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AGRICULTURAL POLICY INSTRUMENTS AND AGRICULTURAL PRODUCTION IN MOZAMBIQUE

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AGRICULTURAL POLICY INSTRUMENTS AND AGRICULTURAL PRODUCTION IN MOZAMBIQUE [1]

Rabia Aiuba

SUMMARY

Agriculture is one of the most important productive sectors of the Mozambican economy, directly affecting not only the lives of millions of Mozambicans, whether at the level of employment and income generation, food and diet of the population, but also in terms of national accounts. This sector, however, remains underdeveloped. It is in this context that agricultural policies play a crucial role in leveraging the agricultural sector. The objective of this paper is to analyse the dynamic effects of variations in agricultural policy instruments on agricultural production in Mozambique in the short-term through the use of an Autoregressive Distributed Lag (ARDL) econometric model. The results of the model suggest a positive relationship between agricultural output per capita and the use of chemical inputs, agricultural commodity price index, agricultural investment, agricultural gross fixed capital formation and the lagged agricultural GDP; a negative relationship between agricultural GDP per capita and the producer price index; and a non-significant relationship between agricultural output per capita and agricultural credit, cultivated land and rural population growth rate. Some of these results are consistent, and others are not, with the empirical evidence found by other authors' research in relation to Mozambique and other countries. However, the results may be biased given the small sample size.

Keywords: Agriculture, Agricultural Policy Instruments, Time Series Analysis, ARDL model, Mozambique

[1] This paper is an adaptation of a master's thesis with the same title, published at the following link, in the English language: https://www.repository.utl.pt/handle/10400.5/26391 .

1. INTRODUCTION

In most developing countries, notably in sub-Saharan African countries (SSA), and in Mozambique in particular, the agricultural sector plays a central role in the economy, both in terms of employment and income generation, feeding the population and in national accounts. In Mozambique, agricultural production has accounted for approximately 20% of Gross Domestic Product (GDP) over the last 20 years and employs about 80% of the economically active population (Di Matteo & Schoneveld, 2016; National Statistics Institute, INE, 2022; Pernechele *et al.*, 2018).

However, despite its importance in the country's economy, agricultural activity is still very rudimentary, although it is a heterogeneous sector, producing on small plots of land by smallholders, dependent on edaphoclimatic conditions and with a low degree of modernisation (low use of inorganic inputs, mechanisation, among others), therefore producing below its productive potential, with low levels of productivity, which results in its limited capacity to contribute positively to poverty alleviation, food insecurity, malnutrition, inequality, among other problems (Badiane & Makombe, 2014; Lindert, 1991; Mosca, 2011).

It is in eradicating the problems of agriculture that agricultural policies and their various instruments play a crucial role. However, it can be seen that these policies in SSA, and in Mozambique in particular, are linked, according to currently accepted theoretical thinking, to the needs of the international market and come under pressure from international financial institutions (World Bank, WB, and International Monetary Fund, IMF) and international public and private actors, rarely adjusting to the real needs of farmers[2]. This means that, over the years, agricultural policies in the region have followed different approaches, where the ultimate stated objective is the development of agriculture, while the policy instruments remain the same.

This paper seeks to analyse the dynamic effects of variations in agricultural policy instruments on agricultural production in Mozambique, in the short-term, in the period between 1995 and 2019, corresponding to a Mozambique post-socialist experience, where the economy started to acquire characteristics of a market economy. The following specific objectives were defined: 1) to describe the evolution of Mozambican agricultural policy instruments in the period under analysis; 2) to identify the impact of agricultural policy instruments on the agricultural sector; and 3) to measure the effect of agricultural policy instruments on Mozambican agricultural production.

Thus, the author formulated the following research question, considering positive economics: How have agricultural policy instruments impacted agricultural production in Mozambique? In an attempt to answer this question, the following hypotheses were defined:

- H0: Not all the agricultural policy instruments analysed have a positive impact on agricultural production in Mozambique.

- H1: All the agricultural policy instruments analysed have a positive impact on agricultural production in Mozambique.

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[2] The main objective of these programmes, strategies and projects: increasing agricultural production and productivity, may not always be consistent with the needs and desires of producers, for example, "reducing risks, reducing the volume and drudgery of work, improving diets, obtaining cash income and balancing this with the objective of self-sufficiency and food security, establishing a balance between resource use and conservation, among other aspects" (Mosca, 2014, p.25).

In general, experience in different contexts tends to find a positive relationship between agricultural policy instruments (prices, credit, investment, agricultural research, among others) and agriculture, although there are factors that can cause them to produce results contrary to expectations (Hemming *et al.*, 2018; Neto, 1996; Pernechele *et al.*, 2018; Sunmer *et al.*, 2010).

As agriculture is one of the main economic activities and source of income generation for a large part of the population in low-income countries, the continuous search for understanding its functioning and the role of the government, through its general and sectorial policies, for the growth and development of this sector is extremely relevant. This paper seeks to contribute to the production of empirical material for understanding agriculture in Mozambique.

In addition to Chapter 1, this text is composed of five more chapters. Chapter 2 corresponds to the contextual analysis, which seeks to explain the context of the main concepts in Mozambique and analyses the evolution of each of the variables under study. Chapter 3 corresponds to the literature review, where a small compilation of empirical results from other research on the relationship between agricultural policy instruments and agriculture in Mozambique and other countries is made. Chapter 4 contains the methodology, explaining the process of data collection and processing, the method of analysis and the reasons for its choice. Chapter 5 presents the analysis of the results of the econometric model. Chapter 6 presents the main conclusions of this study, limitations and recommendation.

2. CONTEXTUAL ANALYSIS

This chapter contains a brief explanation of agriculture in Mozambique, agricultural policies in the country and analysis of the evolution of the variables chosen to represent agricultural policy instruments in Mozambique.

2.1. Agriculture in Mozambique

Mozambique is an agrarian country, where agriculture is one of the main activities in this sector. In the last 20 years, this activity has accounted for about 80% of agricultural production, 20% of GDP and employed just over 80% of the economically active population (Di Matteo & Schoneveld, 2016; INE, 2022).

Agriculture in Mozambique is a heterogeneous activity, including a multiplicity of production systems, where a large part of this activity is practised by the family sector, consisting of small farmers who carry out the activity on small plots of land (about 95% produce on farms of less than 5 ha). Agricultural production in this production system is characterised by intensive use of labour, limited use of capital and modern inputs, limited access to financing, technical assistance, extension services, information and markets, weak integration into value chains, dependence on the soil and climatic conditions of the regions, with high production losses in the field and post-harvest (Abbas & Mosca, 2021; Marassiro *et al.*, 2021; Mosca, 2014).

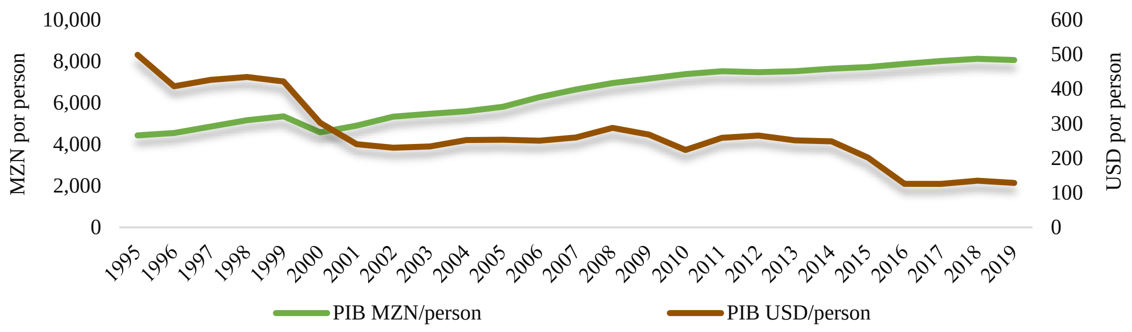
There are also, within and outside this family production system, other production systems, identified by Nova (2021), namely: (1) agribusiness or the large-scale investment model, (2) contract farming or outgrower system and, (3) the small commercial farmer model.[3] As a general

[3] See Nova (2021) for a characterisation of each of these agricultural production models in Mozambique.

rule, these models have a high potential for modernising agricultural activity, especially the last one which covers small producers.
Considering this nature of agricultural production in Mozambique, combined with the country's vulnerability to extreme weather events (droughts, floods, and cyclones), among other reasons, the agricultural sector has low productivity levels (Marassiro *et al.*, 2021).

Chart 1

Agricultural GDP, at constant prices, per capita of the rural population



Source: Calculated by the author based on data from WB (2022b) & INE (2022).

Note: Figures per capita were calculated for the rural population as this is the region where agricultural production takes place. 2014 was the base year defined for the calculation of Agricultural GDP per capita for the rural population at constant prices in MZN. Scale on the right for Agricultural GDP in USD/rural person.

The chart above shows the evolution of agricultural GDP per capita in MZN and USD. The two series evolve in opposite ways despite measuring the same variable: agricultural GDP in MZN showed an upward trend and agricultural GDP in USD showed a downward trend. This divergence is due to the devaluation of the MZN. Abbas & Mosca (2021) points out that production by crop has declined compared to production in the period before independence, except for some food crops, such as maize and cassava, and some cash crops, such as cotton, cowpea, sesame, and tobacco.

The average annual growth rate of agricultural GDP, at constant prices, in this period was 5.4%, above the average growth rate of the total and rural population, 2.8% and 2.3%, respectively (WB, 2022; INE, 2022). However, production still does not meet the food and dietary needs of Mozambicans.[4]

[4] A study by (Aiuba, 2018b) sought to verify whether the production and supply of four staple crops (groundnuts, rice, beans and maize) covered the food needs of Mozambicans, according to the food needs of an adult defined by the Technical Secretariat for Food Security and Nutrition (SETSAN). The study found that, on average, between 1961 and 2016, supply covered about 43% of food needs and national production covered about 32% of per capita food needs for these products.

2.2. Agricultural Policies in Mozambique and their Instruments

Mozambique currently does not have an agriculture policy[5] although it has an agricultural policy since 1995. The fundamental principle and objective of this policy is "to develop agricultural activity with a view to achieving food security, through the diversified production of products for consumption, supply to national industry and for export, based on the sustainable use of natural resources and the guarantee of social equity" (Resolution no 11/95 of 31 December 1995, p. 9).

Following the approval of this agricultural policy, various general and specific plans, strategies, programmes and projects for the agricultural sector were designed, approved and implemented.[6] These implementation strategies of these various instruments of the agricultural policy had as their main objective the increase of productivity, production, competitiveness, income and profitability of the agricultural sector, to feed the domestic and international market, to solve the problem of hunger, malnutrition, poverty, unemployment, deficit of external accounts, and to accelerate the growth and development of the economy. These agricultural policy implementation strategies converged in their approach to modernise the sector through increased use of improved seeds and inorganic inputs, mechanisation, irrigation, provision of extension services and technical assistance, credit, marketing support and access to infrastructure along value chains, while promoting sustainable use of natural resources and preservation of the environment[7] [8] (Mosca, 2011).

However, after more than 25 years of agricultural policy and its operationalization, the Mozambican agricultural sector remains underdeveloped and with limited capacity to feed the growing population, as the existing agricultural policy instruments have hardly been efficient and effective: (1) budget constraints and allocations do not prioritise agriculture and the rural environment, (2) there is no general price policy[9], (3)) input price subsidies benefit medium and

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[5] The SUSTENTA programme was initiated in a pilot phase in 2017 and extended to the national level in 2020. It was initially intended to be transformed into the National Family Farming Policy, but has remained a programme to date. The overall objective of this programme is to "improve the quality of life of rural households through the promotion of sustainable agriculture (social, economic and environmental)" (*Ministério da Agricultura e Desenvolvimento Rural, MADER, 2020, p.2; Ministério da Terra, Ambiente e Desenvolvimento Rural, 2018*).

[7] However, these plans, strategies, programmes and projects differed in whether they promoted the ideals of cooperativism, or followed rural development as a whole approach and considered agriculture as an integral part of the countryside, or emphasised the importance of multi-sectorial planning and coordination, or prioritised small farmers and family farming, the creation of 'emerging farmers' and their integration into value chains, or followed a value chain approach, prioritising a set of crops and regions with high productive potential..

[8] This discrepancy in approaches is not unique to Mozambique but has also been seen in other SSA countries with the constantly changing objectives of development paradigms, especially after independence, which are generally in line with currently accepted theoretical thinking, the guidelines of international financial institutions (WB and IMF), international public and private actors, and the needs of the international market. For example, in the early 1960s, the ideals of Johnston & Mellor (1961) and Schultz (1967) predominated, where smallholders had a central role in agricultural development; in the 1970s, the focus turned to poverty, growth and equity issues; at the same time, in the 1960s/70s, the ideals of industrialisation and import substitution through the protection of infant industries, derived from the models of Lewis (1954) and Ranis & Fei (1961), predominated; in the 1980s to 1990s, there was a strong focus on economic stabilisation and agricultural reform, and the Structural Adjustment Programme (SAP) was implemented; in the 1990s to 2010s, poverty was again at the centre of discussions and agriculture became an important element in accelerating "pro-poor" growth; and; from the 2000s to 2010s, agriculture was again placed at the centre of economic development with the approval of the New Partnership for Africa's Development (NEPAD)/Comprehensive Africa Agriculture Development Programme (CAADP) (Badiane & Makombe, 2014; Lindert, 1991).

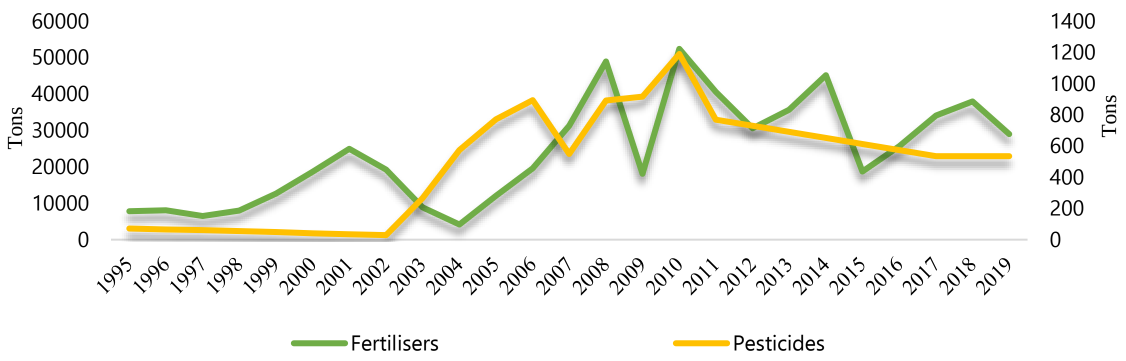
[9] In 1987, the prices of 45 crops were fixed by the government, but since then the number of crops with administratively fixed prices has been reduced annually as part of the SAP. In 1989/90, a minimum price policy was established for nine products, namely: cotton, groundnuts, meat and meat products, cashew nuts, copra, beans, sunflower, mafurra and

large farmers the most, (4) access to information through the Agricultural Market Information System (AMIS) is still limited, slow, and not available to all actors in the value chain[10], , (5) access to credit is weak and government initiatives such as the Fundo de Desenvolvimento Agrário (FDA) (*Agricultural Development Fund*) and the Orçamento de Investimento de Iniciativa Local (OIIL) (*Local Initiatives Investment Budget*), generally provide services and public investment, benefiting public institutions and very small-scale projects, in many cases not linked to agriculture [11], and (6) weak linkages between agricultural research and extension services, lacking financial resources and human capital, hampering the production and dissemination of information on production technologies and best production practices (Casamo *et al.* , 2013; Centro de Estudos Moçambicanos e Internacionais, 2010; Decreto no 60/2016, 2016; Mosca, 2014; Mosca *et al.*, 2013, 2014; Mosca & Abbas, 2013).

In addition, there is little transparency in the use of government funds, corruption, limited stakeholder participation in policy design, and a mismatch between policies and the economic, technical, social and cultural realities on the ground (Mosca, 2014). These policies have generally been unfavourable for most farmers, as the government prioritises other economic sectors and, within agriculture, prioritises medium- and large-scale producers, private companies and investors, value chains in the upstream stages of primary production, and export crops (Casamo *et al.*, 2013; Marassiro *et al.*, 2021; Monjane & Bruna, 2018; Mosca, 2014).

2.2.1. Evolution of Agricultural Policy Instruments in Mozambique

Chart 2
Use of chemical fertilisers and pesticides in Agriculture (in Tons)



Source: Food and Agriculture Organisations of the United Nations (FAO, 2023).
Note: Scale to the right for pesticide consumption.

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sorghum (Tarp, 1990). This policy was initially implemented by the *Instituto de Cereais de Moçambique* (ICM), which in 1981, during the socialist experience, was transformed into the *Empresa de Comercialização Agrícola* (AGRICOM), and in 1994 was again transformed into the ICM. In 1997, price support policies were abandoned and currently a small group of products remain covered by these policies: cotton and cashew nuts have their prices administratively fixed, and sugar benefits from a reference price policy, which serves as protection against dumping and external competition (Aiuba, 2018a; Bruna, 2014; Mosca & Abbas, 2013).

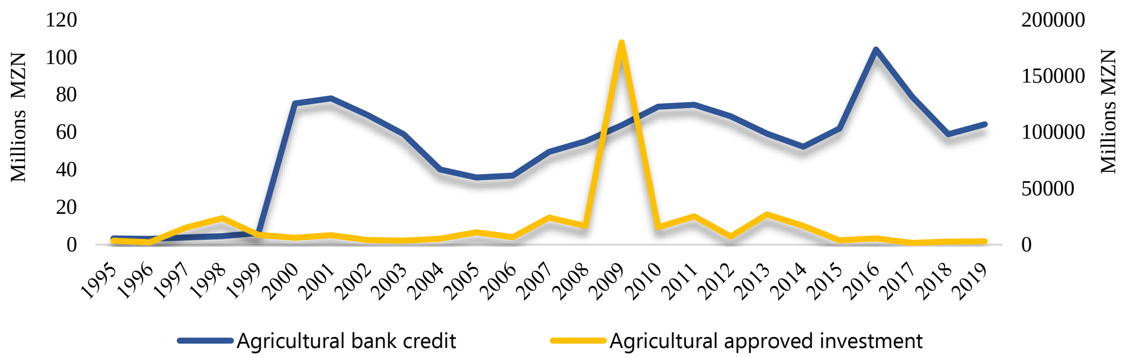
[10] AMIS has been operational since 1991 and disseminates price information by television, radio, mobile phone, internet and in writing (Mosca, 2011).

[11] The OILL has been operational since 2006, replacing the District Development Fund (DDF) which operated from 1998 to 2008. The ADF was established in 2006 as a merger of the Fund for the Development of Agricultural Hydraulics (FDHA) and the Fund for Agricultural Development (FFA).

The above series shows that, in the first 15 years, the use of these inputs evolved not following the same pattern, but, from 2011 onwards, both had a decreasing trend use. In general, the evolution of the use of inorganic inputs can be explained by the behaviour of some crops: in the case of pesticides, by the production of cotton, and in the case of fertilisers, by the production of rice, tomatoes, sugarcane and tobacco, the latter two crops accounting for about 90% of total fertiliser consumption (Benson *et al.*, 2012).

The greater variations in the inorganic input series from the late 1990s and early 2000s are notable, and may be related to the growing recognition by the government of the role of modernisation and the intensification of this process in combating rural poverty and food insecurity (Di Matteo & Schoneveld, 2016). From 2001 to 2004, the decrease in fertiliser consumption is partly due to the withdrawal of public operators from the market, associated with Japan's Kennedy 2 or KR-2 programme (Ministério da Agricultura, 2012).

Chart 3
Bank credit and agricultural approved investment, at constant prices



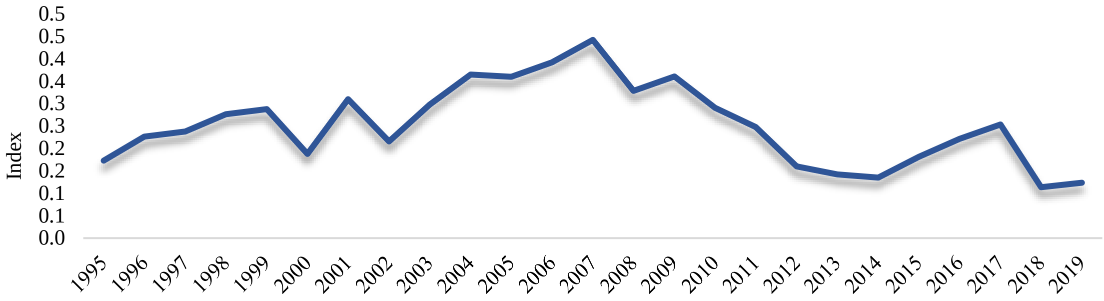
Source: APIEX (1995) and BM (2022).
Note: 2014 has been defined as the base year for the calculation of constant price values of credit and approved investment. Scale to the right for approved investment for the agricultural sector.

Bank credit to agriculture showed an upward trend, with important peaks in 2000 and 2016, followed by a sharp decline in 2017. The behaviour of this series in 2017 is attributed to the contraction of credit to the economy as a result of the persistence of the restrictive monetary policy, initially applied in 2016, to address the negative effects of the "hidden debt" crisis on the economy (WB, 2017).

Despite the growth in value at constant prices, the proportion of bank credit dedicated to the agricultural sector in total credit granted to the Mozambican economy has been decreasing: in 1995, it represented about 26%, and in 2019, about 4% of total credit granted. However, at the same time, there has been an upward trend in bank credit to support services for the extractive industry (energy minerals) (Muianga, 2021).

The volume of investment approved has been volatile throughout the series. The peak in 2009 was due to the approval of 2 projects: Grown Energy Zambeze and Agro-Pecuária PROAL which together accounted for 49% of the total agricultural investment approved that year (APIEX, 2009). In terms of the number of projects, from 2002 onwards, there was a continuous increase in the number of investments approved per year and, coincidentally with this period, and the food and energy price crisis (2007/2008), the number of agricultural investments in the country more than doubled (Di Matteo & Schoneveld, 2016).

Chart 4 [12]
Agricultural gross fixed capital formation index



Source: FAO (2023).

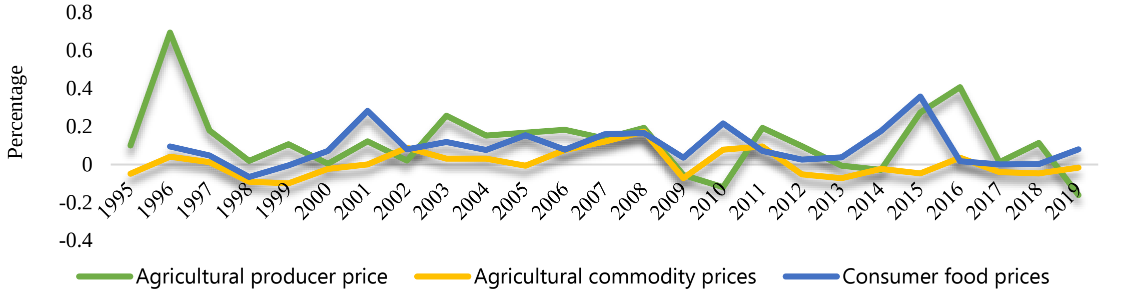
Note: Index values range from 0 to 1.

The values of the agricultural gross fixed capital formation index analysed were always below 0.5, denoting that agriculture receives a lower share of investment relative to its contribution to the economy's value added, which in turn negatively affects its productivity growth and technical progress. From 2008 onwards, a downward trend is observed in the series, which means that, in this period, gross fixed capital formation grew faster in the rest of the economy than in agriculture (United Nations Statistics Division, 2022). Mosca & Dadá (2014) warn that the downward trend in capital accumulation, not only in agriculture but in the economy as a whole, will require huge investments and the recovery of productive capacity will take years.

The acquisition of capital by smallholders for investment in their farms in Mozambique usually includes the purchase of chemical inputs, long-handled hoes, improvement of barns, opening of water wells, among others. Investment (purchase) in tractors and other machinery is usually done by large farmers, farmers' associations and specific programmes and projects, and medium and small farmers have access to these through rental.

[12] This index corresponds to the "total value of producer acquisitions, minus disposals of fixed assets during the accounting period, plus certain additions to the value of non-produced assets (such as subsoil assets or major improvements in the quantity, quality or productivity of land) realised by the productive activity of institutional units" FAO (2023).

Chart 5
Inflation of the Agricultural Producers' and Commodities Prices and Consumers' Food Prices

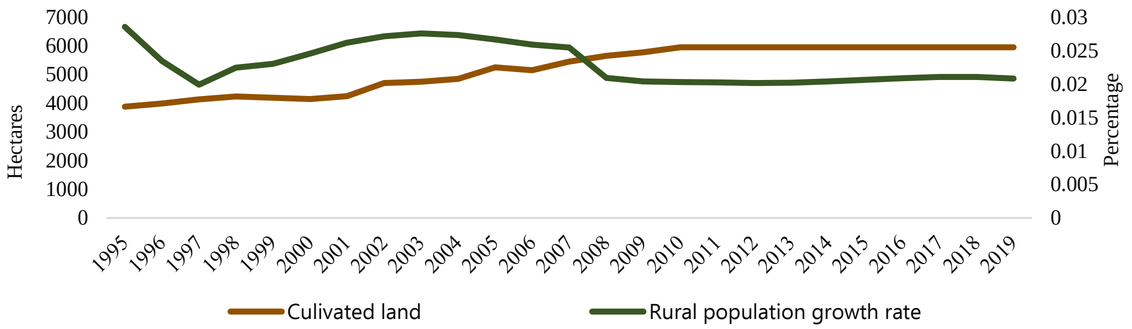


Source: Calculated by the author based on data from WB (2022a), INE (202) and FAO (2023).
Note: The series representing consumer price inflation was not included in the econometric analysis and has the following specificities: 1) data not available for 1995 and 2) data for the years 1996-2016 have the year 2010 as the base for the constant value calculation and data for the years 2017-2019 have the year 2016 as the base.

The above series showed a high amplitude in the variation, especially the consumer and producer prices. This trend of price variability generates uncertainty in the decision-making process of economic agents, both at the production level, since farmers have difficulties in accessing updated information on prices of the final product on the market, and at the level of the household budget by consumers.

The proportion of the value added received by farmers is very low and is concentrated in the downstream stages of the value chain, as pointed out in a study by the authors Aiuba & Nova (2021), which covered three crops: sugar, cowpea and maize. The factors that explain this phenomenon, in general, are the following: 1) weak negotiating capacity of smallholder, due to low literacy and limited access to markets, information on markets and prices; 2) precarious storage systems and the need for immediate liquidity; 3) low quality of harvested production, due to the limited use of modernised inputs, lack of standardisation and quality control of production and lack of processing; 4) market structures; and 5) the armed conflict that began in mid-2010 in the central region of the country, which hampered the transport of goods (Nova, 2018).

Chart 6
Cultivated land in hectares and rural population growth rate



Source: WB (2022b) and FAO (2023).
Note: Cultivated land data are imputed, meaning that in many years estimated given the lack of observed data. Scale to the right for rural population growth rate.

Growth in cultivated land is observed in the first 15 years analysed, followed by stagnation in the remaining years under analysis. The increase in the use of land for agricultural activity is essentially the result of the need to increase production to feed the growing population, among other reasons, and is done mainly through deforestation and burning, activities that have negative effects on the environment (Chandamela, 2021).

The growth rate of the rural population has shown a slow downward trend from a rate of 2.9 % in 1995 to a rate of 2.0 % in 2019. Overall, this growth rate is not very different from the overall growth rate of the Mozambican population, with an average difference of 0.5 percentage points (pp) in favour of the latter.

3. LITERATURE REVIEW

This section provides a brief description of the effects of different agricultural policies in Mozambique and other countries.

3.1. The Effect of Agricultural Policy Instruments on Agriculture

The production and productivity of agriculture, in general, do not depend only on technical considerations, but depend enormously on government actions towards the sector (Chaudhry, 1995). It is in this context that agricultural policies have their merit and are also important in reducing the chronic imbalance that exists between the agricultural sector and other sectors of the economy, as well as in dealing with market instability (Heidhues, 1976). Agricultural policies can be used individually or in combination, where in the latter case, when done in a co-ordinated manner, they can produce greater positive effects on the agricultural sector.

Government funds are one of the main factors for the implementation of agricultural policies. Several studies conducted in different contexts generally find a positive relationship between public spending on the agricultural sector and agricultural productivity and production (Apata, 2021; Armas *et al.*, 2012; Casamo *et al.*, 2013; Wangusi & Muturi, 2015), and between public spending on agriculture and a lower incidence of malnutrition in African countries (Fontan Sers & Mughal, 2019).

Donor funds are a major constituent of public expenditure in low-income countries. A study conducted in Kenya, established a positive causal relationship between donations to the sector and agricultural productivity (Wangusi and Muturi, 2015).

Despite the positive relationship between public expenditures to the agricultural sector and the different variables of agriculture, the authors Armas *et al.* (2012) argue that the composition of these public expenditures dictates the level of the positive effect and in some cases can lead to a negative relationship between these variables. An example is the case of the subsidy policy in Indonesia, where the authors found a negative relationship between input subsidies and agricultural productivity, justifying this result as follows: 1) because these subsidies do not always translate into higher consumption of inputs; 2) because of the existence of diminishing returns from the use of chemical inputs; and 3) because, by subsidising inputs, funds are diverted from activities with greater impacts on agriculture, such as the provision of public goods and services (research, irrigation, infrastructure, among others) (Armas *et al.*, 2012).

A meta-analysis on subsidies for inputs, fertilisers and/or seeds in low- and middle-income countries concluded that they generally have a positive impact on uptake, contributing to increased productivity, output, farmer incomes, GDP, and reduced output prices (Hemming *et al.*, 2018).

Food subsidies (to the final product) generally increase food consumption, especially when they target products consumed by the most vulnerable section of the population. This policy is generally not used for long periods because it is costly (Southworth, 1945).

Price policy is another of the most important agricultural policies that exist, and it can be of price ceiling, minimum prices, reference prices or relative prices. Minimum price policy benefits farmers by reducing uncertainty around their incomes and increasing their bargaining power, but negatively affects the consumer through higher prices compared to the market equilibrium price, although this policy ensures greater price stability. Theoretically, it is assumed that for the minimum price policy to work, the administratively set price should be higher than the equilibrium price in terms of increased supply (Khan Academy, no date; Pernechele *et al.*, 2018).

Cleaver (1985) found in his study that price policy and exchange rates had a negative impact on agricultural production in many African countries. This may result from overvalued exchange rates and at the price policy level, when the minimum price set is used as a guiding price, not allowing producers to benefit from price increases on the international market. An example is cotton production in Mozambique and Benin (Neto, 1996; Pernechele *et al.*, 2018; Sumner *et al.*, 2010).

Tarp (1990) shows that in Mozambique, in the period when widespread fixed and minimum price policies were active, producers seemed to respond to price changes, and this behaviour was more intense in cash crops than in food crops. A study by Berthemly & Morisson (1989) *apud* Mosca (2011, p. 150) found that in Mozambique and Tanzania, rising prices lead to a decrease in supply as a result of "market distress".

Cleaver (1985) further argues that policies affecting input supply, population growth and investment have greater impacts on agricultural growth than price and exchange rate policy. Apata (2021) argues that investment in areas considered "drivers of development", such as health, education and access to infrastructure, has a positive effect on agricultural productivity growth.

Credit policy has a positive impact on agricultural production, but its potential impact can be disrupted by inflationary pressures (Neto, 1996). Mosca *et al.* (2013) did not find a causal relationship between agricultural credit and agricultural GDP in Mozambique, although both variables are positively correlated.

In Mozambique, private investment positively affects agricultural production, although this effect is low (Mosca & Dadá, 2014).

Dercon & Gollin (2014) stated that the literature suggests a positive relationship and a high rate of return to public investment in agriculture, although they address the question of the costs of this policy intervention to the economy to a limited extent. Casamo *et al.* (2013) showed that public investment in Mozambique is not significant in explaining agricultural production, as these funds are usually directed to areas that contribute little to productivity and production, such as debt burdens, administrative expenses, and institutional support.

Export restriction policy, when active, increases the availability of the product in the domestic market. This policy can also be used to control prices when they tend to be above the politically accepted limit (Heidhues, 1976). An example is the case of staple crops in Ethiopia and Tanzania (Pernechele *et al.*, 2018). Dumping policies favour the exporting country by increasing farmers' income (Sumner *et al.*, 2010).

Supply control policies directly interfere with marketable quantities or the utilisation of production factors, mainly land use (Heidhues, 1976).

Protectionist policy protects the domestic producer from external competition by creating incentives for domestic prices, positively affecting agricultural production, as in the case of rice in some SSA countries, with varying degrees of effectiveness. However, this policy (through tariffs on imports) does little to eliminate fluctuations in quantities and prices and, under certain conditions, can increase price instability. Policies to protect domestic production and industries tend to conflict with trade policies for industrial goods (Heidhues, 1976; Pernechele *et al.*, 2018).

In Mozambique, in the case of maize, this policy consisted of a tariff on maize imports of 2.5 % and a value-added tax on the product of 17 %, which together with the increase in demand for this good (by millers and the growing poultry industry) incentivised farmers to increase the price and, in the case of sugar, a surcharge on imports when the product enters the country at a price lower than the price practiced in the domestic market (Aiuba, 2018a; Pernechele *et al.*, 2018).

Investment in research and development (R&D) has proven over the years to increase farm productivity, leading to increased production and consumption and lower prices, and is a long-term policy. Investment in R&D (increased expenditure) also has a positive causal relationship with improved food security in African countries, although this relationship becomes insignificant beyond the second year of the investment (Alston, 2007; Casamo *et al.*, 2013; Fontan Sers & Mughal, 2019; Mosca & Dada, 2014; Sumner *et al.*, 2010).

Although it has positive impacts on agriculture, agricultural research is generally under-valued, especially in low- and middle-income countries, as evidenced by the high rate of return on marginal investment in this area in terms of production and productivity (Alston *et al.*, 2010; Sumner *et al.*, 2010).

The effects of agricultural policies on the agricultural sector are not linear, depending on a number of factors that can generate stronger, weaker, or even contradictory outcomes, such as: the price of output and inputs, the efficiency of the market and communication channels, the supply and demand elasticies of output and inputs, the elasticity of substitution between inputs, the type of farming and economic systems, the target actors and the time horizon of policies, complementary policies and investments, budget constraints, existing infrastructure, the stability of the economic, institutional and political environment, corruption and transparency, environmental conditions, among others (Chaudhry, 1995; Cleaver, 1985; Hemming *et al.* 2018; Pernechele *et al.*, 2018; Sumner *et al.*, 2010).

4. METHODOLOGY

Regarding the course of this research, in a first phase, the literature on the topic was surveyed and reviewed as a way to establish a contextual scenario and to understand the relations of agricultural policy and its instruments with the agricultural sector, both in Mozambique and in other contexts. Next, statistical information was collected. The data were then processed, and the econometric model was developed to analyse the effect of policy instruments on agricultural production in Mozambique.

The sequence of the development of this work was not linear, having undergone changes, corrections and adjustments.

4.1. The data [13]

Agricultural policy defines various instruments for the pursuit of the principles defined for agricultural activity, such as: provision of improved seeds, extension services, subsidies (energy, fuel and lubricants) and price information, promotion of the use of agrochemicals and credit for production and marketing, promotion of investment, increased marketing and export capacity, development of agricultural research, a pricing policy, various infrastructures, production support centres, improved access to land, among other instruments.

However, due to the difficulty of accessing information on these agricultural policy instruments in a series of years in Mozambique, for the development of a time series model that analyses the effect of these variables on agriculture over time, in conjunction with the classification of direct agricultural policies by Mendoza (2000)[14], the following variables were defined:

- Agricultural exports (*agrexpo*), agricultural gross fixed capital formation (*capitalform*), consumption of manure (*manure*), fertilisers (*fertilizer*) and pesticides (*pesticides*), producer price index (*prodprice*) and cultivated land (*land*). These data were taken from the Food and Agriculture Organisation of the United Nations (FAO).

- Agricultural commodity price index (*commdprice*), taken from the World Bank (WB).

- Agricultural GDP per capita (*agrgdp*) and rural population growth rate (*ruralpopl*). These data were taken from the National Statistics Institute (INE).

- Agricultural bank credit (credit), taken from Bank of Mozambique (BM).

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[13] The terms "agrarian" and "agricultural" will be treated as synonyms in this paper, with a preference for the term agricultural and its variations, given the difficulty of accessing information on agrarian and agricultural variables separately and also because agriculture in Mozambique is the largest activity contained in the agrarian sector: in the last 18 years, agricultural production represented about 81 % of total agrarian production (INE, 2022).

[14] The author defines the following direct agricultural policies: price policy (maximum, minimum, guarantee and reference price, input, output, import and export subsidies and taxes on inputs and outputs); marketing policy (reduction of monopoly mark-up, transport, storage and processing prices and increase in efficiency of marketing process); credit policy (increasing the supply of rural credit and reducing the operating costs of financial entities, transaction costs for farmers, risk premium and excess financial profit margin); information policy (markets for agricultural products, capital goods, inputs, technologies, finance, human capital accumulation and soil and climate factors); institutional policy (land tenure, water use, judicial, financial, investment and quality and health control regimes); among other policies.

- Approved agricultural investment (*investiment*), taken from Investment and Export Promotion Agency (APIEX).

Explanatory variables for agricultural production in Mozambique were selected as representative of financing (credit, investment and gross fixed capital formation in agriculture) as a way of denoting the government's efforts to finance agriculture; use of agrochemicals (consumption of fertilisers and pesticides) and organic inputs (use of manure) representative of the promotion of agricultural modernisation and control of soil degradation; prices (producer price and agricultural commodity indices) representative of the current agricultural price policy and; exports, representative of the incentive to international trade. Cultivated land and the rural population growth rate were included in the analysis because land is one of the main factors of agricultural production and agricultural activity in Mozambique takes place almost exclusively in rural areas.

These data is aggregated on an annual basis, covering the period of 1995 -1998.

4.2. Data processing

Before developing the econometric model, the data were processed to some extent. First, the volume of approved agricultural investment, collected in US Dollars (USD), was converted into Mozambican Metical (MZN). Then, this variable, in conjunction with agricultural GDP per capita and agricultural bank credit volume, were adjusted to constant prices of the year 2014, following INE guidelines and using the consumer price index, as a way to exclude the influence of inflation. From this process, the variables: GDP per capita, real volume of approved agricultural investment (*rinvestment*) and real volume of agricultural bank credit (*rcredit*) were created.

The number of variables was then reduced and aggregated using multivariate analysis, Principal Component Analysis (PCA). The PCA method reduces data complexity by transforming a set of correlated variables into a smaller set of independent variables (scores) (Marôco, 2021). The correlation method was used, since the variables had different units of measurement, and the following variables were created: *interinvest* (volume of real agricultural bank credit), *forginvest* (volume of approved real agricultural investment and index of agricultural fixed capital formation), *inorginput* (consumption of fertilisers and pesticides) and *orginput* (consumption of manure). In both PCAs, the first two main components were retained, and it was determined that the financing variables (*forginvest* and *interinvest*) explain 78.28% of the variance and the input variables (*inorginput* and *orginput*) explain 92.13% of the variance. Note that as part of the regressors were created using the PCA method, additional sampling uncertainty was generated.

Next, we applied the logarithmic transformation to all variables as a way to stabilise the variations of the data across the different levels of the series and then tested the series for stationarity (Hyndman & Athanasopoulos, 2018). As each variable has a low number of observations (25 observations), it was decided not to use the results of the unit root tests alone, as these tests have low power and are susceptible to size distortions (DeJong *et al.*, 1992). Therefore, a combination of the results of the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) tests, correlogram analysis and literature review on the stationarity properties of the variables under study was used. In general, non-stationarity was decided for all variables in level and stationarity in first differences and hence, they were transformed to their respective first differences.

Data processing and econometric model development were done using the Microsoft Excel spreadsheet editor and the EViews 12 statistical software package.

4.3. The econometric model

As all variables are in their first differences, I (1), and the sample size is small, the Autoregressive Distributed Lag (ARDL) model was considered as the most appropriate regression model to conduct the analysis (Shrestha & Bhatta, 2018). An ARDL model is a dynamic model that is based on the ordinary least squares (OLS) technique and allows analysing the short-term effects of the independent variables on the dependent variable (Shrestha & Bhatta, 2018).

In general, the ARDL model was defined according to the following relationship:

$$agrgdp = f(\mathrm{commdprice, forgninvest, inorginput, interninvest, prodprice, land, ruralpopl}) \quad (1)$$

The relationship presented in equation (1) was described by the following dynamic model:

$$\mathrm{dlnagrgdp}_{t=}\beta_{0+} \sum_{k=1}^{n} \beta_{1k}\mathrm{dlnagrgdp}_{t-k} + \sum_{k=0}^{n1} \beta_{2k}\mathrm{dlninorginput}_{t-k} + \sum_{k=0}^{n2} \beta_{3k}\mathrm{dlnforginvest}_{t-k} + \sum_{k=0}^{n3} \beta_{4k}\mathrm{dlninterinvest}_{t-k} + \sum_{k=0}^{n4} \beta_{5k}\mathrm{dlncommdprice}_{t-k} + \sum_{k=0}^{n5} \beta_{6k}\mathrm{dlnprodprice}_{t-k} + \sum_{k=0}^{n6} \beta_{7k}\mathrm{dlnland}_{t-k} + \sum_{k=0}^{n7} \beta_{8k}\mathrm{dlnruralpopl}_{t-k} + \varepsilon_t \quad (2)$$

where *t* and *k* represent, respectively, the time period and the lag order, *β0* represents the intercept term, and β_{nk} are the parameters of each of the regressors: Note that the dependent and independent variables are in their logarithmic and first-difference forms, denoted by the prefixes *l* and *dl*, respectively. The item, ε_t, represents the error term. Equation (2) should satisfy the standard conditions of econometric models for time series data that justify the general use of OLS (Wooldridge, 2015).

A positive relationship is expected between the independent variables and GDP per capita (dependent variable):

Code	Independent variable	Expected sign in relation to the dependent variable
commdprice	Agricultural commodity price index	+
prodprice	Producer price index	+
inorginput	Fertiliser and pesticide consumption	+
forginvest	Volume of approved real agricultural investment and agricultural fixed capital formation index	+
interinvest	Volume of real agricultural bank credit	+
ruralpopl	Rural population growth rate	+
land	Cultivated land	+

It should be noted that the variables manure consumption, *orginput*, and agricultural exports, *agrexpo*, initially selected for this analysis, were not included in the final econometric model as they rendered all other variables non-significant in explaining the dependent variable, thus not allowing a good model to be calibrated.

5. EMPIRICAL RESULTS

This section presents the descriptive and correlation analysis of the data, the results of the model and checks whether the model fulfils the assumptions of homoscedasticity, absence of serial correlation, normality of distribution and stability of residuals to be considered a valid model.

5.1. Descriptive Statistics and Correlation Analysis

Table I

DESCRIPTIVE STATISTICS

	AGRGDP (per capita)	CAPITALFORM (indice)	COMMDPRICE (indice)	FERTILIZER (ton)	LAND (ha)	PESTICIDE (ton)	PRODPRICE (indice)	RCREDIT (MZN)	RINVESTMENT (MZN)	RURALPOPL (percentagem)
Mean	6420.846	0.253167	82.28066	23915.32	5195.800	483.5200	59.71800	51222519	1.18E+10	0.023011
Median	6644.613	0.248016	83.74787	19540.00	5450.000	549.0000	57.63000	58947551	4.24E+09	0.021063
Maximum	8127.703	0.442188	109.4827	52356.00	5950.000	1189.000	147.0500	1.04E+08	1.31E+11	0.028557
Minimum	4435.887	0.113546	61.41815	4151.000	3880.000	29.00000	9.840000	3105400.	4.67E+08	0.019913
Std. Dev.	1297.341	0.090114	14.13030	14157.38	793.2957	347.9667	39.88987	27994362	2.58E+10	0.002953
Skewness	-0.153110	0.236782	0.163614	0.397631	-0.409169	-0.013009	0.769521	-0.549497	4.186886	0.545107
Kurtosis	1.452293	2.163959	1.874678	2.082745	1.511292	1.903520	2.583234	2.453922	19.87716	1.689853
Jarque-Bera	2.592882	0.961695	1.430653	1.535207	3.006174	1.253068	2.648277	1.568739	369.7487	3.026094
Probability	0.273503	0.618259	0.489032	0.464124	0.222442	0.534441	0.266032	0.456407	0.000000	0.220238
Sum	160521.1	6.329177	2057.017	597883.0	129895.0	12088.00	1492.950	1.28E+09	2.95E+11	0.575284
Sum Sq. Dev.	40394269	0.194894	4791.970	4.81E+09	15103634	2905940.	38188.84	1.88E+16	1.60E+22	0.000209
Observations	25	25	25	25	25	25	25	25	25	25

Source: Calculated by the author.

In the above table, it can be seen that the average annual agricultural GDP per capita (*agrgdp*) in the period under review was MZN 6.4 thousand, with the maximum and minimum values of MZN 8.1 thousand and MZN 4.4 thousand, respectively. The total annual average cultivated land area (*land*) was 5.2 million hectares, with a discrepancy between the maximum and minimum values of 2.1 million hectares, respectively. The agricultural commodity price index (*commdprice*) had a maximum of 109, a minimum of 61 and an average of 82.

The rural population growth rate (*ruralpopl*) and the agricultural gross fixed capital formation index (*capitalform*) had small standard deviations of 0.003 and 0.09 and an average of 2.3% and 0.25, respectively.

Fertiliser consumption (fertilizer) and pesticides (*pesticides*), the volume of credit (*rcredit*), agricultural investment (*rinvestment*) and the producer price index (*prodprice*) showed large discrepancies between the maximum and minimum values, the first four being justified by the gradual increase of these variables over the years.

All the variables in the table above, except the volume of agricultural investment (*rinvestment*), present normal distribution, considering the skewness values close to zero and the p-value above the 5% significance level in the Jarque-Bera test. These variables are also platykurtic (kurtosis values below 3), which means that most of the series values are below the sample mean.

The volume of agricultural investment (*rinvestment*) has a positive skewness value and the p-value of the Jarque-Bera test is below the 5% significance level, which means that the series does not have a normal distribution. The kurtosis values are higher than 3, interpreting it as a leptokurtic curve with a long tail to the right and most of the sample values above the mean.

Table II

CORRELATION ANALYSIS

Correlation Probability	AGRGDP	CAPITALFORM	COMMDPRICE	FERTILIZER	LAND	PESTICIDE	PRODPRICE	RCREDIT	RINVESTMENT	RURALPOPL
AGRGDP	1.000000									

CAPITALFORM	-0.263779	1.000000								
	0.2026	-----								
COMMDPRICE	0.807656	-0.196761	1.000000							
	0.0000	0.3458	-----							
FERTILIZER	0.725417	-0.197403	0.736948	1.000000						
	0.0000	0.3442	0.0000	-----						
LAND	0.974910	-0.165542	0.830147	0.737039	1.000000					
	0.0000	0.4291	0.0000	0.0000	-----					
PESTICIDE	0.734587	0.208071	0.757136	0.628279	0.825571	1.000000				
	0.0000	0.3182	0.0000	0.0008	0.0000	-----				
PRODPRICE	0.909496	-0.350369	0.599014	0.570703	0.838777	0.513158	1.000000			
	0.0000	0.0860	0.0016	0.0029	0.0000	0.0087	-----			
RCREDIT	0.611000	-0.129453	0.427999	0.581585	0.656581	0.426892	0.602540	1.000000		
	0.0012	0.5374	0.0328	0.0023	0.0004	0.0333	0.0014	-----		
RINVESTMENT	0.250679	0.224042	0.333819	0.093277	0.294942	0.391388	0.087789	0.157197	1.000000	
	0.2268	0.2817	0.1029	0.6574	0.1524	0.0530	0.6765	0.4530	-----	
RURALPOPL	-0.683687	0.405905	-0.736714	-0.565229	-0.611046	-0.419425	-0.575853	-0.256857	-0.305270	1.000000
	0.0002	0.0441	0.0000	0.0032	0.0012	0.0369	0.0026	0.2152	0.1378	-----

Source: Calculated by the author...

The correlation analysis indicates that there is a very strong positive link (yellow coloured cells) of agricultural GDP per capita with cultivated land (0.97) and the producer price index (0.91).

Agricultural GDP per capita also shows a strong positive correlation (blue painted cells) with the agricultural commodity price index (0.81) and with the use of chemical inputs, fertilisers and pesticides, both with a coefficient value of approximately 0.73. The agricultural commodity price index has a strong positive correlation with the use of pesticides (0.76) and fertilisers (0.74), with land devoted to agricultural activity (0.83) and a strong negative correlation with the rural population growth rate (-0.73). Cultivated land is strongly associated with the use of fertilisers (0.74), pesticides (0.83) and the price to producers (0.84).

5.2. ARDL Model

Table III

ARDL MODEL

Dependent Variable: DLNAGRGDP
Method: ARDL
Date: 07/20/23 Time: 03:27
Sample (adjusted): 1999 2019
Included observations: 21 after adjustments
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): DLNINORGINPUT DLNFORGINVEST DLNINTERINVEST DLNCOMMDPRICE DLNPRODPRICE DLNLAND DLNRURALPOPL
Fixed regressors: C
Number of models evaluated: 384
Selected Model: ARDL(3, 0, 0, 0, 1, 1, 1, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
DLNAGRGDP(-1)	0.790849	0.266167	2.971245	0.0208
DLNAGRGDP(-2)	-0.710505	0.170428	-4.168948	0.0042
DLNAGRGDP(-3)	0.325069	0.143490	2.265439	0.0579
DLNINORGINPUT	0.267595	0.074127	3.609950	0.0086
DLNFORGINVEST	0.092840	0.023570	3.938820	0.0056
DLNINTERINVEST	-0.042310	0.031336	-1.350191	0.2190
DLNCOMMDPRICE	0.032748	0.098657	0.331935	0.7497
DLNCOMMDPRICE(-1)	0.341593	0.143967	2.372712	0.0494
DLNPRODPRICE	0.082323	0.043976	1.871991	0.1034
DLNPRODPRICE(-1)	-0.183481	0.063271	-2.899926	0.0230
DLNLAND	-0.626060	0.328235	-1.907355	0.0981
DLNLAND(-1)	-0.775099	0.363899	-2.129985	0.0707
DLNRURALPOPL	-0.011354	0.147868	-0.076785	0.9409
C	0.041781	0.013011	3.211299	0.0148

R-squared	0.932223	Mean dependent var	0.021249
Adjusted R-squared	0.806352	S.D. dependent var	0.047781
S.E. of regression	0.021026	Akaike info criterion	-4.651352
Sum squared resid	0.003095	Schwarz criterion	-3.955004
Log likelihood	62.83919	Hannan-Quinn criter.	-4.500226
F-statistic	7.406152	Durbin-Watson stat	2.913602
Prob(F-statistic)	0.006534		

*Note: p-values and any subsequent tests do not account for model selection.

Source: Calculated by the author.

The ARDL model assesses the short-term relationships between the variables analysed. The model was estimated with an order 1 lag for the dependent variables, according to the Akaike information-based lag criteria, and an order 3 lag for the dependent variable. The estimated ARDL model is significant, with a p-value of the F-statistics (0.0065) below the 5% significance level and the independent variables explain about 93% (R2) of the variance of the dependent variable.

The above results illustrate that, *ceteris paribus*, agricultural output per capita at lag of order 1, *dlnagrgdp* (-1), chemical fertiliser consumption, *dlninorginput*, approved investment and gross fixed capital formation, *dlnforginvest*, agricultural commodity price, *dlncommdprice* are significant and have a positive impact on agricultural GDP per capita, *dlnagrgdp*.

Regarding the first-order lag coefficient of agricultural output per capita, *dlnagrgdp*, the result in Table III means that the increase in output depends on the increase in output of the preceding year. This can be explained by the fact that farmers, especially small-scale farmers, have limited access to up-to-date information on markets and prices and therefore base their production decisions also on information about the previous year's production.

The positive relationship found between the use of inorganic inputs in the production process and agricultural production per capita is consistent with the results of several studies conducted in the area, such as Alston (2007) in the United States and Hemming *et al.* (2018) in low- and middle-income countries. Development models focusing on the modernisation of agriculture attest to these results, as modern inputs contribute to increased productivity and hence agricultural production. This result may also mean, to some extent, that government incentives for the use of chemical inputs have been positively benefiting the agricultural sector. However, Abbas (2015) found in her study for Mozambique that fertiliser use, one of the components of the *inorginput* variable, was not significant in explaining agricultural output. More recently, Abbas & Mosca (2021) found that a set of crops that use the most chemical inputs and improved seeds, and are the focus of most attention from extension services, had low productivity.

Approved investment and agricultural gross fixed capital formation, given by the variable *dlnforginvest*, and agricultural production per capita also have a positive relationship, a result consistent with that found in the study by Mosca & Dadá (2014) on the relationship between agricultural investment and agricultural production in Mozambique. Investment in agriculture allows producers to access inputs for production, various infrastructures (irrigation, storage, among others), generate employment and increase household income in rural areas (Mosca & Dadá, 2014). However, although they induce proven positive effects on agriculture, investment in this area in Mozambique is still low compared to its contribution to GDP.

The price index of agricultural commodities, *dlncommdprice*, positively impacts agricultural production, keeping other factors constant, which means that producers of export products react positively to price increases in the international market.

An increase in the producer price index, *dlnprodprice*, has a negative impact on agricultural output per capita at the first lag, given the negative value of the parameter, keeping the other factors fixed. This result is consistent with that found by Berthemly & Morisson (1989) apud Mosca (2011), who explain that Tanzanian and Mozambican farmers reduce market supply when prices rise, due to market shortages. However, more recent studies have found a positive relationship between these two variables, such as the study by Pernechele *et al.* (2018), meaning that positive changes in prices encourage farmers to increase production as a way to obtain higher yields and, perhaps, higher profits.

Bank credit for agriculture, *dlninterinvest*, the rural population growth rate, *dlnruralpopl*, and cultivated land, *dlnland*, did not show a significant relationship with agricultural GDP per capita at a 95% confidence level, although the latter variable can be considered significant at a 10% significance level. Regarding credit to the agricultural sector, the result in table III is consistent with that found in Abbas (2015) for Mozambique, explained by the low access to this service by small and medium producers, estimating that in 2020 only 0.6% of producers had access to this service (MADER, 2020). Among these producers, producers with farms above 0.5 ha have greater access to bank credit, while farmers with less than 0.5 ha have greater access to financial services (Abbas & Mosca, 2021).

Regarding the growth rate of rural population, *dlnruralpopl*, and cultivated land, *dlnland*, these variables were expected to have a positive relationship with the dependent variable, since: 1) population growth in rural areas is expected to increase production, since agriculture is one of the main employers in this environment; and 2) increasing the use of land for agriculture is one of the main ways to increase agricultural production in Mozambique, especially among small-scale producers. The author attributes the behaviour of these two variables in explaining agricultural GDP per capita in the model designed to the small sample size, which contains only 25 observations.

5.3. Diagnostic Testing of the ARDL Model Results

The tables below present the results of the diagnostic tests of the residuals of the model, as a way of checking whether the model is correctly specified, not violating any of the assumptions for this type of models and therefore not leading to misleading conclusions.

Table IV

BREUSCH-PAGAN-GODFREY HETERSCEDASTICITY TEST

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.641878	Prob. F(13,7)	0.7676
Obs*R-squared	11.41997	Prob. Chi-Square(13)	0.5757
Scaled explained SS	1.125542	Prob. Chi-Square(13)	1.0000

Source: Calculated by the author.

The Breusch-Pagan-Godfrey heteroscedasticity test shows that the p-value=0.7676 is greater than the 5% significance level, failing to reject H0: homoscedasticity, which means that the error variances are constant over time

Table IV

LM BREUSCH-GODFREY SERIAL CORRELATION TEST

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 3 lags

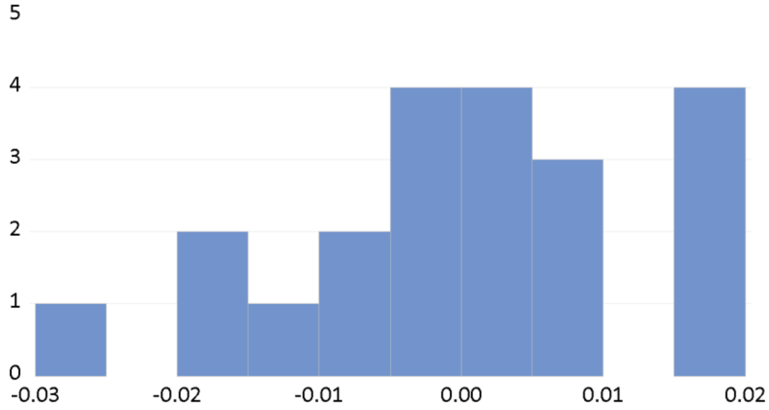
F-statistic	2.235564	Prob. F(3,4)	0.2264
Obs*R-squared	13.15444	Prob. Chi-Square(3)	0.0043

Source: Calculated by the author.

In the table above with the results of the Breusch-Godfrey serial correlation LM test, it can be seen that this model does not suffer from autocorrelation: p-value=0.2264 is higher than the significance level of 5%, failing to reject H0: absence of serial correlation in the residuals

Table VI

NORMALITY TEST



Series: Residuals	
Sample 1999 2019	
Observations 21	
Mean	-8.26e-18
Median	0.000424
Maximum	0.018998
Minimum	-0.028033
Std. Dev.	0.012439
Skewness	-0.306227
Kurtosis	2.774064
Jarque-Bera	0.372879
Probability	0.829909

Source: Calculated by the author.

Regarding the normality of the residuals, through the Jarque-Bera normality test, at a significance level of 5%, with a probability value of 0.829909, H0 is not rejected: the errors are normally distributed.

Table VIII

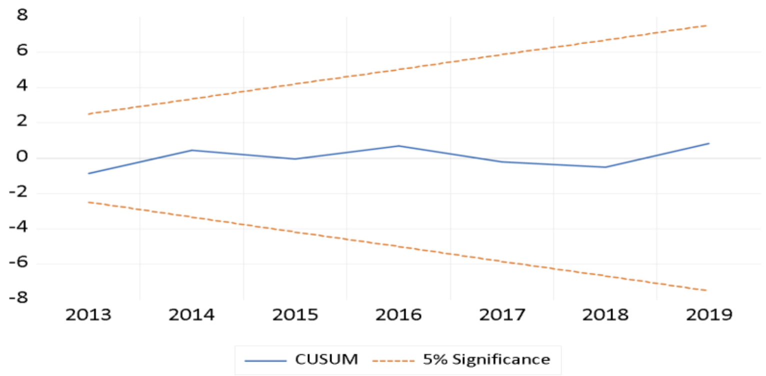
MULTICOLLINEARITY INFLATION FACTOR (VIF) TEST

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
DLNAGRGDP(-1)	0.070845	9.381681	7.371108
DLNAGRGDP(-2)	0.029046	4.134869	3.124827
DLNAGRGDP(-3)	0.020589	2.944626	2.211387
DLNINORGINPUT	0.005495	9.816606	9.650350
DLNFORGINVEST	0.000556	2.186352	2.158846
DLNINTERINVEST	0.000982	2.490009	2.444877
DLNCOMMDPRICE	0.009733	2.204276	2.169245
DLNCOMMDPRICE...	0.020727	5.096854	5.072023
DLNPRODPRICE	0.001934	2.071738	1.383886
DLNPRODPRICE(-1)	0.004003	4.013408	2.268493
DLNLAND	0.107738	5.845754	4.504236
DLNLAND(-1)	0.132422	7.356130	5.467339
DLNRURALPOPL	0.021865	2.575279	2.561807
C	0.000169	8.040388	NA

Source: Calculated by the author.

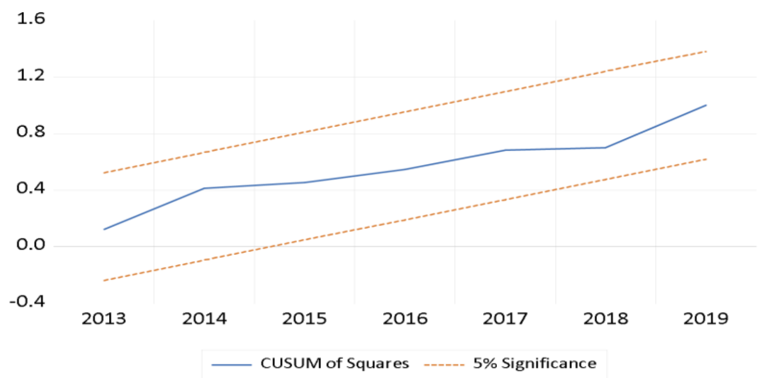
The table above shows that none of the independent variables in the model has a Centred VIF value of 10 or more, which is an indication of the absence of multicollinearity problems in the model.

Chart 7
Cumulative Sum Stability Test (CUSUM)



Source: Calculated by the author.

Chart 8
Cumulative Sum of Squares Stability Test (CUSUMQ)



Source: Calculated by the author.

Both the CUSUM and CUSUMQ tests, charts 7 and 8 respectively, show that the estimated model is stable and credible in form at a significance level of 5 %. The stability of the model can also be verified by the fact that the blue line lies between the red lines.

6. FINAL CONSIDERATIONS, RECOMMENDATIONS AND LIMITATIONS

This paper aimed to analyse the dynamic effects of variations in agricultural policy instruments on agricultural production in Mozambique in the short-term, using an Auto-Regressive Distributed Lag (ARDL) model, as a way to better understand agriculture, one of the country's main productive activities.

Five of the eight explanatory variables selected for this analysis showed an increasing trend, indicating a greater availability of these policy instruments over time, which represents a positive sign for Mozambican agriculture, since, theoretically, they have the capacity to alleviate the sector's problems and contribute to its growth and development. The literature review indicated that agricultural policy is a powerful tool for the growth and development of agriculture, given the evidence in several countries, where, generally, its instruments produce positive effects on agriculture, although there are factors that can make them produce contrary results.

The ARDL model showed that the variables: fertiliser and pesticide consumption (*inorginput*), the agricultural commodity price index (*commdprice*), agricultural investment (*forginvest*) and the gross fixed capital formation index (*forginvest*) and the first-order agricultural production lag (*agrgdp*) have a positive impact on agricultural production per capita; the producer price index (*prodprice*) has a negative impact on agricultural GDP per capita; agricultural credit (*interinvest*), cultivated land (*land*) and the rural population growth rate (*ruralpopl*) have a negative relationship with agricultural output per capita.

In sum, the results of the model do not allow the rejection of H0: Not all agricultural policy instruments have a positive impact on agricultural production per capita in Mozambique.

In general, the variables with a positive relationship with agriculture denote that the modernisation of the production process, the existence of financing for the different categories of producers, especially small producers, and favourable prices, especially for products traded on the foreign market, are important for the growth of Mozambican agriculture. It should be noted that these three components are to some extent dependent on the external market, leading us to conclude that these markets are important for Mozambican agriculture in terms of access to inputs, funds and the market for goods.

These results also reveal the non-utilisation of the potential of agricultural policy instruments, since producer price and credit have not shown evidence of positive contribution to agricultural growth in the country, but also since the evidence produced by other authors, such as (Mosca & Dadá, 2014) and (Abbas & Mosca, 2021), show that the impact of these variables on agriculture, in numerical terms, is still low.

This paper suggests that the government redouble its efforts by ensuring that these policy instruments for the agricultural sector continue to increase and become accessible to all producers, so that their positive effects on agriculture are multiplied, ensuring continued growth of agriculture in Mozambique. These policies should also be coordinated with economic policies to increase their effectiveness and avoid contradictory effects.

This text presents certain limitations, being: 1) small sample (25 observations), which requires caution when interpreting the conclusions, and did not allow to make the analysis of long-term relationships, since bound tests and *cointegration* tests are susceptible to distortion by the sample size; 2) the changes in the data (first-order derivation) allowed to make only the reading of the sign in the relationship between the explanatory variables and the explained; 3) the period of data collection does not allow (1995-2019) the analysis of more recent and important events for the Mozambican economy, such as the Covid-19 pandemic crisis; 4) the unavailability of time-series statistics on other agricultural policy instruments considered important for understanding Mozambican agriculture, such as subsidies, sectorial budget, irrigation, among others; and, 5) aggregate data, which does not allow capturing the heterogeneity of agriculture in Mozambique.

Therefore, the possibility of expanding the time horizon, that is, the number of observations in the sample and the variables included in the analysis may be interesting objects of future research.

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