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Social cultural factors as key determinants of agricultural technology adoption: the case of new rice for Africa (NERICA) adoption in Migori County, Kenya

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Agricultural technologies have been identified as one of the key ways to improve smallholder farmers' food security and livelihoods in Sub-Saharan Africa. However, the adoption of these technologies remains low. Previous studies have focused more on the agronomic and socio-economic aspects influencing agricultural technology adoption. The social and cultural dimensions of adoption have hardly been addressed. The main objective of this study was to establish the influence of social-cultural factors on the adoption of agricultural technologies. The study was carried out in Migori County. Multistage sampling was used by combining purposive and simple random sampling. Data were collected from 262 NERICA rice farmers selected using simple random sample; 22 key informants were purposively selected and interviewed, and eight focus group discussions (FGDs) consisting of 10 to 12 people were conducted from purposively selected NERICA rice-farming villages. Quantitative data were analyzed using SPSS computer software and results were presented in frequencies and percentages. Qualitative data were transcribed and analyzed using thematic analysis. Findings show a statistically significant association between the adoption of NERICA rice technology and social cultural norms associated with agriculture, as indicated by the p-value of 0.001, which is way less than the significance level (α=0.05), hence important in adoption.

Key words: Social, culture, adoption, agricultural technologies, NERICA rice.

INTRODUCTION

NERICA rice was introduced in Migori County in 2009 as an alternative food crop to maize to enhance the community's food security. A study by Kibwage (2007) reported that Migori County was food insecure due to the monoculture of tobacco and sugarcane, which took large acreages of land from the farmers, leaving them with minimal land to use for food production. The cash crops took long to give farmers returns and created food insecurity. NERICA was introduced as an alternative food crop to provide quick returns in terms of food and income hence improving the livelihoods of the communities. The Migori County Integrated Development (MCIDP 2013) reported low uptake of NERICA rice despite the county's efforts to support the rice farmers.

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Many African countries have implemented macro-economic, sectoral, and institutional reforms since the late 1970s. Their main aim was to ensure sustainable economic growth, poverty reduction, food security, and enhanced livelihoods. The Government of Kenya, for example, implemented successful programs and projects including the National Agricultural and Livestock Extension Programmes (NALEP), the National Accelerated Agricultural Input Access Programme (NAAIAP), the Agricultural Sector Programme Support (ASPS), Kenya Agricultural and Productivity Project (KAPP). The government, through Kenya Agricultural Research Institute, developed water and soil conservation technologies, improved seeds, improved storage facilities, and labor-saving technologies. Olwande (2009) observed that a lot of resources had been invested in agricultural enhancement technologies; improving crop varieties, agronomic practices, disease, pest control techniques and natural resource management.

Odame et al. (2013) reported that despite all these developments, there was still low adoption of these technologies in Sub-Saharan Africa (World Bank, 2008). The Bank further reported that an evaluation by Agricultural Research in Eastern and Central Africa (ASARECA) affirmed that the adoption of dairy technologies in East Africa was less than 20%, while that of hybrid maize was between 40 and 70% in Kenya and Tanzania.

For one to understand the low adoption of agricultural technologies there is need to consider the factors that determine a farmer's adoption behavior. Lavison (2013) identified key factors that influenced the adoption of technology, including technological, economic, and institutional. Culture is one of those factors that may have an effect on adoption. Socio-cultural factors may affect the adoption of agricultural technology. The technology may be technically sound and economically acceptable but not socially acceptable in the community due to the existing community norms and social-cultural values. Magnouna et al. (2011) shared a similar opinion that farmers who identify the technology as reliable and well-matched to their environment were likely to adopt it since they perceived it as a productive investment.

Several studies demonstrate that culture influences agricultural technology adoption. Giddens (2006) reported that culture determines the food preferences; how food is prepared and eaten, and the general lifestyle of the people. Some studies have examined the gender differences in agricultural technology adoption in rural households by using the sex of the household head as the gender indicator (Divo et al., 2015; Gaya et al., 2017; Kassa et al., 2013). However, using the gender of the household head as an indicator does not necessarily indicate who makes decisions for adoption and production. This is because some studies report that such decisions are made jointly by men and women, while others are made by women or their sons in the absence of their fathers (Diiro et al., 2018; Lambrecht et al., 2016; Marenya et al., 2015; Murithi et al., 2018). These studies report mixed findings on gender, household decision-making, and technology adoption in rural households.

Agricultural technology may be introduced in a community, and people will interrogate it and consider adopting. According to Bonabana Wabbi (2002) technology is meant to improve a situation to a better state, in this case, improving the yields and productivity of the farmers. It is also meant to increase efficiency and effectiveness in the adoption processes so that the farmer is not overburdened with it. Similar views are affirmed by Loevinsohn et al. (2013) who asserts that new technologies are supposed to be integrated into existing agricultural practices and usually proceeded by a period of trying and some degree of adoption. This implies that a farmer can incorporate a new crop into the existing crops and farming practices. This means that the process of adoption may take long depending on many other factors.

Various studies on technology adoption have been done in Kenya, that show low adoption of agricultural technologies (Ogada, 2014; Makokha et al., 2001; Ouma et al., 2002). These studies focused more on the agronomic practices while others leaned more toward the socio-economic influences, for instance, Mwabu et al. (2006) and Wekesa et al. (2002) examined the social-economic factors that influenced the adoption of agricultural technologies in Kenya. However, social-cultural factors have not been studied to show how they influenced the adoption of agricultural technologies at the community level. The study focused on NERICA rice. The main objective was to establish how social-cultural factors contributed to the adoption of NERICA rice agricultural technology in Migori County. The study has evaluated the complex social cultural factors that come into play in community adoption of agricultural technology. The study is significant to many stakeholders because agricultural technology adoption by smallholders in Sub Saharan Africa has been reported to be very low. This has influenced the research strategy and study design.

MATERIALS AND METHODS

Description of the study area

The study was conducted in the villages of Awendo and Uriri Sub Counties in Migori County. Migori is located in South-Western Kenya bordering Homa-Bay, Kisii, and Narok Counties (Figure 1). The county consists of six administrative Sub-Counties: Uriri, Awendo, Rongo, Kuria, Migori and Nyatike. The inhabitants are Luos, Luyha, Abagusii, Suba-Luos, Somalis, Nubians, Indians and Arabs. The total population of Migori was 1,116,436 persons comprising 553,618 males and 580,214 females (KNBS, 2019).

The study purposively selected Awendo and Uriri Sub-Counties

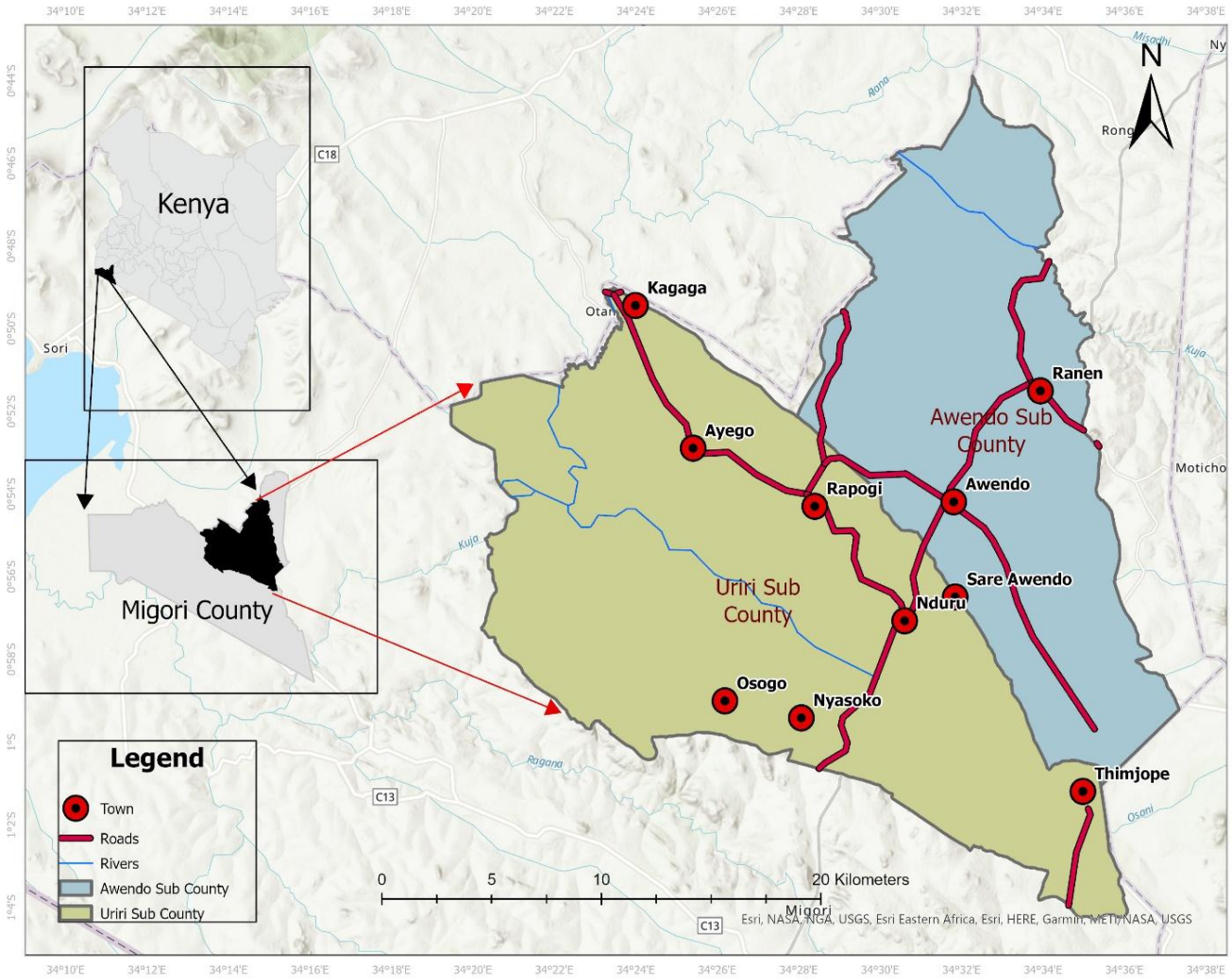

Figure 1. Map of Migori showing Uriri and Awendo Sub Counties (Subsite study areas)
Source: IEBC (2017).

because they were the only ones where NERICA rice was grown; the two were identified to be food insecure because they were dominated by smallholder farmers who overly relied on monoculture of sugarcane and tobacco that paid them poorly after waiting for 24 months (Kibwage, 2007). The major crops grown are vegetables, beans, maize, groundnuts, and coffee on a small scale basis. In livestock farming, farmers in the county keep both free-range and zero-grazed cattle, sheep, goats, and poultry among other animal. Awendo is purely Luo-speaking people, while Uriri has inhabitants from Kuria and Maragoli who have been assimilated into the Luo culture and language over time. The county's altitude ranges between 1140 m above sea level at the shores of Lake Victoria in Nyatike Sub County to 4625 m above sea level in Uriri Sub County. The county experiences two rain seasons in a year; March to May and October to December. The temperatures range between 21 and 35°C. The soils are well-drained and tend to be loamy.

Study design

The study was a mixed-method descriptive research design, encompassing qualitative and quantitative approaches. The study utilized the strengths of both qualitative and quantitative approaches. A household survey, focus group discussions and key informant interviews were conducted. According to Campbell et al. (1999), mixed methods are a powerful way to enhance the validity of results.

Data sources

Primary and secondary data were used in the study. The primary data were collected through focus group discussions (FGDs), key informant interviews (KIIs), and household interviews. An in-depth approach was given to the FGDs and KIIs whereby the respondents freely discussed the cultural issues around food, farming, and NERICA rice farming. A checklist of questions was used to guide and narrow the discussions to relevant issues around the research objectives. Secondary data was collected from relevant documents with pertinent information to the study. Policy documents, including the National Rice Strategy 2012, the Migori County Integrated Development Plan, County Annual Plans, Journal Articles were

reviewed. Data of the household survey were triangulated with the qualitative data from the focus group discussions and key informant interviews. This is in line with Descombe (2010) and Koga et al. (2021) who supported using methodological triangulation to complement or supplement the findings from other methods.

Sampling and sampling procedures

Multistage sampling was used, whereby a combination of purposive and simple random sampling procedures was used. Migori County was purposively selected in the first stage of the sample out of the 47 counties in Kenya based on a study on the national food security status that ranked number 43 out of the 47 counties in terms of national food insecurity status. In the subsequent stage, Awendo and Uriri Sub Counties were purposively selected because they were identified as the most food-insecure owing to their monoculture of sugarcane and tobacco, which had occupied large acreage of their land with minimal returns and little land left for food crops. The two Sub-Counties were the only ones farming NERICA rice, having been identified by the Migori County Government for the rice intervention for food security. Purposive sampling was further used to determine the villages of the rice farmers. Finally, the rice farmers were selected using a simple random sample, creating a sampling frame.

The representative sample size of the household interviews was computed. The sample size was calculated from a finite population at a 95% confidence level and 5% of variability using the Krejcie and Morgan (1970) sampling model given by:

$$n = \frac{X^2 Npq}{d^2(N-1)+X^2 pq}.$$

Where, n = the desired sample size, X^2 = Chi-square value for 1 degree of freedom at 95% confidence level, N = Target population, p = population proportion, q = 1 – p, d = degree of accuracy (margin of error) expressed as a proportion (0.05). Given the target population of 822 NERICA farmers, the sample size was determined to be:

$$\mathrm{n} = \frac{3.481*822*0.5*0.5}{0.05^2(822-1)+3.841*0.5*0.5} = 263 \text{ farmers.}$$

From the above sample, the study distributed it proportionately to the two sub-counties, Uriri and Awendo, whose populations were 226 and 596 farmers, respectively. These samples are given as $\frac{226}{822} * 263 = 72\ farmers\ and\ \frac{596}{822} * 263 = 191\ farmers$, respectively.

Eight villages were purposively sampled for FGDs. The eight villages spread across the two Sub Counties purposively selected for the study. These include Kamuresi, Nyarombo, Nyakuru, Nyambicha, Oyuma, Mori, Pinyowacho, and Thim Jope. Eight focus group discussions were conducted one in each of the purposively sampled villages, constituting 10 to 12 rice farmers. The researcher facilitated the discussions and outlined the goals of the study. A checklist of questions was used to guide the discussions, and field notes were made. Twenty-two key informant interviews were conducted. The key informants who were from the relevant stakeholders in the rice value chain were purposively sampled and interviewed using an interview guide. The key informants included sub-county extension officers, sub-county agricultural officers, the county director for agriculture, and the crops officers in both Awendo and Uriri sub-counties. The experienced and resourceful rice farmers in the community were purposively identified and interviewed as key informants as well. These were the ones regarded by the community as opinion leaders because they represented the community in cultural activities, rites and rituals and other important community matters.

A total of 22 key informant interviews were conducted as follows; one county director for agriculture, one county crops officer, two sub-county agriculture officers, three sub-county extension officers, three village elders, three old and resourceful NERICA rice farmers, two rice researchers from KARLO Kibos and JAICA and one rice promotion officer from the national office ministry of agriculture.

Data collection methods

The primary data was collected using a mixed-method approach. Quantitative data were collected through household survey. The household survey was conducted using a structured questionnaire with open-ended and closed-ended questions. Qualitative data were collected using focus group discussions (FGDs) and key informant interviews (KIIs). A checklist of structured questions corresponding to the study's variables was used to guide the FGDs and KIIs. These were meant to provide in-depth information on the variables of the study. The data analysis methods used were descriptive and inferential statistics and qualitative thematic analysis. The survey data were cleaned, coded, and analyzed using statistical package for social sciences (SPSS) version 23. Descriptive statistics of the main variables of the study were calculated and presented using frequency distribution and percentages and Chi-square test of association were performed to examine the association between variables of the study.

Regarding qualitative data, transcription of field notes from the FGDs and KIIs were analyzed manually for repeated patterns and emerging themes corresponding to the study objectives. Further description of the data around patterns was done to make meaning of the emerging themes and draw appropriate conclusions. The themes were built into the writing process and demonstrated further using vignettes from the corpus of qualitative data, which further reflected the findings' authenticity.

RESULTS AND DISCUSSION

Social cultural norms and farming

The first objective of this study was to investigate if there were cultural norms in the Luo community that affected farming. Results showed that cultural norms affected agriculture in the study area. The findings in Table 1 indicated that 55.1% of the respondents agreed that cultural norms affected farming and agricultural production in the Luo community. In comparison, 44.9% said that such norms were not there. A key informant from Kamuresi in Awendo Sub County remarked:

"Farming is part of our traditions, since times of our ancestors, the elders were to plant first before anyone else, our young people are not allowed to start plowing their land before us parents, if they disobeyed the ancestor would be annoyed and curse them, some would give birth to lame children or misfortunes would befall them."

Regarding food, farming, and food production, cultural elements were evoked in the activities undertaken during plowing, planting, food harvesting and consumption. It was reported from focus group discussions that crop planting was a big occasion for all community members. There was a way in which the culture came in during land

Table 1. Cultural norms and farming.

Response	Frequency	Percent
Yes	118	44.9
No	145	55.1
Total	263	100.0

Source: Authors' computations

Table 2. Effects of socio-cultural norms on NERICA rice farming (Adoption).

Effect on farming/agricultural production	Frequency	Percent
Causes delayed/late planting hence low production	26	22.0
It does not affect in any way	79	66.9
Not sure	13	11.0
Total	**118**	100.0

Source: Authors' computations

Table 3. Adoption of NERICA technology and traditional norms associated with agriculture.

Traditional norms associated with agriculture	Low	Medium	High	Total
Yes	12	29	77	118
No	5	14	116	135
Total	17	43	193	253
Chi-square	14.921			
df	2			
p	0.001			

Source: Authors' computations

preparation and planting. The sons for instance, were not allowed to till their land and plant before their parents' land was tilled and planted. Any young man who went against this norm was cursed *(Chira*) and would face the consequences from the ancestors. These norms prepared the young people to organize their parent's lands for planting before they could return to their land to do the same. In cases where there were two or three wives married in a homestead, the young wives could not plow land and plant crops before the first wife did. Upon inquiry, the respondents reported that if this happened, the one who went against the culture would die or would bring a bad omen to their families. However, some respondents indicated that culture was not very important in farming and did not affect agriculture. On further interrogation on this aspect, it was noted that these respondents had a strong Christian orientation and modern thinking and did not hold cultural issues seriously. Some of these respondents were retired civil servants who had settled back home. They had spent most of their adult life in the cities, they had been assimilated into modern ways of life hence had no strong regard for culture. The responses from the FGDs reaffirmed that the Luo culture encourages people to work hard. Cultural expectations were that a man must own land, work and produce food. This implies that cultural norms had a place in farming, and this ethos governed and guided their farming activities.

The authors inquired further if at all their social-cultural norms affected the farming of NERICA rice. Table 2 shows that of the 55.1% who indicated in Table 1 that there were cultural norms, 66.9% of them explained that these cultural norms did not affect in any way the rice farming, as shown in Table 2 while, 22.0% of those who confirmed that there existed cultural norms around farming and agricultural production, stated that the norms caused delays in planting, 11.0% were not sure of how the cultural norms affected farming and agricultural production.

Table 3 show a statistically significant association between the adoption of NERICA rice technology and traditional norms associated with agriculture, as indicated by the p-value of 0.001, which is way less than the significance level (α=0.05). This suggests that the

Table 4. Social acceptability of NERICA rice as food.

Response	Frequency	Percent
Yes	253	96.2
No	10	3.8
Total	263	100.0

Source: Authors' computations

Table 5. Social acceptability of rice as food and adoption of NERICA rice farming.

Rice is culturally accepted as food	Adoption of NERICA			Total
	Low	Medium	High	
Yes	17	42	184	243
No	0	1	9	10
Total	17	43	193	253
Chi-square	1.256			
df	2			
p	0.534			

Source: Authors' computations

adoption of NERICA rice technology was highly dependent on the available traditional norms associated with agriculture. The more the conventional norms related to agriculture in general, the higher the tendency as to whether to adopt or not adopt NERICA rice farming.

It was revealed in the FGDs that the cultural norms caused a delay in planting the rice. The norms required the young men to organize their parents' lands and plant for them before embarking on preparing their own lands for planting. Given that NERICA rice was a three-month season crop, one had to time the rains and plant on time. However, the respondents reported that in most cases, they planted their rice late resulting in poor harvest. A significant percentage of those who said that the culture did not affect NERICA farming reported that since they did not regard the rice as a traditional crop, they could plant it any time as long as there was rain. This report came from the elderly farmers who understood their culture well and could tell which ones were traditional crops and which ones were not and applied the correct norms.

Social acceptability of rice as food

The study's second objective was to establish the social acceptability of rice as food and its influence on adoption. Table 4 shows that a majority of the farmers, 96.2% indicated that NERICA rice was socially accepted in the community as food, with only 3.8% indicates that the NERICA rice was not accepted as food.

The author investigated further to find out the social acceptability of NERICA and how this influenced the adoption of NERICA rice.

Table 5, rice being culturally accepted as food with a p-value =0.543, which is greater than the significance level (α=0.05), had no statistical association with the adoption of NERICA rice technology. This suggests that the adoption of NERICA rice technology was not dependent on rice being culturally accepted as food. However, rice is widely and culturally accepted as food. Key informant from Thim Jope, Uriri remarked:

"Rice is food like ugali (staple food) because I can eat it anytime and I am satisfied; I eat it in the morning with tea so I don't have to buy bread, at lunchtime I can eat it with beans instead of ugali and even at supper time I can eat with beans and sleep. My children love it too; they are happy when their mother cooks rice. We all love rice. Now we can alternate it with ugali, improving our diet and increasing food in our home.

The rice tastes better and is easy to cook even when we have visitors." Results from the household survey and the focus group discussions concurred that NERICA rice was socially accepted as food in the community. Food is part of the social-cultural items that a community identifies with as part of their lifestyle. When a new food is introduced in a community, the members may take longer to appreciate it depending on their perceptions which may vary. Variations may be informed by interaction with the new food in terms of cooking and eating compared to the existing foods. The perceptions may also be as a result of the social orientation on what food is suitable for people in a particular community. Social exposure may thus affect the extent to which new foods are accepted

Table 6. Usage of rice in households.

Usage	Frequency	Percent
Boiled and eaten with an exotic meal (meat, beans, etc.)	227	86.3
Sold in the Market	5	1.9
Ground into flour for ugali/Uji	4	1.5
Made as *pilau*	3	1.1
Sold to neighbours	2	0.8
All of the above	22	8.4
Total	**263**	100.0

Source: Authors' computations

and eaten in a community, which may further influence the adoption of new agricultural technologies. Culturally, the Luo people ate *ugali* (a paste made from a mixture of finger millet with cassava and maize flour). All family members served the meal with fish, traditional chicken or traditional vegetables (*loti*) at lunchtime and in the evening. Even though this community had their traditional foods, they accepted and incorporated NERICA rice into their conventional food systems and adopted it. Social acceptability of food includes the preparation of the food and its usage. This means that when a new crop is introduced in a community, it does not replace the existing crops but instead, it is integrated with other food crops. This implies that social acceptability is important in adoption of agricultural technologies. If the new crop being adopted is not socially acceptable due to the cultural norms of a community, there is likelihood that the community may not integrate it in the existing food crops.

The study examined how the community prepared NERICA rice and how they used it in their households. Table 6 indicates that 86.3% of the respondents used rice for consumption as food, boiled, and accompanied by exotic foods to make a complete meal. Further, 1.5% said they grounded the rice to make porridge flour, while 1.1% cooked it as *pilau*, a delicacy for many people. Cumulatively, 89.3% of the farmers used rice directly as a source of food for their households.

The results from the study show that a big percentage of the farmers used the rice for household consumption. This means that the rice blended with the culture of the people. Culture of a community dictates how food is prepared and eaten. This finding affirms Giddens (2006) who reported that culture is about peoples' lifestyle, the way they cook their food and the manner in which they eat it. The way in which food is prepared in a community is localized and identical with that particular community. NERICA rice technology got deeper into the culture of the Luo people by being cooked and served on important occasions and festivities such as funerals, wedding ceremonies, and birthday celebrations. In most of these festivities, rice was served on the high table where important guests sat, and this shows how rice created a social class in a rural community. This means that NERICA technology was socially acceptable in the community and it got integrated as food in most households and used in many ways with regard to community cultural rites, values and norms. A key informant from Dede village in Awendo remarked:

"We hold our SDA church camp meetings once a year. During such times, we stay in church the good part of the day to worship and pray, and normally, families carry their food to eat in church to save time. Rice is normally cooked and carried to church by worshippers. My wife is one of those who cook and carry NERICA rice to church during the camp meetings. We eat the rice and this keeps us going the whole day."

This shows that NERICA technology as food went beyond households to the larger community and places of worship. The church leaders further reported that rice was given as a tithe. These findings show that rice penetrated both into the community's cultural rites as well as religious circles, creating cohesion in the community.

Key informant (village elder) from Pinyowacho remarked:

"A certain Politian came to my home after he won a parliamentary seat; he inquired if I had NERICA rice I could sell to him so that he can celebrate his victory as a member of parliament with his community members. I sold him one bag of rice, and he was pleased. I was happy too because I got a lot of money to use for my family's needs."

Politics in the rural community cannot be separated from the culture of the people. The leaders are appointed by the people themselves and their governance follows the social structures within the community. The leaders guide the people by following the cultural norms and laws which exist in the community. The leaders are the ones who bring information of any kind to the people. The politicians are the ones who link the community leaders with the people. The politicians are pathways through which information on adoption of technologies can be achieved. They are the ones who give feedback to the national government and innovators on the status of the

Table 7. Gender distribution in crop choice and size of land portion decision making.

Response	Frequency	Percent
Men	123	46.8
Women	54	20.5
Both	86	32.7
Total	263	100.0

Source: Authors' computations

adoption. By sharing the rice with the politicians, it was a clear way of providing the feedback to the innovators and policy makers on the status of NERICA adoption.

Gender and household decision making and NERICA rice adoption

The third objective was to examine gender and decision-making and its influence on the adoption of NERICA rice. Gender is a critical aspect of agricultural technology adoption. Many studies have been conducted on gender and agricultural technology adoption. The findings are unclear on the role of men and women in the adoption process and household decision-making (bonbana-Wabi, 2002). Similarly, Addison et al. (2018) report that more men can adopt agricultural technologies because they can attend workshops and move around more, hence able to access information on new technologies as compared to women who are around the homes and limited to information access. On the same note, Diiro et al. (2018) assert that women are more flexible and patient; they work on their farms more and can adopt technologies that may require a lot of labor.

Table 7 indicates that in 46.8% of the households, men decide on crop choices and land partitioning for the various crops to be planted. Women make such decisions in 20.5% of the homes, while men and women unite to make the decisions in 32.7%. A discussant from the FGD in Nyarombo said:

"In our culture, men are the heads of the households, and the women are our helpers. We make decisions on important issues for our families while women support our decisions. When it comes to farming, we must guide our women on the type of crops to be planted so that there is adequate food to see us to the next season. This is a responsibility from our ancestors."

Similar findings were revealed in the FGDs. It was established that gender was a significant aspect in adopting NERICA rice technology in the study area. It was reported that when it comes to farming in the Luo community, men and women played different roles and responsibilities. Men or women decided which crop to be planted and the acreage, and both couples could mostly arrive at a consensus. The study also established that according to the Luo culture, the land belonged to the man as the head of the household. In most cases the man decided which parcel of land to be allocated to which crop. The woman was regarded as a custodian hence could not decide but consulted the husband.

Further reporting from the FGDs revealed that in cases where the man died, the woman and her sons could decide how the land could be utilized. This is in line with Deer et al. (2009), who found that there was joint decision-making in male-headed households while men (adult sons) in female-headed households made such decisions.

There were however, exceptions especially with the advent of Christianity and modernity, where households negotiated as couples on almost everything they did, including the management of land and crop production. In such cases, the woman could overrule the husband's decision and plant a specific crop if there was good sense in it. Moreover, it was noted that culture is changing very fast, and some aspects of life are shifting with the changing times. Modern ways of living, for instance, the old retired citizens who had relocated back to the village did not regard certain aspects of culture highly like the traditional rural folks. This category of people left decision making to either the man or woman as long as it was beneficial to the entire household. This showed that education, exposure to other cultures, and being a strong Christian enabled some families to make decisions collectively or allow the woman to make decision regarding farming and adoption of new agricultural technologies. This assertion supports Doss (2015), who reported that decision-making at the household level can be done separately or jointly depending on the individual, household, or other social norms and cultural dictates. This implies that being exposed to modern ways of living and being Christians promotes joint decision making at household level or enables women to make decisions in their households regarding adoption of agricultural technologies. It means that it expands freedom and empowerment to women to make decisions on farming and adoption of technologies as compared to the rural households. Key informant, Nyaobe Village, Sakwa West remarked:

"Some of us sit down and discuss what is best for us as a family and agree on how to use our land. My wife may have a better idea, so I have to listen to her. She also consults me before she plants the crops so we can use our land properly."

Gender and household decision-making affected adoption and farming. Table 8 shows that out of the men who make decisions, as shown in Table 7, 52.0% indicated that it lead to timely planning, while 39.8% indicated that it leads to little acreage given for farming. Of the women, the majority, 88.9%, showed that it results in timely

Table 8. Effects of Household decision making on NERICA adoption and farming.

Decisions	Frequency	Percent
Decisions by men effect on NERICA		
Timely planting	64	52.0
Polygamy makes the man decide	26	21.1
Delayed farming	13	10.6
Little acreage given	49	39.8
Land ownership	22	17.9
Decisions by women effect on NERICA		
Timely planting	48	88.9
Decisions by both men and women effect on NERICA		
Lack of understanding	3	3.5
Better and faster decisions	68	79.1

Source: Authors' computations

Table 9. Men farming rice and adoption of NERICA rice technology.

Men farming rice	Low	Medium	High	Total
Yes	1	7	41	49
No	16	36	152	204
Total	17	43	193	253
Chi-square	2.677			
df	2			
p	0.262			

Source: Authors' computations

Table 10. Women farming rice and adoption of NERICA rice technology.

Women farming rice	Low	Medium	High	Total
Yes	0	4	28	32
No	17	39	164	220
Total	17	43	192	252
Chi-square	3.535			
df	2			
p	0.171			

Source: Authors' computations

planning, while when they both make decisions, 79.1% indicated that they make better and faster decisions regarding farming.

Gender, household decision-making and adoption

Table 9 shows no statistically significant association between adoption of NERICA rice technology and men farming rice, as indicated by the p value of 0.262, which is greater than the significance level (α=0.05). This implies that adoption of NERICA rice technology is not dependent on whether men farm rice or not. Men farming rice does not affect NERICA rice technology adoption.

Table 10 shows no statistically significant association between adoption of NERICA rice technology and women farming rice as shown by the p value of 0.171 which is greater than the significance level (α=0.05). This indicates that the adoption of NERICA rice technology is independent of women farming rice. Women planting rice does not affect the adoption of NERICA rice technology.

This finding is contradictory to Asfaw and Admassie (2004) who reported that social cultural norms may be in favors of men to participate in different extension programmes more than their female counterparts and this may enable men a greater access to information about new agricultural technologies more than women.

Table 11 indicates a statistically significant association between NERICA rice technology adoption and women and men farming rice as shown by the p-value of 0.004, which is less than the significance level (α=0.05). This implies that the adoption of NERICA rice technology is highly dependent on both women and men farming rice. The more involvement of both men and women in planting rice, the higher the tendency to adopt NERICA rice technology.

Table 12 indicate that the adoption of NERICA rice farming has a statistically significant association with either man or a woman being involved in agriculture, as shown by the p-value of 0.031, which is less than the significance level (α=0.05). This implies that NERICA rice technology adoption depends on either men or women being involved. However, man involvement is high, as shown in the table. A discussant from the FGD at Pinyo

Table 11. Both men and women farming rice and adoption of NERICA rice technology.

Both man and woman	Low	Medium	High	Total
Yes	16	32	113	161
No	1	11	80	92
Total	17	43	193	253
Chi-square	11.144			
df	2			
p	0.004			

Source: Authors' computations

Table 12. Either man or woman in adoption of NERICA rice technology.

Both man and woman	Low	Medium	High	Total
Man	11	22	81	114
Woman	2	6	52	60
Both	4	15	60	79
Total	17	43	193	253
Chi-square	13.889			
df	4			
p	0.031			

Source: Authors' computations

wacho in Uriri Sub County remarked:

"We prefer to come together as partners of the household and discuss the best way to carry out our farming. Sometimes our husbands may not think properly, or they may take a lot of alcohol and are careless with issues of the farm. If we discuss and arrive at a consensus, we can make excellent decisions on time."

A similar opinion was revealed in the FGD session that in most households, both husband and wife would prefer to discuss how to go about their farming activities, considering which crop will sustain the family better till the following season. Deliberations and negotiations take place to arrive at a cons0ensus, way before the planting season starts, giving way to timely decision-making in readiness for planting. This implies that even though the culture was highly regarded, there were times that culture was not followed strictly, especially if it was not a traditional crop and there was a need to save a livelihood. Majority of the households would break the norm to safeguard their livelihoods. It further showed that even when a new crop was introduced in the community, it did not affect how decisions were made in households; instead, the new crop was assimilated into the existing crops and treated as part of the system. A widow discussant from the FGD in Nyambija in Awendo Sub County said:

"*My husband was one of the first farmers to plant NERICA rice in 2009. He used to decide how much land to plant the rice and other crops. However, he fell sick and died in 2011. Since then, I have been making decisions alone as a woman on how to use the land and which crops to plant."*

When the women decided on their own, they planted the rice on time because it shortened the negotiation process at the household level, hence they were able to manage the rice crop better. This implies that women primarily farmed in the community even though the men made the decisions. A discussant who was polygamous from Uyomo in Uriri said:

"I have three wives. To ensure that each of my wives contribute to the family food basket, I allocated two acres of land to each one of them. I then remained with slightly less than an acre for myself. I gave them the freedom to decide how to use the land as long as they don't beg or borrow food from my neighbours."

A lady from a polygamous marriage in Nyarombo, Awendo remarked:

"We are three women married to Mzee Okelo; here in Nyarombo, we have been married for fifteen years. Our husband built a house for each one of us and gave us three acres of land and one cow each to milk. He told us to be in charge of our farming and food. He does not come to tell us what to do with the land; he trusts that each of us can make a wise decision. We have never slept hungry with our children and never asked for food from him. He is a wise man."

Polygamous homes had a different approach to gender and decision-making in farming. It was reported from the FGDs that polygamy affected decision making in rice farming and farming in general. The man could allocate each woman certain acreage of land and then give them the power to decide how to manage their farming. In such a case, each woman would then decide how much land to farm the rice and how much to cultivate other crops. This approach worked well because the hard-working ones would plant on time while the lazy ones slowed their farming. This way of doing things was meant to avoid conflicts and make the lazy wives not rely on the hard-working ones. The men indicated that this arrangement gave the women the power to manage the aspect of food security instead of waiting for their husbands to provide food.

Women in polygamous marriages reported that they were happy with such decisions because they were given the freedom to manage their household affairs and were able to plant rice on time. This implies that in polygamous households' things is handled differently but still adoption

of agricultural technologies will take place. It also shows that in most polygamous households more women are able to make decisions on farming and adoption. An older man from Nyakuru in Awendo, remarked:

"*Women can sit in the garden for many hours throwing stones to scare the birds away from the rice, but if you employed us men to scare the birds, we will not sit there for long; we will get bored and go away and later ask to be paid. Women easily form groups to plant rice, and they help each other to weed in groups as they sing; we men cannot do that. We feel it is a waste of time".*

Further findings showed that even though in most of the households, men made decisions regarding farming and rice farming in particular, women were more involved in planting and weeding the rice and they provided the required labor in the entire rice value chain. They embraced new ideas more than men, were more flexible in group formation and networked faster than men. Women were equally good at storing the seeds for the next season.

This implies that when examining the gender and agricultural technology adoption it can be safely said that both men and women are significant in agricultural technology adoption, and each gender has a role in the rice farming process. It also shows that women are important in agricultural technology adoption, and regardless of the social and cultural barriers, they could influence the adoption of technologies to move faster.

Conclusion

This study addressed three objectives: The social cultural norms and how they influenced NERICA farming, social acceptability of rice as food and how it influenced adoption of NERICA rice and finally examined gender and household decision making and how it influenced NERICA adoption. The study concluded that all the objectives had an influence on adoption of NERICA rice technology. The unique aspects of culture shaped the community behavior and perception towards adopting a new agricultural technology and integrating it with the existing food crops. The study addressed the gap on culture and adoption of agricultural technologies and expanded the knowledge and insights on the significance of social-cultural factors in agricultural technology adoption. The study findings will inform policy-level decision-making on similar future agricultural adoption interventions. The study paves the way for more similar studies in rural communities since culture is unique and cannot be replicated elsewhere.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest regarding this research paper.

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