DETERMINANTS OF AGRICULTURAL PRODUCTIVITY GROWTH:

EVIDENCE FROM SOMALIA

BY

WARSAME OSMAN MOHAMED

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DECLARATION

This research project is my original work and has not been presented for a degree or any other award in any other university.

Signature: Date: 27th November - 2022

WARSAME OSMAN MOAMED

X50/37623/2020

This research project has been submitted for examination with my approval as university supervisors.

Signature………lmmbithi…………………Date…November 27, 2022…….

DR. MBITHI MARY LUCIA

Senior Lecturer

University of Nairobi

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ABSTRACT

This research examined the empirical relationship between agricultural productivity and variables affecting the scale of agricultural productivity growth in Somalia, in a period of time from 1991 to 2020, a multivariate time series analysis was estimated to ascertain the link between the agricultural productivity and its most commonly impacted factors, moreover; this study employed entirely quantitative study for the assessment of the secondary data for scientific assessment and determining the conclusions for objectives. The main findings of this research can be concluded that fertilizer, agricultural land and labor has positive and significant effect on agricultural productivity growth in Somalia, while tractors use and export doesn't contribute to the growth of agricultural productivity according to the study.

1. INTRODUCTION

1.1 Background Information

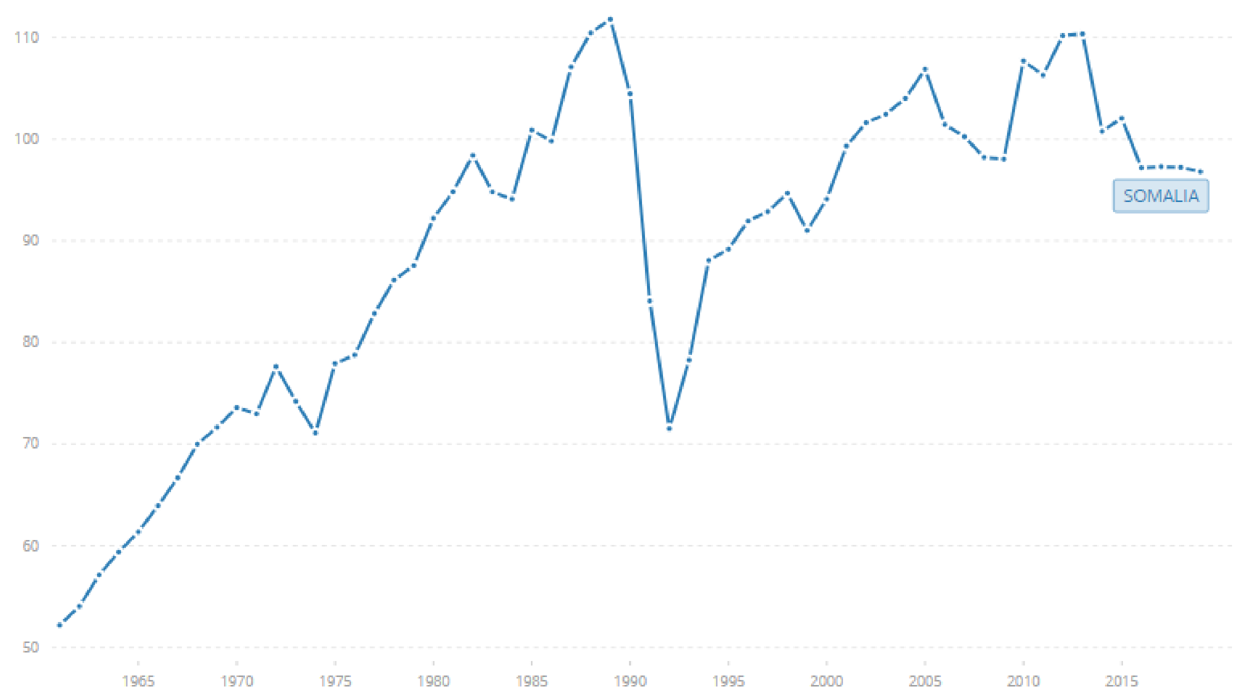
Total factor productivity (TFP) is one of the most revealing indicators of agricultural production. The TFP estimates the quantity of agricultural output created by the mix of land, capital, labor, and material resources used in agricultural output. If total output grows faster than total input, total factor productivity rises (Agriculture, 2022).

Although the modern industrial world was able to leave the Malthusian regime of low population and economic growth and embrace the post-Malthusian regime of high population and economic growth, the Malthusian regime of low growth was the norm until the industrial revolution (Kogel, 2001), nevertheless, development economists across the board have always stressed the need of raising agricultural output as a key to long-term progress (Matsuyama, 1991).

Cropping several risks, including climate shock, have led to below-average spring (Gu') harvests for Somali families this year, which threatens future production levels and food security. Market-related concerns, such as low pricing and demand and high costs for transportation have also been mentioned as obstacles for 2020 and beyond, in addition to weather shocks. During the Gu season of 2020, Somalia had much more rain than typical, which refilled water and pastoral resources and led to improved cattle body states and prices for the majority of the country's pastoral families. Nonetheless, livestock producing families, like cropping households, reported a wide range of obstacles, including problems with markets and access to veterinary services, feed, pasture, and water (FAO, 2021).

Figure 1.1 encompasses crops grown for human consumption and recognized as a source of essential nutrients. Foods like coffee and tea aren't included since they're not very healthy.

Figure 1.1 Food Production Index



Source: (World Bank, 2019)

The United Nations' Food and Agriculture Organization is responsible for compiling the agricultural production index, as seen in the above diagram (FAO). Each year's total agricultural output is measured against the base period of 2014–2016, and the results are shown as an index value on the FAO's agricultural production indexes. They are derived from the aggregate of the volumes of various agricultural products, adjusted for their respective prices and subtracting the volumes put to use as seed and fodder.

Following the late 1970s and early 1980s reforms, agricultural output improved in China, with TFP increasing by an average of 3.40 % per year (Nin-Pratt, 2010). Similar to China, agricultural

TFP growth following reforms in India's late 1980s and early 1990s is at 0.54 percent. The disparities in TFP growth seen in India and China following the reforms are sought to be explained by taking into account two primary aspects. In the first place, China's agricultural development was aided by the country's more basic institutional changes in agriculture, which had a dramatic impact on the industry by boosting efficiency and speeding up technical advancement. There has been no comparable shift in India, where policy changes have mostly included boosting subsidies on inputs, financing, etc., in order to reduce the negative consequences of policies that were unfavorable to agriculture. There were no substantial policy shifts in agriculture after the reforms in 1991 lessened the impact of macro policies on the sector. As opposed to China, India's agricultural TFP series showed little sign of structural change throughout the reform era. The structural break test findings suggest that the transformation of China's manufacturing sector is the second reason driving the disparity in agricultural TFP growth between India and China.

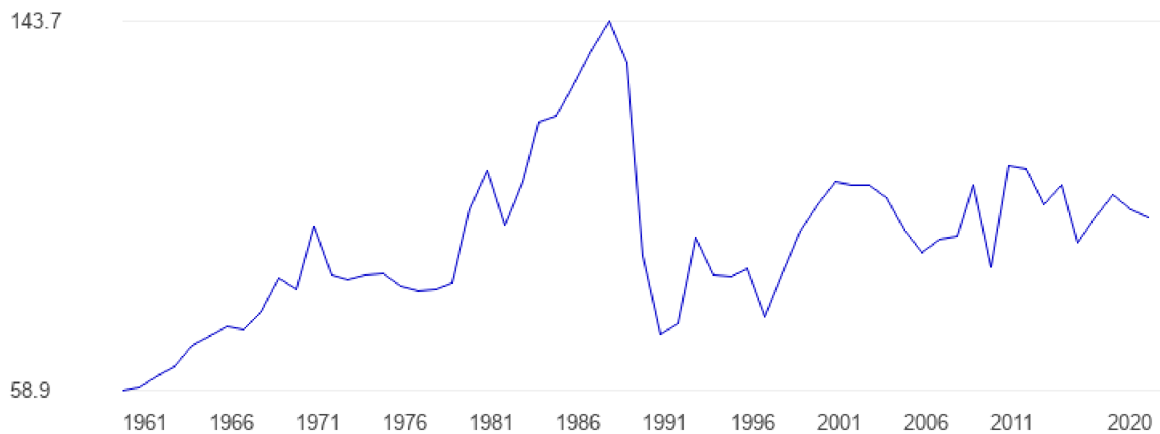
According to (Wanga, 2012), the fast productivity rise in China's agricultural industry is a result of a variety of factors, including reforms, open policies, greater investment in agricultural study, rural infrastructure, and education, and a general trend toward higher productivity. Legal reforms affecting farmland may have also contributed to a rise in China's agricultural output.

1.2 Crop Production

According to the Global Agricultural Productivity Index, an increase of 1.73 percent per year in agricultural productivity is needed to supply food, feed, fiber, and bioenergy sustainably for 10 billion people by 2050. North America, Latin America and Europe are agricultural powerhouses, yet they are seeing a slowdown of rural poverty even as China and South Asia have robust productivity development. In low-income nations, agricultural production is growing at a pace of just 1 percent per year on average. For the UN's Sustainable Development Goals to be achieved, low-income farmers' production must be doubled by 2030 (Tech, 2019).

Based on data for the 2004-2006 base period (2004-2006 = 100), Figure 1.2 displays agricultural production index data for Somalia from 1961 to 2020. During this time period, the average value for Somalia was 93.2 index points, with a low of 58.9 index points in 1961 and a high of 143.7 index points in 1989. The most recent 2020 value is 98.4 index points. Comparatively, the global average for 2020 based on 188 nations is 106.7 index points.

Figure 1.2 Somalia: Crop Production Index



(FAO, 2018)

Somali federal government took strategic policy with the assistance of World Bank and FAO, this strategy, which ensures country ownership and improved coordination, provides economic opportunities and jobs for youth, and uses remittances from the diaspora for investment rather than consumption, should aim to achieve the following goals:

Increase crop production above pre-war levels by fully restoring pre-war public infrastructure and introducing improved technologies and climate-smart farming practices, Protecting and enhancing the natural environment given the vulnerability of all agricultural sub-sectors to the adverse impacts of climate change, Transforming private-run production systems across all sub-sectors into modern, commercial and competitive production systems that add value through agro-processing, and lastly strengthening household resilience and reduce hunger and malnutrition, including through the introduction of advanced technologies for long-term post-harvest storage and drought risk mitigation. (World Bank and FAO, 2018)

1.3 Problem Statement

Increases in agricultural output have the potential to hasten the advent of industrialization, which in turn can have far-reaching impacts on a nation's per capita income. However, the analysis' primary focus is on how learning more about the factors that affect agricultural output can aid in comprehending how currently poor countries develop.

As the economic growth is a common target for every nation in the corners of the world, and even more attaining food security and generating hard currency from agricultural sector is vital for the developing countries.

Somalia in particular for the trajectory of prosperous country, it looking for research based theories of how enhance the agriculture and food security for the Somalis and making strategies to combat droughts and famine the most, with 5.6 million people are currently at risk of food insecurity and the combined effects of protracted drought, floods, desert locusts, the economic impact of COVID-19, and violence have left 2.8 million people unable to satisfy their daily food demands. (IFRC, 2021)

Following these crises, this study analysis the variables that really helps the increment of crop production and how long they contribute on it.

1.4 Objective of the study

1.4.1 General objectives

The main objective of the research is to examine the determinants of agricultural productivity growth in Somalia.

1.4.2 Specific Objectives

i) Analyze the effect of various factors of production on agricultural productivity growth in Somalia. These factors are: fertilizer use, agricultural land, tractors, Labor and export.

ii) Provide recommendation to policy makers in Somalia on actions they can take to increase agricultural productivity

1.5 Significance of the Study

Policymakers will benefit from the research findings in understanding the determinants of agricultural productivity growth in Somalia so as to come up with strategies and policies for attracting the foreign investors. The study findings will assist the government, especially ministry of planning and economic development in formulation of economic policies, in particular, fiscal policy; that is aimed at encouraging the existence and sustenance of agricultural productivity in the country.

The study is also beneficial to the ministry of agriculture and irrigation in coming up with initiatives to ensure foreign investors have access to conducive environment for investment.

The outcomes of the study also provide and contribute to the principal theories of the agricultural productivity impacts on growth. In addition, the research makes addition to theoretical and empirical literature on agricultural productivity effect on growth of the economy and this paves way for future studies. This adds to the existing knowledge on Determinants of agricultural productivity growth.

1.6 Organization of the Study

The research is organized as follows: the second chapter reviews relevant literature, and the third chapter describes the methodology used in the research, including its research design, model specification, variable definitions and measurement, theoretical framework, and data collection and analysis procedures. The fourth chapter includes the research results, while the fifth chapter provides a summary of the findings of the study, conclusions, and policy implications.

2. LITERATURE REVIEW

2.1 Theoretical Literature

We may say almost the focal point of growth of agricultural productivity doesn’t concern a single objective-the growth of the economy, but also to generate more productive use of underutilized factors, especially labor force.

Understanding the structural changes that lead to a greater growth rate and, simultaneously, a decline in the number of people who are underemployed or jobless is central to the field of economic development.

Concerns of this sort are particularly pertinent to the scenario of under developing nations, where a substantial lot of labor force is stuck in the subsistence sector, and where an overall improvement in social and economic sustainability will take place only if both of these outcomes are unachievable.

2.1.1 The Structural Change

The Lewis model, first presented in 1955, was the standard in the field of development theory throughout the 1960s and 1970s. It's been called the surplus labor model, the two-sector model, and a few more names. The paper highlighted the need of nations shifting their economic emphasis from labor-intensive agriculture to more productive industrial pursuits.

In contrast to the structural change model, which has primarily focused on the mechanism by which developing countries transition from an emphasis on traditional subsistence agriculture to an urbanized, modern, and industrially applications diverse service and manufacturing economy, the indigenous technology myth proposes that there is a so-called appropriate indigenous technology that is better adapted to the needs and traditions of developing nation (Agbenyo, 2020).

According to (Daniele, 2012), the analytical frameworks of Leontief et al. (2012) a term used specifically by Leontief but which is based in the tradition of classical economists' examination of structural change identify the key aspects for the structural analysis of economic systems.

Some aspects of an economy's structure are widely regarded to remain constant while others are subject to change. Since the invariance of a structure is always measured in relation to some predetermined description of the structure, this property is a defining one of structure change analysis. This premise is crucial for identifying the range of changes that a certain economic system might experience. The concept of relative structural invariance is intimately connected to the circular method. Because a temporally differentiated representation of the interrelationships within the economic system may be made possible by the relative structural invariance, structural change can be studied.

2.1.2 The Cobb Douglas Production function

The Cobb-Douglas production function was developed as a consequence of Paul H. Douglas and C.W. Cobb's research into the American industrial sector. The industrial production function is a first-degree linear homogeneous production function that takes labor and capital as inputs.

Potential output growth is often used as a measure for the health of an economy's supply side. Although the potential for performance may be estimated, it is not directly observable in practice. By using total factor productivity as a measure for technical and allocative efficiency and hence supply-side operating, the production function approach to measuring potential output growth accounts for the contribution of labor, capital, and the wider economy.

If, on the other hand, total factor productivity trends upward but capital growth rates remain unchanged, one may infer that the supply side is not operating efficiently. So, the production function is a potent instrument for analyzing the macroeconomy and rating the effectiveness of government structural programs. In order to put the production function approach into practice, it is necessary to make assumptions about the nature of the production technology, the size of the market, the features of the technical product, and the returns on investment.

As a result of these assumptions, the range of possible values for the elasticity of output in terms of labor and capital is constrained to zero and one, respectively. For the purposes of approximating the theoretical technical coefficients in reality, the income shares of labor in the output generated is used. To the extent that technical coefficients remain constant, the relative importance of various components of production should also remain constant. If it is not believed that nations have different levels of aggregate technology, then the labor shares should also be comparable (Hajkova and Hurnik, 2007).

Considering that standard neoclassical assumptions like constant returns to scale and perfectly competitive marketplaces are indispensable, (Felipe and Adams, 2005) concluded that neither the existing of the aggregate production function nor its rejection could be verified empirically.

2.2 Empirical literature

(Warr and Suphannachar, 2020) examined the connection between rising agricultural production and rural poverty in Thailand using data at the regional level. The response variable in the regression analysis was the annual rate of change in rural poverty at the regional level between years of available poverty data. Rate of change in total agricultural output by region during the same time periods as poverty measurements, with a one-year lag to account for. Real food prices and non-farm regional incomes were two additional control variables. Negative and statistically significant estimates for the coefficient of change in agricultural productivity suggested that increased productivity in agriculture alleviates rural poverty while holding all other factors constant, with the exception of non-agricultural income.

Using growth accounting methods (Chambers and Pieralli , 2020) investigate the relationship between TFP expansion across US and climate. The focus is on tracing the development of this link from the 1960s to the end of the twentieth century. State-level agricultural TFP growth may be broken down into technology adoption, input/scale effects, weather-related frontier changes, and modification to the limit with the use of an empirical calculation of the production potential frontier derived from state data and mathematical programming. Average state total factor productivity is heavily influenced by technological progress and frontier shifts. The Midwest, while it is still a climatic center, is particularly vulnerable to weather-related impacts because of its location.

(Fan, 1998) used state-level data from 1970-1993 to build a simultaneous equation model assessing the effects of many types of government expenditure on productivity growth in India. Government expenditure on productive output investments (most notably agricultural studies and expansions), rural infrastructure (most notably transport and education), and rural development explicitly focused at the rural poor reduced rural poverty, the study found.

Using yearly time series data from 1986 to 2014, (Matthew and Mordecai, 2016) studied the impact of agricultural production on economic development in Nigeria using a variety of statistical methods. The study found that agricultural output (AOUT) and public Agricultural Expenditure (PXA) were the principal drivers of economic development, as assessed by per capita income, using the Extended Dickey-Fuller unit root test and the vector autoregressive model (PCI). The majority of the delays between the variables were not statistically significant, as shown by the multivariate VAR model. The strong R2 and F values in the VAR regression estimations for PCI, on the other hand, provided persuasive evidence that all lagged components were statistically significant overall, suggesting that agriculture plays a significant part in Nigeria's economic growth. The analysis of variance showed that agricultural shocks contributed more to economic growth than did feedback shocks.

According to research (Muturi and Wangusi, 2015) that analyzed the effects of public expenditure on agriculture on productivity in Kenya, there was a positive and highly significant link between donor agricultural investment and agricultural worker productivity. The government should have continued to encourage donor growth of money for agriculture to appropriately increase agricultural productivity, since it was clear that various forms of agricultural expenditure have varying impacts on agricultural output.

(Ebenezer, 2019) examined the influence of public investment on agricultural output in South Africa using annual time series data from 1983 to 2016. Spending by the government on agriculture had been shown to increase agricultural output, but this effect was long-lasting and only projected to had a positive, statistically significant impact in the future. Moreover, in light of climate change and the increasingly commercial nature of the agricultural system, the importance of government support in South Africa's agricultural sector was emphasized. Even if government investment on the sector in South Africa increased, it would still be too low to have the intended effect on productivity development. Increased government support for agriculture had the potential to boost output in the near run.

Since the beginning of the first term of the Five Year Plan, agricultural growth has depended significantly on government support (FYP). Public funding has increased as a result of agricultural and industrial successes and economic reforms, reducing agriculture's historical contribution of GDP. The agriculture economy might be negatively impacted by this tendency.

Employing time series data spanning 1951–52 to 1988–89, (Selvaraj, 1993) sought to evaluate the influence of government investment on agriculture on agricultural production growth. The study also examined how budgetary inconsistency hinders agricultural development, as the findings demonstrate the importance of government spending policies to the expansion of the agricultural sector and the detrimental effects of cuts to agricultural funding. Government expenditure volatility was shown to be negatively connected to agriculture sector expansion.

In LAC, empirical evidence on the effectiveness of specific interventions to support the delivery of public goods and a range of different types of private agricultural productivity subsidies varies significantly from project to project. So far, empirical evidence on access to information, particularly market information, shows that decreasing inequalities and information gaps have a significant influence on farmers' ability to command higher prices. Also, there is very limited evidence on the influence of direct payment schemes on agricultural productivity and their impact on helping farmers overcome investment barriers (Lopez, 2017).

(Olesen and Bindi, 2002) evaluated what was known about how global warming affects farm output in Europe and what it means for research and policy. The growth season for certain crops (such as cereals) may decrease as a consequence of warming, while the growing season for other crops (such as root vegetables) may expand. Increases in atmospheric CO2 levels will immediately boost plant production and enhance resource use effectiveness, so these impacts may amplify current trends of intensive agriculture in Europe's west and north and intensification in the Mediterranean and south-eastern Europe. However, same benefits may have the reverse effect in the south-eastern Europe and Mediterranean owing to the probable rise in water shortages and severe weather events, which might lead to lower agricultural yields, more yield variability, and a decrease in land appropriate for conventional crops. Europe's agricultural industry requires assistance adapting to climate change, and the whole agricultural sector needs assistance mitigating climate change by lowering greenhouse gas emissions.

European food crop production has been estimated using the IPCC SRES framework's several scenarios from 2000 to 2080 (Ewerta, 2005). The findings highlight the significance of technical progress for future productivity, focusing emphasis on the linkages that affect technological progress. Significant increases in productivity, especially in a global market, point to the anticipated continuation of agricultural land abandonment in Europe over the next years. Alterations in agricultural land use and the availability of new alternatives for such usage may have far-reaching effects on the design of future food production systems. In order to conduct such an analysis inside the SRES scenario paradigm, the estimates of productivity changes were crucial.

The approximation of the nation's long-term agricultural productivity equation found a substantial inelastic relationship between total export, foreign reserve, inflation rate, and external debt external debt (Brownson, 2012). In contrast, manufacturing capability utilization and the nominal naira to US currency exchange rate have a significantly positive relationship. However, the study found a significant negative inelastic correlation between total exports, foreign reserves, foreign debt, and inflation rate in the short-term model for agricultural productivity, and a positive inelastic influence between CRP per capita, industrial capacity utilization, and the nominal exchange rate. The results of the new research employing variance decomposition and impulse response analysis corroborate the earlier ones, and they also provide new insights into the historical trend of agricultural output.

(Mathur, 2016) Over time, some plantation rice, crops, and wheat lost comparative advantage to cotton, maize, and various fruits and vegetables. India is losing its strategic advantage, particularly in Asia, in the export of spices and other plantation-derived items. Enhancing a country's export comparative advantage guarantees a rise in exportable surpluses at internationally competitive prices. There were substantial differences in yield increase across crops and crop groupings. Possible determinant of India's capacity to develop exportable surpluses, comparative advantages, and export expansion would be yield enhancements resulting from changes in TFP.

Non-agricultural exports are crucial to Pakistan's long-term economic development and prosperity, according to (Zahir, 2012). The study e advocated for policy changes that would boost non-agricultural exports from the government. Providing companies with incentives like tax breaks, subsidies, and low-cost energy may boost exports of non-agricultural items. Also, the export composition of a country should be altered by shifting away from raw materials and semi-finished goods and toward completed goods.

Using multi-period multilateral TFP indicators across a 34-year time frame, (Anik, 2017) evaluated the long-term viability of South Asian agriculture (1980-2013). Along with this, the study investigated how financial investment had boosted agricultural output in South Asian countries. Overall, the statistics suggested that agricultural production was increasing in all nations, but at different rates. Estimated annual total factor productivity (TFP) growth rates ranged from 0.06% in Nepal to 1.05% in Bangladesh, 0.52% in India, 0.38% in Pakistan, and 0.06% in India (Sustainability 2017, 9, 470, 19 of 24).

(Headey, 2010) examined DEA and SFA data for agricultural TFP increase in 88 countries from 1970 to 2001. It was argued that because there was so much room for mistake in national statistics on agricultural production and inputs, the results from the SFA would be more applicable in most cases. SFA-based series have been proven to be more stable, having a stronger relationship to labor productivity, and to be devoid of the kinds of technical mistakes sometimes seen in DEA estimations. Despite the inherent subjectivity of such assessments, the SFA results were consistent with established theories of TFP growth in China and India.

(McMillan, 2015) the Chinese government devised a technique for analyzing the relative impact of price rises and implemented an accountability system for improved agricultural performance as part of the 1978 economic reforms. Taking use of a production function method that accurately reflected farmers' optimal effort decisions. When the value of agricultural goods or the value of the peasants' portion of the marginal product rises, the amount of work provided by the peasants rises accordingly. The central case results indicated that higher prices accounted for 22% of the rise in output in Chinese agriculture between 1978 and 1984, with caveats regarding the theoretical model's simplifying assumptions, data limitations, and the exclusion of other possible sources of productivity growth from the analysis. The projected 32% rise in agricultural total factor output can be linked to the incentive effects of the transition from the communal to the responsibility system after 1978. These findings held up rather well in the face of alternative evidence and theories.

(Birch, 2018) discovered that pricing information influenced production activities, such as B. selecting what to plant and when to harvest, pushing farmers to grow current crops but having less impact on the introduction of new ones. Uncertain was its effect on farmers' negotiating strength. Demand information was often seen as more crucial for decision making than pricing data. A third of farmers who use M-Farm still rely on radio for pricing information and rate its quality as equivalent. In the early phases of manufacturing, radio was seen as a valuable source of information, whereas M-Farm becomes more significant as the sale nears. Despite the fact that potentials for expanding these services were identified in light of technological improvements and cost reductions, some reservations were expressed: the majority of these services were still in their infancy and have not been monitored and evaluated; their development should have be driven by customer requirements and not by technology available; and they can only ever be a part of a broader solution to the challenges facing the sector.

2.3 Overview of the literature review

The majority of research on agricultural productivity factors measure agricultural productivity as the ratio of agriculture products to agricultural inputs. While individual output is normally assessed by weight, sometimes known as crop yield, quantifying total farm output is complicated by the presence of diverse food. Therefore, agricultural productivity is often judged by the final product's market worth.

From the literature that has been done by scholars hasn’t been focused on the geographical area pertaining my research topic, and this study shall contribute what determines agricultural productivity growth in Somalia so far.

3. METHODOLOGY

This chapter is third chapter of the research of determinants of agricultural productivity growth, the chapter covers the study's theoretical framework, the research design, model specification, then, description of the data used and the source of that data and finally fingering out the statistical software used in data analysis.

The study depends only on quantitative research for the evaluation of secondary data for scientific evaluation and the establishment of objectives.

Correlational research was highly accepted in the determination of the variables considering as Determinants of agricultural productivity growth in Somalia.

3.1 Cobb-Douglas Production Function

The Cobb-Douglas function type is homogeneous of degree E$i. The return to scale parameter, or function coefficient, is equal to the sum of the $ values at each input, provided all inputs are explicitly treated as variables. The $ values represent the elasticity of production with relation to the corresponding input and are constants (Debertin, 2012).

Returns to scale show the proportionate change in output when all components experience the same proportional change.

Cobb–Douglas production function is a specific kind of production function that is often used to depict the technical connection between the quantity of two or more inputs (typically physical capital and labor) and the quantity of output that may be generated by those inputs.

Cobb-Douglas production function states that returns to scale equal labor and capital output elasticities: $\alpha + \beta$.

If $\alpha + \beta = 1$ you may argue that returns to scale are constant. It indicates that doubling the quantity of capital and labor would results in double the output. This is what Paul Douglas saw when he originally established the function from the available United States industry data (Manias, 2022).

3.2 Model used in the analysis

Model specification is derived from theoretical framework as follows;

$$CrP = \beta_0 + \beta_1 Frt + \beta_2 AgricLND + \beta_3 Tr + \beta_4 L + \beta_5 EXP + \varepsilon$$

Where:

Frt – Fertilizer, **AgricLND** – Agricultural land, **Tr** –Tractors , **L** – Labor, **EXP** – Export

β_0 – Constant, β_1, β_2, β_3, β_4 and β_5 are Regression coefficients.

ε - error term.

3.3 Data types and source

The research utilised secondary data sources, which covers in period of 1991 to 2020 in which majority of the data on Crop production, fertilizer, agricultural land, tractor, labor and export are obtained.

The source of the data acquired from World Bank and relevant thesis and journals. Data for this study is time series data in which observations are made on the basis of several variables over a certain period and are usually organized sequentially when the time horizon, such as annually, is different.

The study was collected annually for all the variables such as crop production, fertilizer, agricultural land, tractor, labor and export, quantitative data will also be analyzed using trend analysis and descriptive statistics including standard deviation, mean, kurtosis and skewness.

Table 3: Summarizes the variables used in the study, their measurements, data sources and hypothesis.

Table 3: Description of variables used in the study

Data type/ variable	**Source**	**Hypothesis/Expectation**
Crop production (measured in tons per hectare)	World Bank	
Fertilizer use quantifies the amount of plant nutrients utilized per unit of arable land. Includes nitrogenous, potash, and phosphate fertilizers (including ground rock phosphate)	World Bank Development Indicators	Positive effects (if fertilizer use increases, productivity increases)
AgricLND (Agricultural land is the proportion of land that is arable, under permanent crops, and under permanent pastures)	World Bank Development Indicators	Positive effects (if agricultural land increases, productivity increases)

Tractors (Units per 100 sq/km of arable land)	African Development Bank Indicators	Positive effects (if tractors use increases, productivity increases)
Labor productivity (total output / total input)	World Bank Development Indicators	Positive effects (if labor productivity increases, productivity will increase)
Export (amount of dollar received from export)	World Bank Development Indicators	Positive effects (if the export goes up, productivity increases)

3.4 Pre-Estimation Tests

These are the Pre-Estimation Tests that will be undertaken:

3.4.1 Augmented Dickey Fuller (ADF) Unit Root Test

The ADF test is a statistical significance test, hence it offers results for null and alternative hypothesis testing. The unit root test yields a p-value from which it is necessary to make inferences on the stationarity of the time series (Verma, 2021)

3.4.2 Normality Test

This is examined through the Shapiro-Wilk test. When the Shapiro-Wilk significance value is larger than 0.05, the data are often available. Below 0.05, the results are significantly out of line with the normal distribution.

3.4.3 Multicollinearity Test

Multicollinearity is a statistical term that defines the correlation of numerous predictor variables inside a model. Two variables are deemed completely collinear if their correlation coefficient is +/- 1.0. Multicollinearity between predictor variables makes statistical results less accurate (HAYES, Multicollinearity, 2022)

3.5 Post estimation test

3.5.1 Heteroscedasticity Test

Heteroscedasticity happens in statistics when the standard deviations of a predicted variable are evaluated over a range of predictor variable values or compared to previous time periods and exhibit no consistency. Visual inspection of residual errors shows that heteroscedasticity is present when the mistakes spread out over time (HAYES, Heteroskedasticity, 2022).

3.5.2 Regression analysis

Regression analysis refers to a collection of statistical procedures used in statistical modeling to estimate the associations between a dependent (or "outcome") variable and one or more predictor variable (or "covariate," "explanatory," or "feature").

3.6 Limitation of the study

Lack of existing research on the issue that would have permitted further analysis, In fact, the previous studies forms a separate section and generally occupies the second section of the framework of scientific inquiry, and is of course closely related to it.

The prior studies contribute to the improvement and enrichment of scientific research and provide the researcher with a solid basis and essential information about the research carried out.

In this way, the researcher should be familiar with all the information related to their research. In addition, the previous studies also help the researcher not to repeat the areas already studied and never fall into the same mistakes made by other researchers.

4. DATA ANALYSIS INTERPRETATION AND DISCUSSION

4.1 Introduction

The objective of this research is to examine the determinants of agricultural productivity growth in Somalia. Analyze the effect of various factors of production on agricultural productivity growth and Provide recommendation to policy makers in Somalia on actions they can take to increase agricultural productivity

4.2 Descriptive Statistics

The findings in Table 4.1 provides the descriptive statistics for the following variable: fertilizer use, agricultural land, tractors, Labor and export. For the period 1991 to 2019.

Table 4.1: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
crp	30	95.114	10.41035	71.83	110.17
fertilizer	30	2024201	959136.7	1000000	3806128
agriclnd	30	70.3246	.1450523	70.17725	70.73836
tractor	30	.040371	.006381	.03188	.06321
labor	30	699335.5	1016065	145975	2884818
export	30	13.9	7.644471	1	27

The data suggest that the mean CRP for the period is 95.11, with maximum and lowest values of 110.17 and 71.83, and a standard deviation of 10.4. The average use of fertilizer over the research period is 2024201, with a minimum of 1,000,000 and a maximum of 3806128. The standard deviation is 959136.7. The average Agriculture land for the period is 70.32; the maximum is 70.73 while the standard deviation is 0.145. The average labor force measured for the period is 699335.5

where the maximum labour force size is 2884818 with a minimum of 145975 and standard deviation of 1016065.

4.3 Estimation Tests

4.3.1 Augmented Dickey Fuller (ADF) Unit Root Test

Table 4.2: Making a model for forecasting purposes in time series analysis, we are examining if this time series analysis is better for prediction by being stationary or not.

Source SS	df MS	Number of obs	= 30
	F(5, 24)	= 4.85	
Model 1579.93257	5 315.986514	Prob > F	= 0.0033
Residual 1562.95607	24 65.1231698	R-squared	= 0.5027
	Adj R-squared	= 0.3991	
Total 3142.88864	29 108.37547	Root MSE	= 8.0699
crp Coef.	Std. Err. t P>t	[95% Conf.	Interval]
fertilizer 4.21e-06	1.70e-06 2.47 0.021	6.90e-07	7.72e-06
agriclnd 39.14454	11.08849 3.53 0.002	16.25903	62.03005
tractor 179.6362	356.932 0.50 0.619	-557.0353	916.3077
labor 8.78e-07	2.11e-06 0.42 0.680	-3.47e-06	5.22e-06
export -.1594618	.293434 -0.54 0.592	-.7650798	.4461563
_cons -2671.873	776.7507 -3.44 0.002	-4275.008	-1068.738
Durbin-Watson d-statistic(	6, 30) = 1.665592		

According to the above table; R-squared is 0.5 and Durbin-Watson is 1.6, following the rule of thumb that when R-squared is less than Durbin-Watson the data come to be stationary.

4.3.2 Normality Tests

The findings of the test for normality of the study's variables are shown in Table 4.2.

Table 4.3: Normality tests

To ascertain whether the variables were normally distributed, the Jarque-Bera test was used. In this situation, the null hypothesis is that the variables are not substantially out of line with a normal distribution.

All the variables in this scenario have Jarque-Bera probability values higher than the level 5%, indicating that they are statistically insignificant and follow a normal distribution.

Skewness/Kurtosis tests for Normality			
	-------	joint ------	
Variable Obs Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
crp 30 0.1455	0.8900	2.33	0.3123
fertilizer 30 0.2206	0.0009	10.15	0.0063
agriclnd 30 0.0005	0.0168	13.62	0.0011
tractor 30 0.0051	0.0037	12.67	0.0018
labor 30 0.0012	0.3705	9.39	0.0091
Export 30 0.9702	0.0509	4.04	0.1329

4.3.3 Multi-collinearity Test (Variance Inflation Factor)

The variance inflation factor (VIF) is shown in Table 4.4; it quantifies the extent to which one predictor variable's behavior (variance) is affected by its interaction/correlation with other predictor variables.

Variable	VIF	1/VIF
tractor	2.31	0.432904
Export	2.24	0.446295
labor	2.04	0.490631
fertilizer	1.19	0.841352
agriclnd	1.15	0.868048
Mean VIF	1.79	

The above table shows that there is no Multicollinearity problem in the study. Because all variables are less than 10 according to their variance inflation factor.

4.4 Post-Estimation Tests

4.4.1 Normality of the Residuals

Skewness and kurtosis of transformed multivariate data to guarantee independence form the basis of the Doornik-Hansen test for multivariate normalcy (Doornik and Hansen, 2008). Its null hypothesis is that the underlying data is normal.

Table 4.5 Normality of the Residuals

	Skewness/Kurtosis	tests for Normality	
	-------	joint ------	
Variable	Obs Pr(Skewness)	Pr(Kurtosis) adj chi2(2)	Prob>chi2
myResiduals	30 0.8233	0.7825 0.13	0.9389

Results from table 4.4.1 imply that we fail; to reject the null hypothesis, thus the underlying data is normal.

4.4.2 Auto Correlation

Table 4.6 explains the correlation between two observations at different points in a time series.

	crp	fertil~r	agriclnd	tractor	labor	Export
crp	1.0000					
fertilizer	0.3871	1.0000				
agriclnd	0.5275	-0.0878	1.0000			
tractor	0.3773	0.3127	0.3047	1.0000		
labor	0.2548	0.1412	0.0482	0.3185	1.0000	
Export	-0.0138	-0.0080	0.1843	0.4058	-0.4520	1.0000

This table 4.3 indicates a perfectly positive linear correlation between all variables following their Pearson correlation coefficient.

4.4.3 Heteroscedasticity of Residuals

The variance of the residuals is assumed to be fixed in the context of ordinary least squares (OLS) (i.e. they should be Homoscedastic). This study used the Breusch-pagan test to test for heteroscedasticity.

Table 4.7: Test for heteroscedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fertilizer agriclnd tractor labor Export
chi2(5) = 7.00
Prob > chi2 = 0.0609

The probability value of the chi-square statistic is more than 0.05, as seen in the figure. Therefore, at a 5% level of significance, the constant-variance null hypothesis may be rejected. Since heteroscedasticity is not present, the residuals must be normally distributed.

4.5 Regression Estimate

Table 4.8 shows the processes of estimating the link between a response variable and predictor variables.

Source	SS	df MS	Number of obs	= 30	
		F(5, 24)	= 4.85		
Model	1579.93257	5 315.986514	Prob > F	= 0.0033	
Residual	1562.95607	24 65.1231698	R-squared	= 0.6027	
		Adj R-squared	= 0.4991		
Total	3142.88864	29 108.37547	Root MSE	= 8.0699	
crp	Coef.	Std. Err. t	P>t	[95% Conf.	Interval]

fertilizer	4.21e-06	1.70e-06 2.47	0.021	6.90e-07	7.72e-06
agriclnd	39.14454	11.08849 3.53	0.002	16.25903	62.03005
tractor	179.6362	356.932 0.50	0.619	-557.0353	916.3077
labor	8.78e-07	2.11e-06 0.42	0.043	-3.47e-06	5.22e-06
Export	-.1594618	.293434 -0.54	0.592	-.7650798	.4461563
_cons	-2671.873	776.7507 -3.44	0.002	-4275.008	-1068.738

The F-test of the model is statistically significant. Its value is 0.0033 This means independent variables have jointly significant effect. Significantly to explain the dependent variable this is crop production. The fitness of the model is good. This can be explained based on R2. The R2 of the model is high, which is 0.6027. This means that 60% of the variation comes from fertilizer, agricultural land, tractor, labor and export.

5. CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Introduction

This section concludes the research and summarizes its key results. In addition, it summarizes the dissertation's most important finding, discusses its policy implications, and recommends measures to boost the factors influencing agricultural productivity.

5.2 Summary of key findings

The findings of the model show that the coefficient of fertilizer is positive and statistically significant at the 5% level. This means that there is significant relationship between fertilizer and crop production in Somalia. If fertilizer increases by one unit, the crop production will increase 4.2 units.

(Endale, 2011) calculated using data on fertilizer application and output for the five most important cereal crops. Except for sorghum, all of the outcomes were optimistic and statistically significant. Sorghum differs because fewer farmers in the sample produce the crop and because it is often planted in low-rainfall regions.

The coefficient of agricultural land is positive and statistically significant at the 5% level. This means agricultural land has a positive and great impact on crop production in Somalia and a unit of agricultural production contributes 39.14 crop production.

In order to approximate the theoretical technical coefficients to reality, the income shares of labor in the generated output are used. As long as the technical coefficients remain constant, the relative importance of different production components should also remain constant. Unless nations are assumed to have different levels of aggregate technology, the proportions of work should also be comparable (Hajkova and Hurnik, 2007).

(Shilpi, 2016) applies the exclusion constraint on rain in the result regressions, providing the point-estimated causal impact of a rise in crop (rice) production on the outcome variables. According to IV estimates, a 1% increase in agricultural output leads to a 0.5% rise in personal consumption and a 1% increase in farm pay.

In contrast, tractors has statistically insignificant relationship with crop production. This means that there is no relationship between tractors use and crop production in Somalia, on the other side, labor has a significant link with crop production and according to it's coefficient tells that a unit of labor increases crop production by 8.7 unit and finally export has no relationship with crop production.

In spite the lack of relationship between crop production and tractor use in this study, (Umar, 2021) concluded that the use of tractors in Nigeria is a necessary evil as Nigeria's growing population, despite its crowding out tendency and cost, calls for investment in mechanized agriculture to increase productivity, improve farmers' income and livelihoods and especially to achieve food security.

(Ingram, 1994) discovered that trade performance is a significant factor in long-term productivity increase. It was shown that agricultural export increase had a statistically significant beneficial effect on productivity. Negative export growth in several nations over the research period was the cause of productivity declines in three of the four areas examined.

5.3 Conclusion

The conclusion is almost not contradicted to the previous studies and settled that;

5.3.1 The coefficient for fertilizer was positive and signification. Based on this finding, it is concluded that:

Fertilizer is an important determinant of agricultural productivity in Somalia.

5.3.2 The coefficient for agricultural land was positive and significant, its therefore concluded that the size of agricultural land is a vital determinant of agricultural productivity in Somalia.

5.3.3 The coefficient for labor was positive and significant, its therefore concluded that the labor is a determinant of agricultural productivity in Somalia.

5.3.4 The coefficient for tractor was positive but have insignificant relationship with crop production, its therefore decided that the tractor is not a vibrant determinant of agricultural productivity in Somalia.

5.3.5 The coefficient for export was negative and insignificant, Its therefore concluded that the export is not a factor determining agricultural productivity in Somalia.

5.4 Policy Implications and Recommendations.

From the results of the research, the following policy recommendations are suggested:

i. Government should find ways of ensuring increased use and widespread use of fertilizers in Somalia.
ii. Realizing potential productivity gains in Somalia requires a clear definition of property rights, ensuring security of land tenure and enabling the use of land as security.
iii. The government should provide trainings to labor force which brings down the rampant youth unemployment, plummeting the rate of poverty and increases the rate of agricultural output in Somalia.

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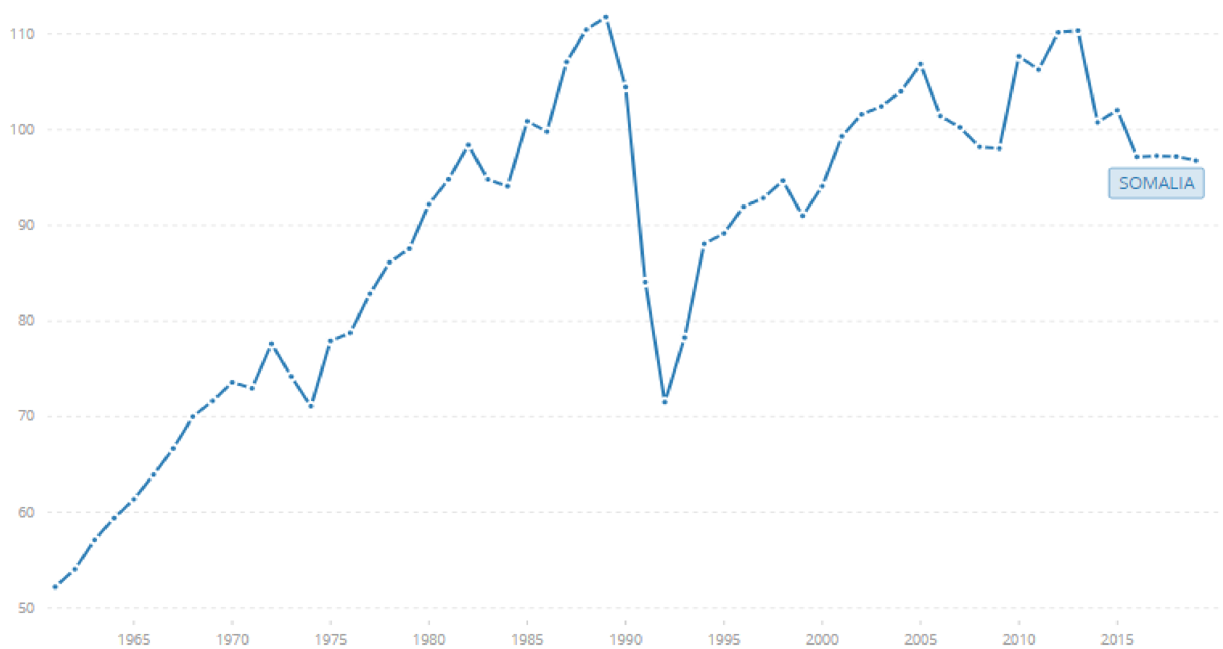
Appendix



110
100
90
80
70
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1965
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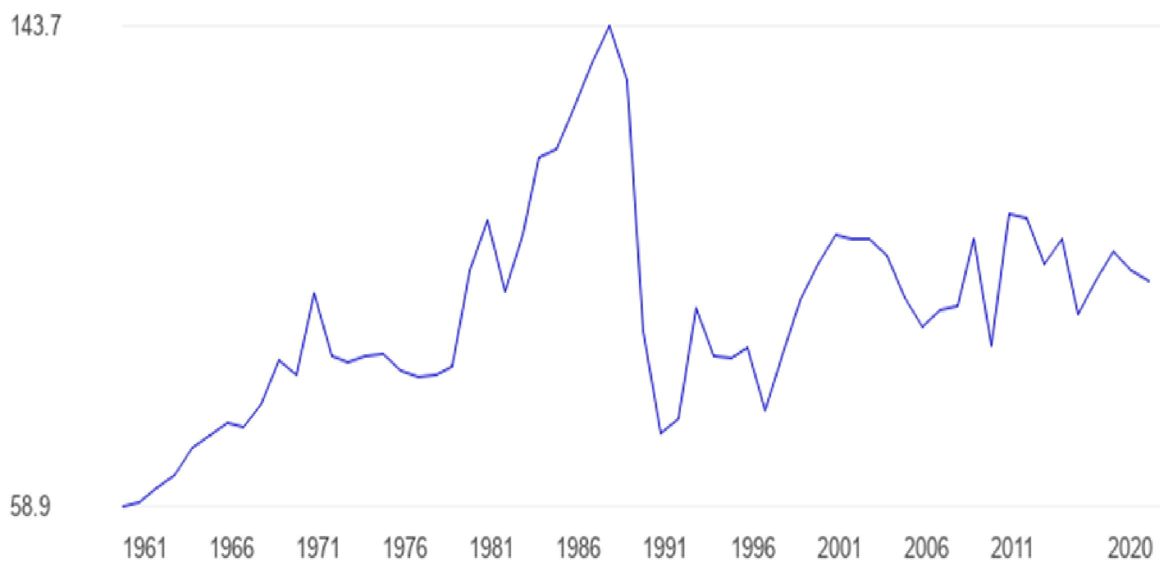
SOMALIA



143.7
58.9
1961
1966
1971
1976
1981
1986
1991
1996
2001
2006
2011
2020

Table 4.1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
crp	30	95.114	10.41035	71.83	110.17
fertilizer	30	2024201	959136.7	1000000	3806128
agriclnd	30	70.3246	.1450523	70.17725	70.73836
tractor	30	.040371	.006381	.03188	.06321
labor	30	699335.5	1016065	145975	2884818
export	30	13.9	7.644471	1	27

Table 4.2: Augmented Dickey Fuller (ADF) Unit Root Test

Source SS	df MS	Number of obs	= 30
	F(5, 24)	= 4.85	
Model 1579.93257	5 315.986514	Prob > F	= 0.0033
Residual 1562.95607	24 65.1231698	R-squared	= 0.5027
	Adj R-squared	= 0.3991	
Total 3142.88864	29 108.37547	Root MSE	= 8.0699
crp Coef.	Std. Err. t P>t	[95% Conf.	Interval]
fertilizer 4.21e-06	1.70e-06 2.47 0.021	6.90e-07	7.72e-06
agriclnd 39.14454	11.08849 3.53 0.002	16.25903	62.03005
tractor 179.6362	356.932 0.50 0.619	-557.0353	916.3077
labor 8.78e-07	2.11e-06 0.42 0.680	-3.47e-06	5.22e-06
export -.1594618	.293434 -0.54 0.592	-.7650798	.4461563
_cons -2671.873	776.7507 -3.44 0.002	-4275.008	-1068.738
Durbin-Watson d-statistic(	6, 30) = 1.665592		

Table 4.3: Normality tests

Skewness/Kurtosis tests for Normality			
	-------	joint ------	
Variable Obs Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
crp 30 0.1455	0.8900	2.33	0.3123
fertilizer 30 0.2206	0.0009	10.15	0.0063
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tractor 30 0.0051	0.0037	12.67	0.0018
labor 30 0.0012	0.3705	9.39	0.0091
Export 30 0.9702	0.0509	4.04	0.1329

Table 4.4: Multi-collinearity Test (Variance Inflation Factor)

Variable	VIF	1/VIF
tractor	2.31	0.432904
Export	2.24	0.446295
labor	2.04	0.490631
fertilizer	1.19	0.841352
agriclnd	1.15	0.868048
Mean VIF	1.79	

Table 4.5: Normality of the Residuals

	Skewness/Kurtosis	tests for Normality	
	-------	joint ------	
Variable	Obs Pr(Skewness)	Pr(Kurtosis) adj chi2(2)	Prob>chi2
myResiduals	30 0.8233	0.7825 0.13	0.9389

Table 4.6: Auto Correlation

	crp	fertil~r	agriclnd	tractor	labor	Export
crp	1.0000					
fertilizer	0.3871	1.0000				
agriclnd	0.5275	-0.0878	1.0000			
tractor	0.3773	0.3127	0.3047	1.0000		
labor	0.2548	0.1412	0.0482	0.3185	1.0000	
Export	-0.0138	-0.0080	0.1843	0.4058	-0.4520	1.0000

Table 4.7: Test for heteroscedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fertilizer agriclnd tractor labor Export
chi2(5) = 7.00
Prob > chi2 = 0.0609

Table 4.8: Regression Estimate

Source	SS	df MS	Number of obs	= 30	
		F(5, 24)	= 4.85		
Model	1579.93257	5 315.986514	Prob > F	= 0.0033	
Residual	1562.95607	24 65.1231698	R-squared	= 0.6027	
		Adj R-squared	= 0.4991		
Total	3142.88864	29 108.37547	Root MSE	= 8.0699	
crp	Coef.	Std. Err. t	P>t	[95% Conf.	Interval]
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