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Socio Economic Drivers Influencincing Smallholder Maize Production in Tobacco Growing Zones of Migori County, Kenya

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Abstract
Known by its scientific name *Zea Mays,* maize is the staple food for most households in Kenya. It is mostly produced by small scale farmers. Maize is also an important livestock feed both as silage and as crop residue, grain and is also used industrially for starch and oil extraction. It is an important source of carbohydrate, protein, iron, vitamin B, and minerals. Kenyans consume maize in a wide variety of ways (ugali, porridges and beer). Green maize, fresh on the cob, is eaten roasted or boiled separately or mixed with legumes. Every part of the maize plant has economic value: the grain, leaves, stalk, tassel, and cob can all be used to produce a large variety of food and non-food products. The general objective of this study was to investigate the socio economic constraints to smallholder maize production in Tobacco growing regions of Migori County, Kenya. However, it was guided by the following specific objectives; to determine the effect of tobacco farming on maize production and to assess the impact of socio-economic factors on smallholder maize production. This study used time series techniques to investigate the relationship between tobacco farming and smallholder maize production in Migori County, during the period 1967 to 2010.The data was collected from Kenya National Bureau of Statistics. The data that was parametrically analyzed using E-views to giving descriptive statistics and inferential statistics. Descriptive statistics involved comparison of means, cross tabulation, use of tables, pie charts and bar graph. A fitted Cobb-Douglas production model was adopted in this study and using the framework of error correction mechanism, it was found that the lagged capital input, fertilizers, labor, research and extension services significantly propagate maize production. Unit root and Granger-causality tests were carried out to make adequate allowance for the dynamic relationship, on stationary and spurious regression problems. However, in the structural macroeconomic model, the individual lagged variables, the aggregated co-regressed variables resulted into a positive R squared at 0.01 significant levels. Surprisingly, the coefficient of the lagged maize production was found to be negative (-0.4747) and insignificant only at the 10% level.
Keywords: Smallholder Maize Production, Error Correction Model and Food Security

Introduction

In the beginning of the independence movement (1960s), Africa was self-sufficient in terms of domestic food production and a leading agricultural exporter. In contrast, Asia was the epicenter of the world food crisis. But by the mid 1960s, Asia had launched the green revolution, which at present adds 50 million metric tonnes of grain to the world food supply each year. Although Asia struggles with issues of household food supply, it is Africa, not Asia, which bears the brunt of the world food problem (Byerlee, 1997). The food balance sheet in Africa has shifted from positive to negative. For example, between 1970 and 1985, food production grew by 1.5 percent while the population growth was 3 percent. This has led to a decline in per capita food consumption, making Sub-Saharan Africa the only region in the world where average calorific intake has declined over time. This problem of stagnation in food production is reflected in growing reliance of food imports, food aid, rising poverty and increasing degradation of the natural resource base. Human population is expected to double to 1.2 billion by 2020, which will further increase demand for food. Africa's food production gap demands fresh thinking and urgent attention by scientists and policy makers.

Two preconditions are essential for alleviating the downward spiral of poverty and malnutrition in Africa. First, in nearly all the African countries, the key to economic growth is growth in agriculture. The bulk of the population depends on agriculture, and increases in agricultural household income generate further rounds of spending that stimulates economic growth by increasing demand for rural non-farm products, as well as urban industrial products. The second precondition is rapid technical change in food production (Byerle, 1997). However, technology alone will not provide the momentum for a maize revolution. Institutional changes, rural infrastructure and changes in policy are crucial to succeed. Maize is the dominant staple in Eastern and Southern Africa and its importance equals that of rice and wheat in Asia. It was introduced in Africa in the sixteenth century by Portuguese traders on the Eastern and Western Africa coast and slowly moved inland through the incursion of slave traders who valued maize as a storable and easily processed grain (Miracle, 1966).

However, agricultural production has erratically fluctuated with a declining trend over the years. The status of the agricultural sector mirrors that of the economy whose growth has been declining (Nyoro, 2002). In order to attain the target economic growth, it is necessary to address growth in agriculture. This is because sustainable industrial development requires sufficient domestic demand, which calls for increasing rural household incomes. The close relationship between agricultural performance and that of the economy imply that agriculture must grow at a higher rate for it to spur economic growth. In 2003, the country's GDP was $13.8 billion, 64 percent of which came from services, 19.1 percent from the industrial sector and 16.9 percent from agricultural value added. The contribution of agriculture to GDP has declined from 25 percent in 1999 to 16.9 percent in 2003 and this decline has persisted to date.

Agriculture mirrors the economic performance and has also grown from 0.8 percent in 2002 to 1.5 percent in 2003. However, the growth in Kenyan agriculture is considered relatively low in comparison to the 4.8 percent growth in 1994 (Economic survey, 2003). Further growth in agriculture could be improved if the following factors were addressed: increased farm productivity, improved access to credit for rural farmers, improvement in market efficiency, improved farm policies and the socio economic constraints to agricultural production. For example, in the early 1960's, private commercial banks were required by law to disburse 17 percent of loans to agriculture (Kodhek, 2002). Currently agricultural lending by commercial banks is only 5.35 percent of the lending portfolio. Kenyan farming credit system collapsed in the early 1990's following the wave of liberalization, where farmers who had been given credit sold their produce to new entrants, and thus advanced loans were never recovered. In addition there was a collapse of the Agricultural Finance Corporation (AFC), the body mandated to provide credit. The main deterrent to borrowing credit is high interest rates with annual percent rate between 12 percent for commercial banks to 65 percent for village banks (Kodhek, 2004).

Maize is Kenya's main staple crop and therefore is of vital concern to agricultural policy decisions, food security and the overall development of both the agricultural sector and the economy. However, there has been a declining trend in maize production which threatens household food security and income sources in the tobacco growing regions. Over 85 percent of the rural population derives its livelihood from agriculture, most of who engage in other cash crop production for example, tobacco ignoring maize production yet it accounts for roughly 20 percent of gross farm output from the small-scale farming sector (Jayne, *et al.,* 2001). There was tremendous growth in maize production between 1964 and 1997, fueled by the introduction of hybrid maize and related technologies often dubbed "Kenya's green revolution" (Karanja, *et al*., 1998). However, there has been a marked decline in yield since 1997. Maize yield has declined from 1.85 metric tonnes per hectare in the period 1985-89 to the current yield of 1.57 metric tonnes per hectare. Shortage of maize in Kenya results in famine among the poor urban and rural households.

Maize produced in Migori County is not enough to sustain the surging population. Only 431,267 bags of maize were produced in Migori County against the projected 742,265 bags for consumption in the year 2012 yet the Kenyan government policy objective for the maize sub sector is to encourage increased production so that self sufficiency and food security can be achieved (Wanzala *et al.* 2009). However, the production of the crop has fluctuated over the years, partly due to climatic conditions and socio economic constraints. Some of the main reasons for the dwindling performance of maize production in Migori County are associated with the following challenges: poor access to credit after the collapse of the Agricultural Finance Corporation and Cooperative Societies that had been mandated to give inputs on credit, inadequate use of recommended technologies, high costs of inputs, lack of agricultural extension services, poor flow of information from the research stations to farmers, limitations in the development of infrastructure, low prices from the maize market reforms resulting in lower input use, a general decline in performance of the economy among others. Lack of credit translates into inadequate working capital, and therefore, farmers are unable to purchase productivity enhancing inputs such as seeds, fertilizers, pesticides and land preparation. One way of reducing the cost of production is to increase farm output. This study has reviewed some of the socio economic constraints to maize production among smallholder farmers in bid to enhance productivity.

Materials and methods

Study Area

The study was carried out in Migori County. Migori County, Kenya. It has a total population of 917,170 and covers an area of 2,597 km^2. The presence of Lake Victoria, Migori and Kuria rivers and the relatively good weather patterns in Migori County have allowed the soils in the region to be well drained making the county a conducive environment for agriculture. Agricultural produce consists of tobacco, sugarcane, maize, beans, coffee, groundnuts and vegetables. Fishing is a major economic activity while livestock farming is undertaken on a small scale basis. Due to mineral resources available in the county, there is a nascent but growing mining industry particularly gold mining that many residents have taken up.

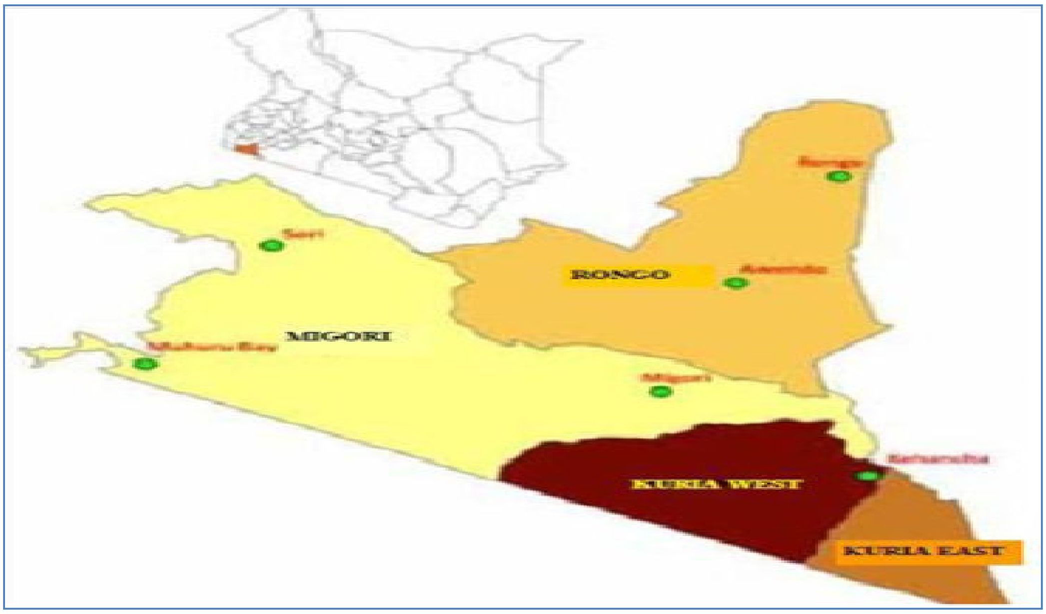

Fig 2.2: Map of Migori County

Research Design

This study used theoretical and empirical approach based on the study of socio economic drivers to smallholder maize production. Multiplicative Cobb-Douglas production function was used to determine the impact of tobacco farming on smallholder maize production.

Data sources and collection

This study employed secondary data from various sources. Data was collected from Kenya National Bureau of Statistics and Kenya Agricultural Data Compendium website www. Kilimo.go.ke, journals, newspapers, statistical abstracts and economic surveys spanning from1967 to 2010.

Methods of Data Analysis

Two methods were used in the analysis of data in this study; descriptive statistics and econometric models. Descriptive statistics will involve the comparison of means, cross tabulation, use of tables, pie charts and bar graph. Econometrics models involved Cobb Douglas production function and the ECM for the estimation of parameters. The data collected was analyzed statistically using parametric procedures where E-views were used. The data available was analyzed considering its basic properties. The findings of the stationarity and diagnostic tests and a list of variables of interest were also presented for the time series data.

Empirical Models

This study was guided by Cobb-Douglas production model which is a mathematical relationship that describes the possible maximum output that can be achieved for a given combination of inputs (Handerson and Quandt, 1971). The study considered a farm that is producing a non negative output Q hence having a flow of the output being produced from the inflow of n variable inputs X_i (i =1, 2, 3… n). The production function which specifies the maximum output obtainable from the input mix can be written as;

$$Q = f(x_1, x_2 x_3, \ldots\ldots, x_n) + \mu \quad \ldots\ldots 1$$

Where μ is the error term

The general form of Cobb-Douglas production function is expressed as;

$$Q = \beta_0 \prod_{i=1}^{n} X_i^{\beta_i} e^{\mu} \quad \ldots\ldots 2$$

Where Q is the maize production in tonnage and X_i's are the input variables in maize farming.

For the secondary data, application of least squares estimation with time series data could lead to spurious regression problems (Thomas, 1997). This is a problem that arises when variables in an equation are non-stationary (have non constant mean and variance overtime), that is, they have correlated stochastic trends. The estimation results may show high coefficient of determination, significant t-statistics and low serial correlation. But is the series are non stationary, such results are deceptive. There the following tests are carried out;

I) Unit root tests

In order to determine a meaningful long-run relationship, estimation of equation (3) requires that all variables are stationary. The first step in this methodology is to investigate the time series properties of the data. This involves determining whether the variables in the maize production equation are stationary or non-stationary (have a unit root). If they have unit roots, the issue becomes to what degree they are integrated. This is done using the Augmented Dickey-Fuller (ADF) tests which involve estimating the following regression equation;

$$\Delta y_t = \alpha + \beta_1 y_{t-1} + \beta_2 t + \sum_{j=1}^{t} \gamma_j \Delta y_{t-j} + \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

Where y_t is the relevant variable in the maize production equation, is a white noise residual, t is trend term. The test involves $H_0 : \beta_1 = 0$ (variables has unit root/non-stationary) against $H_1 : \beta_1 \neq 0$(variable has no unit root/stationary). If the computed ADF statistic is negative enough (more negative than the ADF critical value), the null hypothesis of unit root in the variable may be rejected. But if the computed ADF statistic is not negative enough (less negative than the ADF critical value), the null hypothesis of unit root may not be rejected. If the variables are not stationary in levels, the ADF tests are conducted on first differences. If a variable is stationary at the first difference then it is said to be integrated of degree one, I (1).

II) Co-integration

If the variables in the maize production equation are stationary after first differencing, the next step is to determine whether there is a stable non-spurious (co-integrated) relationship between them. Engle and Granger (1987) propose a residual based test for co integration. This involves determining whether the residuals from long-run regression are stationary. To illustrate consider the two variables Y and X. To test whether they are co-integrated, estimate the co-integrating regression (4) and obtain the residual (5).

$Y_t = \beta_0 + \beta_1 X_t + u_t$.. (4)

$e_t = Y_t - \beta_0 - \beta_1 X_t$..(5)

If e_t is stationary then Y_t and X_t are co-integrated. To test whether the residuals are stationary ADF test is applied. If we reject the null hypothesis of unit root then variables in (4) are co integrated of the orders CI (1, 1).

According to Engle and Granger (1987) when variables are co-integrated, the short-run dynamic process through which the variables in the model adjust toward the long-run equilibrium can be modeled using an error-correction model (ECM). Co integration is present if and only if an Error correction model (ECM) exist (Granger, 1964).

$\Delta Y_t = \beta_0 + \Sigma\beta_i \Delta X_{t-i} + \gamma e_{t-1} + v_t$.. (6)

Where the error-correction term, e_{t-1} are the residuals from the cointegration regression and v_t is the error term. The ΔX_{t-i} captures short-run disturbances in the regressors.

Results and Discussions

The result of skewness and kurtosis displayed in table1 indicates that the distribution of the variables was normal.

Table 1: Descriptive Results for the Time series

	CAPITAL	EXTENSION	FERTILIZERS	LABOUR	MAIZEPRODUCTION	PUBLICRESEARCH	RAINFALL
Mean	2,038,923.00	0.23	1,804,001.00	419,778.70	2,709.77	1,706.61	938.58
Median	1,563,320.00	-	1,070,200.00	420,820.00	2,464.00	1,791.00	930.00
Maximum	4,604,146.00	1.00	4,228,000.00	709,500.00	4,238.00	4,996.00	1,304.00
Minimum	317,920.00	-	273,840.00	175,300.00	1,500.00	176.00	622.00
Std. Dev.	1,451,642.00	0.43	1,318,707.00	163,747.10	644.45	1,393.34	137.08
Skewness	0.60	1.31	0.57	0.08	0.59	0.66	0.07
Kurtosis	1.89	2.72	1.84	1.74	2.93	2.54	4.06
Jarque-Bera	3.47	8.99	3.41	2.07	1.79	2.54	1.46
Probability	0.18	0.01	0.18	0.35	0.41	0.28	0.48
Observations	31	31	31	31	31	31	31

This conclusion was arrived since all the skewness coefficients were between +2 and -2. In addition, the kurtosis was between -3 and +3 which still imply normality. The Jarque-Bera test statistic also tested that the distribution of the variables was not significantly different from normal. The resultant p values from the test were higher than the conventional p value of 0.05 implying that all the variables were normally distributed. The following tests were done;

Unit root tests

Prior to testing for a causal relationship and co integration between the time series, the first step is to check the stationarity of the variables used in the model. The aim is to verify whether the series have a stationary trend, and, if non-stationary, to establish orders of integration. The study used both Augmented Dickey-Fuller (ADF) and the

Phillips-Perron (PP) tests to test for stationarity. The test results of the unit roots are presented below

Table 2: Unit root tests Level

Variable name	ADF test	PP test	1% Level	5% Level	10% Level	Comment
CAPITAL	0.725	0.725	-3.666	-2.963	-2.620	Non Stationary
FERTILIZERS	0.386	0.386	-3.666	-2.963	-2.620	Non Stationary
LABOUR	-0.016	-0.016	-3.666	-2.963	-2.620	Non Stationary
MAIZEPRODUCTION	-1.695	-1.695	-3.666	-2.963	-2.620	Non Stationary
PUBLICRESEARCH	1.383	1.383	-3.666	-2.963	-2.620	Non Stationary
RAINFALL	-5.344	-5.344	-3.666	-2.963	-2.620	Stationary

Results in table 3 indicated that capital, fertilizers, labour, maize production and public research are non stationary (i.e presence of unit roots) at 1%,5% and 10% levels of significance. Rainfall is stationary (i.e. has no unit roots) at 1%,5% and 10% level of significance. This calls for first differencing of the non stationary variables. Table 3 displays the unit root tests after first differencing. From the results, it is clear that the variables capital, fertilizers, labour, maize production and public research become stationary (unit root disappears) on first differencing.

Table 3: Unit root tests at first Difference

Variable name	ADF test	PP test	1% Level	5% Level	10% Level	Comment
CAPITAL	-4.474	-4.474	-3.675	-2.967	-2.622	Stationary
FERTILIZERS	-6.705	-6.705	-3.675	-2.967	-2.622	Stationary
LABOUR	-7.432	-7.432	-3.675	-2.967	-2.622	Stationary
MAIZEPRODUCTION	-7.181	-7.181	-3.675	-2.967	-2.622	Stationary
PUBLICRESEARCH	-4.648	-4.648	-3.675	-2.967	-2.622	Stationary

Cointegration tests

After ascertaining the stationarity properties of the series, co integration analysis was done. The first step was to generate the residuals from the long run equation of the non-stationary variables. Then stationarity of the residual was tested using ADF. The results indicate that the lagged residual is stationary (i.e. has no unit roots). It is clear from the Engle Granger test of co integration that the lagged residuals were stationary at 1%, 5% and 10% levels which imply that all the variables converge to an equilibrium in the long run(i.e. are co integrated).

Table 4: Engle-Granger Cointegration test

ADF Test Statistic	-3.757519	1% Critical Value*	-3.6752
		5% Critical Value	-2.9665

*MacKinnon critical values for rejection of hypothesis of a unit root.

Results from table 5 shows that R squared were 0.748 indicating that the overall goodness of fit of the model was satisfactory. This implies that 74.8% of the variances in maize production (dependent variable) are explained by the variances in fertilizer, labour, capital, rainfall, extension and public research (independent variables). The f statistic of 11.9 (p value 0.00003) indicated that the independent variables have good joint explanatory power. In the long run, there exists a positive and significant relationship between rainfall and maize production as revealed by a regression coefficient of 1.22447(p value =0.021). This implies that an increase in rainfall by 1 unit leads to an increase in maize production by 1.224 units. The long run relationship between public research and maize production is positive and significant. This was supported by a regression coefficient of 0.4084 (p value 0.0144). This implies that an increase in public research funding by one unit leads to an increase in maize production by 0.4084 units.

The long run relationship between labour and maize production is positive and significant. This was supported by a regression coefficient of 0.0079 (p value 0.0004). This implies that an increase in labour by one unit leads to an increase in maize production by 0.4084 units. The long run relationship between withdrawal of extension services and maize production is negative but insignificant. This was supported by a regression coefficient of -358.577 (p value 0.14). This implies that an increase in withdrawal of extension services by one unit leads to a decrease in maize production by 358.577 units. Capital and fertilizers had a positive effect on maize production. However, the effect was not significant as shown by probability values of more than the conventional 0.05. The long run relationship between type of seeds used and maize production is positive and significant. This was supported by a regression coefficient of 2.006 (p value 0.0003).

Table 5: Long Run Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2778.700	660.4943	4.207001	0.0003
CAPITAL	0.000448	0.000292	1.534488	0.1380
FERTILIZERS	0.000332	0.000265	1.251926	0.2227
LABOUR	0.007972	0.001932	-4.126273	0.0004
PUBLICRESEARCH	0.408437	0.154799	2.638498	0.0144
RAINFALL	1.224470	0.496696	2.465231	0.0212
EXTENSION	-358.5774	235.4731	-1.522795	0.1409
SEEDS	2.005641	0.000978	2.098701	0.0003

R-squared	0.748441	Mean dependent var	2709.774
Adjusted R-squared	0.685551	S.D. dependent var	644.4538
S.E. of regression	361.3825	Akaike info criterion	14.81343
Sum squared resid	3134335.	Schwarz criterion	15.13723
Log likelihood	-222.6082	F-statistic	11.90081
Durbin-Watson stat	1.186973	Prob(F-statistic)	0.000003

Error Correction Model

Since the variables in the model linking maize production to the determinants are co integrated, then an error-correction model was specified to link the short-run and the long-run relationships. Residuals from the co integrating regression are used to generate an error correction term (lagged residuals) which is then inserted into the short-run model. The estimates of the error-correction model are given in table 6. In the short run, maize production is positively and significantly affected by rainfall (regression coefficient of 1.427, p value =0.032). Labour is also negatively related to maize production in the short run (regression coefficient =-0.005, p value =0.047).

Table 6: Error Correction Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1386.138	617.7410	-2.243881	0.0352
ΔCAPITAL	0.000377	0.000363	1.038314	0.3104
ΔFERTILIZERS	0.000328	0.000289	1.134534	0.2688
ΔLABOUR	-0.005124	0.002439	-2.101063	0.0473
ΔPUBLICRESEARCH	0.439118	0.256599	1.711302	0.1011
ΔEXTENSION	165.9986	190.0000	0.873677	0.3917
ΔRAINFALL	1.427168	0.625106	2.283081	0.0324
LAGRES	-0.474651	0.302023	-1.571571	0.1303

R-squared	0.543364	Mean dependent var	78.33333
Adjusted R-squared	0.398071	S.D. dependent var	481.9761
S.E. of regression	373.9369	Akaike info criterion	14.90923
Sum squared resid	3076233.	Schwarz criterion	15.28288
Log likelihood	-215.6384	F-statistic	3.739771
Durbin-Watson stat	1.605412	Prob(F-statistic)	0.008132

The error correction term (Lagres) measures the speed of adjustment to the long run equilibrium in the dynamic model. The error term is negative (-0.475) and statistically insignificant at the 5% level .This result implies that there is a gradual adjustment (convergence) to the long run equilibrium. The coefficient of -0.474 indicates that 47.4% of the disequilibria in maize production achieved in one period are corrected in the subsequent period.

Summary and conclusions

Descriptive results indicate that tobacco production in Migori County has continued to grow rapidly at the expense of the traditional food crops while simultaneously degrading the environment. Although it is a cash crop, the amount of income from the tobacco sub sector is not enough to sustain the livelihoods of the smallholder farmers. This poses a major challenge to the achievement of goals on food security and poverty reduction.

A Cobb Douglas production model was fitted from the survey data where the value of R squared was recorded as 0.746. This implied that 74.6% of the variations in maize production are explained by variations in the regressors e.g. Tobacco Production among others such as; Agrichemicals use, use of fertilizers, total farm size, information on soil and conservation measures and labour source for maize. It was noted that tobacco production is negatively significant to maize production. Increase in tobacco production by one unit reduces maize production by 0.053 units. However, the use of agrochemicals, use of fertilizers, farm size, labour source for maize production information on water and soil conservations and Gender of the household head are positively and significantly related to maize production.

The results indicates that the majority of residents in Migori County are purely involved in the growth of tobacco but obtain low returns hence the hatred towards the production of this crop. Secondly, they draw the bulk of the labour source from their families and that tobacco seriously competes for the meager piece of land with food crops hence low food production. On the other hand, the biggest market for tobacco in this region is Alliance but it appears that they offer bad prices to the farmers. Tobacco degrades the environment and therefore hampers the growth of other food crops e.g. tomatoes and maize. It was established that majority of the residents propose that tobacco farming has worsened their economic ability because it occupies most of their time on the farm and requires large capital inputs yet the returns is low in the long run. Thirdly, majority of the residents believe that there is no major soil erosion and if any then it may arise from intense rainfall.

Recommendations

Owing to declining farm sizes due to population increase, farmers in many of these high potential areas have resorted to continuous cultivation. The study established that cultivation generally increases the potential for soil erosion due to the breakdown of soil aggregates and reduction of soil cohesion thereby further exacerbating environmental degradation. To create room for tobacco production, while at the same time providing fuel for curing the tobacco, the total area under forest cover has continued to decline as trees are felled. The dwindling forest cover has a severe effect on the climate and wildlife. Trees are sinks for carbon and hence help to mitigate the effects of carbon dioxide which is a greenhouse gas. The indiscriminate cutting of trees is thus contributing to climate change hence the need to discourage any farming activity that is not friendly to the environment because in results to fluctuations in rainfall patterns among other adverse effects. On the other side it will be prudent to launch massive sensitization of birth control measures in order to attain an increased per capita consumption and poverty alleviation.

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