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Public Spending as a Predictor of Livestock Total Factor Productivity in Namibia

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ABSTRACT

This paper investigates public spending and its catalytic role towards a productive agricultural sector. This was done empirically by testing how agricultural total factor productivity could be increased. Data used is for the period 1991 to 2021. A Tornqvist-Theil Index was developed. A simultaneous equation became the chosen and implementable analytical tool for this study. While an agricultural total factor productivity index for Namibia did not exist before, the livestock component was generated for the first time in this study to fill this gap. Stunning is the fact that the Malabo declaration in terms of its convergence target of 10% is not yet met. The results show that by increasing productive labour to the livestock subsector by 10%, real gross domestic product will increase by 12%. Likewise, should capital formation and spending towards agriculture be increased to 10%, the growth of the agricultural sector will increase by 8.5%. This would require input-base needs to be expanded for output to increase. The work done by the Namibian Government so far yearn for further efforts to create more jobs, increase food production, and foreign income earning, remains to be addressed. To achieve all these, compliance with the Malabo declaration would be necessary.

Keywords

Agricultural Indices, Malabo declaration, Productivity in livestock sector, livestock production

1.1 Introduction

One of the salient features of the Namibian Vision 2030 is its goal to improve the quality of life for its citizens to the level of counterparts of the developed world by 2030. That Vision document proposes socio-economic changes and adjustments in different forms for the Namibian economy to reach a new equilibrium. Industrialisation was prioritised, suggesting that the agricultural sector provide the initial spur to economic development. The understanding that agriculture is a vital pacesetter is also shared widely by scholars in the past (see Rosenstein-Rodan, 1943, Schultz, 1953, Lewis, 1954). It is expected that, the Namibian industry ensures that there is efficient provision of inputs and guarantee the improvement of the

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socioeconomic infrastructure for increased agricultural productivity (see Todaro and Smith, 2011). The interdependency between agriculture and the industry is crucial for overall economic development.

Vision 2030 regarded productivity growth as the solution to income growth, living conditions, and improving the wellbeing of Namibian citizens. However, little agreement of implementers exists on what productivity growth is, whether it is associated with technical change, to be achieved by eliminating inefficiencies, or used as a pursuit to cost minimisation in production growth. Productivity is a type of an efficiency measurement, converting inputs into output, which expands if output grows faster than inputs. Therefore, productivity measures how resources are used to allow for adjustments in the production possibility frontier. It was used by Krugman (1994), to explain how the Asian economic growth was driven by input accumulation rather than by increases in productivity. Literature also shows that economic growth attributes to optimum factor accumulation, but that the maintenance thereof is dependent on productivity.

Economic growth in Namibia is volatile and therefore, changes have to be identified and as such economic movements need to be understood in order to effect correct proactive policies. Public spending is one measure to adjust the productivity required for the intended economic growth. In the 2000s, agriculture became a high-priority policy agenda among African leaders, understanding that the agricultural output should result into economic growth and poverty alleviation (Fontan Sers and Mughal, 2019, Mustapha and Enilolobo, 2019). It resulted in a conference almost 30 years ago where the relationship between public spending in the agricultural sector and national economic growth was discussed, which was articulated into the Maputo Declaration of 2003 (Ademola *et al*., 2013, Ndhleve *et al*., 2017, Ele *et al*., 2014). The suggestion was to apply a guideline of ten percent public spending on agriculturee to stimulate the national economy and to create employment (Temitope, 2013, Qiong and Junhua, 2015). A few years later in 2014, the Malabo delegation reaffirmed the decision. Since then, research showed that agricultural spending on infrastructure, research, and development increased agricultural productivity, stimulating the purchasing power and aggregate demand (Edeme *et al*., 2020; Mengoub, 2018; Yeboah and Jayne, 2018). During that Malabo conference, the leaders also defined a wider and more transformative agenda with clear commitments on areas of gender, trade, resilience, youth, and nutrition (Badiane and Makombe, 2014). The commitments to the principles and values of the Comprehensive African Agricultural Development Programme (CAADP), are critical and directly linked to the Sustainable Development Goals for Namibia, as outlined in its Harambee Prosperity Plan. Since the guidelines were provided, most countries in the sub-Saharan region have increased their spending on agriculture (Fontan Sers and Mughal, 2019).

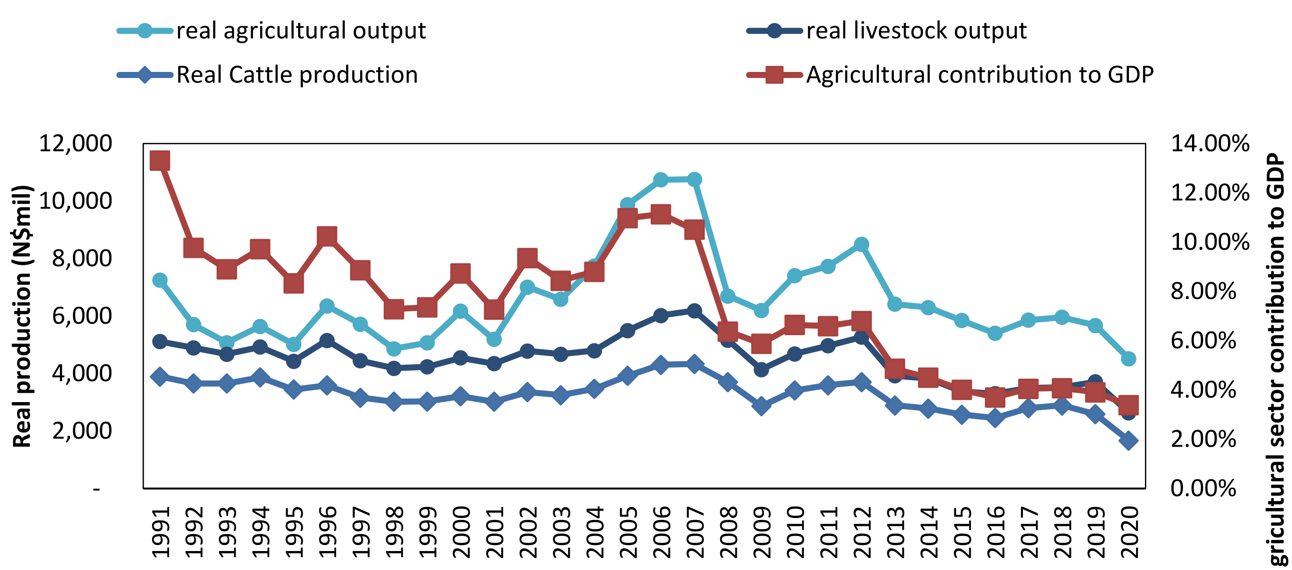
Christiaensen and Brooks (2018) stated that as countries develop, their economies move away from agriculture to other sectors such as tourism, service, construction, and manufacturing. As such, it is vital to evaluate the changes in the effects of public agricultural spending on the agricultural sector in Namibia over time as it will indicate the relevance of public agricultural spending and associated goals.

The paper attempts to determine an empirical link between the above relationships for Namibia. In Namibia, a productivity index for the agricultural sector is not available, and limited research exists on public spending on agriculture, growth, and employment. The empirical results of this paper might be a start to understand the effects of public spending on agriculture, to curb decreased production, food insecurity, and unemployment in Namibia. It might be a stimulation for further solid research, coordination between key sectors to reach national goals, and to put a coherent statistical protocol in place to reduce the existing data gaps. It is hypothesised that the Namibian agricultural productivity results in increased GDP, that there is a likelihood that public agricultural spending will result in employment in the long run and increases productivity to raise incomes and aggregate demand. Increased aggregate demand, therefore, prompts investors from all circles of the economy to produce more and this creates more labour demand, hence reducing cyclic unemployment.

The agricultural sector

Like most countries in Sub-Saharan Africa, the Namibian agriculture can be regarded as a backbone for society, providing food, jobs, and business at local, national, and international levels. The sector was used as a driving industry during the colonial era, and since the 1970s, practices were slowly revised through government support measures to allow for productivity gains. Although the early support focused to benefit the regime at that time, many intentions had significant multiplier effects on the economy within a well-structured agricultural sector. After independence, many important policy changes were executed to correct the past. This paper only focuses on the period post 1990 Independence era.

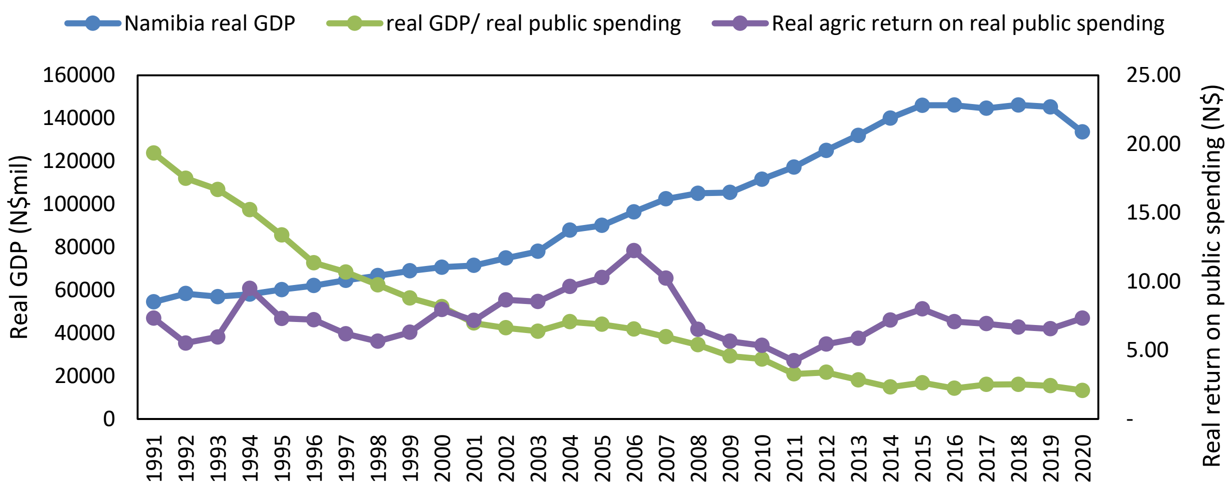
The Namibian agricultural sector is not only regarded as the important economic pillar to the national economy, but also as a livelihood to most of its citizens (BDO, 2016). The growth in the agricultural sector is interrelated with the entire economic process of the economy. Agriculture's contribution to GDP (excluding fishing) since Independence averaged at 5% annually, of which the livestock sector historically contributed to approximately 70% (NSA data). However, this proportion recently declined to an estimated 60% in the past five years (NAU data, 2021). The other primary agricultural products include crop farming, biomass, and forestry. The export of crops, vegetables, biomass, fruits, and forestry products has grown by value, which explains the shift of contributors within the agricultural sector. Figure 1 presents an overview of how the agricultural sector is declining in economic value during the past years, even in real terms.



Source: Authors' estimates based on NSA data sources

Figure 1: Overview of the Namibian agricultural production (1991-2020)

While the Namibian food and nutrition security situation has improved during the past decades, some undernourishment remained. Koroma (2016), described the agricultural sector as "constrained by a variety of challenges, including limited human and institutional capacity, weak implementation of policy and legal frameworks, poor coordination between government agencies on food and nutrition security issues, poor access to agricultural data by policy makers and farmers, low crop productivity, constraints to sustainable management of water, land, forests and rangelands, inadequate capacity in land use management and land valuation, weak capacity in processing, marketing and quality/safety standards for crop, horticulture and livestock products, vulnerability to different threats and crises (such as droughts, floods, the HIV/AIDS pandemic, transboundary pests and diseases) and issues of gender inequality in agriculture." Therefore, support is called for a strong and efficient sector to grow its industries that process agricultural produce to create jobs and generate income. This will stimulate the availability of marketable animals, open markets, allow for economies of scale, avail finance, and improve the transport systems (Mushendami *et al*, 2008). It will depend on the capacity of innovative systems to address the diverse range of needs. It calls for improved farm productivity, environmental performance, and responsiveness to climate change. Therefore, the government as the regulator has a role to play by ensuring that policy is conducive to improve agriculture's long-term productivity and sustainability, by increasing the impact of public expenditure that strengthens the human and infrastructure capacity to achieve market opportunities. The Namibian real GDP, its relation to public spending in comparison to the real agricultural return on its public spending, is illustrated in Figure 2. The illustration shows that the national GDP is increasing even being deflated by the CPI until 2015. The downward slope of the real national return to its real spending by government corresponds to most African countries' agricultural return on real public spending (see Pernechele, *et al*, 2021). The Namibian situation differs and indicates some policy intentions during the past 30 years.

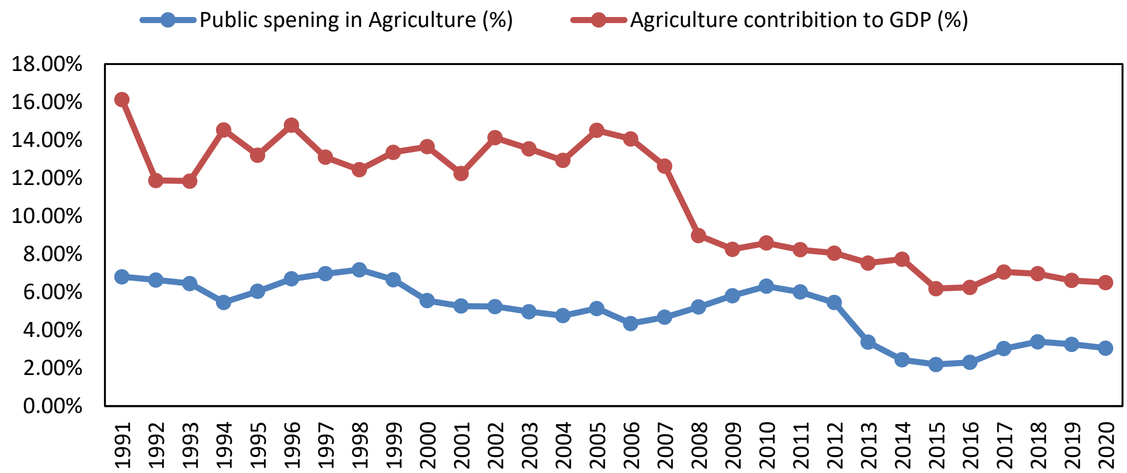


Source: Authors' estimates based on NSA data sources

Figure 2: The real agricultural GDP and its relation to the real public spending

Literature review on public spending on the agricultural sector

"Public expenditure is one of the main tools enabling governments to alleviate poverty, fight hunger, and accelerate the transformation of agriculture" (Pernechele *et al*, 2021). Akroyd and Smith (2007) point out that the relationship between government expenditure and economic growth have been empirically analysed, with some research specifically analysing the link between government spending and agricultural growth and poverty reduction.All these studies show that positive growth and poverty reduction is an outcome result from the level of public spending in agriculture. Yet, in many developing countries like Namibia to the public expenditure on agriculture is declining (see Figure 3).



Source: Authors estimates based on NSA and ReSAKSS data

Figure 3: Namibian agriculture contribution to GDP and public spending on agriculture

Direct spending increases knowledge and employs people in agriculture, results in production investment, value addition, and entrepreneurship, and indirectly results in increased self-employment and job opportunities for others (Deekor, 2019). Investment in agricultural capital infrastructures, such as roads, electricity, markets, storage facilities, and processing plants attracts investors to stimulate the economy. Edeme *et al*., (2020) argue that these investments often reduce the production costs and accelerate output to allow for more employment opportunities in the broader sector. The spiral continues that increased productivity accumulate into purchasing power (Yeboah and Jayne, 2018), which creates multiplier effects on the rest of the economy. This was explained in the Keynesian theory of unemployment (Keynes, 1936), that agricultural spending increases productivity, aggregate demand, and employment directly into the agricultural sector and secondarily it increases national economic growth on national employment creation (Ademola *et al*., 2013, Jambo, 2017, Mapfumo *et al*., 2012, Ndhleve *et al*., 2017, Covic and Hendriks, 2016, Yeboah and Jayne, 2018).

Some studies investigated the effects of public spending on productivity (Krugman, 1994). African research determined that public agricultural spending increases productivity, which is as expected since output and productivity are closely related (Benin, 2015, and Wangusi and Muturi, 2015) and increased the economic growth in these SSA countries (Mapfumo et al., 2012, Ademola *et al*., 2013, and Ele *et al*., 2014). Pernechele, et al (2021) found that the public spending on agriculture is generally smaller in decentralized countries, which is an obstacle to adjusting the level of spending required for change. This paper attempts to provide empirical evidence for the Namibian situation to justify higher levels of public expenditure, combined with policies better spend public funds.

Methodology

Framework

Already forty years ago, productivity statistics for the agricultural sector were called for to identify sources of economic growth, to estimate production relationships, to determine indicators for technical change, to justify price changes, and many more. This is presented as total factor productivity, a suitable performance measurement over time, and defined as a ratio between the aggregate output produced relative to the aggregate input used (Coelli *et al*., 2005). However, the measurement presents some difficulties, such as how to address the rate of technical change, externalities, and comparability.

Typically, two approaches are used to measure TFP, either the frontier or the non-frontier approach, each of them subdivided into parametric and non-parametric techniques (see Frija *et al*. 2015). Both parametric and non-parametric approaches of the non-frontier method regard the production function as the starting point. The non-parametric approach follows the growth accounting employing the Divisia, Solow, Laspeyres, Paasche, Fischer, and the Thornqvist-Teil indices, while the parametric approach follows the production function. The two main frontier approach methods are the Malmquist (nonparametric approach) and the stochastic frontier (parametric) approaches, of which the latter is often estimated by the ordinary least square regression as the line of best fit through the sample data (Kathuria *et al*., 2011).

In Southern Africa, an agricultural aggregate TFP index was derived using the Tornqvist-Theil Index[†] and published in 1993 and Botswana followed soon. These country measurements were possible because of available data and statistical services. An estimation for Namibia was outstanding because of gaps within data, especially the lack of input data for various sub-sectors. However, the various calls to estimate agricultural productivity for Sub-Saharan Africa (see Jayne and Sanchez, 2021) convinced the authors to follow the approach by Thirtle *et al*. (1993) to compile a TFP index. However, data restricted an aggregated agricultural TFP, while a TFP on the commercial livestock was possible. This was appropriate because the livestock sector in Namibia was always the main subsector in agriculture and thus it was believed that this index could be used as a proxy to assess the impact of policy decisions on agricultural productivity see Perez *et al*., 2007).

Mathematical Model

The mathematical approach used weights of all inputs as shares in the total production output, i.e. the TFP livestock index was measured as the ratio of output Y to aggregated input X:

$$TFP = Y/X \qquad (1)$$

Because of the diverse range of commercial livestock outputs (beef, live cattle exports, mutton, goats, pork, etc.) and an even more diverse range of inputs (land, labour, intermediate inputs, machinery, and capital), the measure required a means of aggregating these diverse output and input quantities into a total output and total input quantity. The Tornqvest-Teil application of the Divisia method was used to determine this index, through the weighted sum of the rates of output and input changes:

$$\ln \ln\left(\frac{TFPt}{TFPt-1}\right) = \sum_i \frac{1}{2}(Rit + Rit - 1)\ln\left(\frac{Yit}{Yit-1}\right) - \sum_j \frac{1}{2}(Sjt + Sjt - 1)\ln\left(\frac{Xjt}{Xjt-1}\right) \qquad (2)$$

where t and t-1 are adjacent annual observations, of outputs Y_i and inputs X_j, R, and S the revenue and input cost shares, respectively, and ln is the natural logarithm. The livestock share weighted and chained TFP index assumed the Hicks-neutral technical change and constant returns to scale, presenting each value relative to the previous year, and not relative to a single base year (see Diewert, 1986). The period was selected from 1980 to 2020, but the presentation of this paper is limited to the period of post-Namibian Independence.

According to the theory, if the growth of output is less than the growth of inputs, then the total TFP is not growing (Chatterjee, 1995), and pointing out some inefficiencies of the sub-sector. Therefore, the

[†] Explanation on theoretical properties and issues in the measurement of productivity through the Tornqvist Index can be found in Diewert (1978, 1980); Capalbo and Antle (1988), and Coelli et al., (2005).

declining TFP means that other variables such as expenditure, investments, GDP, and hours worked will also decline, which then results in socio-economic shortages.

Mouhammed (2011) stated that declining TFP is the result of the lack of improvements in technology, skills, inventions, and high costs of imports. Productivity can be increased by developments in science, research, developments, and management techniques, which improvements reduce unemployment. Therefore, from this theory, it can be concluded that public spending in agriculture is likely to lead to the growth of TFP in the agricultural sector.

The relationships between the national economy, the agricultural sector and the livestock subsector is very complex. To determine the relationship between output, and inputs, a three stages system was applied Zeller & (Theil, 1962), wherein through iterations the estimates of the residuals of the structural equations and the weighting matrix system of equations are estimated. Although the 3SLS is generally asymptotic, it is more helpful than the 2SLS in providing coefficients for the various independent variables (Robinson, 1991). This allows to simultaneously select and determine robust variables explaining total agricultural production, the livestock and cattle production as dependant variable. An econometric system approach is presented as:

$$Y_{GDP} = \beta_0 + \Sigma_{j=1..p}\, \beta_j X_j + \varepsilon$$

$$Y_{Agriculture} = \beta_0 + \Sigma_{j=1..p}\, \beta_j X_j + \varepsilon$$

$$Y_{Livestock} = \beta_0 + \Sigma_{j=1..p}\, \beta_j X_j + \varepsilon$$

$$Y_{Cattle} = \beta_0 + \Sigma_{j=1..p}\, \beta_j X_j + \varepsilon \qquad (3)$$

where Y is the dependent variable, β_0, is the intercept of the model, X_j corresponds to the jth explanatory variable of the model (j= 1 to p), and e is the random error with expectation 0 and variance σ^2.

Explanatory variables were deflated from nominal to real values. Variables tested were the public spending in agriculture, the capital formation in agriculture, number of employees in the commercial livestock sector, land rental for pasture land, cattle stock, product prices, etc. Furthermore, the variables were tested as both absolute and relative values.

Using the STATA package, different simulations were undertaken. To obtain a robust model output, there was need to include explanatory variables. It was required to isolate variables presenting the opposite relationship to the dependant variables, and secondly the selected independent variables were aligned with insignificant explanatory power.

Data and its Sources

Data used were obtained from the Namibia Statistics Agency, the Meat Board of Namibia, the Directorate of Veterinary Services, the Namibian Agricultural Union and from the CAADP-managed Region Strategic Analysis and Knowledge Support System (ReSAKSS) website. Type of data sourced from these agencies is secondary in nature and for the period 1991 to 2020. The nature of the data considered is on economic output and production data, employment and capital formation, livestock production and prices, the livestock census, the production of the various agricultural sub-sectors and their livestock input prices, and various Namibian research papers. Data on the public spending on agriculture was obtained.

Construction of Indices

The paper aims to determine the TFP indices for the commercial livestock sector in Namibia. Various steps were necessary following the Tornqvest-Teil application. The productivity is dependent on the quality of the inputs and how such factors are integrated in the production process.

In order to obtain a robust annual output value, data had to be obtained from NSA and matched with various livestock sector production and prices from the MBN. The prices had to be deflated by the CPI first in order to obtain the correct output value. Livestock prices applied were a weighted average of the various sub-sectors' production lines i.e. beef carcass, live export, mutton production, pork, etc. The unchained log of the annual growth of the real production was obtained by applying the natural log to the value, divided by its predecessor to reverse it to the base, the exponent. To base the annual, the exponent to base e was applied to all annual values. These values were indexed as the growth livestock output index (see Figure 4). With the output index in place, partial land and labour productivity indicators could be determined, eg. calculated by dividing the quantity of output by the total hectares of land used:

$$\text{Land productivity} = \frac{\text{Volume of output}}{\text{Land surface used}} \tag{4}$$

To understand these indices, the effective precipitation index was required and is explained in the subsequent content.

The input growth index worked similarly, with an exception that various contributing inputs had to be determined. The assumption applied here followed the classical theory in that land, labour, intermediary inputs, and capital makes up the inputs for agricultural production. The difference applied to this approach was to change the capital input for commercial livestock production into two variables, machinery, and the livestock equity stock. These values were obtained from various sources and presented as average input shares for production.

The intermediate inputs are goods and services that are used in livestock production. They include inputs such as animal feed, veterinary inputs, energy, fuel, oil and lubricants, repairs and maintenance, etc. These intermediary inputs were based on the NAU quarterly indices available since 2006 and merged with indexes obtained from the Directorate of Planning (see Sartorius von Bach and Metzger, 1990).

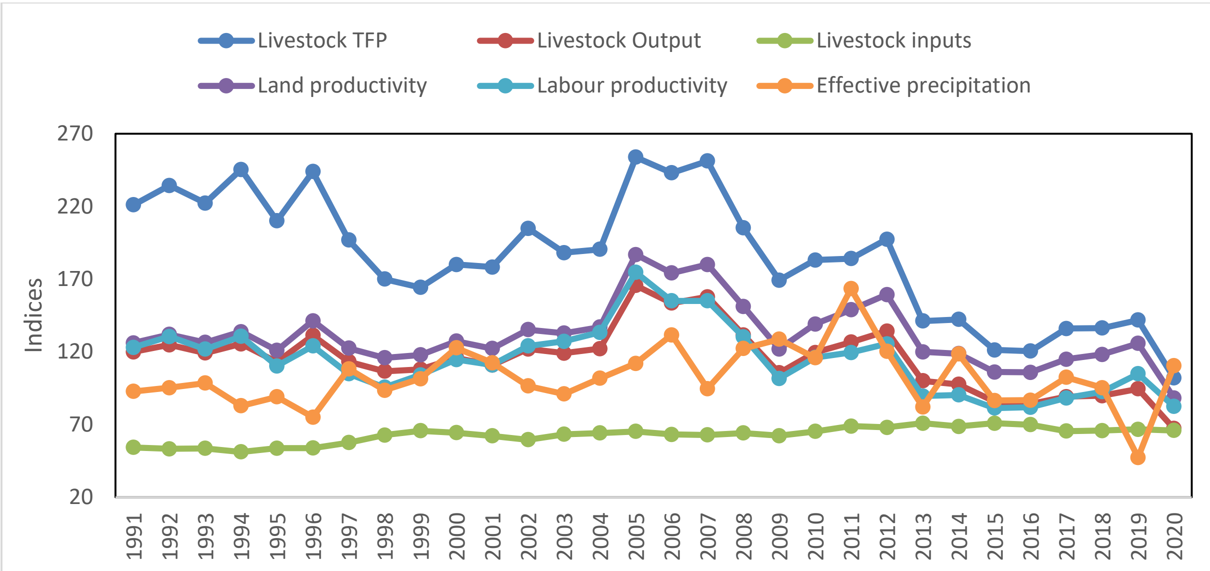
The average cost shares were compared to local research values and commercial livestock study group estimates. The average annual shares obtained were 2% for land rental, 22% for labour, 71% for intermediate inputs, 1% for herd equity investments, and 4% for machinery. These annual shares were changed into weighted growth rates, unchained into logs, reversed into the base, and finally indexed as growth livestock input index (see Figure 4).

The product between the output and input index was defined as the livestock TFP, assuming the Hicks-neutral technical change and constant returns to scale, i.e., each annual index is presented relative to the previous year. Figure 4 presents the livestock production efficiency indices were highest during years 1996 and the period 2005 to 2007.

The effective precipitation was constructed as a merger of two factors, namely annual rainfall and average annual temperature. Rainfall data was used as the average of four points, Windhoek for the central commercial area, the Waterberg area for the north-eastern area, and Kamanjab area for the northwest[‡], and Keetmanshoop for the southern part. This annual average was multiplied by the Namibian average temperature. To reverse the product into a single number, the square root was taken of that effective precipitation and indexed to the average of 100. The index shows that the worst effective precipitation year for the 2019 year followed by 1996, 2013, 1994, etc, while the best effective precipitation years were 2011, 2006, and 2009. Although it was expected that precipitation is one of the direct contributors to production output and TFP (see Azzam and Sekkat, 2005), analysis showed that the coefficients were not statistically

[‡] Unfortunately, no complete rainfall data is available from stations in the southern parts from Namibia

significant, but for the completeness of the paper necessary to understand the impacts (see Rojas-Downing, 2017).



Source: Authors' estimates

Figure 4: Namibian commercial livestock indices (1991 – 2020)

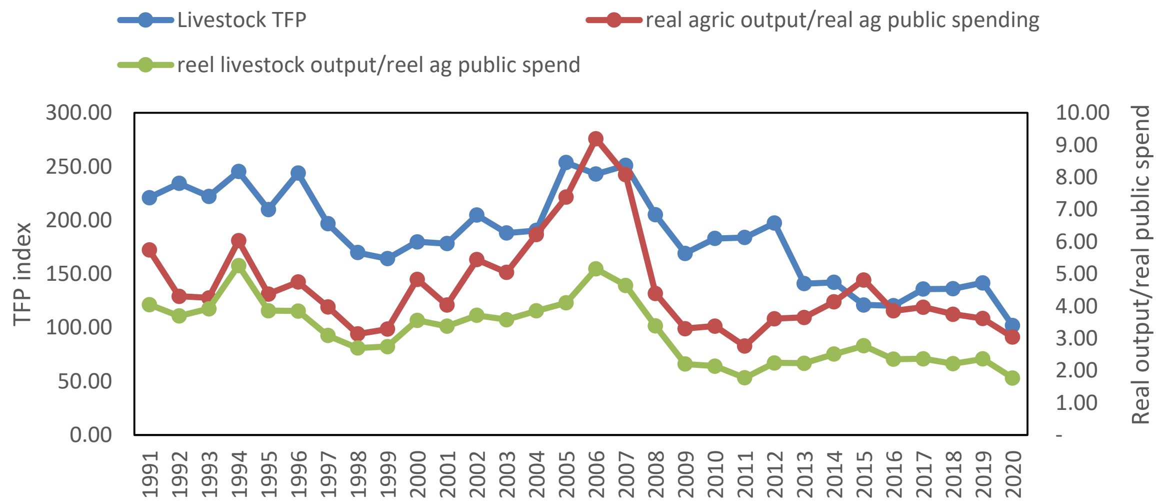
These indices were derived to be used as an independent variable contributing towards explaining production in the agricultural sector. The growth index for livestock output shows a declining average annual growth of 1.23%, while the annual growth of inputs for livestock production grew with 0,58% annually, resulting in the average annual livestock total productivity growth of -0.167%. Both the average annual land and labour productivity were negative, presented in Table 1. In comparison to the full period, the average growth rates during the past drought (2013-2020) are provided. The growth rates during the drought resulted into a tenfold reduction in land and labour productivity. The TFP accelerated the decline from 1.6% to 6.7%. These growth rates indicate that farmers were not sufficient supported and advised during the past drought, which calls for an improved early warning system.

Table 1: Average annual growth rates

Period	Livestock Output	Livestock Input	Livestock TFP	Land productivity	Labour productivity
1991- 2020	-1.299%	0.578%	-1.669%	-0.530%	-0.529%
2013 - 2020	-7.359%	-0.348%	-6.749%	-6.076%	-4.057%

Source: Authors' estimates

To visualise the livestock TFP index over the past 30 years and how it relates to the real agricultural (livestock) output per real agricultural public spending, Figure 5 is presented.



Sources: Authors' estimates

Figure 5: The relationship between livestock productivity and public spending on agriculture

It is evident that there has been a general sliding in the pattern of livestock total factor productivity (see Figure 5) post the global economic crisis of 2008/9. The global economic slump may also to blame for reduced capital formation and shrinking export market opportunities starting from late in 2018 to the end of 2019. The impact of COVID-19 also shows a bearing on the 2020 indicators. For Namibia, such a supply shock resulting from reduced agricultural investments and production will last for a while but will not have some permanent consequences.

Results and discussion

The regression results from the 3SLS model are summarised in Table 2. Variables were selected based on explaining the Namibian production output of the full economy, the total agricultural sector, its livestock sub-sector and its cattle division simultaneously. A stepwise approach was used to select the final best-fit model from many systems, which were inclusive of either insignificant explanatory variables or variables presenting the opposite explanatory value.

Independent variables tested included the livestock input index, TFP index, public spending on agriculture, land rental, estimated labour numbers employed in the livestock sector, capital formation in agriculture, livestock stock, number of livestock marketed, various livestock prices, etc. Different variables contributed significantly in explaining output. The national real GDP was driven by its own deflator, the CPI, which can also be seen as a proxy of indirect growth. The capital formation significantly explained the real GDP in such a way that if the real capital formation in agriculture would increase by 10%, then the GDP would grow by 4%. Additionally, the simultaneous equation showed that if the staff employed in the livestock sub-sector would increase by 10%, then the real GDP would increase by 12%.

Table 2: Model results explaining the changing agricultural outputs in Namibia (1991-2020)

Independent variable	Real Namibian GDP	Real agriculture production	Real livestock production	Real cattle production
Livestock input index			63.3029 7.930***	11.2154 1.680*

			0.8841	0.2155
Livestock TFP index			22.9361 21.630*** 0.9492	12.46483 14.530*** 0.7096
% Public spending on agriculture		1222.9270 30.210*** 0.8589		
Reel public spending on agriculture		3.2054 20.070*** 0.7262		
Real capital formation in agriculture	11.6055 4.790*** 0.4053			
Number of cattle marketed				0.5699 2.280** 0.0603
CPI	776.9554 22.320*** 1.4630			
Staff employed in the livestock subsector	1.895218 3.640*** 1.2170			
Constant	-4859.812 -0.430	-3845.3540 -10.200***	-3744.9490 -5.740***	47.7753 0.090
Adjusted system R^2	0.9713	0.9689	0.9483	0.8870
Chi2	1540.44	932.52	552.33	298.24

Note: Selected independent variables presented as coefficients, followed by t-statistics below and elasticity below. *, **, and *** indicate that the estimated coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively. n=30, and model required 41 iterations.

The middle column of Table 2 presents the real agricultural output, showing that the percentage public spending on agriculture significantly drives the total agricultural output. This relationship was described in the earlier sections on the Malabo declaration. Fiscal restrictions allow Namibia to allocate only 3% of its budget to agriculture. The model presented in Table 2 shows that if the allocation would increase by 10%, the total agricultural growth would increase by 8.5%. Furthermore, it shows that the real public spending on agriculture has an elasticity of 0.7262, which supports the Keynesian theory that agricultural spending increases productivity, aggregate demand, and employment directly into the agricultural sector and secondarily it increases national economic growth on national employment creation.

The model results show that the Tornqvest-Teil input and TFP indices significantly explaining the livestock output. It shows that an investment of 10% increase in inputs would result into an 8.8% increase in real outputs, while a 10% improvement in production efficiency (measured as TFP) would yield a 7.1% increase in livestock production output. It shows that the sector responds to inputs, which justify higher levels of public expenditure, combined with policies better spend public funds, to grow the agricultural sector.

The cattle division was explained by the obvious number of cattle marketed, but not by the pricing system. The number of cattle marketed can be seen as proxy for the production requirements, high fertility, low mortality, and genetic improvements of the produce. Additionally, the index variables selected for livestock production explained the real cattle output too, but with smaller elasticities.

Conclusion

This paper has presented the situational aspect of the Namibian livestock sector. Factors that are vital to determining total factor productivity were reflected on. The non-existent growth indices were later generated from data that was collected. The model was estimated and the results presented. It came out that determining total livestock factor productivity in Namibia is imperative and more so when linked to public sector spending as this could drive the direction of growth of the sector.,

Namibia spends less than the Malabo declaration indicator of 10% allocation towards the agricultural sector. Yet empirically, the results confirmed a positive relationship between public spending and agricultural total productivity. It will be useful for the Namibian Government to consider a higher allocation to this sector so that job creation, livelihoods and food security may be triggered. When viewed from an input-output perspective, it is clear over the years that total labour, livestock and the general total agricultural productivity have been declining. In order to reverse this trend, reskilling the agricultural sector, utilizing innovative technology and devoting an incremental and sustained budgetary allocation would impact directly on output over time.

The livestock sub-sector is vital and in order to continue ensuring that output from that angle increases, there will be need to ensure that disease outbreaks are controlled and also continuing improving the genetic content through stud breeds should receive considerable attention. This being the highest foreign currency earner from the sector, livestock production needs to be prioritized through policy and all forms of needed investments. Changing such a picture would again require deliberate efforts through a turn-around strategy on the side of industry players and especially on the side of Government as a policy driver.

Declaration of conflict of interest

The authors declare no conflict of interest

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