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Adoption of Drought Tolerant Sorghum in Western Kenya

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Abstract

Food and nutritional insecurity are responsible for poverty and low livelihoods of about 33% of people living in western part of Kenya. This is against MDG1. The production of sorghum which is a staple food crop is below 0.5 t/ha, against the potential of 3-4 t/ha. Drought is a major factor responsible for the low and declining yields of sorghum, especially in the smallholder farms where agricultural inputs including improved cultivars are not normally utilized. Drought tolerant sorghum variety has been developed and deployed to western Kenya and its uptake remains low. The study aimed at assessing factors influencing adoption of drought tolerant sorghum variety. The research was carried out in various sites in Nyanza and Western Provinces. Data was collected using structured questionnaires. Systematic random sampling was employed in selected sites to identify 100 small scale sorghum farmers. The results showed that about 88 percent of farmers used uncertified sorghum seed. About 41 percent of farmers were aware of drought tolerant sorghum. Despite the significant level of awareness, only 7 percent had adopted drought tolerant sorghum. The probit model identified age, gender, social capital, sorghum farm size, income, extension, and total land holding as significant factors affecting adoption of drought tolerant sorghum. It is recommended that technology disseminators in sorghum should target the older farmers; farmers to operate in groups to access technology, farmers to increase the land size allocated to sorghum, and extension agents should strengthen their role as the link between research and the farmer.

Introduction

Food and nutritional insecurity are responsible for poverty and low livelihoods of about 33% of the more than 15 million people living in the western part of the country comprising the former Nyanza, Western and parts of Rift Valley Provinces. This is against the millennium development goals of which Kenya is a signatory. The production of maize and sorghum, which are the staple food crops is commonly below 0.5 t/ha, against the potential of 3-4 t/ha. Drought, low soil fertility, soil acidity, pests and diseases are the main factors responsible for the low and declining yields of sorghum, especially in the smallholder farms where agricultural inputs including improved cultivars are not normally utilized. Using new sorghum based technologies could lead to improved food security and livelihoods. Delivering "development" to the vulnerable communities of western Kenya via sorghum technologies is very important because the crop is generally produced by small-scale, resource-limited farmers. Sorghum grains could guarantee carbohydrates, whilst the protein comes from pulses commonly grown by the small scale farmers in this region. Most sorghum produced in the region is consumed locally, and only minimal quantities get into the markets. The use of sorghum as feed, bio-energy and industrial brewing should provide opportunity for improved and diversified incomes (EABL, 2010; Pari, et al., 2008; Scurrah-Ehrhart, 2006). Sorghum has potential to contribute to attainment of MDG1 and the vision 2030 goals on enhancing food security (CPHP, 2002).

Problem Statement

Sorghum is mainly produced by smallholder farmers in western Kenya who use low input levels and have limited access to new technologies. Consequently, sorghum yields are declining and are normally less than 1.0 t/ha, (FAOSTAT, 2006). It is predicted that in the marginal areas of Eastern Africa including the dry land areas of western Kenya, global climate change will cause more food deficit, increasing vulnerability of the populations. For example, it is estimated that the grain yield of sorghum will decline by about 17 % owing to climate change (Lobell *et al*., 2008). If not checked, drought and other environmental stresses prevalent in western Kenya may prevent the country from realizing the vision 2030 and (MDG) No. 1. Drought tolerant sorghum variety has been developed and deployed to western Kenya yet the uptake of this technology still remains low. This study sought to establish constraints to adoption of drought tolerant sorghum variety, and to give recommendations for increased uptake of the technology given that it guarantees output even during dry spells.

Objectives

a) Characterization of the level of awareness and adoption of sorghum variety adapted to drought in western Kenya.

b) Assessment of socio economic factors influencing adoption of sorghum variety adapted to drought in western Kenya.

c) Provide policy recommendations for enhanced awareness, access and adoption of technologies in sorghum in dry land areas of western Kenya.

Hypothesis

Socio economic factors do not affect adoption of sorghum cultivars adapted drought in western Kenya.

Study Area

The study was carried in various sites in both Nyanza and Western Provinces. The sites included; Karungu and Ukwala (Nyanza), Nangina, Koyonzo and Angurai (Western).

Materials and Methods

Data Collection, Types and Sources

Data collection was done using structured questionnaires. Types of data included general demographics of the respondents such as age, gender, and education level. Data on technology awareness and use in sorghum was also collected.

Sample Size and Procedures

The target population was sorghum farmers in the five sites. A sample of 100 smallholder sorghum farmers was purposively selected from each of the five sites. In each site, 20 farmers were systematically selected.

The Probit Model

In order to explain the behaviour of a dichotomous dependent variable a suitably chosen Cumulative Distribution Function (CDF) is used. The logit model uses the cumulative logistic function. But this is not the only CDF that one can use. In some applications, the normal CDF has been found useful. The estimating model that emerges from the normal CDF is known as the Probit Model or Normit Model. (Vasisht, 1999)

The Probit model has the expression:

Probit (π(x)) = $\phi^{-1}(\pi(x)) = \alpha + \beta x;$ (i)

Where $\phi^{-1}(.)$ is the inverse standard normal cumulative distribution.

It is assumed that there is a latent variable Y * which is generated from a familiar looking model:

Y* = β'x + e…….. (ii)

Where β is a K-vector of parameters, x is a vector of explanatory variables and e ~ N (0; 1) is a random shock. We observe y = 1 if y* > 0 and y = 0 otherwise.

The model was specified as follows;

Y* = Farmer's adoption of drought tolerant sorghum cultivar (1 = Adopted, 0 = Not adopted)

X_1 = Total farm size owned by the household (acres)

X_2 = Farm size allocated to sorghum (acres)

X_3 = Income of household head (Kenya shillings)

X_4 = Extension advice (received advice = 1, did not receive advice = 0)

X_5 = Occupation of household head (farming = 1, business = 2, formal employment = 3)

X_6 = Membership to sorghum producer group (member = 1, not a member = 0)

X_7 = Education of household head (pre primary = 1, primary = 2, secondary = 3, post secondary = 4)

X_8 = Gender of household head (male = 1, female = 0)

X_9 = Age of household head (Number of years household head has lived)

Data Analysis

The data was analyzed using the statistical package for social sciences (SPSS) 17.0.

Results and Discussions

General Descriptive Information

Table 1: Gender distribution

Gender of household head	Name of Division					Total
	Koyonzo	Angurai	Nangina	Ukwala	Karungu	
Female	7	6	9	12	9	43
Male	13	14	11	8	11	57
Total	20	20	20	20	20	100

Source: researcher's own compilations, 2011.

About 43% of the sampled households were female headed and 57% were male headed. This scenario gives the indication that men dominate household farming decisions in western Kenya.

Table 2: Education level of respondents

Highest level of education	Name of Division					Total
	Koyonzo	Angurai	Nangina	Ukwala	Karungu	
No Education	4	2	1	4	1	12
Pre Primary Education	4	1	2	4	4	15
Primary Education	12	7	15	7	7	48
Secondary Education	0	9	2	3	6	20
Post Secondary Education	0	1	0	2	2	5
Total	20	20	20	20	20	100

Source: researcher's own compilations, 2011

Cumulatively, about 75% of the respondents had not gone beyond the primary level education; indicative of the fact that they may not be front runners in adoption of technologies since their education may be limiting their access to information and willingness to try out new innovations.

Table 3: Land sizes

Land size	Minimum	Maximum	Mean	Std. Deviation
Total farm size	.50	20.00	3.95	3.43
Farm size under maize	.25	6.00	1.35	.968
Farm size under sorghum	.25	4.50	.510	.686

Source: researcher's own compilations, 2011.

The average land holding in all the five sites was 3.946 acres, with a minimum holding of 0.50 acres and a maximum of 20 acres. Farmers allocated 0.25 to 4.50 acres of land on sorghum growing.

Table 4: Extension advice on sorghum

Extension advice on Sorghum	Name of Division					Total
	Koyonzo	Angurai	Nangina	Ukwala	Karungu	
No	17	11	11	8	14	61
Yes	3	9	9	12	6	39
Total	20	20	20	20	20	100

Source: author's own compilations, 2011.

Majority of farmers interviewed (61%) did not receive any extension advice on sorghum production; while only 39% reported to have received extension advice on sorghum production. This state of affairs raises concern on the effectiveness of extension agents to deliver information to farmers.

Table 5: Type of seed for growing sorghum

Seed type for growing sorghum	**Name of Division**					**Total**
	Koyonzo	**Angurai**	**Nangina**	**Ukwala**	**Karungu**	
Certified	0	0	8	3	0	11
Uncertified	8	12	6	25	37	88
Both	0	0	0	1	0	1
Total	8	12	14	29	37	100

Source: author's own compilations, 2011.

About 88% of farmers used uncertified seed and only 11% used certified seed. Farmers cited affordability of certified sorghum seed, their preference of maize over sorghum for food and the susceptibility to birds' destruction of sorghum crop grown from hybrid seeds as reasons why they may not be willing to invest much into the sorghum enterprise.

Table 6: Awareness of Drought Tolerant Sorghum

Awareness of technology		Name of Division					
		Koyonzo	Angurai	Nangina	Ukwala	Karungu	Total
Drought tolerant Sorghum	No	15	15	8	6	15	59
	Yes	5	5	12	14	5	41

Source: author's own compilations, 2011.

About 41% of the farmers were aware of drought tolerant sorghum. An estimated 59% were not aware of the technology. Ukwala Division registered the highest number of farmers aware of drought tolerant sorghum at 14% followed closely by Nangina Division at 12%. Koyonzo, Angurai and Karungu Divisions had the highest level of farmers who were not aware of this technology, all at about 15%.

Table 7: Adoption of Drought Tolerant Sorghum

Adoption of technology		Name of Division					
		Koyonzo	Angurai	Nangina	Ukwala	Karungu	Total
Drought tolerant Sorghum	No	19	18	19	17	20	93
	Yes	1	2	1	3	0	7

Source: author's own compilations, 2011.

Generally, majority of farmers, 93 percent, had not adopted drought tolerant sorghum with only 7 % of farmers having adopted the technology. It was interesting to note that Karungu division had no farmer adopting the technology and yet it was comparatively dry to the other study sites.

Probit Model Regression Results

A probit model was used to assess the factors that influenced adoption of stress tolerant sorghum by small holder farmers in western Kenya. Statistics for variables incorporated in the model are shown in the table below.

Table 8: Variables in the Equation

Variable	β	S.E.	Sig.	Variable	B	S.E.	Sig.
Age	.054	.003	.006	Sorghum farm	.805	.155	.016
Gender	-3.656	.057	.017	Income	.034	.011	.043
Education	.520	.665	.544	Advice	.823	.114	.050
Member	.939	.067	.003	Total Farm	-.887	.078	.024
Occupation	.581	.042	.435	Constant	-23.520	5757.000	.997

Cox & Snell R Square → 0.500

Nagelkerke R Square → 0.695

Sample Size → n = 100

Source: author's survey data, 2011

There was a positive and significant relationship between adoption of drought tolerant sorghum and the age of the respondents at 5% level. A unit increment in age of respondents led to an increase of log of odds in favour of adoption of drought tolerant sorghum by 0.054. Older people were more likely to adopt drought tolerant sorghum than young people. This could be explained that sorghum as a crop is mainly consumed by the older generation who have valued the crop through the years as opposed to young people who may view sorghum as an inferior cereal.

Gender was significant at 5% level and negative. The results indicated that an increase in the number of male headed households by one unit would bring about a decrease in the log of odds in favour of adoption by 3.656. Sorghum farming is usually the preserve of women especially in the western part of the country. Sorghum is a small grain that needs patience in handling in terms of sorting out seeds for planting, and once harvested the process of drying and winnowing to get the refined grain can be tedious. Men may not have patience for all these.

Membership to sorghum producer group was significant at 1% level

meaning that a unit increase in the number of farmers who are organized in groups to grow sorghum would bring about an increase in the log off odds in favour of adoption by 0.939. Farmers who organize themselves in groups often have set objectives to improve their farming and thus welcome strategies to enhance those objectives. They seek information and share among the members of the group. Groups also make it economical to get the attention of technology innovators.

Land size allocated to growing sorghum influenced adoption of drought tolerant sorghum positively at 5 percent level. Small scale sorghum farmers who had allocated a larger portion of their land on sorghum production were more likely to adopt the technology than those who had allocated a small portion. This scenario is so because those who were producing sorghum on relatively large pieces could find it economical to take up the technology as opposed to those with small pieces of land.

The relationship between income and adoption of drought tolerant sorghum was positive and significant at the 5% level. A unit increase in income of farmers from their various sources of income would lead to an increase in the log of odds in favour of adoption of stress tolerant sorghum by 0.034. New technologies come at a cost and it is only those with a reasonable income that can afford them.

Extension advice was significant at 5% level and positive. The results indicated that a unit increase in the number of farmers who receive extension advice increased the log of odds in favour of adoption of drought tolerant sorghum by 1.881. Farmers who do not get extension advice may lack information on the various technologies and may be averse to adoption of the technologies.

Total land size owned by a farmer had a negative and significant relationship with adoption of drought tolerant sorghum variety at 1% level of significance. As the total land owned increased, there was a tendency for farmers to abandon sorghum farming and move to other crop enterprises like maize, sugarcane, and tobacco as was observed in the sampled sites. This was so because farmers being economic rational beings would seek to engage on a bigger scale in those farming activities that yield more output and therefore income.

Hypothesis Testing

Testing of hypothesis was done using t – test. T-values were computed using SPSS and then compared with tabulated t value at the 95 percent confidence level. Computed t values are as shown in the table below.

Table 9: Computed t values

Variable	Age	Gender	Member	Sorghum farm	Income	Extension	T/land size
t value	27.331	21.250	30.762	15.804	11.056	23.831	18.534

Source: author's survey data, 2011.

Age and membership to a sorghum producer group were significant at 1 percent while gender, size of land allocated to sorghum, income, extension advice and total land size were significant at 5 per cent. Computed t values for these parameters exceeded the tabulated t value of 1.960 for the surveyed sample indicating that these parameters were at least statistically significant at 5 percent level. The null hypothesis that household socio-economic characteristics had no effect on adoption of drought tolerant sorghum variety among small holder sorghum farmers in western Kenya was rejected.

Recommendations

Technology disseminators in sorghum should target the older people; especially the women and farmers should organize themselves into farmer groups to grow sorghum. Farmers should seek to increase the land size allocated to sorghum. It is also imperative for farmers to expand their scope to earn more income. Extension agents should strengthen their role as the link between research and farmer.

References

EABL (East African Breweries Limited). 2010. EABL Maltings' shift to Sorghum production set to improve livelihoods in Eastern Province: Press release.

Famine Early Warning Systems Network (FEWSNET). 2009. FEWSNET Executive Overview of Food Security.

Pari, L.; Grassi, G.; Sénéchal, S.; Capaccioli, S.; and Cocchi, M. 2008. State of the art: harvesting, storage and logistic of the sweet sorghum. 16th Europian Biomass Conference & Exhibition, 2-6 June 2008. Valencia, Spain.

Scurrah-Ehrart, C. S. (2007). Economic vulnerability, beer and HIV/AIDS: the struggle to sustain farmer livelihoods and indigenous sorghum varieties in eastern Uganda. Singapore Journal of Tropical Geography 28: 71-89.

Scurrah-Ehrhart, C. 2006. Economic vulnerability ability, beer and HIV/AIDS: The struggle to sustain farmer livelihoods and indigenous sorghum varieties in eastern Uganda. Singapore Journal of Tropical Geography 28 (2007) 71 –89.

FAOSTAT data, 2006.

Vasisht, A.K. (1999) Logit and Probit Analysis. New Delhi.