

Social Factors Influencing Adoption of Grain Amaranth/Maize Intercrop among Small Holder Farmers in Kiminini, Kenya

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Abstract

Food insecurity is a real challenge to most populations in Sub Saharan Africa. Agriculture has been the single most important sector; however, most farmlands under cultivation have reduced significantly due to global population pressure on land. Declining yields per unit area has also been on the increase, hence creating food deficits in most countries. Trans-Nzoia County of Western Kenya, despite being the bread basket of Kenya has experienced a decline in production in most parts of the county with Kiminini sub-county on the lead. Grain Amaranth/Maize intercrop is one of the most efficient ways of optimizing on land use and availing good nutritional crop mix for the vulnerable households. This study therefore sought to determine the social factors influencing adoption of Grain Amaranth/Maize intercrop among smallholder farmers in Kiminini sub-county, Kenya. Cross sectional survey research design was used through structured questionnaire among 100 smallholder farmers from 5 wards of Kiminini Sub County. Data collected was subjected to descriptive statistical analysis and the binary logistic regression model. The findings indicated that the levels of amaranth cultivation by respondents were (79%). Those aware of amaranth/maize intercrop were (90%), however, only (53%) of the farmers practice the intercrop system. (41%) agreed that amaranth/maize intercrop provides nutritional value while (44%) of them agreed that the system increases yields. Respondents further reported that the intercrop system plays other roles like medicinal (60%), commercial (29%), animal feeds (10%) and manure (1%). Results further indicated that (45%) of the respondents accessed information on the intercrop via radio while only (1%) through newspaper. Results further showed that gender ($p < 0.05$) and level of education ($p < 0.01$) had a positive significant effect on adoption of Grain amaranth/maize intercrop. The study therefore, concluded that besides factoring in gender when promoting agricultural technology, the study recommends the need for capacity building in agriculture on Grain Amaranth/Maize intercropping among the farming community. This will enhance the ability of the farmers who have attained formal education to understand and interpret the benefits associated with adoption of new agricultural innovations.

Keywords: Grain Amaranth, Maize Intercrop, Small Holder Farmers

INTRODUCTION

Food insecurity is a real challenge to most populations globally. For several years, agriculture has been the single most important sector, providing livelihood for at least 53% of the economically active population. In particular, about 84% of economically active are small holder farmers (SHF) engaged by the agricultural sector (FAO Statistics, 2000). For

years, most farmlands under cultivation or arable land have reduced significantly due to global population pressure on land. Africa, for example, has seen an increase in its populations hence creating a big demand for food. These parcels of land have continued to reduce to a level that significant agricultural practice is to the bare minimum. Declining yields per unit area has also been on the increase, hence creating food deficits in most countries. According to Scribner (2017), around 3.4 Million Kenyans are severely food insecure, while 309,000 have been internally displaced due to food insecurity and drought. The 2007 Economic Review of Agriculture indicates that 51% of the Kenyan population lack access to adequate food.

Trans-Nzoia County is the bread basket of Kenya where more than 50% of maize, the Kenyan staple food is grown, has seen a decline in production in most parts of the county, with Kiminini sub-county on the leading. Poverty index is high with about 60% (County profiles, 2013) therefore there is an increase demand for cheaper and yet nutritious food. The sub-county has also a high HIV prevalence rate of 5.2% (Trans-Nzoia County integrated development plan, 2013-2017). To meet the increasing demand of food for people, several ways to increase production must be adopted. Grain Amaranth, a pseudo-cereal, has unique agricultural properties because of its high yielding, fast growing and is resistant to drought characteristics compared to other cereals. It has also been reported to provide vital nutrients for HIV/AIDS patients (Muyonga *et al.*, 2014). Grain amaranth with its potential to substitute other staple food crops such as maize and beans needs to be promoted for adoption among these small holder resource poor farmers. Grain amaranth intercropped with maize crop is likely to be a more viable way of securing the county in terms of food security as it is a way of optimizing on land use. Awareness on adoption of the production of a highly nutritious and yielding grain amaranth with maize has been done for several years, yet adoption of this system has not been totally maximized at the community level as well as the house hold level, (Mwangi, 2014). The consumption and utilization of grain amaranth in western Kenya is generally low. Intercropping maize with amaranth would increase crop yield and land use efficiency (Alemayehu and Bendevis, 2015). Intercropping grain amaranth with maize could enhance adoption of the crop and increase its production.

Statement of the Problem

Alternative cropping systems such as grain amaranth/maize intercrop has not been fully practiced to efficiently optimize on the limited parcels of land. Despite the fact that efforts have been made to create awareness on alternative cropping system to enhance production, Trans-Nzoia County continues to suffer from serious food shortages (County Profiles, 2013). This can be attributed to increased population in the Sub-county, standing at 166,635 (KNBS, 2009), putting a lot of pressure on the already declining parcels of land. Mono-cropping is a common practice, with maize as the commonly grown crop. HIV prevalence is high in the sub-county, accounting for 5.2%, higher than the national prevalence rate. Studies have shown that HIV/AIDS has significant impact on the lives of small holder farmers in terms of labor provision. Grain amaranth in a maize cropping system would provide an avenue for increased production, increased nutritional dense foods. According to Ndungu *et al.* (2014), grain amaranth dietary intake contributes significantly to the nutritional status of people living with HIV/AIDS. Intercropping not only stabilizes crop production by reducing the impact of weather vagaries, but also increases cropping intensity considerably (Ahlwatet *et al.*, 2005). Little research has been done on the potential adoption of grain amaranth in East African farming systems, hence the need to bridge this gap. Therefore incorporating the production of highly nutritious and yielding grain amaranth in

the predominantly maize farming system as a supplementary food in Kiminini sub-county may help alleviate food insecurity situation in the area of study. Empirical evidence regarding the factors influencing the adoption of grain amaranth/maize intercrop among small holder farmers in Kiminini Sub County is not clear and therefore this study sought to establish the factors for the low adoption of the technology. The objectives of the study was to determine the effect of social factors such as age, gender, marital status and educational level, health status (HIV/AIDS status) on adoption of grain amaranth/maize intercrop among smallholder farmers in Kiminini Sub-County.

MATERIALS AND METHODS

The Study Area

Trans-Nzoia County is a county in the former Rift Valley Province, Kenya, located between the Nzoia River and Mount Elgon 380 km Northwest of Nairobi. At its centre is the town of Kitale which is the capital and largest town. The county borders Bungoma to the west, Uasin Gishu and Kakamega to the south, Elgeyo Marakwet to the east, West Pokot to the north and the republic of Uganda to the Northwest. Trans Nzoia covers an area of 2495.5 square kilometers, with a population of 900,000 (County Profiles, 2013 and KNBS, 2009).

The Study Design

The study employed a Cross sectional research design to determine the social factors influencing adoption of grain amaranth/maize intercropping. The collection of data was aided by use of structured questionnaires. The study employed simple random sampling (SRS) technique to select 100 small holder farmers from the sub-county. The choice of the respondents who are the smallholder farmers from each of the five wards was proportionately chosen from each of the five wards as follows;

Table 1: Wards and Populations

Wards	Total population	Sampled population
Sikhenyu	36,659	22
Kiminini	34,993	21
Nabiswa	38,326	23
Waitaluk	36,659	22
Hospital	19,996	12

Source: KNBS, 2009

Kiminini was purposively chosen due to its increasing high population, the sub-county has a high poverty index of about 60%, HIV/AIDS prevalence is high as compared to other sub-counties in the entire county with 5.2% prevalence, and secondly, Key informants such as extension officers, caregivers, and community health volunteers (CHVs) were also used to identify affected households.

Sample Size Determination

The required Sample size was determined by the use of proportionate to size sampling methodology as specified by Kothari (2004) as follows for a finite population;

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2(N-1) + z^2 \cdot p \cdot q} \dots \dots \dots (1)$$

Where:

N = the population size,

n = sample size,

p = the sample proportion (q = 1-p),

Z= the standard variation at a given significance level () and

e= acceptable error (precision). 21

Using $p=0.5$ as the proportion of farmers who adopted amaranth („n“ will be the most conservative sample and will give the desired precision).

$Z=1.96$,

$p=0.5$ and an acceptable error of 10% (e).

q= the weighting variable and is computed as $1-P$.

The sample was determined as

$n = (1.96^2 \times 0.5 \times 0.5 \times 166,635) / (0.1^2 \times 166,634) + (1.96^2 \times 0.5^2) = 96$.

This sample size was however adjusted to 100. The sample size is justified on the basis that although too large samples would require a lot of financial and human resources, they are more reliable as compared to smaller samples. A too small sample diminishes the utility of the results, according to (Bartlett *et al.*, 2001).

Data Analysis

The data from the field was organized, coded and entered into Statistical Package for Social Sciences (SPSS) version 20.0 for windows. Data was analyzed by use of both qualitative and quantitative techniques. Quantitative data was analyzed by use of descriptive statistics presented in frequency tables and measures of central tendency. In inferential statistics, the researcher employed binary logistic regression model and correlation analyses were used to test levels of significance and strength of the relationship among various variables of the study and tabulated to enable the researcher to employ both descriptive statistics and inferential statistics. The Logit model is used to model dichotomous outcome variables, the log odds of the outcome are modeled as a linear combination of the predictor variables. The model tends to have higher parameters of 1.6 to 1.8 than in probit model (Rejulton, 2011). It is from this that a comprehensive conclusion was drawn on the factors influencing adoption of grain amaranth/maize intercrop in Kiminini Sub-County, Trans-Nzoia County, Kenya. Qualitative data from in-depth interviews was also analyzed and presented according to the study objectives.

Analytical Model

The study employed a binary logistic regression model to explain the factors that influence adoption of grain amaranth/maize intercrop among smallholder farmers in Kiminini Sub County.

The generalized model is as follows;

$$Y = \alpha + \beta_i X_i + \varepsilon_i \dots\dots\dots (1)$$

Where;

Y = dependant variable

α = Constant

β_i = Coefficient of independent variable X_i

X_i = independent variable

ε_i = Random error term

($i = 1, 2, 3 \dots n$)

The dependent variable was adoption or non-adoption of grain amaranth/maize intercrop. The independent variables considered to influence adoption of grain amaranth/maize intercrop are as follows:

The binary logistic regression model

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i \dots\dots\dots (2)$$

Where,

Y= if a farmer has adopted grain amaranth/maize intercrop or otherwise.

α = Constant

β_1 =Coefficient of independent variable X_i

X_1 =Education level

X_2 Age of the farmer measured in years

X_3 Gender of farmer (1 if is a male 1,female 2, otherwise measured as dummy variable)

X_4 Marital status

X_5 Health status

ϵ_i Random error term

RESULTS

Demographic Information

Gender, age, marital status, education level and household head formed the demographic information of the present study.

Gender

Results on gender of the respondents showed that the percentage of females (69%) was greater than of the males (31%).

Age

Majority (55%) of the respondents were aged 36-50 years, (35%) of the respondents were above 50 years while a paltry 10% were aged 19-35 years.

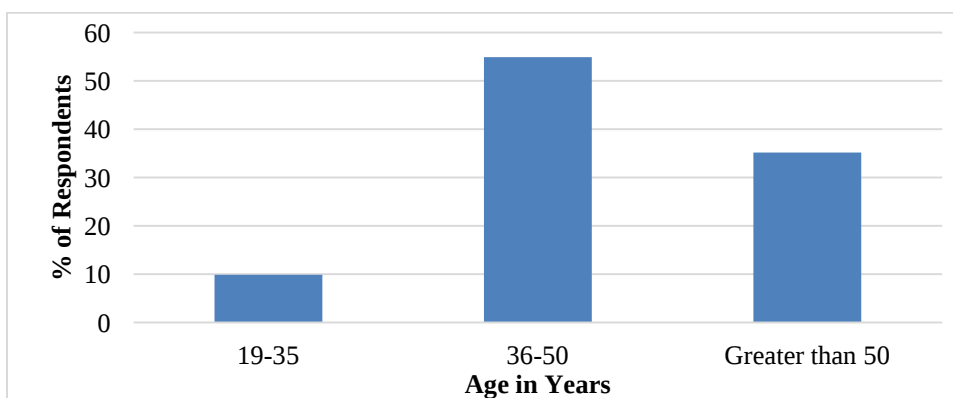


Figure 1: Age of the respondents

Marital status

As shown in Figure 4, majority of the respondents, (77%) are married (15%) are widowed (6%) are single while only (2%) of the respondents have been married but are single due to separation/divorce.

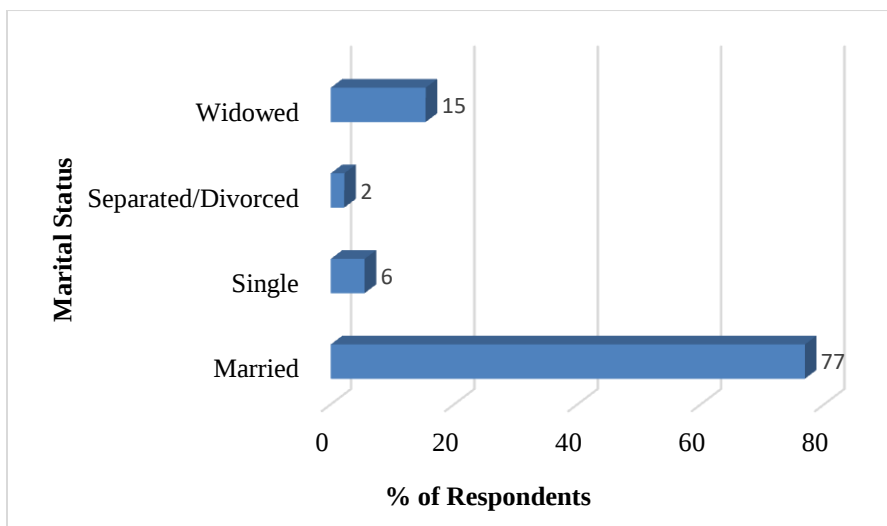


Figure 2: Marital status of Respondents

Level of Education

A good number of the respondents (45%) have tertiary level of education (30%) and (22%) have secondary and primary level of education respectively. Approximately (2%) of the respondents do not have formal education while only (1%) has university level of education (Figure 5).

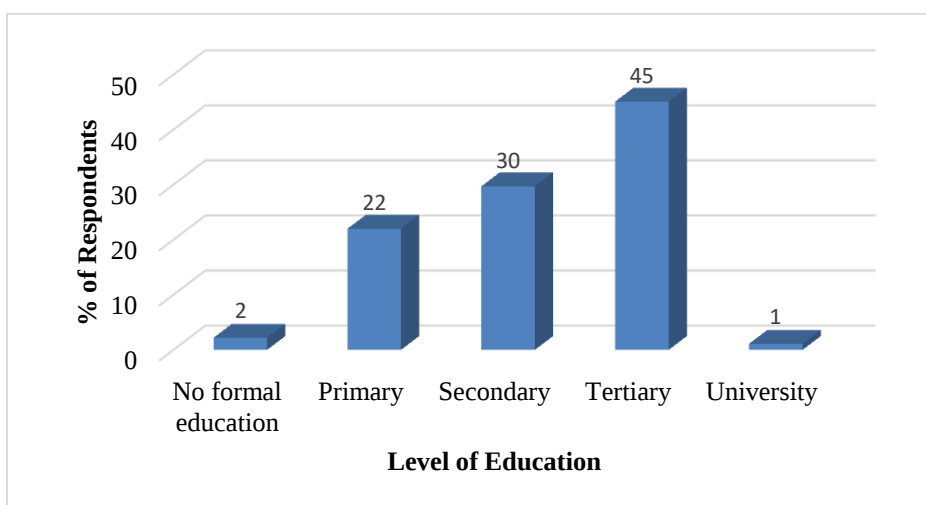


Figure 3: Level of Education of Respondents

Decision making process

The study also revealed that the major decision makers on adoption were the male spouses accounting for (55%) followed by female spouses (44%) and others accounting for 1%.

Table 2: Households head of Respondents

Household decision maker	Frequency	Percentage (%)
Husband	55	55
Wife	44	44
Others	1	1

Levels of Amaranth/Maize intercrop Adoption

Results on the levels of amaranth cultivation and amaranth/maize intercrop were summarized in Table1. Majority of the respondents (79%) plant amaranth while, (21%) of them do not. In addition, a good number of the farmers (90%) in the study area are aware of amaranth/maize intercrop, however, only (53%) of the farmers practice the intercrop system. On the benefits of amaranth/maize intercrop, (41%) of the respondents strongly agreed that the system provides nutritional value while (44%) of them agreed that the system increases yields. Respondents further reported that the intercrop system plays other roles like medicinal (60%), commercial (29%), animal feeds (10%) and manure (1%).Results further indicated that (45%) of the respondents accessed information on the intercrop via radio while only (1%) through newspaper.

Table 3: Level of Amaranth/Maize intercrops Adoption

Characteristic	Value% pe% rppe% =100
Planting Amaranth	79
Aware of amaranth/maize intercrop	90
Practice Amaranth/Maize intercrop	53
Amaranth/maize intercrop provides nutritional value	42
Amaranth/maize intercrop increases yields	44
Other uses of amaranth/maize intercrop	60
i. Medicinal	
Source of information on the intercrop	45
ii. Radio	

Effect of Social Factors on Adoption of Amaranth/Maize intercrops systems

Binary Logistic regression results on the effect of social factors on adoption of Amaranth/Maize intercrop system are presented in Table 2. Generally, the effect of social factors considered in the present study was reported to be positive but insignificant ($r=0.103$; $p=0.244$). Findings on individual social factors on the adoption of Amaranth/Maize intercrop are summarized in Table 2. Notably, the farmers' educational levels and gender had positive and significant influence ($p<0.05$) on the adoption of Amaranth/Maize intercrop system ($r=0.987$ and 0.046) respectively.

Table 4: Influence of Social factors on adoption of amaranth/maize intercrop

Variable	Regression	Partial	P-Value
	coefficient(b)	Correlations(r)	
Gender	1.128	0.790	0.046*
Age	1.190	0.187	0.072(NS)
Marital Status	1.290	0.017	0.251(NS)
Education level	1.880	0.987	0.001**
Household head	1.274	0.146	0.527(NS)
Health Related Challenges	1.108	0.088	0.564(NS)
Overall	1.312	0.103	0.244(NS)

Constant/predictor variable: Social Characteristics of Farmers; Dependent Variable: Adoption of Amaranth/Maize intercropping
n= 100; NS-not significant; ** -significant at the 0.01 level (2-tailed); * - significant at the 0.05 level (2-tailed)

DISCUSSION

Effect of Social Factors on Adoption of Amaranth/Maize Intercrop

Results obtained from the present study reported positive significant effect of gender on adoption of amaranth/maize intercrop. This finding could be attributed to the fact that females are expected to adopt the technologies since they provide most of the farm labour for food production. The adoption process requires a lot of labour thus; high adoption rate is expected from females. In addition, more males tend to have off-farm employment as they are perceived to be more educated than females and therefore do farming as part time activity. On the other hand, cultural system requires women to remain at home while husbands attend seminars, and yet do not always teach the women what they have learnt in the extension meetings (Morris, 1991). Women also do not have accessibility to the key productive resources of land, labour and capital, as well as being under privileged in education and knowledge (Mazvimaviet *et al.*, 2009). The present findings are in agreement with those reported by Kamumu (1998), where gender was reported to be a significant factor in the adoption of agricultural technologies. This contradicts with Ndiema *et al.*, (2002), who found no significant relationship between adoption of improved seed varieties and gender of the farmers. Also, Doss and Morris (2001) found insignificant influence of gender on adoption in their study on factors influencing improved intercropping technology adoption in Ghana.

Results further reported that respondents' education level affected adoption of amaranth/maize intercrop significantly ($r=0.001$; $p=0.987$), with most farmers having post-secondary education level. This could be due to the fact that education increases a person's awareness of his environment and his ability to acquire and process information about his environment and to detect changes in it. Increasing literacy helps farmers to acquire and understand information and to calculate appropriate input quantities in a modernizing or rapidly changing environment. It also enhances farmers' ability to identify alternatives and compare benefits and costs associated with each of the alternatives possibly under different state of nature (Schultz, 1981). Educated farmers easily acquire and comprehend new information hence, are more rigorous to demand and utilize new presumably superior agricultural technologies. In this study, education level of the farmer was expected to have a positive influence on probability of adoption of any agricultural technology. The present results concur with Norman (2005) who reported a positive significant influence of

education on farming practices including intercropping systems. The results further correlate with Gem (2004) survey findings, that education plays a pivotal role in the survival of the organization and therefore employees should be exposed to various educational programmes to enable them to acquire knowledge in their respective endeavors. The finding is further consistent with Langyintuo and Makuria, (2005) who asserted that educated farmers are better able to process information and search for appropriate technologies in the quest to alleviate their production challenges. This goes a long way in enhancing adoption of any agricultural technologies. For instance a study by Okunlola *et al.* (2011) on adoption of new technologies by fish farmers and Ajewole (2010) on adoption of organic fertilizers found that the level of education had a positive and significant influence on adoption of the technology. This is because higher education influences respondents' attitudes and thoughts making them more open, rational and able to analyze the benefits of the new technology (Akudugu *et al.* (2012). On the other hand, this finding contradicts with some authors who have reported insignificant or negative effect of education on the rate of technology adoption (Grieshop *et al.*, 1988; Khanna, 2001; Banerjee *et al.*, 2008; Samiee *et al.*, 2009; Ishak and Afrizon, 2011).

Studying the effect of education on technology adoption, Uematsu and Mishra (2010) reported a negative influence of formal education towards adopting genetically modified crops. Age is a critical factor in adoption of any technology. In this study the age bracket of between 36-50 accounting for 55% is mostly referred to as youthful were the majority. Younger farmers are typically less risk-averse and are more willing to try new technologies. For instance, Alexander and Van Mellor (2005) found that adoption of genetically modified maize increased with age for younger farmers as they gain experience and increase their stock of human capital but declines with age for those farmers closer to retirement.

CONCLUSION AND RECOMMENDATIONS

Results showed that gender and farmers' education level had positive significant association on the adoption of amaranth/maize intercropping. However, age, marital status and household head reported positive insignificant effect on adoption of the intercropping system, concluding that specific social factors influence adoption of amaranth/maize intercropping in the study area.

The study therefore recommends the need for capacity building in agriculture on Grain Amaranth/Maize intercropping among the farming community.

Suggestions for Further Research

Significant research gaps remain in this area of study which will need to be filled in order to increase the effectiveness of adopting amaranth/maize intercrop in Kiminini sub-county. These areas are:

Research should be done on other factors that affect adoption of technology in other sub-counties within the County and beyond.

Influence of the moderating variables like resource adequacy, Government policies and community cooperation on the adoption of amaranth/maize intercropping.

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