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- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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WEBSITES

- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

DETERMINANTS OF TOBACCO OUTPUT IN ZIMBABWE

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ABSTRACT

The study attempts to model the determinants of tobacco output in Zimbabwe over the period 1980 to 2012. An Ordinary Least Squares estimation technique is adopted and some necessary statistical and econometric specification tests are performed. The findings reveal that acreage is a positive determinant of tobacco output while the number of growers and the price of a substitute crop (soya beans) have a negative effect on tobacco output. Although these variables are significant, their influence on tobacco output is minimal as depicted by the elasticities estimates which are less than one. Tobacco prices and rainfall have an insignificant effect on output at the 5% level of significance. The study recommends the expansion of acreage and irrigation facilities in order to boost tobacco output.

KEYWORDS

Acreage, Ordinary Least Square (OLS), rainfall level, tobacco output.

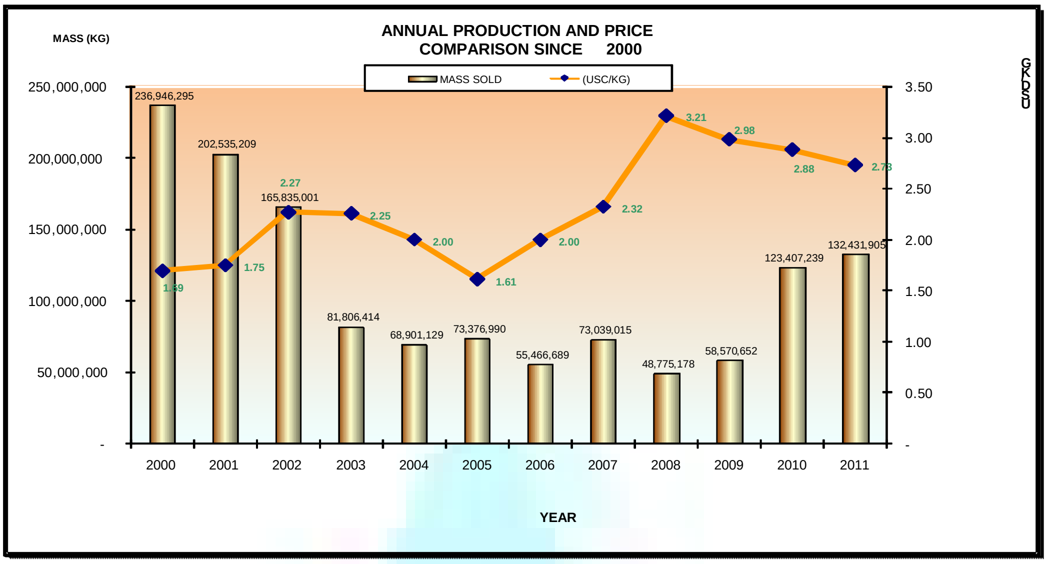
INTRODUCTION

Tobacco is an important commodity in Zimbabwe, employing 30% of the population and about a third of the people employed in the agriculture sector (Leaver, 2004). The crop contributes about 20% of total export revenue, making it the second largest export contributor after minerals that account for 25% of total export revenue (NKC Independent Economist, 2010). Quite recently the number of tobacco growers has increased considerably from 48 000 in 2008 to 56 656 in 2011. A huge number of unregistered growers also exist in the midst of the registered ones (Tobacco Industry and Marketing Board (TIMB), 2012). These growers and their families depend on tobacco farming as a source of income. The crop is generally labour intensive in Zimbabwe, requiring human labour for nursing the seeds, transplanting, weeding, spraying, harvesting and drying.

Having been grown in Zimbabwe for more than 100 years now, tobacco output appears to be sensitive to world commodity price developments due to shocks in both supply and demand. International tobacco prices have been on the rise from US 8 cents per kilo in 1980 to US 65 cents per kilo in 1990. The price further increased to US 1.69 dollars in 2000 and further increased to US 2.27 dollars in 2002 and thereafter the trend reversed and the price fell to US 1.61 dollars as at year 2005. From the year 2006 the price took a positive trend to reach a maximum of US 3.21 dollars in 2008 after which it gradually declined to reach US2.78 in 2011.

Figure 1 shows annual tobacco output and price comparisons between 2000 and 2011. The data presented in figure 2 depictss a negative correlation between the price of tobacco and the output produced particularly for the periods 2000-2002 and 2008-2011. The same relationship is not so well pronouced over the period 2003-2007, possibly disqualifying the prediction of the Cobb-webb model of agricultural production which envisage output to respond the price changes with a lag. From the figure, in years where the price is increasing output is declining and the reverse holds. Agricultural economic theory predicts a positive relationship between price and quantity produced and supplied. This would therefore suggest that other factors, both exogenous and endogenous could be the significant drivers of tobacco output. For instance, Jerie and Ndabaningi (2011) found that rainfall level, which is an exogenous component, is very important for successful tobacco production.

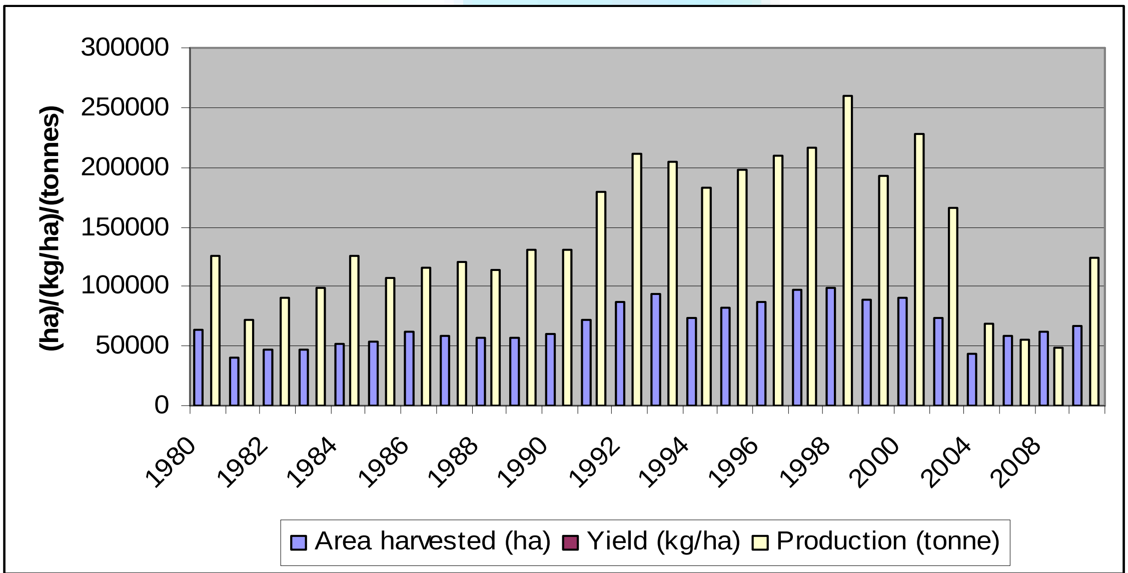
FIGURE 1: ANNUAL OUTPUT AND PRICE COMPARISON 2000-2011



Source: TIMB Annual Statistics (2012)

Figure 2 shows tobacco trends in output and acreage for the period 1980-2010. In the 1980s tobacco yield averaged 2.05kg/ha and this increased to 2.36 kg/ha in the 1990s and thereafter the yield drastically declined to an average 1.65 kg/ha in the new millennium. The area planted took a similar trend to that of yield between 1980 and the year 2000. However, yield drastically declined between 2005 and 2008 as output fell by a larger proportion relative to area under the crop. Some schools of thought attribute the poor performance of tobacco between 2000 and 2008 to the government's Fast Track Land Reform Programme (FTLRP) of 2000 which substantially reversed landholding patterns between the white minority large scale commercial farmers and the majority black indigenous peasant farmers. Consequently, experienced and well resourced white tobacco farmers were replaced by inexperienced and poorly resourced but eager indigenous farmers.

FIGURE 2: TRENDS IN OUTPUT AND HECTARE FROM 1980-2010



Source: TIMB Annual Statistics (2012)

REVIEW OF LITERATURE

The greatest challenge facing developing countries today is improving agricultural production to eliminate hunger and poverty (Nhemachena, 2003; Parry, 1978; Parry, 1981; Youdeowe, Ezdina and Onazi, 1986). Tobacco production has the potential to meet these two goals through enhancing farmers' incomes and wealth. However, to address this challenge it is important to first of all understand the various factors that influence crop production. Most studies on the determinants of crop production tend to agree that rainfall and acreage [(Igwe and Esonwune (2011), Olujenyo (2004), Jerie and Ndabaningi (2011), Harashima (2008), Mohammad et al (2007)], are strong variables that influence crop output. The World Meteorological Organisation (WMO) report on Zimbabwe (2007) also reports that rainfall is by far the most important variable that affects crop production. This is particularly likely, especially in communal areas of Zimbabwe where rainfall is exceptionally variable in the absence of dam and irrigation facilities. However most of these studies tend to generalise rainfall as the important determinant of crop production, thereby ignoring the "rainfall level" which is particularly important for successful tobacco production. For instance, tobacco requires about 20mm to 30mm of rainfall after every two weeks (Jerie and Ndabaningi, 2011). This translates to rainfall of between 450mm to 800mm per cropping season. Extreme rainfall variability in the absence of supportive dam and irrigation facilities may result in reduced crop yield.

A compilation of studies by the Food and Agricultural Organisation (FAO) in 2003 regarding tobacco production in most producing countries revealed that in China 40% of variations in tobacco output from 1970 to 1999 were attributed to the total land under cultivation. In the same compilation, a study on Brazil's tobacco industry also shows that tobacco output is influenced by acreage as well as labour costs. The results show that 0.8% of discrepancies in tobacco output are influenced by total land area under cultivation. Mohammad, *et al.* (2007) in their study for Pakistan found that crop acreage is significantly influenced by the price of the crop and the prices of other competing crops while rainfall and irrigation were found to only have a positive effect on crop output in the short run. Their study used acreage as a proxy for agricultural output, hence implicitly assuming that farmers can increase their output by utilising more land. This is a weak proxy since output and acreage may not be positively correlated as output may depend on a whole array of other factors, both exogenous and endogenous

In trying to model the price elasticity of tobacco output in Zimbabwe, Leaver (2004) highlighted some of the factors that determine tobacco output in Zimbabwe. Using time series data for 1938-2000 and applying the Nerlovian model to verify the supply response of tobacco output, results indicate that current tobacco output and market prices were positively related to the next season's tobacco at the 1% level of significance. Rainfall and sales quota were both found to have a negative influence on tobacco output. Leaver ignored the effects of acreage on output which is a key factor of production in agriculture. Quite recently, Pfumayaramba (2011) investigates tobacco output response to output itself, tobacco prices, prices of other crops as well as production costs in Zimbabwe using time series data for the period 1980 to 2010. Results show that except for the price of competing crops, own tobacco price and quantity have positive influence on tobacco output whilst production costs and price of other crops are negatively related to tobacco output. These results are consistent to those by Leaver (2004). Both studies did not make an attempt to assess the influence of "the rainfall level" as well as the "number of farmers" on overall tobacco output. The FTLRP brought a substantial increase in the number of farmers participating in tobacco production. These farmers are spread over small farm sizes, a situation found to enhance farmer productivity in some countries due to the popularised inverse farm size-productivity relationship (Berry and Cline 1979, Carter 1984, Cornia 1985)

SIGNIFICANCE OF THE STUDY
Zimbabwe underwent an economic recession in the last decade to December 2008 such that overall agricultural output was severely depressed. Tobacco, which is one of the country's major income earner and employer was also severely affected. Examining and re-examining the factors that influence tobacco output in an effort to formulate policies that promote increases in tobacco output is key to the successful turnaround of the Zimbabwean economy. Apart from the already established determinants of tobacco output by previous scholars, this study attempts to access the "rainfall level" and two key variables (number of growers and acreage) which were grossly transformed by the FTLRP of the year 2000.

STATEMENT OF PROBLEM
The Zimbabwean economy is agro-based with tobacco as the major agricultural export crop and employer. Tobacco output is therefore directly linked to GDP and hence economic growth. The tobacco industry experienced a decline in output from 236 000 tonnes in year 2000 to 48 000 tonnes in 2008 (TIMB, 2011). In other periods output has been fluctuating and currently production is below the nation's full potential. This production instability has culminated in a decrease in the country's exports, income and GDP. A decrease in income negatively affects the welfare of the nation since 30% of the population is employed in the tobacco sector. The reduction in income also affects the country's saving and investment levels. Researching on factors that determine tobacco output, which is one of the prime drivers of economic growth in Zimbabwe, is therefore key to addressing an array of economic challenges.

OBJECTIVES OF THE STUDY
The overall objective of the study is to determine the factors that influence tobacco output in Zimbabwe. Specific objectives are;
- To establish the effect of "rainfall level" on tobacco output.
- To determine if acreage influences output.
- To investigate the relationsgip between output and the number of growers
- To determine if the price of tobacco influences tobacco output.
- To establish the effect of yield on output
- To establis whether the price of a substitute crop affects tobacco output

RESEARCH METHODOLOGY
The Ordinary Least Squares (OLS) regression methodology is widely used because it produces estimators which are best, linear, unbiased and efficient (BLUE). It is also relatively easy to compute when compared to other regression methodologies. This methodology is applied on an extended and log-linearised Cobb-Douglas production function of the form $Q = AL^{\alpha}K^{\beta}$ where L and K are the factors of production representing labour and capital, Q is output, α and β are parameters representing the marginal productivities of labour and capital respectively and A is a constant. This conventional production function is modified to incorporate other agricultural factors of production as explained in the Cobb Web and Barnum-Squire models. A log model is estimated after linearising the tobacco production function. The tobacco output function is therefore as follows:

$$LQ_t = \beta_0 + \beta_1 LG_t + \beta_2 LPT_{t-1} + \beta_3 LPS_{t-1} + \beta_4 LA_t + \beta_5 LV_t + \beta_6 R_t + \mu_t \quad \text{.......... (1)}$$

Where LQ_t is the logarithm of total tobacco output in tonnes produced in year t, LG_t is the logarithm of the total number of tobacco growers in year t, LPT_{t-1} is the one period lag of the logarithm of tobacco prices, LPS_{t-1} represents the one-period lagged log of prices of competing crops (Soya beans), LA_t is the log of acreage in year t, LV_t is the log of the yield per hectare in year t, R_t is a dummy variable for rainfall level in year t. The dummy takes the value 0 in years with rainfall below 450 millimetres or above 800 millimetres and 1 in years with rainfall level within the optimal range for tobacco production, $\beta_0, \beta_1, \ldots \beta_6$ are parameters to be estimated and μ_t is a random error term.

Tobacco output is measured by the actual total of flue-cured tobacco output delivered to the auction floors. Because data on actual tobacco output delivered to the auction floors is readily and accurately available, we use delivered tonnage to proxy total tobacco output. This is based on the assumption that all output produced is sold.

Tobacco price is the average price for tobacco offered at the auction floors. To account for both the pre and post dollarisation periods and for uniformity, prices are in American dollars as recorded and provided by the TIMB. The average price of soya beans is used as a proxy for the price of competing crops. The average price is in US dollars after having converted Zimbabwean dollar values into US dollars using the official exchange rate as provided by the Reserve bank of Zimbabwe (RBZ). The prices are valued through indirect quoting due to the inflationary conditions which prevailed before dollarisation in 2009. Soya is grown in similar geographical regions as tobacco. It is also very sensitive to rainfall patterns as it requires neither too much nor too little rain just like tobacco and this authenticates soya bean price as a better proxy for competing crops. Prices are lagged by one period since farmers' output decisions are usually based on prices that prevailed in the previous farming season.

After the FTLRP in year 2000, land holdings were restructured to smaller units. This resulted in an increase in the number of participants in commercial agriculture. To capture the effect of the agrarian transformation on tobacco output, the total number of tobacco registered growers for a particular season is included to be an explanatory variable. Also, to assess this inverse farm size- productivity relationship we take acreage to represent a measure of farm size and regress it against output.

Yield measures the efficiency with which farmers use available resources to produce a given level of output. This is essential as it captures knowledge and technological aspects of production. We take yield to mean total tobacco output per every hectare planted.

ESTIMATION PROCEDURE

The E-views econometric software is used is our analysis and a general to specific modelling approach is adopted. This approach requires diagnostic tests to be performed in order to ensure the effectiveness of the technique. These tests involve testing for multi-collinearity, stationarity, variable significance, normality and the goodness of fit. These tests are carried out to authenticate the assumptions of the Classical Linear Regression Model (CLRM) as well as to ensure that the results obtained are BLUE. To detect high collinearity between variables a correlation matrix is first constructed. Secondly to avoid the risk of spurious regression caused by non stationary data, Augmented Dick Fuller unit root tests are carried out to test for stationarity, or the lack of it. Thirdly, non stationary variables are differenced to make them stationary. Fourthly, the tobacco output function is estimated using the OLS method and any insignificant and unimportant variables are dropped, and finally, model diagnostic tests are performed.

The presence of autocorrelation results in an overestimated coefficient of determination and renders the F-test and t-tests invalid (Gujarati, 1995). The Durbin Watson (DW) statistic is used to test for autocorrelation which requires the statistic to have a value around two in the absence of autocorrelation. The t- statistic test is also performed to ensure that exogenous variables are relevant. The inclusion of irrelevant variables inflates the variances of the coefficients. A huge variance reduces the efficiency of estimated parameters. Because the CLRM requires the error term to be normally distributed about the mean (Gujarati, 1995), the Jarque Bera statistic of skewness and kurtosis measures are computed to check for the normality of residuals. The goodness of fit test is also computed to verify if the model is correctly specified. The coefficient of determination (R^2) and the F-statistic are used to test for model specification bias.

RESULTS & DISCUSSION

Table 1 shows minimum variability in most of the variables except for LG_t, LPT_{t-1} and LPS_{t-1} which have relatively huge standard deviation scores. Most variables are negatively skewed as indicated by the negative values of skewness, implying that higher values of variables were observed at the beginning of the period under consideration except for soya beans prices and the number of growers which are positively skewed.

TABLE 1: SUMMARY OF DESCRIPTIVE STATISTICS

	LA_t	LG_t	LPS_{t-1}	LPT_{t-1}	LQT_t	LV_t	Rt
Mean	11.07	8.50	-1.15	-0.11	11.77	7.56	0.73
Median	11.06	7.98	-1.11	0.52	11.74	7.61	1.00
Maximum	11.43	10.94	3.03	1.17	2.47	7.93	1.00
Minimum	10.55	7.04	-4.61	-2.53	10.70	6.67	0.00
Std. Dev.	0.22	1.32	1.17	1.18	0.42	0.31	0.45
Skewness	-0.27	0.48	0.55	-0.77	-0.29	-1.30	-1.02
Kurtosis	2.33	1.70	7.98	2.11	2.55	4.21	2.04
Jarque-Bera	1.03	3.57	35.84	4.33	0.74	11.37	6.99
Probability	0.60	0.17	0.00	0.11	0.69	0.00	0.03
Observations	33	33	33	33	33	33	33

Normality of variables is tested by kurtosis and the Jarque-Bera (JB) statistics which should be close to 3 and 2 respectively to accept the null hypothesis of normality. All variables are normally distributed except for LPS_{t-1} which has a value of 7.98 for kurtosis and 35.84 for the JB statistic. Despite the failure of $LPSt_{-1}$ to satisfy the assumption of normality, we can still proceed to include it in the model. Green (2003) postulates that the assumption of normality is often viewed as an unnecessary and possibly inappropriate addition to the regression model. Gujarati (2004) also emphasized that regression analysis can still be carried out regardless of the normality of a variable.

TABLE 2: MULTI-COLLINEARITY TESTS USING PAIR WISE METHOD (CORRELATION MATRIX)

	LG_t	LPT_{t-1}	LPS_{t-1}	LA_t	LV_t	R_t
LG_t	1					
LPT_{t-1}	0.764687	1				
LPS_{t-1}	-0.021583	-0.264396	1			
LA_t	0.182486	0.582975	-0.320664	1		
LV_t	-0.618429	-0.226929	-0.044868	0.347784	1	
R_t	0.275542	0.199792	-0.182219	0.081553	-0.064645	1

The correlation matrix depicts the linear relationships amongst exogenous variables. High colleniarity between variable, as depicted by values greater than 0.8, would result in the problem of multi-collinearity in exogenous variables. The results in the matrix have values below 0.8, implying that all the variables can be included in the regression model as potential explanatory variables

TABLE 3: AUGMENTED DICK-FULLER UNIT ROOT TEST RESULTS

Variable	ADF Statistic	Order of Integration
dLQ_t	-3.242113***	I (1)
dLG_t	-2.922017**	I (1)
dLP_{t-1}	-4.231370***	I (1)
LPS_{t-1}	-4.959449***	I (0)
dLA_t	-4.079628**	I (1)
dLV_t	-4.526110***	I (1)
R_t	-4.727048***	I (0)

*** indicating stationary at 1% (all levels),**stationary at 5% and **d** indicating change

Unit Root Test results suggest that the stationarity properties of the variables do not warrant the use of co-integration since the variables are not integrated of the same order. Only two variables (R_t and LPS_{t-1}) are stationary in levels while the rest became stationary after first differencing.

TABLE 4: OLS REGRESSION RESULTS

Variable	Coefficient	t-statistic	p-value
C	-0.092978	-1.966931	0.0604
dLA_t	0.709920	4.593067	0.0001
$dLPT_{t-1}$	0.060996	0.729945	0.4722
LPS_{t-1}	-0.055781	-2.752054	0.0109
dLV_t	0.513521	4.272621	0.0002
dLG_t	-0.300366	-2.779258	0.0102
R_t	-0.078609	1.472435	0.1534
R-squared	0.811080	S.E. of regression	0.124352
Adjusted R-squared	0.765739	F-statistic	17.88847
Durbin Watson stat	1.877130	Prob (F-statistic)	0.000000

Dependant Variable: dLQt, d shows change

A summary of the regression results is given in the table 4. A Durbin Watson (DW) statistic value of 1.877 (which is approximately equal to two) indicates the absence of autocorrelation, a crucial requirement of the CLRM. The coefficient of determination (R-squared) indicates that about 81% of the variations in tobacco output are explained by the combined variation in the exogenous variables in the model. The F-test shows that the overall regression is significant at 1% level of significance as indicated by a low probability value of the F-statistic (0) and the greater value of the F-statistic (17.89). On the basis of these statistical results, we conclude that the model is correctly specified and is of a "good fit".

Total area under tobacco is significant at the 1% level of significance. It positively influences tobacco output as shown by the positive coefficient, conforming to apriori expectations. However considering a coefficient of 0.71 which is less than one, the increase is only marginal. A 10% percent increase in acreage is expected to yield 7.1% increase in tobacco output. This shows that tobacco output is inelastic to changes in acreage. The results are in line with those found by Igwe (2011) which had an elasticity of 0.44.

The estimation found yield to be a significant variable in influencing tobacco output at 1%. Yield is positively related to output, that is, output increases as yield increases. From the results, a percentage increase in yield would culminate into a 0.5% increase in output. The adoption of technology to improve yields has positive although minimal effects on overall tobacco output.

The price of soya (a substitute crop) is significant at the 5% level of significance and is inversely related to tobacco output. An increase in the price of soya would result in a decline in tobacco output. The result also reveals that output is inelastic to relative changes in the price of soya, as indicated by a price elasticity of 0.05. A study by Pfumayaramba (2011) also established tobacco output to be price inelastic and negatively related to output.

The number of growers is negative and significantly related to output at the 5% level of significance. A 1 percent increase in the number of tobacco registered growers would result in a 0.3 percent decline in tobacco output. The negative relationship is not in line with our priori expectations. We conclude that new tobacco farmers are less productive when compared to the former large scale commercial farmers. Their low productivity may be attributed to the lack of the technical knowledge which is essential for successful tobacco farming and possibly the lack of the necessary farming equipment

The results show no evidence of a significant influence of previous season tobacco prices on current tobacco output. However, Leaver (2004) and Pfumayaramba (2011) found past prices to be significant in influencing output. We attribute the difference in results to the differing time periods considered in the studies as well as data inconsistencies in the new millennium due to the volatile economic environment that was experienced during that time.

Rainfall level has no influence on tobacco output at 10% level of significance as revealed by the results. We conclude that most tobacco farmers tend to supplement low rainfall with irrigation water and that rainfall levels have generally been on the downside with extreme cases in which droughts have occurred.

SUMMARY AND POLICY RECOMMENDATIONS

The study sought to determine the factors that influence tobacco output in Zimbabwe by employing an OLS methodology on time series data from 1980 to 2012. ADF tests were done to avert the possibility of spurious regression and test results showed that all variables are stationary at 1st difference with the exception of the price of soya and rainfall level which were stationary at levels.

Acreage, yield, number of growers and the price of soya are found to be the significant determinants of tobacco output while rainfall level and previous season tobacco prices are insignificant. We conclude that most tobacco farmers tend to supplement low rainfall with irrigation water and that rainfall levels have generally been on the downside with extreme cases in which droughts have occurred. We also conclude that new tobacco farmers are less productive when compared to the former large scale commercial farmers. Their low productivity is attributed to the lack of the technical knowledge which is essential for successful tobacco farming and possibly to the lack of the necessary farming equipment.

Some policy implications can be drawn from the study results. Policy makers should consider incentives that promote land utilisation since tobacco output is positively related to acreage. The setting and enforcement of a "minimum acreage" for farmers to be registered as growers should also be considered. There is need to construct more dams and irrigation facilities in order to counter the adverse effects of droughts and "below optimal" rainfall levels in tobacco farming. Agricultural institutions such as AGRITEX have to be adequately funded in order for them to implement government agricultural policy through the provision of technical and extension services. The smooth functioning of these institutions assists in the timely and proficient delivery of farmer education on the optimum methods of production.

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