliated to. Selection was carried out at random to achieve the respondents at a sample frame of 80 NERICA-Participants and 80 Non-NERICA technology participants. The sample was achieved from a total population of 480 spread across the four sub counties of Elgeyo Marakwet County. The sample was acquired through proportionate among the target population in the four Sub Counties.

The researcher carried out data collection by administering a structured questionnaire that was administered to 160 respondents. The copies of questionnaire was administered to the randomly chosen participants from the list of the intended population. The respondents were requested to cooperate in answering questions asked by the researcher. The researcher administered questionnaire face to face to the respondents. The respondents were encouraged to be truthful in answering the questions asked. The questionnaire were filled during the exercise to enhance efficiency and accuracy of data for analysis purpose.

Data from the questionnaire was coded and entered into SPSS for interpretation through computerized analysis where a conversion was made through a computer package, the SPSS version 24 program which facilitated the analysis of the information. The stages in the analysis included data preparation and tabulation. Statistical analysis included descriptive statistics which included means, frequencies and standard deviation. Furthermore the data was analyzed inferentially using multiple Linear Regression and t-test. The results were presented in form of description, frequency tables, charts and tables showing the level of significance.

The information was not revealed to anybody without the participants' consent. The participants were informed on the purpose of the research, the researcher preserved the anonymity of the informant by not writing the names of all those who were involved in the research process.

3. RESULTS

A total of 160 questionnaires were administered to the selected respondents in Kerio Valley where the CADSAL project took place and a total of 157 questionnaires were returned having been sufficiently filled to provide relevant information pertaining the research objectives. The return rate therefore translated to 98.1 percent of the total questionnaires an indication that the respondents and community at large had a good will to the research objectives and process. The mean age of the farmers who responded was 45 years an indication that many of the CADSAL target population was of the middle age category and who are energetic enough to adopt and carry out the farming activities.

A total of 65 percent of the respondents were male while 35 percent of the respondents were female. The response return rate was high an indication of acceptability of the research exercise with an almost equal ratio of male/female representation.

3.1 Response Rate of CADSAL Participants and Non-Participants

The study sought to find out on the participation of the respondent in the CADSAL project activities in the area of study. Through the question of whether the respondents participated in the CADSAL project or not, a total of 56.1 percent of the respondents indicated as having participated in the project while a total of 43.9 percent of the respondents indicated they did not participate in the project as indicated in the results presented in Table 2. This indicates almost half of the respondents were participated or did not participate in the project activities in the area. The results are presented in Table 2.

Table 2. Participated in the CADSAL project

Participated in the CADSAL project	Frequency	Percent
Yes (Participated)	88	56.1
No (Did not participate)	69	43.9
Total	157	100.0

3.2 Difference in Knowledge Acquired between CADSAL and non-CADSAL Participants in NERICA Technologies

The findings of the study whose respondents were 157 in all the questions relating to determining and comparing the difference in knowledge acquired between CADSAL and non CADSAL participants on NERICA rice technology adoption in Kerio valley area of Elgeyo Marakwet County, the results indicated the participants and non-participants were of almost equal level with participant mean of 1.60 and non-participant mean of 1.97. The findings on knowledge areas of adoption indicated most of the NERICA technologies knowledge areas were Moderate level.

The rate of agricultural knowledge acquired through CPE was established as shown in Table 3, with planting, seed selection and spacing being with moderate mean rate of 2.05, 1.74 and 1.99 for participants respectively. On the other hand the non-participants had a mean rate of 4.23, 3.88 and 3.99 respectively. The results were presented by 26.1 percent, 23.5 percent and 28.755 as true for the participants and 33.2 percent, 30.0 percent and 36.6 percent for non-participants of the CADSAL project. On areas of disease & pest control, weeding and harvesting the mean were moderate (1.88, 1.98 and 2.10) for participants respectively while the mean findings for non-participants were 3.57 percent, 4.09 percent, 4.01 percent respectively. Post-harvest measures are presented with mean of 1.99 for participants and 3.79 for non-participants.

On the question of whether the project targeted all farmers irrespective of the status in the community, the findings indicated a true mean of 1.19 for participants and 1.01 for non-participants. Furthermore, the selection of NERICA was important in achieving the higher yields with a mean of 1.28 for the participants and 1.10 for on participants. The respondents did not agree with the statements that NERICA rice is grown only in flood areas, neither did they agree that all insects were harmful to rice as a plant. The mean response for the growing conditions being floods only and all insects infestation being harmful was false with response means of 1.56 and 1.58 with respective SD of 0.498 and 0.495. On the question of soil conservation increasing agricultural yields and control weeds helping in the development of rice growing in the Kerio Valley, the response was true to the statements with mean response of 1.27 and 1.67 for participants and 1.09 and 1.42 for non-participants respectively. Termites were not the worst pests and enemy to rice plantation in Kerio Valley according to the response mean of 1.56 for participants and 1.33 for non-participants. It was also true from the findings that two ploughs in the area was important for soil to hold water necessary for rice production, the response mean of 1.45 for participants and 1.24 for non-participants.

Respondents during the research denied that the most recommended planting methods was broadcasting with response rate of 2.02 for participants and 1.73 for non-participants. In Kerio Valley area, NERICA rice was not difficult to handle after harvesting similarly, weeds were not a key challenge to manage and indicated by a response mean of 1.99 for participants and 3.79 for non-participants and 1.27 for participants and 1.09 for not participants respectively. The findings of the study indicated there were several stages of rice growth, more so the findings established that spacing was not so important in

Table 3. Mean and standard deviation on performance level based on knowledge acquired

Performance Level Based on Knowledge Acquired in NERICA technology	% Freq of participants			% Freq of N/participants			Std. Dev
	True	False	Mean	True	False	Mean	
Rate of planting knowledge	26.1	68.1	2.05	33.2	86.9	4.23	1.138
Seed selection	23.5	72.4	1.74	30.0	92.3	3.88	1.22
Spacing	28.7	64.0	1.99	36.6	81.6	3.79	1.332
Disease and pest control	28.7	64.0	1.88	36.6	81.6	3.57	1.201
Weeding	26.1	68.1	1.98	33.2	86.9	4.09	1.14
Harvesting	28.7	64.0	2.10	36.6	81.6	4.01	1.18
Post-harvest measures	28.7	64.0	1.99	36.6	81.6	3.79	1.35
Project meant for all categories of farmers	64.0	28.7	1.19	81.6	36.6	1.01	0.312
Higher yields from seed selection	64.0	28.7	1.28	81.6	36.6	1.10	0.404
Four Varieties were introduced	64.0	28.7	1.27	81.6	36.6	1.09	0.394
NERICA Grown in flood land	64.0	28.7	1.67	81.6	36.6	1.42	0.498
Insects harmful to rice	64.0	28.7	1.69	81.6	36.6	1.44	0.495
Soil conservation increase production	64.0	28.7	1.34	81.6	36.6	1.14	0.433
Weeds Control increase rice development	64.0	28.7	1.27	81.6	36.6	1.09	0.392
Termites not worst pests	64.0	28.7	1.56	81.6	36.6	1.33	0.5
Ploughs and Harrowing prepare tilth	64.0	28.7	1.45	81.6	36.6	1.24	0.481
plant rice through Broadcasting or Drilling	64.0	28.7	2.02	81.6	36.6	1.73	2.625
Difficult to thresh	64.0	28.7	1.56	81.6	36.6	1.33	0.5
Weeds not main challenge	64.0	28.7	1.42	81.6	36.6	1.21	0.472
Several stages of rice	64.0	28.7	1.28	81.6	36.6	1.10	0.404
Spacing is not important	64.0	28.7	1.58	81.6	36.6	1.35	0.501
Birds destroy rice fields	64.0	28.7	1.40	81.6	36.6	1.20	0.462
Spray rice field on insect sight	64.0	28.7	1.35	81.6	36.6	1.15	0.441
High plant density increases yields	64.0	28.7	1.50	81.6	36.6	1.28	0.492
Not wearing protective cloths is ok	64.0	28.7	1.75	81.6	36.6	1.50	0.482
Participatory extension approach was used	64.0	28.7	1.26	81.6	36.6	1.08	0.389
Overall average mean			1.60			1.97	

rice production in the area, the mean response for the two questions was 1.28 for participants and 1.10 for non-participants as well as 1.58 for participants and 1.35 for non-participants respectively. Birds could destroy rice field in the area with mean of 1.40 and 1.20 for participants and non-participants respectively. Indeed any sight of insects in the field should cause spray with insecticides as indicated by mean response of 1.31. The study established that there was relationship between high density of rice and its production with mean of 1.50 for participants and 1.28 for non-participants. The community through the study were aware that wearing protective clothing during mixing and application of pesticides was very important with response mean of 1.75 for participants and 1.50 for non-participants. CADSAL project used participatory extension approach during the in promoting the technology adoption of rice in the area, the mean response rate was 1.26 for participants and 1.08 for non-participants. Most of the technologies were important in ensuring that upland rice was well grown with most response tending towards true.

T-test was carried to establish the knowledge acquired during the community participatory extension training packages on NERICA rice technologies between CADSAL and Non CADSAL participants and the results as shown the Table 4 indicate significant difference in the knowledge with *p*=value being (P=0). The degree of freedom for all the sets of response was 156 (df=156) and mean of 1.60 for participants and 1.97 for non-participants. The null hypothesis was rejected owing to p<0.05 as shown in Table 4.

The regression results indicated p value of 0 (P<0.05) with R square value being 0.699 as illustrated in Table 5. This is an indication that CADSAL Community participatory extension approach in Kerio Valley had significant influence on the technology adoption and dissemination of NERICA rice technology.

The terms of the weight of influence, sharing of knowledge was more prevalent in the participatory extension approach in the area and on NERICA rice as shown in Table 6. The model focus on the technology adoption through as may be influenced by the community participatory extension approach. This was analyzed based on the whether the respondents were aware that CPE was in use during the CADSAL project. The interest was also in establishing whether CPE was in any was better and if the knowledge acquired was adequately shared among the farmers. This therefore was summarized as in the equation below

$$Y = C + PE_U + PE_b + S_E$$

Where,

Y= Technology adoption
C= Constant
PE_u = Participatory Extension use
PE_b= Participatory Extension being better
S_E = Sharing Extension Knowledge

The coefficients obtained from the multiple regression were C=0.009, PE_u=0.164, PE_b=0.034 and S_E=0.940 as illustrated in Table 6. Hence,

$$Y = 0.009 + 0.164PE_U + 0.034PE_b + 0.940S_E + e$$

Table 4. Test of significance of performance level based on knowledge and skills acquired through participatory extension trainings by CADSAL and non-CADSAL participants in Elgeyo Marakwet County

Categories of participants	N	Mean	Standard dev	T-value	2-tailed probability
NERICA participants	88	1.60	1.332	1.138*	.000
Non-NERICA participants	69	1.97	0.389		

Legend: (*) Significant at the .05 levels

Table 5. Regression model summary showing significance coefficients

Model	R	R square	Adjusted R square	Std. error of the estimate	Change statistics					Durbin-watson
					R square change	F change	df1	df2	Sig. F change	
1	.840[a]	.706	.699	.306	.706	91.378	4	152	.000	1.896

Table 6. Coefficients of regression

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.	95.0% Confidence interval for B	
	B	Std. error	Beta			Lower bound	Upper bound
(Constant)	.009	.167		.054	.957	-.322	.340
All categories of farmers	-.159	.162	-.089	-.983	.327	-.479	.161
Shared Nerica knowledge	.940	.054	.805	17.439	.000	.833	1.046
Participatory extension approach was used	.164	.075	.114	2.185	.030	.016	.311
Participatory extension is better than conventional	.034	.044	.076	.784	.434	-.052	.121

4. DISCUSSION

The objective of CADSAL project was to enhance the dissemination and adoption of NERICA rice growing in Kerio Valley. Community participatory extension approach in the project was meant to increase technology adoption. This was important because it provides an opportunity for one to get primary information and may be able to seek clarification as agreed by findings by Naemi, Karbasioum and Abbasi [9]. The findings of the study agrees with Naemi et al, [9] about how important it is to participate in the ongoing activities of the project especially when it comes to understanding the concepts and accepting to adopt the technology. Adoption of technologies in the agriculture extension is progressive in nature with the initial duration being low to moderate then it progresses to high and very high as time goes by. This is experienced in the research findings whose results indicate moderate rate of adoption of technologies. The results concurs with those established by Lahmar [10].

The study established that farmers are aware of what is right or wrong in an area and enterprise under consideration during the extension process. This is why it is important to always consider enquiring what could be the gap that is needed to be emphasized during the project implementation cycle as asserted by Morris and Bellon [11] and Aref [12]. This was confirmed by the results of the agricultural knowledge test questions and statements that were posed to the respondents. The results of the response were relevant to the conventional general knowledge and information on crop agronomy. There is significant difference on the level of knowledge between those who participated in the CADSAL project and those who did not participate in the same project as illustrated by the results and as illustrated by Morris and Bellon [11] and Naemi et al. [9].

5. CONCLUSION

Based on the objectives of the study, the following conclusion were drawn. Community participatory extension approach increased NERICA rice technology adoption. Community participation provided primary information and clarification hence understanding the concepts and accepting to adopt the technology. The overall adoption level through participation was moderate. There was significant difference on the level of knowledge between those who participated in the CADSAL project and those who did not participate in the same project.

6. RECOMMENDATION

Based on the research finding extension agents need to involve the stakeholders in the process of technology dissemination and adoption so that the level of adoption is enhanced and sustained. Further research could be carried out on the level of rice production in the Elgeyo Marakwet. To increase the rate of adoption and dissemination of technologies, community participation is key and important. Participation increases sense of ownership and confidence in taking up the technology. Participation further remove any fear that the technology could be non-beneficial in any way hence making it easy to adopt and even disseminate to other people within the catchment area. Further research is recommended on influence of participation and knowledge acquisition through community development projects.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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