AGRICULTURAL PRODUCTION GROWTH IN THE SADC REGION : AN ANALYSIS OF INFLUENCING FACTORS

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In the past two decades, the performance of agricultural production within the Southern African Development Community (SADC) was characterized by sluggish growth rates. Cross-sectional time-series data of 1974 to 1990 were used to examine the factors that determine total agricultural and food production growth in the region. The results show that agricultural workers, cropped land, fertilizer and use of tractors had significant effects on the regional total agricultural and food production growth. These factors together accounted for between 37 and 41% of the total variation in food and agricultural production growth. This suggests that other variables, not included in the models due to data problems do play a very crucial role. These findings have important implications for improving food and agricultural performance in the region. In promoting food and agricultural growth, SADC governments should not only concentrate on improvements in the productivity of the four conventional factors of production, also on other parameters. Other policy-related variables such as producer prices, weather factors, and irrigation and land degradation indices should be given due consideration.

LANDBOUPRODUKSIEGROEI IN DIE SADC-STREEK : 'N ONTLEDING VAN BEÏNVLOEDENDE FAKTORE

Oor die afgelope twee dekades is die prestasie van landbouproduksie in die Suider-Afrikaanse Ontwikkelingsgemeenskap (SADC) gekenmerk deur lae groeikoerse. Dwarssnit tydreeksdata van 1974 tot 1990 is gebruik om die faktore wat totale landbou- en voedselproduksiegroei in die streek bepaal, te ondersoek. Die resultate toon dat landbouwerkers, bewerkte grond, kunsmis en die gebruik van trekkers betekenisvolle effekte op die regionale totale landbou- en voedselproduksie gehad het. Gesamentlik het hierdie faktore tussen 37 en 41% van die totale variasie in voedsel- en landbouproduksiegroei verklaar. Dit impliseer dat ander veranderlikes wat weens dataprobleme nie in die model ingesluit is nie, 'n baie belangrike rol speel. Hierdie bevindings mag belangrike implikasies inhou vir die verbetering van die prestasie van die voedsel en landbousektore in die streek. In die bevordering van voedsel- en landbougroei behoort SADC regerings nie slegs te konsentreer op verbeterings in die produktiwiteit van die vier konvensionele produksiefaktore nie, maar ook op ander parameters. Ander beleidsverwante veranderlikes soos produsentepryse, weersfaktore, en besproeiings- en grondagteruitgangsindekse behoort aandag te ontvang.

INTRODUCTION

In the past two decades, growth rates of agricultural production in the Southern African Development Community (SADC) member countries (Angola, Botswana, Lesotho, Namibia, Malawi, Mozambique, Swaziland, Tanzania, Zambia and Zimbabwe) have been dismal (Mumbengegwi, 1988). This poor performance has been a major concern of all the SADC governments, donor countries, non-governmental organizations and researchers in the region (SADCC, 1982; Chidzero, 1988). In part, this stems from the historical importance of agriculture to the economies of most of the countries. Also, it reflects the continuing problems associated with food shortages in many of the member countries. Population growth rate in the region has outstripped growth in food production during the same period (SADCC, 1989). The prospects of a reversal of this trend depend on both the region's ability to slow population growth and its capacity to increase production through sustainable and intensive agriculture.

It is no surprise, therefore, that all SADC member countries have adopted either food security and/or self-sufficiency as an objective of national agricultural policies (SADCC, 1982), and SADC, as a regional organization, has endorsed these objectives as the cornerstone of regional policy coordination in agriculture. Agricultural research has accordingly been selected as an area a productive cooperation must be encouraged among its member countries. The subsequent establishment of the Southern African Centre for Cooperation in Agricultural Research (SACCAR) in 1984, attests the desire of the member governments (Mumbengegwi, 1988; Wanchinga, 1991). While the research effort of SACCAR, since its inception, has been geared to the precise objective of increasing food production, thus, reducing hunger and malnutrition in the region, this has yet not been achieved. Food production growth in the region still remains dismal due to many factors including, poor soils, variability and unavailabilty of rainfall, inadequate and high-cost fertilizers, pests and diseases, lack of improved seeds, and labour supply constraints.

The extent of influence of the respective limiting factors is still a subject of considerable debate. This issue has received little or virtually no quantitative attention. This article is primarily concerned with identifying the factors that determine the agricultural and food production growth and in establishing the respective effects of such factors on the regional agricultural production growth over the period of 1974-1990. It is hoped that a better understanding of this will help us to learn how better to proceed in the future with our regional agricultural/food production related problems, particulary those of food security.

The remainder of this article is organized into four sections. First, a brief background of the importance of agriculture in the SADC economy is presented, followed by a discussion of the empirical model and data employed in this study. The results and analysis are presented in section three. Section four ends the article with concluding remarks.

THE ROLE OF AGRICULTURE IN THE SADC ECONOMY

Agriculture plays a crucial role in the economies of the majority of SADC member countries. About 80% of the population in the SADC region live in the rural areas and depend directly or indirectly on agriculture for their livelihood (SACCAR, 1989; Moyo *et al.,* 1993). According to Wilson (1988), agriculture contributes 34% of the Gross Domestic Product (GDP) of the SADC region, employs 79% of the total labour force and accounts for 26% of the total foreign exchange earnings. In countries where mining does not dominate the economy, its contribution to the foreign exchange earnings is very substantial, about 60% (SADCC, 1992; Moyo *et al.*, 1993).

Most farmers in the region are subsistence-oriented. However, there is a considerable number of large scale farmers (SACCAR, 1990). Large scale farmers are, by and large, successful relative to their small-scale counterparts. They are able to obtain sufficient inputs to support their farming operations and achieve higher yields. Although, commercial farming plays a major role in some SADC countries (e.g. Zimbabwe), the bulk of the domestic food production comes from small scale farmers. The staple crop in the region is maize but sorghum is widely grown.

There is sufficient potential in terms of resources endowment, particularly, labour, water and land, for increased agricultural production in the region (SADCC, 1992). Out of a total land area of 477 million ha, only 5% is cropped, 40% is range land, 33% forest and woodland and 22% is considered unsuitable for agricultural use given the available technology (Wilson *et al.*, 1988). However, the majority of SADC member states have experienced stagnant or declining food and agricultural production per capita. Available evidence indicates that the regional food production rose by 0.9 percent per annum during 1971-1980, while food demand and population grew at 3.6 and 3.1 percent, respectively, implying a growing food deficit of 2.7 percent annually over the period (Mumbengegwi, 1988).

EMPIRICAL MODEL AND DATA

The conceptual framework for estimating the factors which influence agricultural production growth in SADC region follows the concept of metaproduction function hypothesized by Hayami and Ruttan (1985). It involves estimation of a regional production function of the Cobb-Douglas type based on data of all the SADC member states. This can be written as as:

$$(1) \qquad Y_{it} = f(X_{jit}, \ldots X_{jnt}, t)$$

where Y_{it} denotes quantity of output produced by country i in year t, X_{jit} is the quantity of input j used by country i in year t, t = time. The implied assumption underlying the use of metaproduction function is that all the producers in the region have potential access to the same set of technology options but the choice of a particular one by each producer will be a function of the resources endowment and relative inputs prices pertaining in each country (Zhao *et al.*, 1991).

In this study, the model is specified for aggregate regional agricultural growth function over the period 1974 to 1990. The specification of the model is based on the judgement of the need to pool cross-sectional time-series data and at the same time trying to account for time-series-related disturbances, cross-section disturbances, and a combination of both. An error-component model is therefore adopted and expressed as:

$$(2) \qquad Y_{it} = f(X_{jit}, \ldots X_{jnt}, m_{it})$$

where Y_{it} and X_{jit} are as described above, and m_{it} is a disturbance-term summarizing the influence of unobserved factors. The empirical equation for the SADC regional agricultural growth function is specified in log-linear form as :

$$(3) \qquad \ln Y_{it} = \ln a_o + a_1 \ln A_{it} + a_2 \ln L_{it} + a_3 \ln F_{it} + a_4 \ln T_{it} + m_{it}$$

where Y_{it} denotes growth rate of agricultural production obtained by country i in year t; A_{it} number of agricultural labour (in thousands of people) used by country i in year t; L_{it} total cropped land (measured in thousand hectares) cultivated by country i in year t; F_{it} total fertilizer (in thousand metric tons) consumed by country i in year t; T_{it} total number of tractors used in country i in year t, $a's$ parameters to be estimated; and m_{it}, already described. According to Pindyck and Rubinfeld (1991), the m_{it} is assumed to compose of three main sources of variation such as

$$(4) \qquad m_{it} = u_i + v_t + w_{it}$$

The first term u_i, the cross-sectional error component captures the time invariant country-specific heterogeneity that can arise from the omission of some key variables, such as land degradation characterisitics. The term v_t, time-series error component represents a year effect common to all countries in a given year, and w_{it}, combined error component. Following observations by Pindyck and Rubinfeld (1991), it is assumed that the disturbance-term may be correlated across time and individual units (countries) and also that the individual error-components are uncorrelated with each other and are not autocorrelated (across both cross-section and time-series units). It is further assumed that the mean effect of the random time-series and cross-section variables is included in the intercept term.

The dependent variable is expressed in relative terms as an average index during 1974-1990 with 1973 equal to 100 because this analysis focuses on the relative changes in output rather than their absolute levels. The specified model is solved for two types of agricultural growth: growth of total agricultural production (TAP) and growth of total food production (TFP). The former accounts for the growth of all total agricultural production reflecting all agricultural activities thus, the gross domestic product produced in agriculture and the latter is the growth of total food production consisting mainly of grain and livestock.

In specifying the model, major effort was made to include all relevant explanatory variables. However, this was constrained by the unavailability of time-series data on certain variables for all the SADC member countries as observed by Lipton (1988). Because of this, some factors crucial for the dominant rainfed agricultural systems in the region, for example, such as rainfall and irrigation variables could not be considered. The model ended up with only the four selected variables for which a complete time-series data exists for all the member countries.

The analysis is based on cross-sectional time-series data from 1974 to 1990 for all the ten countries in SADC region. The data were collected mainly from the various statistical records published by Food and Agriculture Organization (FAO) (e.g. 1980, and SADC publications. To account for cross-section and time-series related disturbances, the model parameters were estimated using two stage least squares procedure (Pindyck and Rubinfeld, 1991).

RESULTS AND DISCUSSION

The estimates of the production function for total food and agricultural growth using two-stage least squares procedure (2 SLS) are presented in Tables 1 and 2 respectively. The parameter estimates are generally satisfactory on both theoretical and statistical grounds. All the regression coefficients are significantly different from zero at or above

Table 1: Log-log estimates of total food growth function (TFP) on SADC member countries time-series data, 1974-1990

Independent variable	Estimated coefficient
Agricultural labour	0.023 [0.85]
Land	1.111 [6.49]***
Fertilizer	0.031 [2.10]**
Tractor	0.130 [7.11]***
Intercept	-32.470 [-1.73]
F-value	19.32***
R^2	0.37
No. of observations	170

*** Indicates that coefficient is significant at 1% level; and ** at 5% level. Figures in [parantheses] are t-values.

Table 2: Log-log estimates of total agricultural growth function (TAP) on SADC member countries time-series data, 1972-1990

Independent variable	Estimated coefficient
Agricultural labour	1.241 [2.00]**
Land	2.038 [6.64]***
Fertilizer	0.781 [4.35]***
Tractor	1.031 [6.87]***
Intercept	8.335 [5.44]***
F-value	29.09***
R^2	0.41
No. of observations	170

*** Indicates that coefficient is significant at 1% level; and ** at 5% level; and at 0.10 level. Figures in [parentheses] are t-values.

the 5 percent level, as indicated by their respective 't'- ratios. Moreover, the estimated coefficients with respect to all the explanatory variables have the expected signs as regards their relationships with the dependent variables. The goodness of fit of the model is acceptable even though the R^2-value for each function is relatively low; it is 0.37 for total food production growth and 0.41 for total agriculture. According to Gujarati (1988), a model's goodness of fit, should not be judged by the high R^2 criterion alone but other criteria (e.g. a priori expected signs or values of the coefficients) should be considered.

The relatively low R^2-values indicate that a greater part of the variability in the agricultural/food production growth is accounted for by certain omitted explanatory variables which really contribute to output variability in the agricultural systems in the region and this may suggest inadequacy in the specification of the model. The latter issue of course was a major concern in the model specification but could not be rectified due to unavailability of cross-sectional time-series data as mentioned earlier on.

RESPONSE OF AGRICULTURAL/FOOD PRODUCTION GROWTH TO THE SELECTED EXPLANATORY VARIABLES

Agricultural workers: Tables 1 and 2 show that the estimated coefficient for agricultural workers is not significant for the food growth function but highly significant for total agricultural production model. The insignificant estimate of labour in the food production model is assumed to be due to an excess labour supply in the food production systems among the rural people who dominate crop production in the region. Several studies (i.e.,Nadar and Rodewald, 1981; Diehl, 1982; Pearson and Smith, 1994) have shown labour productivity among smallholder farming systems to be relatively low.

The switching of labour out of food production activities to different non-food agricultural activities is epected to have positive impact on total agricultural production as revealed in Table 2. Labour shortages have been found to be a major constraint on production of non-food agricultural activities among smallholder farmers. These farmers prefer to spend most of their household labour on food production to utilizing it on any other activity because of their aim of ensuring food security at the household. Hence, it is logical that as of now increases in labour for non-food agricultural activities would bring about an appreciable increases in total production.

Land: The estimated coefficient for land is the largest in absolute terms and significant at 1% level for both agricultural and food growth production models. This implies that increases in land areas resulted in increasing food and agricultural production over the specified period for the region. The positive increasing effect of land on growth of both food and agriculture conforms to expectations. As observed in most African agricultural systems, there is minimal use of yield increasing technologies (i.e. fertilizer) with the exception of the few large scale farming systems. Thus, the only alternative for most of the farmers to utilize their excess labour and increase their production is through area expansion. This, however, is possible only in areas with abundant land.

Fertilizer: The use of fertilizer played a crucial role in increasing the rate of both food and agricultural production growth. Tables 1 and 2 show that the regression coefficients of this factor were highly significant and positive. However, they were the least in magnitude. The significant estimates of this factor in both models are consistent with several studies on individual countries or crops (e.g. Panin *et al.*, 1993). The results indicate that if farmers are encouraged to increase the use of fertilizer, food and agricultural production in the region will likely boost up.

Tractor: The estimates for tractor power are significant at 1% confidence level in both models (Tables 1 and 2). The significant estimates which contrast observations made by several authors (i.e. Donaldson and Mclnerney, 1973; Binswanger, 1978; Panin, 1994; and Panin, 1995) could be attributed to the presence of the few experienced large scale farmers in the region. Donaldson and Mclnerney (1973) and Binswager (1978) observed that the use of tractor power per se has no effect on productivity unless it is associated with other yield-increasing technologies. It is believed that the large scale commercial farmers in the region do operate on a different production level which is quite efficient. They utilize substantial quantities of fertilizer and apply irrigation technologies.

CONCLUSIONS

A quantitative analysis of the factors influencing agricultural/food production growth within SADC region during the period 1974 to 1990 was undertaken in this paper. The results show that agricultural workers, cropped land, fertilizer and use of tractors played significant role in the growth of food and agricultural production in the region during the specified period. However, the combined explanatory power of the four factors accounted for only 37 to 41% of total variation in food and agricultural growth,respectively. The implication of these findings for future development of the current food and agricultural situation in the region is that policy makers, in their attempt to find solutions to address how to improve the efficient utilization of the four factors, should pay considerable attention to other factors omitted in this analysis due to inadequate time-series data.

Policy-related variables such as producer and input prices, weather related factors and irrigation systems are examples of those factors that need consideration in the future research work.

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