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# Agriculture and Manufacturing Sector Growth in Namibia During the Period 1981 to 2012: A Granger Causality Test

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## Authors' contributions

*This work was carried out in collaboration between all authors. Author JMN designed the study, performed the literature search and together with author MS did the statistical analysis, author MS searched and did data cleaning and uploading in e-views. Author RO gave a conceptual framework and nested the study on it. All authors read and approved the final manuscript.*

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## ABSTRACT

Namibia became independent in 1990. Since then, the democratic government has pursued various development policy tools to empower Namibians economically. The 4<sup>th</sup> National Development Plan identified four strategic economic growth enhancing activities, namely agriculture, manufacturing, logistics and tourism. Agriculture remains the largest employer while manufacturing, logistics and tourism are growing, but slowly. This paper is premised on investigating whether or not there is a causal and long term relationship between agriculture and manufacturing sector growth over the period 1981-2012. Ascertaining the direction of the relationship is part of the objectives. Analytical methods that were used include unit root, correlation test and a Granger Causality model. With the use of time series data, the results confirmed stationarity of the data. With 31 observations, no causal relationships were established between agriculture and manufacturing in Namibia. Appropriate policy interventions are required to influence how the two sectors should benefit from each other. Such holds potential for both sustained employment creation opportunities and economic growth in Namibia.

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## **1. INTRODUCTION**

Namibia is an upper middle income country. The main quest for Namibia is to reduce poverty by means of creating employment opportunities for its citizens. For historical reasons, Namibia became independent in March 1990, making it one among the latest countries to achieve independence in Africa. The country is sparsely populated and it has a human population size of 2.1million. The economy is modestly growing but it has not created many jobs over the years. The slow worker absorption by the economy has led to a high unemployment rate which currently stands at 27 percent.

Over the years, Namibia's primary sectors have largely exported commodities in raw form. Value-addition is only being emphasized in recent times. Thus the economy is heavily dependent on exports from mining, fisheries and agriculture. This dependency holds very little prospects in a long run which suggests the need to diversify the economy from being mainly an exporter of primary products to one that produces finished goods. The biggest employer among the primary sectors is agriculture while other sectors trail behind it. Mining is the biggest foreign currency earner while tourism is the fastest growing sector. All the sectors are interrelated by the network of logistics. As outlined in the 4<sup>th</sup> National Development Plan, logistics is one of the crucial sectors that need special attention [1].

It is common knowledge to think that sectors of the economy work together. This means that there should be some interrelationships across various economic sectors. Since agriculture provides raw material to manufacturing, intuition suggests that testing for an existence of a relationship between the two sectors may shed more light on policy interventions needed in the medium and long term.

The objectives for this paper are: to study whether or not there is a causal relationship between growth of agriculture and of manufacturing, and also to determine the direction of the relationship if it exists. The hypothesis that was to be tested is that 'there is no relationship between agriculture and manufacturing'.

## **2. LITERATURE REVIEW**

There are various studies that have tested the relationships between economic variables. Some of the studies applied the methodological approaches that come closer to what was used in this paper. In a study by [2] about financial intermediation and economic growth in Sudan, unit root and cointegration tests were applied. Although his paper did not focus on agriculture and manufacturing, the manner in which the two tests that were mentioned earlier were applied provided some insight for the current paper.

While studying how the agricultural sector is linked to other sectors in Romania, [3] found that industrial growth had a harmful effect on the future course of agriculture, while the service sector stimulated the development of agriculture. [4] assessed the relationship between exports and economic growth in India using a Granger causality test. The results points to a directional causality which runs from economic growth to exports and vice versa.

In attempting to establish the causal relationship between tourism and economic growth in Sri Lanka, [5] ran a unit root test and applied the Johansen Cointegration test. These two

tests were helpful in establishing for stationarity and cointegration. A decomposition test was conducted. The findings are that general economic growth is caused by its own and by tourism, while tourism is only caused by economic growth at home and abroad.

When investigating the causality between exports and economic growth in South Africa, [6] applied a linear granger and found no significant relationship between the two variables. In another study, [7] studied the causality between agricultural output and economic growth in Libya. The granger causality test, together with other techniques was employed in the study. It was found that there was a unidirectional causal relationship between agricultural output and economic growth but only in a short run.

In another study of the relationship between total exports, manufacturing and agricultural output in which the Granger causality model was applied, [8] found that industrial growth caused both growths of exports and of agriculture. Further, growth of agricultural output did not lead to higher growth rates of exports or industry.

When studying to establish the causal relationship between gross domestic product (GDP), agriculture, industrial and services sectors, [9] revealed that equilibrium relationships existed between the sectors. It was found that growth of GDP granger-caused growth of agriculture and vice versa. Industrial sector growth granger-caused GDP growth and vice versa. The same was observed for industrial and services sectors. An unidirectional Granger causality was found to occur from industrial sector to agriculture and also from GDP to the service sector.

Closely similar to [9,10] studied the causal relationship between GDP, agriculture, industrial and service sector growth in North Cyprus and achieved interesting results that point to the fact that agriculture is the back bone of that economy. It is agriculture that feeds the industrial sector with raw materials. However, agriculture in that economy does not stimulate growth of GDP.

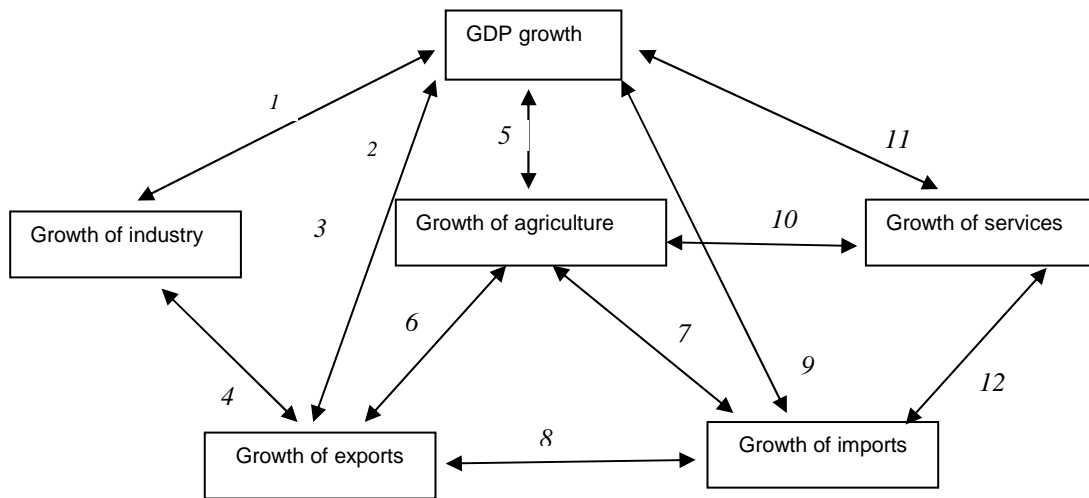
Agriculture was found to be an engine for economic growth in various studies in certain countries and those includes studies done by, among others, [10,11]. In developing countries, agriculture was found to be declining in terms of its contribution to economic growth. A more robust role for agriculture in terms of economic growth was observed across Asian states. The conclusion is that by increasing value addition in the agricultural sector, general economic growth can benefit [11].

A study by [12] to determine whether or not there was a long-run relationship between agriculture and economic growth in Thailand used among others, a Granger causality model. The findings are that economic development stimulated agriculture. It also enlightens that long-term stable agricultural growth is necessary to allow economic development to occur. In Iran, [13] evaluated the relationship between tourism industry and economic growth. Applying a granger causality test proved that there is a mutual causal relationship between the tourism sector and economic growth. Still in Iran, [14] also investigated the relationship between tourism industry and GDP. In this case, a granger causality test was used and it was found that there existed a bi-directional causality between income earned from tourism and GDP.

In India, it was found that agricultural output growth causes imports and exports to grow, while import growth also caused agricultural output to rise. With regards to manufacturing, it came out that growth of manufacturing output and of imports jointly caused exports to increase. Exports and imports jointly caused manufacturing output to rise [15]. This study, however, did not ascertain the relationship between agriculture and manufacturing directly but only via their relations to imports and exports.

An interrogation of Mellor’s Law comes to mind here. Mellor’s Law provides that as the agricultural sector grows faster, its relative size declines. This notion comes about due to the fact that technological know-how is seen as being more imperative to addressing the challenges of a growing population [16]. It is a contestable argument to have to believe that agriculture will decline after it has grown faster. While this Law is useful, its applicability will vary depending on the country’s strategic sector growth priorities.

The literature presented ushers in a schematic view of the various economic components that links well with agriculture and manufacturing in the Namibian economy. Focus is not on all of the arrows but the following: 1, 3, and 5 while other arrows 4, 6–12 only show a wide relationship in the mainstream economy.



**Fig. 1. An overview on the possible causal relations between GDP and its sectors**

In Fig. 1 above, the Namibian economy is multifaceted in terms of its economic drivers. Growth in various drivers is imperative to the aggregate growth of the economy which has been referred to as GDP growth. Thus, agriculture and manufacturing are also vital players in Namibia’s economic growth path. Existing interrelationships among various drivers which are presented in web-type connections are important in studies of causal relationships.

### 3. MATERIALS AND METHODS

#### 3.1 Data and Analytical Procedures

The study used annual GDP time series data for the period 1981 to 2012 at 2004 constant prices for both agriculture and manufacturing. The data was obtained from Namibia Statistics

Agency. In order to determine whether or not the data is stationary, unit root test was undertaken by means of applying the Augmented Dickey-Fuller (ADF) test. [17,18] used the ADF test in their studies that applied time series data when testing for stationarity. The ADF proved to be a useful tool in that regard. The ADF test was founded by Dickey and Fuller in 1979. In this case, stationarity was confirmed and thus cointegration test became unnecessary.

### 3.2 Model

Due to lack of empirical evidence which could conclusively indicate sequencing from either direction between agriculture and manufacturing output growth rates the Granger causality test was performed on the data. The following equations were constructed to establish the growth linkages between the agricultural and manufacturing variables:

$$AgGR_t = \alpha + \sum_{i=1}^n b_i AgGR_{t-1} + \sum_{i=1}^n y_i ManGR_{t-1} + e_t$$

$$ManGR_t = \alpha + \sum_{i=1}^n b_i ManGR_{t-1} + \sum_{i=1}^n y_i AgGR_{t-1} + e_t$$

Where:

- AgGR<sub>t</sub> is agriculture's growth rate variable,
- ManGR<sub>t</sub> represents manufacturing sector's growth rate variable, and
- $\epsilon_t$  is the error term.

## 4. RESULTS AND DISCUSSION

Using the correlation test (Table 1) to show the association of GDP growth in the agricultural and manufacturing sectors, the results reveals a positive correlation between the two sector GDP growth rates with an  $R^2=0.79\%$ .

**Table 1. Correlation matrix table**

	<i>AgGR</i>	<i>ManGR</i>
<i>AgGR</i>	1	0.7921
<i>ManGR</i>	0.7921	1

*Unit root test*

The ADF test was applied to test for stationarity, but it should be noted that this test provides a test of the null hypothesis of non-stationarity. Table 2 below shows the ADF test results for both Agriculture and Manufacturing output growth rates series. In this case the null hypothesis is rejected with an understanding that the variables are stationary. This carries that the data is integrated in order.

**Table 2. The Augmented Dickey-Fuller test results**

<b>Augmented dickey-fuller (ADF) test statistic</b>			
<b>Variable</b>		<b>ADF(L)</b>	<b>CV</b>
<i>AgGR</i>	Level	-5.354670 (0)	-2.960411
	First Difference	-6.704914 (1)	-2.967767
	Second Difference	-5.693543 (4)	-2.986225
<i>ManGR</i>	Level	-5.928171 (0)	-2.960411
	First Difference	-6.491467 (0)	-2.967767
	Second Difference	-5.489849 (7)	-3.004861

Note: L denotes the lag length selected using SIC, and CV denotes critical values at 5% significance level

Due to the existence of stationary that was confirmed in the ADF unit root test, co-integration test could not be done as the time series data were integrated in order. However, the next step was to test for causation using the granger causality test.

#### 4.1 Granger Causality Test

**Table 4. Granger causality results of data for 1980-2012**

<b>Null hypothesis:</b>	<b>Lag</b>	<b>Obs.</b>	<b>F-statistic</b>	<b>Prob.</b>	<b>Decision</b>
Manufacturing does not Granger Cause agriculture	1	31	0.10133	0.7526	Accept
	2	30	0.09740	0.9075	Accept
	3	29	0.29970	0.8252	Accept
	4	28	0.39859	0.8072	Accept
Agriculture does not Granger cause manufacturing	1	31	0.25854	0.6151	Accept
	2	30	0.14695	0.8641	Accept
	3	29	0.25381	0.8578	Accept
	4	28	0.16801	0.9520	Accept

Granger Causality test results (Table 4) for the data of 1981 to 2012 confirms that the null hypothesis which states that the growth in manufacturing GDP does not granger cause the growth in the Agricultural sector (from lag 1 to 4) was accepted. This means that growth of manufacturing output occur without a direct influential cause on economic output in the agricultural sector. In the same way, it was found that growth of agricultural output does not granger-cause manufacturing output to rise. This came from an accepted null hypothesis which purposed to test whether agricultural growth does not granger cause manufacturing (i.e. lag 1 to 4). Thus there is no causal relationship between the two sector variables.

These findings reflect that although the Namibian economy is spearheaded by relevant policies however, sectoral linkages between agriculture and manufacturing are not that effective to have strong impact on each other. The findings also points to the fact that despite conducting an investigative study of a long term causal relationship among the two sectors, convergence was not found and is thus lacking. Therefore, existing policies are not driving the relationship to an extent of inculcating a multiplier effect on each other. This lack of causality between the two sectors can be attributed to existing policy weaknesses that undermines development in these sectors.

## **5. CONCLUSION**

Literature review has shown that several countries have managed to create positive sectoral feedback loops, and that agriculture can be a dynamizing sector. As years pass, the principle of Mellor's Law may apply but robust policy measures to strengthen the role which the agricultural sector may play in supporting manufacturing and vice versa will highly be needed. Given the empirical evidence that there is no causal relationship between the growths in agriculture and manufacturing sectors, Namibia has to work on ensuring that sectoral economic policies are coordinated in a manner that national economic growth is stimulated.

Since agriculture comprises of both crop and animal production, it is expected to contribute more raw materials to manufacturing than it does currently. Manufacturing should also be structured in such a way that it does not only draw more on the production resources from agriculture but that it should also become a supplier of needed inputs to the agricultural sector. Going it this way can offer better scope for proper economic planning and attainment of reasonable sector growth, holding all other things constant.

## **COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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