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REPORT ON FACTORS LIMITING THE ADOPTION OF THE CONTROL MECHANISMS OF STRIGA WEED IN NYAKACH DISTRICT-KISUMU COUNTY

BY

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ACRONYMS
GoK- Government of Kenya

AATF- Africa Agricultural Technology Foundation

ISC- Integrated Striga Control

KARI- Kenya Agricultural Research Institute

ALS- Acetolactate Synthase

HR- Herbicide Resistant

OLS- Ordinary Least Square

CLT- Central Limit Theorem
1. INTRODUCTION

Kenya is an agriculture based economy with a big population of people who depend directly or indirectly on agriculture and agricultural products (GoK, 2005). Agriculture is commercialized in areas with good environmental conditions that support agricultural production. Various crops are therefore adapted to various conditions of growth.

Cereals make the greater percentage of crops grown as food crops as well as cash crops, majorly grown in Kenya include: maize, millet and sorghum. According to Nzuma (2008) Maize, wheat, rice and sorghum may be considered as necessities in Kenya. Wheat and rice complement maize consumption in Kenya while sorghum is a substitute. This therefore, is a likely indication that maize is the principal cereal crop in Kenya. Evance et al., (2011) indicated that maize and sorghum are the principal food and cash crops for millions of people in the predominantly mixed crop-livestock farming systems of eastern and southern Africa.

In developing countries, maize is consumed directly and serves as staple diet for some 200 million people (Jean, 2003). Maize is a staple food in Kenya, large scale as well as small scale farmers produces the crop as an income-generating crop and food as well.

Maize in Kenya is grown in various agro-ecological zones according to variety and adaptability to such given environment. It is extensively grown in Trans Nzoia, Nakuru, Bungoma and UasinGishu County. In south Nyanza, other parts of Rift Valley and Western province, maize is grown alongside other subsistence crops like beans, potatoes and bananas.

Cereal production in Kenya especially maize has faced a number of challenges that have limited maximization of targeted output even in good management of the farms (Magani et al. 2011). In maize for example, small scale farmers who rely on their own input in maize production, have faced such challenges as; high cost of production because of the expensive farm inputs such as fertilizers, maize price fluctuation in the local markets, climatic hazards such as prolonged droughts or floods that may destroy the maize in the fields, competition arising from importation of cheap maize that flood the local markets, monoculture(prolonged planting of maize that leads to soil exhaustion), poor marketing strategies resulting to farmers selling maize at throw-away
prices and pests, weeds and disease infestation in the fields or stores that destroy cereals leading to heavy losses to the farmers.

In western Kenya, insect pests and weeds have given farmers problems. Maize stem borer is an example of such pests; witch weed (*striga* *hermonthica*) is one notorious weed that has also limited farmers’ participation in maize production. Striga, according to Evans et al. (2011) is the major problem in cereal production producing huge losses in grain yield. Esilaba, (2006) purports that striga causes yield losses between 65-100% depending on the level of severity in the field. This in some cases has resulted into farmers abandoning much of arable lands in Africa (Khan et al. 2003).

Residents of Kisumu County have embarked on subsistence farming as the major option in ensuring food security. Fishing which has been their major cultural and socio-economic activity, however, is deteriorating because of infestation of Lake Victoria by equally notorious water hyacinth which has limited fishing in areas around the lake. This has called for diversification and consequent diversion of income generating activities alongside food production. Among such income oriented activities is cereal production majorly maize, rice, millet and sorghum. Production of these cereals in Kisumu County targets direct consumption where maize and sorghum is used to make Ugali which for a long time has been a staple food for the inhabitants of western Kenya and the sale of surplus at times of bumper harvest. Therefore, cereal production is a socio-economic activity in Kisumu County.

The yields from maize, millet and sorghum, however, have been decreasing due to heavy infestation by Striga weed. Maize farmers have identified striga as a constraint to cereal production and attributed its increasing incidence to insufficient funds to purchase inputs such as fertilizer and decreasing soil fertility since much of their income is channeled towards strategies to control witch weed (Evans et al. 2011). Various control mechanisms have been put in place to try and counter the effects of striga (AATF, 2011; Magani et al. 2011). However, none has given consistent, effective and economically feasible results when used alone (Frankie et al. 2006; Hooper et al. 2009). A combination of a wide range of technologies into an integrated striga control (ISC) program has been identified as an effective approach to contain the parasite (Esilaba, 2006). Esilaba (2006) further notes that the adoption and successful implementation of
this technology largely depend on farmers’ perception and reaction towards it. For instance, the use of chemical control mechanism has been highly criticized by farmers on the basis of its residual effects on soil fertility, expensive and pollution at large. Mechanical and cultural control mechanisms have also faced the same criticism on the basis ineffectiveness, tedious and time wasting among others. Biological control on the other hand takes a longer time to solve the problem at hand. All these therefore give room for the adoption and application of integrated mechanism that incorporates other control mechanisms at different levels. The big question therefore is; what limits the adoption of the integrated control mechanism of striga so as to do away with striga and to increase income through increased production and sale of surplus of cereal crops especially maize, millet and sorghum in Kisumu County?

1.2 Research problem
To produce maize of high quality and sufficient enough for home use and/or sale, calls for better management of various challenges to crop production. Striga is a problem to the cereal farmers in greater parts of Kisumu County and the major cause of low yields in maize among other cereals, consequently low income (KARI, 2006). A number of strategies have been tried in order to combat the effects of striga, they include; the use of resistant and tolerant varieties of maize, use of herbicides, fertilizer and manures many of which involve cash expenditure, for instance the use of agrochemicals, add a cost on production thus reducing profits to farmers who target markets and also leads to lose of income which could be used for other forms of investment or production or to meet other expenses (Frankie et al. 2006; Hooper et al. 2009). A lot of literatures focus on these various strategies to try and combat striga. According to Esilaba (2006), these technologies have not been widely adopted due to the mismatch between the technologies and the farmers’ socio-economic conditions particularly their purchasing power. This creates a wide gap between the availability of the control measures purportedly to be adopted and the adoption of such measures. Therefore, efforts should be made to sensitize farmers on the adoption of control measures. This project therefore sought to help fill this gap by seeking to find out various delimiting factors in the adoption of the control measures that are available.
1.3 Objectives
The main objective of this study was to investigate what limits the adoption of striga weed control mechanisms in Nyakach district in Kisumu County.

The specific objectives for this study were;

i. To characterize maize farmers on the basis of their socio-cultural activities.

ii. To analyze factors influencing the farmers’ adoption of available striga control mechanisms.

1.4 Hypothesis
The first objective of this study was achieved by the use of descriptive statistics hence no hypothesis was formulated for its achievement. Therefore the hypothesis in this case was tested for the second objective.

i. Individual farmer characteristics do not affect their adoption of striga control mechanisms.

1.5 Justification
This proposed study is important since it will seek to address the issue of adoption by evaluating and determining the factors that deter farmers from adopting the proposed control measures. It is important to the cereal farmers, agricultural institutions especially research based and the government;

To the cereal farmers, the study seeks to bring to their attention the availability of control mechanisms of striga and to sensitize them on the need to adopt such measures to ensure increased yields.

To the research based agricultural institutions such as KARI and AATF, this proposed study seeks to bring to their attention the need to sensitize and monitor farmers’ adoption of their proposed ways to control striga.

To the government, this work is of great value since if implemented, it will ensure that striga is eradicated hence increased cereal production in the rural settings like Nyakach district leading to
food sufficiency consequently enabling the government meet extreme hunger and poverty eradication as a Millenium Development Goal.

1.6 Study area
Kisumu County was of interest for this study because it is one county that comprises of small scale subsistence maize farmers who have had challenges in production especially with respect to striga infestation. Despite the good environmental conditions that support maize production, it still lags behind in maize output volumes. Pressure from projected population increase in this county also calls for food self-sufficiency hence the need to address striga control. Nyakach district in Kisumu county leads in severity of striga instances despite having good agricultural soil hence forms the best site for data collection. This study was conducted in two divisions in Nyakach district that is; upper Nyakach and west Nyakach divisions.

1.7 Organization of the proposal
The rest of the report is organized in such a way that chapter two covers the relevant literature review on striga control; chapter three covers the methodology applied during the study; chapter four covers the results and discussions, chapter five deals with the conclusion and recommendations and lastly referencing of the materials used.
2.0 LITERATURE REVIEW

Striga remains a major constraint to not only cereals but also other crops of the grass family such as sugarcane (AATF, 2011). A number of research works have been commissioned in order to come up with comprehensive reports on the various methods of control of striga. All these concentrate majorly on the control leaving out the possibility of farmers adopting their proposed control mechanisms. This thus creates a big gap making the control strategies ineffective simply because of failure by the researchers to as well find out the cause of slow adoption of their proposed control measures of striga.

AATF (2011) in their quest to carry out a feasibility study on striga control in sorghum in Ethiopia, Mali and Nigeria, focused majorly on the control mechanisms of striga by generating information on the viability of developing, testing and deploying herbicide resistant (HR) variety of sorghum in selected Sub-Saharan African countries. This study found out that there are potential benefits in terms of yield gains and farmer income from use of HR sorghum varieties. They also suggested that adopting the technology would also lead to improved food security. They concluded that Acetolactate Synthase (ALS) resistant sorghum has the potential to control the spread of striga and also produces high yields. The study is similar to the proposed study because the focus of this study is to find out the factors that limit the adoption of control measures of striga among them the use of striga resistant crop varieties.

Zeyaur et al. (2007) studied on-farm evaluation of the ‘push–pull’ technology for the control of stem borers and striga weed on maize in western Kenya. They focused on the control of striga and stem borers using a push-pull technology. The technology involved the use of desmodium which adds nitrogen to the soil and suppresses striga weed. The desmodium also produces some exudes that repel (push) stem borers hence when intercropped with maize, the pest would be repelled to Napier grass planted at the borders of the maize field which produces a sticky substance that attracts (pull) the pests and because of the stickiness, the pest is trapped ending up dieing hence the name push-pull. They found out that there were significantly lower proportions of stem borer damaged maize plants in the ‘push–pull’ than in the monocrop plots in all the districts during the entire study period. Striga infestation also decreased significantly in all the
districts in the push-pull case than in the monocropping. The study is similar to the proposed study because of the underlying interest of striga control; the proposed study, however, further focuses on the factors that limit adoption of control mechanisms push-pull for instance.

Esilaba (2006) carried out a study on options to striga management in Kenya. Just like other studies, this study was for the similar thought that striga is indeed a problem hence should be controlled but lacked in the evaluation of the adoption of the practices that the research proposed. Interestingly, the study identifies that the control technologies have not been adopted by farmers simply because of the mismatch between the technologies and the farmers’ socio-economic conditions particularly the non-availability of economically feasible and effective technologies. It goes ahead therefore to propose various control strategies such as cultural/mechanical control, development of striga resistant/tolerant varieties, chemical control methods, biological control methods and integrated striga management. In conclusion, the study recommends that to control the spread of Striga, the mechanisms of dispersal need to be better understood. Increased efforts on developing resistant and tolerant varieties are needed including the use of the recently developed biotechnology approaches.

Evans et al. (2011) carried out a research on farmers’ perception and constraints to the adoption of weed control options; the case of strigaasiatica in Malawi, Individual interviews were conducted in Mpingu (Lilongwe District) and Mponela (Dowa District) in 2010 in a sample of 247 respondents. The study revealed that crop production was the main source of livelihood for households. Farmers identified striga as a constraint to maize production and attributed its increasing incidence to insufficient funds to purchase inputs and soil infertility. On strigaccontrol mechanisms, manure application was perceived to be the best by farmers, followed by crop rotation, fertilizer application and hand pulling. Even though striga infestation is increasing in farmers’ fields, they have not adopted the control options. The low adoption of the options has been justified as “too risky” as farmers do not trust them. The study concludes that emphasis should be laid on undertaking on-farm trials and development of technologies should involve farmers if they are to gain wide acceptability. This study is similar to the proposed study the only
difference being that it was conducted in Malawi and none of such has ever been done in Kisumu County-Kenya.

Magani et al. (2011) in their study of the role of biological control in integrated management of striga in maize (*Striga hermonthica*) in the Southern Guinea and the savannah of Nigeria, focused on the evaluation of the efficiency of a combination of granular mycoherbicide formulation applied pre-plant and post-emergence herbicides for the control of *Striga hermonthica* in maize. They found out that, the use of *Fusarium oxysporum* fungal pathogens (foxy 2), isolated from diseased plants from Ghana, proved to be highly pathogenic against all developmental stages of the parasite including seeds and offers good prospects for control of striga. The main objective of this study as well was therefore skewed towards control of striga biologically and not concerned with whether this technique was adoptable by farmers or not hence the difference with the proposed study whose main goal is adoption.
3.0 METHODOLOGY

3.1 Data collection and sampling procedures
A multistage sampling procedure was used for this study. The first stage involved purposive selection of two divisions (upper Nyakach and west Nyakach divisions) and one location from each division was selected based on the production levels of maize and severity of striga (Thurdibuoro location in west Nyakach division and Nyakach south in upper Nyakach division). The second stage involved a random selection of 30 respondents using Central Limit Theorem (CLT). Every maize farmer was selected for face to face interview using survey questionnaire. The survey captured the farmer’s characteristics such as sex, age, educational level, farming experience, access to extension services, source of farming capital and access to information on farming. Data analysis was done using statistical package for social science (SPSS) version 16.0.

3.2 Model used
Factors influencing adoption of the available striga control mechanisms was estimated using some socio-economic and farm-level characteristics of the farmer. Data analysis was done using SPSS version 16 for descriptive statistics and regression. The ordinary least square (OLS) regression analysis model was used with adoption considered as dependent variable expressed as:

\[ Y_i = \alpha + \beta x + u_i \]

Where;
\( Y_i \) = the adoption,
\( \alpha \) = constant term
\( \beta \) = vector of parameters to be estimated; variable of interest
\( u_i \) = error term
3.3 Variables included in the model and expected output

Table 1: Expected output

<table>
<thead>
<tr>
<th>Variable</th>
<th>description of variable</th>
<th>expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Age of the respondent</td>
<td>+</td>
</tr>
<tr>
<td>Gender</td>
<td>sex of the respondent</td>
<td>+</td>
</tr>
<tr>
<td>Education level</td>
<td>level of education of the respondent</td>
<td>+</td>
</tr>
<tr>
<td>Extension service</td>
<td>respondent’s access to extension services</td>
<td>+</td>
</tr>
<tr>
<td>Credit</td>
<td>Respondent’s access to farming credit</td>
<td>+</td>
</tr>
<tr>
<td>Income</td>
<td>Respondent’s level of income</td>
<td>+</td>
</tr>
</tbody>
</table>

Owners of agricultural lands and most of the farming activities are carried out by the elderly in the community, the older an individual is, the higher the chances that he/she participates in maize production especially in the study area unlike the young who majorly target higher levels of education and other jobs especially in the town centers. Therefore the main participants in farming activities, the elderly in this case, are the likely adopters of various striga control methods thus the expected positive relationship between age and adoption of striga control measures.

Gender discrimination in land ownership in most of the traditional communities limits women’s chances of owning agricultural land. Women are perceived as labor providers in the farms therefore it is expected that most agricultural lands are owned by men. Men are mostly the head of the families except in cases where the woman is widowed. This mostly gives the man title to most of the decision making process in agricultural activities for instance. For these reasons, it is expected that there is a positive relationship between adoption of striga control methods and the gender of the respondent.

Farmers who are well educated are well informed of most of the farming activities based on the knowledge acquired from primary, secondary and probably post-secondary education. Based on
their ability to write, read, analyze and acquire various sources of information, they are expected to be the early adopters of striga control mechanisms hence the positive relationship. Farmers with frequent access to government/private extension service provision are well informed of various farming activities and are in a better position for adoption of various striga control methods than those with limited access to extension service provision hence the positive relationship.

Ease of access to credit by farmers improves their financial position which in turn likely to increase the farmer’s farming capability in terms of input acquisition and to carry out other farm operations. Farmers with enough capital are therefore the most likely adopters of control mechanisms of striga hence the expected positive relationship. Farmers with adequate income are better placed in terms of farming capital and are perceived implementers of most of agricultural activities than those with little income. Therefore such farmers with adequate income are in a position to control striga in their farms by adopting various control mechanisms hence the positive relationship.
4.0 RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Table 2: continuous variables and dummy variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>descriptive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (% male)</td>
<td>67.7</td>
</tr>
<tr>
<td>View on production (% good)</td>
<td>35.5</td>
</tr>
<tr>
<td>Experience with striga (% yes)</td>
<td>67.7</td>
</tr>
<tr>
<td>Adoption (% yes)</td>
<td>54.8</td>
</tr>
<tr>
<td>Extension service provision (% yes)</td>
<td>54.8</td>
</tr>
<tr>
<td>Access to farming credit (% yes)</td>
<td>48.4</td>
</tr>
<tr>
<td>Education (% secondary and above)</td>
<td>45.2</td>
</tr>
<tr>
<td>Occupation (% self-employed)</td>
<td>64.5</td>
</tr>
<tr>
<td>Age of respondents</td>
<td>43.61 (6.103)</td>
</tr>
<tr>
<td>Maize output last season (kg)</td>
<td>920.97 (900.577)</td>
</tr>
<tr>
<td>Respondent’s income level</td>
<td>5780.65 (1748.412)</td>
</tr>
</tbody>
</table>

Note: standard deviation in parenthesis.

Majority of farmers interviewed are men a clear indication of the fact that men are the heads of many families and the major decision makers when it comes to land and farming issues. Women’s place is provision of labor in farms and serves second to the man in decision making. A few of the farmers interviewed agreed with last season’s maize production in the study area as good. Majority were for the opinion that the production was poor. Among the cited reasons for the poor production was; poor rainfall, pest and diseases, weeds (striga), insufficient use of inputs and lack of enough farming capital.

Majority of the farmers agreed to have had experience with striga and attributed it to the major cause of reduced maize output depending on the severity and the method used to control the situation. 68% of the farmers also admitted that they have had various sources of information on how to control striga in their farms such as attending agricultural workshops, knowledge from school, visits by NGOs and their own farm knowledge on control mechanisms.
54.8% of the farmers are adopters of the available control measures of striga such as Push-pull method, cultivation of resistant varieties of maize and use of HR herbicide among others. Among the limiting factors to adoption, insufficient knowledge on control mechanisms of striga, ineffectiveness in the available methods of control and low income were the major cited reasons. 55% of the respondents have had varying frequency of visits by the extension service providers in the study area in the last twelve months. Lack of capital to cater for the extension service provision was the main reason.

Nearly half of the farmers (48%) have access to farming credit from various sources. 52% have not got any farming credit hence have low farming capital a probable reason behind low adoption. Only 45% of the farmers have had secondary and above education. Majority of the respondents are less educated hence have little knowledge about striga, its adverse effects and the control, a likely reason behind low adoption.

A large number of respondents (65%) are self-employed either in full time farming or running a small business. Much of the income from farming and/or the businesses are used for family keep up, little of which is channeled towards farming activities thus limiting adoption of control measures of striga among other farming activities.

Most young people age 30 and below are not involved in farming activities in the area of study a likely reason being that they are probably still pursuing their education, some are employed in the town centers others running their own businesses. Those above age 60 are probably old enough and weak to get involved in intensive farming hence the average age of respondents in the study area involved in intensive farming is at 43 years.

The maize output varies from a minimum of 95kg to a maximum of 3600kg. The amount of output is dependent on a number of factors faced by the farmers in the study area. Such factors include; pest and disease infestation, weeds, insufficient use of inputs, level of income, farmers’ age and farming experience, contact with extension service providers and gender of the farmer. On average therefore, each farmer in the area produces 921kg each season. On average, each
respondent in the study area earns a monthly income of Ksh. 5780 depending on whether one is full time farmer, self-employed or employed.

4.2 Regression

Table 3: OLS results

<table>
<thead>
<tr>
<th>Variable</th>
<th>coefficient</th>
<th>standard error</th>
<th>significance (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.618</td>
<td>0.612</td>
<td>0.322</td>
</tr>
<tr>
<td>Credit</td>
<td>0.310</td>
<td>0.169</td>
<td>0.078</td>
</tr>
<tr>
<td>Income</td>
<td>-8.400E-5</td>
<td>0.000</td>
<td>0.078</td>
</tr>
<tr>
<td>Education</td>
<td>0.683</td>
<td>0.149</td>
<td>0.000</td>
</tr>
<tr>
<td>accesstogovernmentextension</td>
<td>0.130</td>
<td>0.159</td>
<td>0.422</td>
</tr>
<tr>
<td>ageofrespondent</td>
<td>0.024</td>
<td>0.013</td>
<td>0.076</td>
</tr>
<tr>
<td>sexofrespondent</td>
<td>0.143</td>
<td>0.156</td>
<td>0.369</td>
</tr>
</tbody>
</table>

The results from the regression above shows that some variables are directly related and others have inverse relationship with the dependent variable. Constant term refers to other variables that were not included in the regression but affect the dependent variable; the last column of the table shows the level of significance of each variable.

There is a positive relationship between respondent’s access to credit and the adoption of striga control mechanisms as expected. Increase in access to credit by farmers in the study area increases their adoption of control methods of striga by 31%. Farming credit makes available more capital to help in running various farming activities such as purchase of inputs and accessing extension services among others.

The respondent’s level of income is inversely related to the adoption of striga control methods. This is the opposite of the expected sign in table 1.0. An increase in the level of income of the
respondents in the area of study decreases their adoption of striga control methods by 0.0084%. The likely reason for this is because income earned from farming and/or any other source such as businesses is channeled towards satisfying other family needs such as paying school fees, clothing, and food among other necessities.

Increase in the level of education increases the level of adoption of striga control methods in the study area by 68%. This, as expected is depicted by the positive relationship between education and adoption. Education, formal or informal is a source of knowledge and information on various issues. Farmers are educated when visited by extension service providers, farmer group discussions, visits to agricultural workshops and shows and through knowledge gained from school for those who make it to secondary school and above.

As clearly indicated in table 4 above, a positive relationship exists between respondent’s access to extension service provision and adoption. Increase in access to the extension services increases the adoption by 13%. This is because extension service provision is both a corrective measure taken to correct a particular deviation from the expected practice and a source of knowledge to a farmer who is enlightened in issues that he/she may not have known.

Age goes in hand with the level of experience in a particular field. An increase in age of an individual involved in a particular practice farming for this case, increases his/her experience in the same field. This supports the positive relationship between adoption and age of the respondent as expected. Therefore a unitary increase in age of the farmer increases adoption increases by 2.4%.

The direct relationship between gender and adoption as depicted in table 4 means that with every male farmer, adoption of striga control methods is likely to increase by 14%. This as explained earlier is due to the fact that most of the agricultural lands and most of the agricultural activities and decisions are undertaken by men who are the head of most households. Men in the study area are also well informed and educated as compared to their women because they in the most cases are the target groups for any organization seeking to carry out studies or education involving farmers for example extension service providers, NGOs among other bodies.
5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions
The study concludes that as much as there exists a number of research and projects conducted to help combat the effects of striga in Nyakach district in Kisumu County in order to ensure food sufficiency, there exists much other than simply putting in place various control mechanisms. A close examination of the characteristics of the population of interest in order to determine various factors that may make the proposed mechanism to control striga ineffective is necessary. Analysis of socio-economic factors of the population of interest such as age (experience), gender, income, education and occupation among other factors, should be given first priority so as to clearly understand what the farmers need before any advancement in carrying out a project or research and declaring any control measure effective for the farmers to adopt.

5.2 Recommendations
There exists a big gap between striga control technologies that are put in place for adoption by a target group and the ease of adoption itself. This has been so because of the mismatch between the technologies and the farmers’ socio-economic conditions such as gender, age, education, income and occupation among others majority of which have proved significant among the factors that affect adoption of striga control mechanisms. The study therefore recommends a close examination and analysis of the targeted group of farmers before imposing a striga control mechanism which may prove expensive in terms of the farmers’ capabilities. The study also recommends a thorough search to be conducted not only to recommend various control mechanisms but also on factors that may limit the adoption of various control of striga in various areas.
References


