



**“Analysis of Government Spending on Agriculture Sector and its
Effects on Economic Growth in Rwanda”**

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Analysis of Government Spending on Agriculture Sector and its Effects on Economic Growth in Rwanda

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DEDICATIONS

Allow me to extend my dedications:

To Almighty God,

My Mum

To my Supervisor,

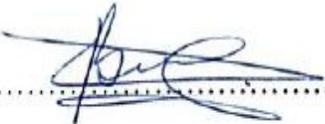
And finally special dedications to all my family and relatives, Brothers and Sisters, to whom I owe opportunities to attain the MSc. Education level.

DECLARATION

I, HARERIMANA Bernard declare that this MSc. thesis entitled “Analysis of Government Spending on Agriculture Sector and its Effects on Economic Growth in Rwanda” contains my own work except where specifically acknowledged.

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AUTHORIZATION FOR SUBMISSION



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A handwritten signature in blue ink, appearing to read 'Ndemezo Etienne'.

AKNOWLEDGEMENTS

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ABSTRACT

The purpose of this study is to investigate the effect of government spending on agriculture (GEA) sector and its contribution to Rwanda's economic growth. Rwanda has achieved strong and sustained growth since 2000s, its economy has changed gradually over the past years and has expanded at an average annual growth rate of more than 7% and on average of 8.2%, from 2008 to 2012. Large agricultural output, although Agriculture contribution to GDP has declined, agriculture sector remains the core contributor of the economy, with one-third of the GDP, the production of food crops have been identified as one important contributing factor led to tremendous socio-economic achievements, in addition to robust exports and strong domestic demand. This study intends to analyze the effect of government expenditure on agriculture sector towards boosting economic growth. Using panel data analysis tools EViews for Rwanda country from 1997 to 2014 sourced from the Ministry of Finance and Economic Planning (MINECOFIN) and the National Institute of Statistic of Rwanda (NISR), a model and expanded equation was estimated seeking to quantify the effect of government expenditures for agricultural development and impact to GDP. The results indicated that government expenditure on agriculture sector has significant and positive effect where the results show that in the long run, government expenditures on agriculture explains GDP growth. Ordinary Least Squares, (OLS) estimates shown that the coefficient for Government Spending on Agriculture (GEA) was estimated that it is statistically significant. In sum, a 1 unit increase in government spending on agriculture was found associated with almost 3% effect (2.5%) increase in GDP.

Keywords: Agriculture, Agricultural growth, government spending, Economic growth, OLS, Rwanda.

JEL Classification Codes:O13; Q14; Q18; C23.

LIST OF SYMBOLS AND ABBREVIATIONS

AgGDP	Agricultural Gross Domestic Product
AfDB	African Development Bank
ASIP	Rwanda's Agriculture Sector Investment Plan
CAADP	Comprehensive Africa Agriculture Development Programme
CIP	Crop Intensification Programme
COFOG	Classification of Functions of Government
EICV	Rwanda Integrated Household Living Conditions Survey
EDPRS	Economic Development and Poverty Reduction Strategy
EAC	East African Community
Frw	Rwandan Franc
GEA	Government Expenditure on Agriculture
GMM	General Method of Moments
GoR	Government of Rwanda
IFPRI	International Food Policy Research Institute
IMF	International Monetary Fund
MINAGRI	Rwanda's Ministry of Agriculture and Animal Resources
MINECOFIN	Rwanda's Ministry of Finance and Economic Planning
NAEB	National Agricultural Export Board
NEPAD	The New Partnership for Africa's Development, A Program of the Africa
NISR	National Institute of Statistics of Rwanda
OLS	Ordinary Least Squares
ICT	Information and Communications Technology

PSTA	Strategic Plan for the Transformation of Agriculture
PER	Public Expenditure Review
RAB	Rwanda Agricultural Board
RoR	Republic of Rwanda
R&D	Research and Development
SAKSS	Rwanda’s Strategic Analysis and Knowledge Support System (SAKSS) for monitoring and evaluation of CAADP investment programs
SDGs	Sustainable Development Goals
UNDP	United Nation Development Programme
USD	United Stated Dollar

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CHAPTER ONE: GENERAL INTRODUCTION

1.1. Introduction

Rwanda's economy suffered heavily during the genocide against Tutsi in 1994, but has since strengthened. The structure of the economy has gradually changed mostly drawing much of Gross Domestic Product (GDP) contributions from the agriculture sector and most recently from service sector which is dominated by tourism. Agricultural sector has significant role to play while examining the impact of contribution of sectors on economic growth given it provides enough food for ever increasing population, the employment to generations and raw material for secondary and tertiary sectors; improving the welfare of the rural people, wealth accumulation and exports (World Bank 1998, Johnston and Mellor (1961 and Roetter et al. (2007).

The large share of Rwandan population became food secure as result of enough production of food crops namely cereals: maize, paddy rice, wheat, tubers and roots: Irish potatoes and cassava, and pulses such as beans, soybeans and legumes. Also policies on developing the livestock and significant increase of animal production and export of animal products such as meat, hides and skins and milk (MINAGRI 2009).

From this perspective, agrarian sector has been important to Rwanda like in many African countries as it forms the backbone of their economies. The efforts were made by the Rwandan government in policy formulation to diversify the economy into sectors starting with agriculture, manufacturing and tourism. Agricultural sector targets were outlined in four key strategic documents, the vision 2020, the National Agricultural Policy (2008-2012), ASIP-Rwanda (2013-2018), Development and Poverty Reduction Strategy (EDPRS 2: 2013/14-2018)¹ and PSTA III (2013-2018), aiming at translating the vision 2020 objectives including aspiration of transforming the country from subsistence into a knowledge-based economy.

Rwanda has scaled-up public investments to support agriculture interventions through Crop Intensification Programme (CIP) focusing to improve agriculture infrastructures through the

¹This Second Economic Development and Poverty Reduction Strategy (EDPRS 2) is a five year plan designed to accelerate the progress already achieved and to shape the country's development in the future. It will build on those policies from EDPRS 1 which have been effective in accelerating growth, creating employment and generating exports.

development of terraces and feeder roads to facilitate easy access to markets by farmers. Government increased its public financing to agriculture sector and the development expenditures in agriculture increased from USD 46.6 billion in 2010 to USD 81.5 billion in 2013 (MINAGRI 2015) and agriculture sector has been a major source of growth, accounting for 34% of GDP (NISR 2014).

However, there have been challenges slackening agricultural growth and GDP growth. Those have been attributed to reduced expansion of output in agriculture being constrained by several factors. That is that land is scarce (IFPRI 2014) that is has not been fair in that there was absence of land administration system and poor settlements patterns in rural areas, characterized by small farming, small land holding and poorly developed farming, (World Bank 1998 and 2007). 50% of households have difficulties in accessing food, mostly due to small average farm size. Although, the farm size is essential to raise the economic productivity of farm land IFPRI (2014) reported that in Rwanda that lies less than 0.7ha. Factors affecting intensity of cultivation (ability of producer to make a proper combination of factors of production), quantity of production, agriculture prices for which fluctuations occur frequently, variation in a capital costs, variation in wages, pitch of rent, and stage of economic growth.

Like in any other developing country, agriculture sector is a more complex sector and measuring the impact of that sector to the overall performance of economic growth is narrow. For instance, much of literature on Rwanda focus on whether agriculture-led growth was among the ways for increasing the national output and yielded results toward the reduction of poverty in rural areas (MINECOFIN 2007, IFPRI 2014 and MINAGRI 2009). The problem regarding the role of the public sector, particularly the government in the development of agriculture sector in particular gained attention. Comprehensive Africa Agriculture Development Programme (CAADP) initiatives (AU/NEPAD 2003) and (Mogues, Fan and Benin 2015).

Being inspired by the literature on Rwanda, that the country has achieved substantial progress in many aspects after the 1994 genocide, including that the economy has grown faster (IMF 2013)² at an average of 8.2% annually and achieved significant poverty reduction under EDPRS1 (MINECOFIN 2013), this study is intended to analyze the relationship between the government

²Despite being a low-income and non-resource-dependent country Rwanda's progress toward the MDGs has accelerated and was classified among the best performers.

expenditure on agriculture and economic growth, through assessing impact of the expenditures in agriculture sector (if any) and estimating whether that effect has been significant or insignificant over the period 1997 to 2014.

1.2. Statement of problem

The GDP growth levels are always attributed to the growth of the three economic service sectors (Fan, Hazell and Thorat (2000): Agriculture, services and industry. Much of literature sought to examine the relationship between public investments in agriculture sector and the effects on the economy as whole. A number of researchers found that government expenditure in agriculture sector has a direct significant relationship with the economic growth. That is measured through government revenue from taxes, its share to GDP, productivity growth, standard of living, infrastructure developments, employment generations, and manpower developments.

They acknowledge the fact that the agrarian sector³ in spite of its neglect (Mogues et al. 2015), it still remains the source of economic vibrancy in the developed and developing economies, mainly Africa (IMF 2013, Thirtle et al. 2003 and de Janvry et al.2010). Moreover, it has been difficult to isolate contribution of agriculture areas mainly government spending to drive the core agriculture growth and insufficient to break down its contribution to bring about a significant increase of growth and reduction in poverty.

Given that todate, Rwanda's agricultural growth remains at 5% per annum which is below the targeted growth of 8.5% by the Government (MINAGRI 2013) and 6% in CAADP and despite the laudable efforts, Rwanda's agricultural sector is still characterized by low yields, attributable to the use of crude machinery, declining soil fertility due to population pressure, low level of inputs, World Bank (1998) and limited areas under cultivation among others.

Most of literature of agricultural impact in Rwanda, however focus on explaining linkages between agriculture and the poverty reduction (GoR, 2012; MINECOFIN, 2007;Mackinnon et

³Although structural transformation remains limited, agriculture was a contributing force in some countries, and offers much future potential (IMF 2013). Although, it has been argued that the role of agriculture in growth "...is likely to be very different in different settings, depending on whether a country can take advantage of manufacturing opportunities, whether it is dependent on others for its natural resources, or whether it is landlocked and with few natural resources of its own".

al., 2003 and IMF, 2013). Also findings on agricultural inputs use, Kelly et al. (2001), IFPRI. (2014) and GoR (2015). Yet more public commitments on funding the agriculture initiatives and suggestions every time on leveraging private investment have been made.

These studies are limited in knowledge of the impact of government expenditure, in Rwanda in inducing the growth of agricultural output and effecting the economic growth. For instance, critical issues on the rationale for agricultural public expenditure, complementarity with other expenditures, real effect of government expenditure into the sector have been rarely studied and insufficiently addressed. Also the effect of government spending at different levels of the public sector and the effects of economic growth and development, have not been broadly investigated.

The study attempts to fill gap of insufficiency empirics on whether government expenditures in agriculture (GEA) sector have been significant to the growth of economy in Rwanda and drawing implications addressing uncertainties on whether government should continue prioritizing investments in agriculture.

1.3. Objective of the study

The general objective of the study is to investigate the effect of government expenditure on agriculture sector on Rwanda's economic growth and specific objectives are:

- To analyse the extent to which Rwanda has invested in agriculture sector over the period under study
- To estimate the impact of government expenditure on agriculture on economic growth

1.4. Study questions

The study tries to respond the following questions:

- To what extent does the Government of Rwanda supported the productivity growth of agricultural sector from 1997 to 2014?
- Were the public investments in agriculture sector significant to affect the national output growth (GDP)?

- Whether agriculture sector holds the role of being an engine for economic growth in Rwanda

1.5. Research hypotheses

By assuming 5% level of significance, we hypothesize the following:

$H_0: \beta = 0$ Government expenditure on agriculture sector have no effect on economic growth in Rwanda.

$H_1: \beta \neq 0$ Government expenditures on agriculture have positive effect on economic growth in Rwanda.

The assumption of the study is that government expenditure on agriculture sector in Rwanda has significant and positive impact on economic growth.

1.6. Structure of the study

The report is outlined in five (8) chapters. Chapter 1) Introduction, 2) Literature review, 3) methodology, 4) Data analysis and interpretations, and chapter 5) Summary, Conclusion and suggestions for future academia undertaking the researches of similar nature.

CHAPTER TWO: LITERATURE REVIEW

Agriculture sector corresponds to ISIC⁴ divisions 1-5 and includes cultivation of crops and livestock production, forestry, hunting and fishing (World Bank 2016). Agriculture, also called farming or husbandry, is the cultivation of plants, animals, fungi, and other life forms for food, fiber, biofuel, medicinal and other products used to sustain and enhance human life.

Agriculture⁵ was the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food that nurtured the development of civilization. The role of governments is essential in promoting agricultural production and growth of the economy.

Agriculture makes a market contribution to economic growth, Kuznets (1961). He identifies two major role of agriculture to economic growth, first by purchasing some production items from other sectors and second selling its products to other sectors and makes them emerge and grow. In achieving socio-economic commitments as well as targets for poverty reduction and food security. IMF (2013), World Bank (2014) and Fan, Hazell and Thorat (2000) found that agricultural productivity growth give high rates of returns and has a substantial impact on poverty, which was reducing considerably (by 27 million of people per annum) in Africa and Asia (Thirtle et al., 2003). AU/NEPAD through CAADP and IFPRI found that African countries should ensure investments in agriculture to ensure that the economic benefits and welfare impacts reach the poorest and the agricultural output growth influence the economic growth.

Agriculture output also referred to as crop yield, refers to the measure of yield of crop per unit area of land cultivation. Value of agricultural production is defined as output of agricultural activity (c.f. ISIC) expressed in monetary term of aggregated production (in quantity term)' and 'price per unit of quantity' (World Bank 2016).

Total government Expenditure is divided into non-development and development spending. Development spending is subdivided into spending on social and economic services (e.g. Agriculture, Transportation, Trade and industry) (Danladi et al. (2015).

⁴International Standard Industrial Classification

⁵Covers microeconomic and macroeconomic issues related to public agricultural finance. Includes studies related agricultural investment at the sectoral level.

2.1. Description of Agriculture sector versus Rwanda's economy

Rwanda is a rural country with about 70% of the population engaged in (mainly subsistence) agriculture⁶. It is the most densely populated country, population density was 414 inhabitants per square km (in mid-year 2012), already one of the highest in Africa (NISR 2014) and is landlocked; and has few natural resources and minimal industry. Primary exports are coffee and tea. By 2014, the farm size on average, was less than one hectare (IFPRI2014).

The Rwandan economy is based on the largely rain-fed agricultural production with small land, semi-subsistence farming. It has few natural resources to exploit and a small, non-competitive industrial sector. While the production of coffee and tea is well-suited to the small farms, steep slopes, and cool climates of Rwanda and has ensured access to foreign exchange over the years, farm size continues to decrease.

Situation of agriculture sector before the civil war and the 1994 Genocide: in the 1960s and 1970s, Rwanda's prudent financial policies, coupled with generous external aid and relatively favourable terms of trade, resulted in sustained growth in per capita income and low inflation rates. However, when world coffee prices fell sharply in the 1980s, growth became erratic. Compared to an annual GDP growth rate of 6.5% from 1973 to 1980, growth slowed to an average of 2.9% a year from 1980 through 1985 and was stagnant from 1986 to 1990.

Rwanda has made significant progress in stabilizing and rehabilitating its economy. In June 1998, Rwanda signed an Enhanced Structural Adjustment Facility with the International Monetary Fund. Rwanda has also embarked upon ambitious privatization program with the World Bank. The United States, Belgium, Germany, the Netherlands, France, the People's Republic of China, World Bank, IMF, African Development Bank (AfDB), Development Programme and the European Development Fund assisted in the recovery of the economy and have continued to account for the substantial aid. Rehabilitation of government infrastructure, in particular the justice system, was an international priority, as well as the continued repair and expansion of infrastructure, rural development and agricultural transformation, expansion of health facilities and schools; (World Bank, 2014 and MINECOFIN 2007).

⁶Agricultural employment is measured as the percentage of total population, employed in agriculture. Data for 2010/11 and 2013/14 are reported by the NISR, and the remaining by World Bank.

Aspects of agriculture sector activities to the economic growth of Rwanda: In the last four decades, agriculture in Rwanda has gone through three distinct and contrasting periods: i) A twenty year period (1960-1980) characterised by high growth; ii) a period of stagnation followed by a serious repression (1980-1994) and iii) period of reconstruction and economic recovery (after 1994).

These periods were characterized by three different approaches in the formulation of agricultural policies: five or ten year plans 1950 and 1990 with a period of not activity from 1960-1967, planning based on the adoption an economic policy and financial framework and an elaboration of Public Investment Programmes (1991-2002) and the new form of planning based on a long-term vision, a national strategy for poverty reduction and sector strategies (MINAGRI2009).

The government has recommended agricultural policy measures, the rural area sometimes do not associate being concerned with programmes and projects put in place in order to contribute to improvement of the living conditions of the rural population. At certain times especially in 1989-90, some developments were introduced in the name of agricultural policy⁷. Hence the concept of food security replaced the concept of self-sufficiency in food, which helped in adjusting the objectives and programmes. Also the concept of development of commodity chains equally developed at the time, leading to the necessity to streamline all operations of production, transformation and communication in an integrated manner.

In sum, the evolution of agricultural exploitation system in Rwanda was characterized by two factors: the demographic factor on one hand and the institutional factors connected to the interests of the colonial administration and the development of export crops on the other. The duality (food crops, cash crops) which appeared in the colonial agricultural policy system continued and amplified by the post-colonial effects from the above mentioned two types of factors (MINAGRI 2009).

Agricultural sector toward specific characteristics for development of Rwanda and poverty reduction in rural areas: the general overview of poverty in Rwanda reveals very low achievements if development indicators such as: i) nominal GDP per capita income is about USD 250 and USD 225.1 in 1995 and 2000 respectively (MINECOFIN2013), ii) The real GDP per

⁷Rwanda implemented strategies among others, crop intensification programme, Strategic Plan for the Transformation of Agriculture in Rwanda phase II& III and Agriculture Sector Investments (ASIP)

capita rose up to USD 740 in 2014. Population below poverty line in 2000 was 64% (iii) estimate household under the poverty line in rural areas is higher (68 %) than urban areas 23 %; (iv) levels of agricultural yields are very low and on decline and 66 % of the production is for subsistence and 34% commercial, (v) export revenues represent about USD16 per capita (Sub-Saharan Africa's average is USD 100) (vi) quantity of utilized fertilizers per hectare are low (MINAGRI2015).

Table 1: Measures of productivity in food crops

Indicator	Year/period	cereals	Roots and tubers	Banana	Legumes	Total food crops
Share in food crop GDP	2006	18.5	29.6	18.8	16.2	
	2011	20.5	30.5	14.1	17.7	
Share in food crop area	2006	19.4	25.7	22.3	23.9	
	2011	21.1	26.4	17.9	27.5	
GDP per ha (constant RWF 1,000)	2006	316.8	381.8	279.5	224.9	332.2
	2011	374.3	442.9	302.6	246.2	383.7
GDP annual growth rate	2006–2011	8.1	6.6	-1.3	7.8	5.9
GDP per ha growth rate	2006–2011	4.2	3.6	1.3	2.8	3.4

Source: IFIPRI 2014 and MINAGRI 2014

Table 2: Estimation of land and labour productivity in agriculture sector in 2012

Value of production in Frw		328,375,074,000	Frw	USD
Value of production in USD		572,082,010		
Productivity Indicators	units	Number	Productivity per unit (Frw)	Productivity per unit (USD)
Cultivated land per year	ha	1,400,000	234,554	408.63
Cultivated land per year	Number	2,800,000	782	204.32
Farms	HJ	420,000,000	78,185	1.36
Labour (2 actives/exploitation)	Number	4,200,000	521	136.21
	HJ	630,000,000	234,554	0.91

Source: MINAGRI 2015.

Table 1 and 2 present statistics in agriculture sector, the value of the production in 2012 which was estimated to be equivalent to Frw 328 billion (USD 572 Million). This corresponds to a labour productivity between 0.91 and USD 1.36 per day of labour and USD 400 per cultivated hectare and less to the land area managed by a household, integrating with crops grown twice a year (1 ha managed on an area of about 0.75 ha for a household).

Role of agriculture sector on economic growth of Rwanda: Agriculture remains an important sector in Rwanda, for its contribution to GDP and being the main economic activity for the people. It provides employment to about 70% of the total population⁸ and contributes one third of Rwanda's Gross Domestic Product (GDP) (NISR2015 and IMF2013). As a way to achieve Vision 2020⁹ and the Millennium Development Goals (MDGs) to eradicate poverty, Rwanda has

⁸Third Rwanda Integrated Household Living Conditions Survey (EICV) reported that 72.6% Rwandans were engaged in Agriculture and 2013/14, Fourth EICV confirmed that Agricultural population employed in the sector is 69.7 % and most of the poor are in rural areas (79.2%) and women (81.9%). The Rwandan economy is largely agricultural in that many people have jobs in agriculture.

⁹Rwanda is primarily agrarian economy that is in transition to a middle-income country by 2020. This objective is reflected in the Vision 2020, which identifies six interwoven pillars. An earlier version of GoR Vision 2020 was

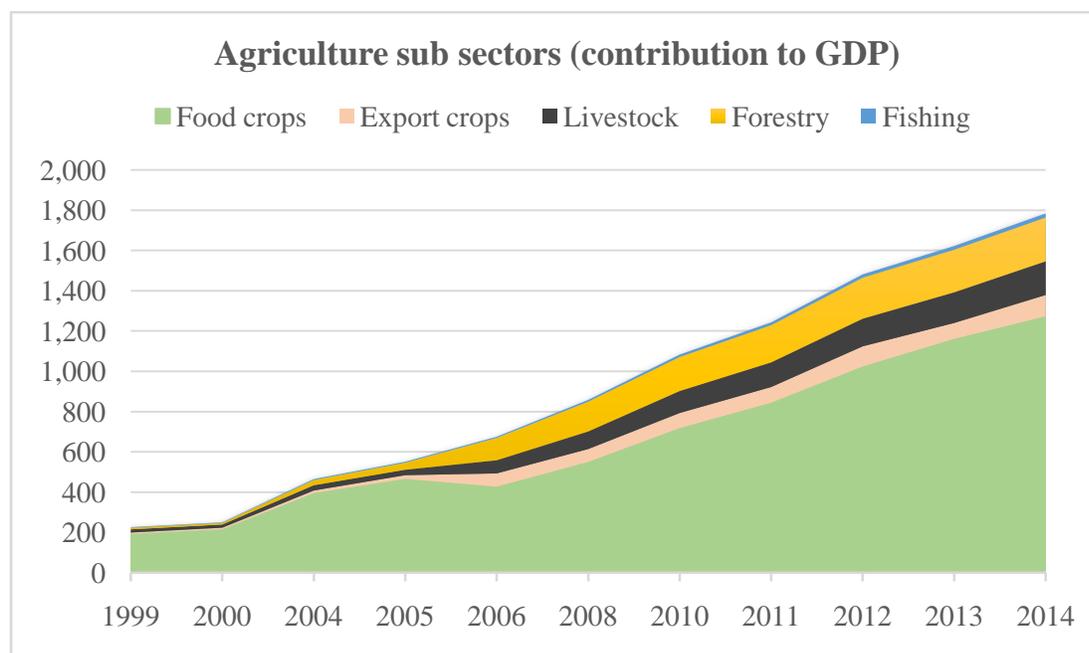
improved the agricultural sector by sensitizing its citizens about farming techniques to increase productivity. That will help do wipe out poverty and improve the standards of living for everyone. Rwanda's real economic growth for instance over the period 2008-2012 averaged 8.2% annually and thus translated into GDP per capita growth of 5.1% per year (MINECOFIN 2013).

In 1996 it was estimated that 34 % of households were female-headed, out of which 21 % were widows. The proportion of households headed by widows varies from Province to Province 13 % in South province and 28 % in North province. Participation of the Rwandese women in production and notably in agricultural production is something so common that any anomalies or challenges in that field usually go unnoticed. A glimpse at their activities shows that: (i) rural women work almost all the time without rest except for some hours of sleep and second (ii) Women take part in all forms of activity whereas men do not do certain types of work reserved for women by nature (breastfeeding, childcare) or by tradition (grinding on the traditional grinding stone). Women play an important role in agricultural production activities.

The economic activity was driven by a large increase in agricultural output, robust exports, and strong domestic demand. The figure 1 below, shows trend broken-down of Agriculture subsectors and evolution of their contribution to GDP from 1999 to 2014.

published in 2000 and has as objective: of transforming Rwanda from an agrarian subsistence economy into a sophisticated knowledge based society.”

Figure 1: Agricultural output sector breakdown contribution to GDP, 1999-2014 (In Constant Prices, Billion Frw).



Source: NISR, Gross Domestic Product by kind of Activity, 2015

The figure shows that although the value added share to GDP for agriculture sector has reduced over time from 46.0% in 1997 to 33.1% in 2014, sector contribution in values has increased significantly from FRW 540 Billion to FRW 1,440 billion in 2014 (NISR 2015). The main source to this increase was realized in food crops which grew by 71% of agricultural output with average growth of 6%.

Food crops grew at 5.8% and 5.7% in 2007-2011 and 2012-2014 (NISR 2013/14) respectively. According to analysis by MINECOFIN statistics, a unit percentage point increase in food crops directly leads to 0.3 percentage point increase in GDP (MINECOFIN 2015). IFPRI found that the contribution of food crop-led growth to overall GDP growth was impressive. It has projected that 87% of agricultural growth could come from increased production factors and only 13% from TFP growth (IFPRI 2014).

Role of agriculture sector for peasants without land: people who have no land comprise 11.5% of households in Rwanda according to EICV 1 (2000-2001) (NISR 2015) with the western province

(13%), North province (7.8%) and Eastern province (7.2%) on top of the list. Those households without land and who have to rent it often get bad quality land. These families are often poor with no means to acquire farm inputs, which would help to produce enough food for them. They depend essentially on their productions for their livelihood and have no other source of income apart from farming for others or renting land. Therefore any shock on their production (e.g. climatic) throws them into a food insecurity situation.

Agriculture performance, especially during PSTA II was effective depending on the contribution of the support sectors described below.

Governance and local development: decentralization process has transferred responsibility to local governments and has created a situation of reducing the direct relationship between MINAGRI and producers. Mechanisms and modalities adapted to the new situation has been established so that requests from producers and grassroots receive the support contained in the action plan of the ministry. The beneficiaries` needs collected in participatory workshops and stored in a data base will serve as a mirror to all stakeholders to facilitate use of that information in identification, funding and monitoring of agricultural micro projects initiated by grassroots communities in a decentralized way.

Environment, water and land security: given that all environmental problems draw the interest of all agriculture sub-sectors, attention to this issue will be integrated as crosscutting in all actions. Anti-erosion fight, promotion of corridor cultivations, rational management of pastures and intensive cattle raising systems, promotion of organic manure, biological methods of cultivation and agro-forestry. (MINAGRI2014).

Commerce, industry and handicrafts: improvement and institutional capacity building will be achieved through revision of the legal and regulatory framework. The latter must first create conditions for food products safety. A study is to be conducted to establish an agency or another institution in charge of food security and food safety standards. Such a structure should be responsible for the coordination of activities, setting and controlling standards in matters of national food safety, certification of food industries, programs of education on good cultivation practices, danger control for food, implementing activities related to food products like the National Bureau of Standards, reinforce national capacity namely of the National Office of Standardization, develop national laboratories to carry out specific tasks. Promotion of agro

business is seeking improvement of added value of specific networks in order to serve internal and external markets. Quality starts with production; good farming practices should be introduced during production to avoid taking late corrective measures, after having suffered losses. (MINAGRI 2014).

These considerations, indicate that the sector of commerce, industry and handicrafts is expected to play a key role to foster the implementation of PSTA. Further to what is indicated, the following complementary actions are expected: 1) promoting services for access to information, access to training and local, regional and international markets; 2). develop, though appropriate institutions, new transformation technologies, communication and marketing techniques, 3) set international standards in matters of food safety and food hygiene, 4) foster networks and associations of agribusiness with other regional and international organizations, 5) promote initiatives and activities for the development of handicrafts and industry. (MINAGRI2014).

Infrastructure of transport and communication (ICT): cooperation is needed between MININFRA in order: 1) to rehabilitate roads, 2) for promotion of transport of goods, easing administrative constraints and diversification of routes and corridors for regional and international trade, 3) dissemination of new information and communication technologies in rural areas and to the professionals of the sector.

2.2. Review of literature on nexus between government spending and economic growth

Wagner Law (1835-1917) and Keynes 1936) saw that growth of public expenditure was a consequence of economic growth in one way or another. Wagner introduced a model posterior results) that public expenditures are endogenous to economic development. The basic Wagnerian assumption is that public expenditure grows continuously associated with the continuing growth in community output in developing countries. (Wagner 1883)

The Wagner's work on impact of public expenditure on growth inspired a large number of researchers in many ways. Recently a big number of researchers have been interested in studying the law of increasing expansion of public expenditure, others the aspect of government spending and government expenditure e.g. Barro (1990) and Yilgör, Ertuğrul and Celepcioğlu (2012). Also investigating effects of those expenditures on economic growth (Hung Mo, 2007; Muhammad,

Xu and Karim, 2015; Al-Fawwaz, 2016; Danladi, Akomolafe, Olarinde and Anyadiegwu, 2015; Okafor and Eiya, 2011) and further studies on the government expenditures/budget allocations on agriculture sector, economic growth as well as the role of agriculture to economic development of economies, Kareem, Bakare et al. (2015), Kuznets (1961) and Lawal (2011) and Johnston and Mellor (1961).

According to Danladi et al. (2015) government expenditures are classified into three main types depending to their purposes. Government purchases of goods and services for current use, also referred to as government consumption, capital investments (intended for future benefits) and transfers payments (investments that are not directly purchases of goods and services).

From the literature by above researchers, there are relatively large variation in their empirical findings on the magnitude of the impacts and to some extent on the direction of impacts, due to methodologies and data that have been employed. Many of those literature are clear on the expected impacts of different types of public investment programs in many sectors on economic growth and the poverty reduction.

Literature revealed that investments in core public goods have high payoffs, in the form of economic growth and reduced poverty (World Bank 2014)¹⁰. Findings by Danladi, Akomolafe, Olarinde and Anyadiegwu (2015) and Fan et al. (2000) support that raising of the government expenditure contribute to resilience of different sectors of economy. Danladi et al. (2015) found a significant positive relationship between both capital expenditure and recurrent expenditures on economic growth. Furceri (2007) examined the relationship between public expenditure and economic growth, using cross-country panel data from 1970 to 2000, he found that countries with higher government expenditure business cycle volatility have lower growth. Mogues, Fan and Benin (2015) found that with increasing attention to investment in agriculture, is seen as essential for achieving development goals. These studies have recommended that the governments should give priority to investments in areas such as the infrastructure investments and research: rural roads, agriculture, R&D and education.

However, there are also researchers whose studies revealed contrasting situations about the effect of government expenditure. Egbetunde and Fasanya (2013) findings shown that impact of public

¹⁰Agriculture is a crucial sector for realizing the MDGs of gender equality and environmental sustainability. According to World Bank, increased productivity and commercialization of the agricultural sector was also directly responsible for 45% of the 12 point poverty reduction under EDPRS I (2008-2012).

spending on growth is negative except the recurrent expenditure. Yilgör, Ertuğrul and Celepcioğlu (2012) observed, in contrast to current and transfer expenditure no causal relationship between investment expenditures and economic growth. Landau (1986) through his study on government expenditure in 96 Less Developed Countries and developed countries, found a negative relationship between the government expenditure in GDP and the growth of per capita GDP. They found a very weak impact of government capital expenditures on economic growth. Okafor et al. (2011) identified determinants which hinders the government expenditure to grow and effect negatively the economic growth such as inflation and budget deficits.

Unidirectional relationship between government expenditure and GDP was found by Muhammadet al. (2015) and in their study on impacts of increase in public expenditure on poverty in Rwanda, Mackinnon et al. (2003) indicated that there was a negative and significant correlation between what was defined as productive government consumption expenditure and real per capita GDP.

2.3. Literature on Public expenditure-agriculture and economic growth nexus

Roetter et al. (2007) highlighted three specific roles of agricultural in rural development strategies: i) basis for changing livelihoods, ii) provider of high quality affordable food and iii) provider of environmental services and Johnston and Mellor (1961) have listed five contribution the agriculture to economic growth among others are i) increased transfer of labor resources, ii) increased capital formation and iii) increased purchasing power. They emphasized that agricultural development often stimulate growth that extends well beyond rural areas over the past decades, higher incomes from agriculture and access to cheaper food.

World Bank (2014), IMF (2013), IFIPRI (2014), Fan et al. (2000) and de Janvry and Sadoulet (2010) revealed that agriculture-led development is fundamental to reducing poverty, generating economic growth, reducing the burden of food imports and facilitating an expansion of exports. Accordingly, agriculture was deemed to be given a more prominent as part of the development agenda. Also the AU/NEPAD (2003) argued that most countries achieve rapid economic growth only when it is accompanied by growth in agriculture. According to IMF, agricultural growth has strongly supported the country's growth and led to successfulness of the national recovery strategy in Rwanda.

Johnston and Mellor (1961) concluded that capital accumulation which plays the vital role. The capital accumulation depends upon the creation of surplus, as in an industry, the surplus is created through profits of the industrialists etc. In the same way, the economists are of the view that the surplus can also be created through agriculture. Chang, Chen and Hsu (2006), Kuznets (1961), Johnson (1960), and Todaro and Smith (2014) that the creation of agriculture surplus becomes possible by: increasing agriculture production, utilizing the surplus labour in agri. Sector, supply of employment to non-agricultural sectors, imposing tax on agriculture. Sector and keeping terms of trade against agriculture sector. Also the contribution of food crops studied by IFPRI, in its results shown that are important to total agricultural and overall economy due to its linkages effects to the rest of economy.

Mellor (1986), Chang et al. (2006), and Ademola et al. (2013) in their studies found that agricultural sector has a significant role to encourage economic growth (in other words, it is a variable) when examining the impact of economic growth. Oyakhilomen et al. (2013), Ebere et al. (2012) and Chand et al. (2004) examined the government allocation to the agriculture sector and economic growth in countries like Nigeria and Pakistan. From an econometric perspective, the results of their analysis shown that the relationship between agricultural budgetary allocation and economic growth is positive, however the sector still encounters problems of inadequate financing, poor infrastructures, farm fragmentation (Sandford 1984).

Kareem, et al. (2015) and Ademola et al. (2013) found that government expenditures in agricultural sector have significant impact on economic growth. While Ele et al. (2014), Benin et al. (2009) and Iganiga et al. (2011) studying on impact of agricultural types of expenditure on agricultural output growth in Nigeria and Ghana, found that government expenditures in agricultural sector have significant positive impact on agricultural productivity, which led them to conclude that if agriculture is properly funded it could bring about sustainable economic growth.

Nevertheless in contrast to these above, Kumar, Kamble and Chaudhary (2014) and Looney (1994) in his study found that deficiencies in several types of infrastructure physical or soft for agriculture i.e. irrigation, mechanization, cropping, public finance, investment in R&D among others, may lead to moderate constraint on agricultural productivity. Johnson (1960), identified problem of subsistence farming and Lawal (2011), IFPRI (2014), Sandford (1984) and Mogues,

Fan and Benin (2015), that government are inconsistent in financing it which justify insignificance of contribution of thesector to the economic growth. Dholakia (2007) when he was comparing contribution of various sectors in the Gujarat state, concluded that agriculture and fishing among other areas were the weaker sectors in Gujarat economy due to inefficiencies in implementing the policies of those sectors.

Mogues et al. (2015) revealed that in developing economies, agriculture sector was somehow challenged by government policies and development paradigms towards the 1960s to the early 2000s. That was seen in declining or inappropriate public investments in agriculture. In addition, (Kumar et al., 2014) and Fan et al. (2000) also inadequacy in use of fertilizers, public finance, and small-landholding, cropping intensity, agricultural research and education, among others factors for causing conditional convergence. Fan et al. (2000) indicated serious under-investment in research on agricultural productivity, as evidenced by very high cost rates of return on government investments¹¹. Inexistence of good accessible road networks; no accessible markets; no power generations, no incentives, rather burdensome taxation on the side of the public finance (World Bank 2007), limited provision of fertilizers, insecticides and pesticides; no provision of irrigational facilities, better tools, and implements (tractors, etc.); there was no means of communication and transportations.

In their study on four countries, England, USA, South Korea and China, by Tsakok and Gardner (2007) found little well-identified evidence on causal relationship between agriculture developmental investments and economic growth. They controverted views that agriculture development is necessary for overall economic transformation of economies, and revealed that adverse supply shocks in agriculture sector could influence adversely the economy. Whereas Kuznets (1961) expressed complexity of isolating the role of each of economic sector, including agriculture to aspect of growth due to interdependence of the sectors. Chand and Kumar (2004), observed an asymmetry in the effect of public investment on private investment by confirming that increase in public investment induces a rise in private investment, whereas a decline has adverse impact on the latter.

¹¹See IFPRI (2012) budgetary expenditures lead to capital formation in the agricultural sector. Capital formation included physical and human capital.

Challenges limiting potential of agricultural productivity and growth and GDP growth has merely attributed to reduced expansion of output in Agriculture being constrained by several factors. Kumar et al. (2014) and AU/NEPAD (2003) viewed those limitations to agriculture leading to low productivity. For the latter low productivity in agriculture is the result of low investment in all the factors that contribute to agricultural productivity¹² whereas for Kumar, it is the nature which put limits on agricultural potentials. Therefore required that the profitability of agricultural investments should be increased and made more attractive. Moguees et al. (2015) in their study focusing on policy environment of greater attention needed for agriculture investment, identified gaps in relation to that effect of government expenditure at different levels of financing and effectiveness of investments were not receiving much attention. A general summary of the literature on government expenditure and economic growth nexus and effect of the government expenditure on agriculture is presented in Appendix A.

In addition, it was found by many scholars that agricultural growth has special powers in reducing poverty across all country types. Cross-country estimates show that GDP growth originating in agriculture is at least twice as effective in reducing poverty¹³ as GDP growth originating outside agriculture. Similar importance have been highlighted by Thirtle et al. (2003) and IFPRI (2014) who revealed that agricultural growth brought by agricultural technology can help to reduce poverty through lowering food prices, etc. . For Thirtle et al. (2003), every 1% increase in yield brought about by investments in agricultural R&D, 2 million Africans can be lifted out of poverty.

Although the rates of poverty¹⁴ reduction have been modest, in Rwanda between 2000 and 2007 and have been not so fast enough to meet the global MDG targets, whereby the total number of poor people was up to five million and over 90% of poor people were living in rural areas, the pace accelerated both in rural and urban areas since the EDPRS 1 period (2008-2012) as result of the government efforts seeking to transform the agriculture and the prioritization of the

¹²Africa's share of total world agricultural trade fell from 8 percent in 1965 to 3 percent in 1996. Low productivity is the result of low investment in all the factors that contribute to agricultural productivity and effective use of available resources. To correct the problem will require Africa to significantly increase investment in agriculture. This in turn requires that the profitability of agricultural investments be increased and so made more attractive.

¹³According to the World Bank increased productivity and commercialization of the agricultural sector was also directly responsible for 45% of the 12 point poverty reduction under EDPRS I, 2008-2012.

¹⁴Poverty levels overtime are presented in table 8 of appendix B

development of rural areas. Table 2 presents key agricultural indicators and related socio-economic indicators with pattern of agriculture performance.

Table 3: Rwanda's agricultural related trends, 2000-2014.

Indicator	2000	2008	2010/11	2013/14
Agriculture as % of GDP	45	33	33	33
Agricultural sector (annual growth, %)	9	6	5	5
Poverty %	64	56.7	44.9	39.1
Agricultural production kcal/day/person	1,612	n/a	2,385	2,069
% of households that are food secure	n/a	n/a	83	80%
% of HHs with acceptable Food Consumption Score (FCS)	n/a	79	78.5	74
Employment in agriculture (% of total employment) ¹⁵	n/a	79	72.6	69.7
Land under "modernized" agric. (%)	3	n/a	20	25
Area of land under irrigation (ha)	n/a	13,000	15,000	31,812
Fertilizer application (kg/ha/annum)	0.5	8	14	32
Soil erosion protection (% total land)	20	-	83.5	85.4

*n/a: data not available

Source: MINAGRI; Agriculture Sector Annual Report 2014/15 and NISR, EICV 4, 2015.

¹⁵There has been diversification of household income sources as the proportion of the employed labour force engaged in agricultural occupations fell by 9% nationally to 80% between 2000/01 and 2005/06, with most of the decline occurring among men.

Table 3 shows indicators on the performance of the sector. Poverty in Rwanda has been reducing over time both in rural and urban areas. Population living under poverty line are now at 39.1%. In 2014, studies by World Bank and IFPRI revealed that government expenditure on agriculture did not only contributed toward the growth of agricultural output, but also indirectly to poverty reduction. Over the last two decades, poverty had two peaks in 1980s and in the 1990s. The proportion of poor households was 53 % in 1993. It sharply rose to 78% in 1994 and declined to settle at 60 % in 2001 and 39.1% in 2013/14 (NISR 2015). Although, poverty was more rampant in rural areas (68 %) than in towns (23 %) and further accompanied by other hardships such as insufficient means of production or lack of access to land, as the average size of farming land was 0.76 ha in 2000; (GoR 2015).

2.4. Theoretical framework and model

The present study is built on the Wagner’s law of increasing state activities and the casual relationship between government spending on services (such as education and health), Agriculture and Trade and industry (transportation, infrastructures), on GDP and Consumer Price Index. The literature pronounces that growth of public expending was a natural consequence of economic growth. The hypothesis tries to find there is either significant or likely not significant positive or negative consequential effect of government support in agriculture on economic growth.

We use the production functional relationship of agricultural expenditure and growth of its output over time. The Cobb-Douglas function as reviewed by Mankiw, Romer and Weil (1992) to estimate using calendar expenditure macro data from 1997 to 2014 and testing causality relationship between expenditure made by the government on agriculture sector and GDP growth.

$$(1) \quad Y_t = K^\alpha_t + (AL^{1-\alpha}_t) \quad 0 < \alpha < 1$$

Where the notation is: Y is output, K capital and L labor and A level of technology. Solow’s takes the rates of saving (s), population growth (n) and technology progress (A) as exogenous.

Avoiding Spurious Regression

Spurious regression is misleading due to its ability to reflect false relationships between variables; where as spurious regression refers to a regression that provides statistical evidence of a linear relationship between independent non-stationary variables (Gujarati, 2003).

Before any empirical estimation is conducted it is necessary to conduct pre-unit root tests to understand the underlying data generating process for application of suitable methodology. Various parametric and non-parametric pre-testing methods are discussed in this subsection before their pros and cons are highlighted.

Confirmatory Analysis

Results of the usual unit root tests can be confirmed using tests with stationarity as null hypothesis.

These tests of confirmatory unit root testing with stationarity as null TEST 1 (Usual test) can be in the form as given by: $H_0 : Y_t$ non stationarity (unit root) and $H_0 : Y_t$ non stationarity (unit root), Maddala and Kim (1998).

These tests are conducted in either order and both reject the null hypothesis, then the presence of unit roots cannot be confirmed. In his conclusion, he deduced that the 5% level of significance gives better results than the 10% significance level. Joint non-rejections are far more common than joint rejections.

However false confirmations are equally likely. If the true model is trend stationary, chances are between 50-60% that confirmatory results are congruent with other pre-test results and half of these are correct, when the true model is difference stationary, the proportion of confirmation is 60-65% of which about 82% are correct. Overall, many scholars are of the notion that unit root tests are of some substance than using confirmatory analysis due to its defectiveness.

Model Diagnostic Inspection Analysis

After model specification, a battery of diagnostic instruments is applied to check if the model is statistically adequate and the fitness of fit.

Most of them are more focused on diagnosing regression pathologies through regression residuals. The presence of regression pathologies such as serial correlation, multi collinearity and heteroscedasticity violates the classical assumptions of the Ordinary Least Squares, OLS and

hence invalidate statistical validity of parameter estimates. Application of co-integration test and an establishment of linkage and direction of causality among the variables of interest was followed to determine whether those are present and measure fitness of estimation using single expanded equation (6).

2.5. Descriptive Analysis of the residual Analysis

The deficiency of a model can be detected by plotting the residuals. Outliers, in homogeneous variances or structural breaks can be detected in the residual series. They are standardized before plotting them to spot unusual residuals. To standardize them, their mean is calculated and divided by their standard deviation to obtain the standardized residuals. If the residuals are normally distributed with a mean of zero, roughly 95% of the standardized residuals should deviate by a factor of 2 along the zero line. Autocorrelations and partial autocorrelations of the residuals may be worth looking at because these quantities contain information on possible remaining serial dependence in the residuals. The presence of serial autocorrelation in the squared residuals is indicative of conditional heteroscedasticity in the model.

Examination of residuals through formal tests analysis

There are numerous diagnostic tests that can be applied to measure statistical adequacy of models.

Serial correlation: the Breusch-Godfrey test (Verbeek 2000) is used extensively to detect for higher order serial correlation in the residuals. There is a Lagrange Multiplier (LM) version as well as the F-statistic version. Notably, the two versions are asymptotically equivalent. The LM statistic for the null of interest can be obtained easily from the coefficient of determination R^2 of the auxiliary regression model. The null hypothesis of no serial correlation is rejected, both in the LM and F-version testing approaches, if the probability value (p-value) is smaller than the level of significance which can be at most 0.1 and at least 0.01 or 0.05.

Non-normality tests: the Jarque-Bera test of the normality of is used to detect violation of the OLS assumption of normally distributed residuals in a model. This is against the assumption of the classical regression model that residuals ought to be normally distributed with a mean of 0 and constant variance. The implication of violations of this assumption is that inferential

statistics of a model, such as the t-test and the F-test, are rendered invalid. The Jarque-Bera test is based on the skewness and kurtosis of a distribution.

Heteroscedasticity: the statistical implication of heteroscedasticity is that the variance of residuals is no longer constant. Although coefficients of estimated parameters are still unbiased and consistent, their efficiency is lost. In fact the presence of heteroscedasticity causes the OLS method to underestimate variances and standard errors, hence leading to overestimated and misleading t-statistics and F-statistics (Asteriou and Hall 2007). The Breusch-Pagan and the White tests are applied to check for heteroscedasticity in models (Gujarati 2003).

The LM and F versions are complementary and the null hypothesis of no heteroscedasticity cannot be rejected if the p-value of the Breusch Pagan statistic is greater than the specified levels of significance.

Autocorrelation LM test: autocorrelation can be defined as relation between members of a series of observations ordered in time. It arises in cases where the data have a time dimension and where two or more consecutive error terms are related. In this case, the error term is subject to autocorrelation or serial correlation. It arises as a result of either excluded variables or the use of incorrect functional form. The consequences of autocorrelation are that the OLS remains unbiased, but becomes inefficient and its standardized errors are estimated in the wrong way Gujarati (2003) and Verbeek (2000).

Residual normality test: the assumptions of the Classical Linear Regression Model (CLRM) require that the residuals are normally distributed with zero mean and a constant variance and violation of this restriction will result in t- and F-statistics being not valid. One way of detecting misspecification problems is through observing the regression residuals. Usually the normality test checks for skewness (third moment) and excess kurtosis. Jarque-Bera normality test compares the third and fourth moments of the residuals to those from the normal distribution under the null hypothesis that residuals are normally distributed.

Stability Analysis: It is tradition in modern empirical analysis to check for model stability over time. As such parameter instability and structural change are inspected if there is a reason to suspect structural breaks in the underlying data generating process. To this the *CUSUM tests*: also the cumulative sum of recursive residuals (CUSUM) tests are to be applied. The CUSUM and CUSUMQ are quite general tests of structural change in that they do not require prior

determination of where the structural break takes place. To check for impacts from suspected simultaneous or synchronous shifts in parameters of the model, the CUSUM-of-squares (CUSUM-SQ) plots are observed based on the formula below may be more informative. The null hypothesis of structural stability is rejected if the plots cross the critical lines at 5% significance level.

CHAPTER THREE: METHODOLOGY

3.1. Data

This section describes the methodology of the study and the data used. The research methodology is the process used to collect data and other types of information for use in making business decisions. Examples of this type of methodology include documentation surveys, and research of publications. This part is about the overall approach to the research process, from the rationale underpinning of the study to the collection and analysis of the data.

The study collected secondary data on macroeconomic variables for the period 1997-2014. In the due course the researcher collected relevant data needed to test the research hypotheses. In this study the researcher has adopted a case study approach, whereby Rwandan economy was particularly chosen. A case study is an intensive description, analysis and interpretation of economic correlation results between variables¹⁶ of Gross Domestic Product; Government Expenditure on Agriculture; Agriculture Value Added; Purchases of Goods and Services; Gross savings and Wages and Salaries in Rwanda during the period of the study based on information obtained from the sources.

Data for these variables were presented in billion francs values (in Local Currency Unit, LCU)¹⁷ at current prices on annual basis, however for the purpose of our analysis variables were first transformed into logarithm to avoid problem of different time intervals between observations.

The data were collected by using the secondary data in the study; the primary data has been collected by National Institute of Statistic of Rwanda (NISR), then the researcher has collected the data of from MINECOFIN. Secondary sources of data for this study will include macroeconomic statements, financial reports, government publications, library books and internet sources.

¹⁶ Selected data are drawn are for macroeconomic indicators drawn from official reports by MINECOFIN retrieved http://www.minecofin.gov.rw-MINECOFIN,MacroFramework_Public_Dataset-June_2015. These were complemented by NISR publications and those downloaded from World Development Indicators Database (World Bank, WID 2016). For example, data on GDP for 2 years before 1999 were not available from MINECOFIN and NISR, but found on World Bank. Note. Data are presented in table 7 in appendix.

¹⁷ All variables were collected in Billions Franc, which is the LCU for Rwanda.

Definitions of variables and parameter values in the model: the variable to be explained in this study is the gross domestic product (GDP which was defined in its value terms, In billion francs (FRW). The GDP which was referred in the model as LGDP, according to NISR defines the sum of gross value added by all resident producers in the economy measured as the difference between production and intermediate consumption plus any product taxes and minus any subsidies not included in the value of the products. Whereas the independent variable of our interest was GEA: government expenditure on agriculture was taken in billion Frw as reported in budget execution reports by MINECOFIN and MINAGRI.

AGVA: Agriculture value added (in Billion Frw of GDP), Forestry & Fishing, PGS: purchases of goods and services as reported by MINECOFIN as component of the government expenditure, WS: Government expenditure on Wages and Salaries in billion franc and GS: Gross savings

The expected signs (effect) of the explanatory variables on GDP consistent with the theories above is given in table 4 below.

Table 4: Expected signs

Variables	Description	Expected sign
GDP	Gross Domestic Product	Positive or Negative accordingly
GEA	Government expenditure on Agriculture	Positive
AGVA	Agriculture value Added	Positive
GS	Gross savings	Positive
PGS	Purchases of Goods and Services	Positive
WS	Wages and Salaries	Positive

Source: Researcher's expectations, 2016

3.2. Method

The study has used that research methodology as best understood as the process of arriving at dependable solutions to problems through systematic collection, analysis, interpretation of data.

It is important to decide on the sources of data that would give most appropriate responses to the questions and which methods and tools most appropriate to collect the relevant data.

The researcher has used quantitative as an approach that believes in quantifying responses in different levels, it uses mathematical conclusions such as mean, percentages, standard deviation etc. To show the degree of correlation of responses from different respondents, in this research data was analysed through the sample tabulation of the targeted population and percentages was calculated to describe the degree or level of correlation of the results collected from different respondents. Measurement of the GDP and the relationship with the government spending on agriculture used empirical analysis and model variable estimation referring to panel data. Panel data due to the measure of time and place variations of growth as well as comparing trends and performances across variables into considerations.

Macroeconomic research sample data: a sample was taken by the researcher as the process of selecting people to be included in the research study. The immediate purpose of a sample is to increase the ability of generalizing the outcome of the population and to ensure that the population includes all units of interest to the study. The sample must always be viewed as an approximation of the whole rather than as a whole in itself. Because of availability of different variables which are presented in an economy, the researcher has chosen to analyse with the macroeconomic and the econometric interpretation about Gross Domestic Product; government expenditure on agriculture; agriculture value added; purchases of Goods and Services; Gross savings and Wages and salaries in Rwanda for the period of 1997 to 2014.

Documentary sources, observation, (library and internet search) were used by the researcher to collect secondary data while primary data was obtained through structure and unstructured of research guide of National Institute of Statistic of Rwanda (NISR). Documentation have been used by which contain the information about a phenomenon that researchers wish to study. In this study the documents that will be targeted are number of documents available in the library, on the internet web and the annual reports of the MINECOFIN, were consulted for the purpose of obtaining secondary information relevant to the subject matter.

Key informant interviews: Key informant interviews are qualitative in-depth interviews with people who know what is going on in a specific area of study. For the purpose of our study we collected data from a wide range of people involved in agriculture including officials in

MINAGRI, NAEB, MINECOFIN, and NISR, experts in the sector and consultants who worked in the field. Both telephone interviews and face to face interviews are applied here.

*Econometrics modelling:*the econometrics technique was used by the researcher for analysing and interpreting the data from the results of all econometric tests which are presented in model specification, estimation and results, where the econometrics approach as technique is the application of mathematics, statistical methods, to economic data and is described as the branch of economics that aims to give empirical content to economic relations.

Literally, the word “economics” means “measurement in economy”. Econometrics is a branch of economic sciences which provides the result of a certain outlook on the role of economics, consists of the application of mathematical statistics to economic data to lend empirical support to the models constructed by mathematical economics and to obtain numerical results. The first task of econometrics is to formulate an economic model.

3.3 The Model

As this chapter is based on the study of the effect of GEA on GDP in Rwanda, we can't ignore that the growth is explained by many variables, but here we are going to analyse this effect in supply function by using GDP as endogenous variable and of GEA as exogenous variable.

As stated, our hypothesis is built on basic Wagnerian assumption that the government expenditure growth is associated with the economic growth (Gemmell 1993:104). Wagner's suggestion had led to different literature including the study by Islam (1995) who examined whether or not the results of the augmented Solow model obtained by MRW using cross-section regressions change by using different techniques, namely panel data. Barro (1990), in turn, found the government may affect the production function. For this study, since we are interested to study the effect of government expenditure on agriculture to the GDP (as measure of economic growth), and we refer our regression model on Wagner's law.

We begin with the Solow's growth model¹⁸ that is reviewed by Mankiw, Romer and Weil (1992) analyzed through the Cobb-Douglas production function and specify our model with variables of interest in our study.

Further, Solow assumes factors governing evolutions in capital stock:

$$(2) \quad \dot{k}^*(t) = sf[(k(t))] - (n + g + \delta)k(t)$$

$$\text{Alternatively } k^*_t = [s/(n + g + \delta)]^{1/(1-\alpha)}$$

Where n and g are exogenous parameters and where a dot over a variable denotes a derivative with respect to time. $sf[(k(t))$, actual investment per unit of effective labor, Capital stock per unit of effective labor, k , $n+g$, growth rate of effective labor, and δ is the capital depreciation

Since the central predictions of the Solow model concerned the impact of saving and population on real income (this study derives its only model predicting the effect of government expenditure on economic growth) and also depending on data under the study.

$$(3) \quad Y = \beta e^{\rho t} L^\alpha K^{1-\alpha}$$

Where Y represents economic growth e^σ is technical change which takes place at constant rate σ in time t , L is labour force in the sector and K is public inputs in agriculture sector.

Our model is therefore formulated to measure the impact on growth considering different items of government expenditures. A standard growth accounting model for this study, allows to present different types of expenditures by government as determinants of growth, the model in which variables are specified in linear log forms shown in equation (6).

$$(4) \quad Y_{it} = \beta G_{it} + \gamma X_{it} + \mu_{it} + v_{it} + \varepsilon_{it}$$

Where Y_{it} - is the dependent variable (economic growth).

G is the government expenditure on agriculture and X is the vector of set of control variables, identified as important variables for country expenditure-growth model, i indicates the observations over time period, t from 1997 to 2014.

¹⁸Equation (2) is the key equation of the Solow model. It states that the rate of change in the capital stock per unit of effective labor is the difference between two terms.

β is the parameter of interest capturing the effect of government expenditure on agriculture on GDP.

μ_{it} – Country fixed effects vector, v_{it} – Time fixed effects vector, ε_{it} – is the random error term vector.

The error term is composed of two components $\varepsilon_t = v + \mu$, where $v \sim N(0, \delta^2)$ captures the effects of the statistical noise and the second error component $\mu \geq 0$ is intended to capture the effects of technical inefficiency. The v_{it} component represents things that cannot be controlled by the farms like pests, insects and so on making the stochastic frontier allowing for variation across farms. The μ_i component represents the effects that can be controlled. Thus the producer operates on or beneath stochastic production frontier according to whether $\mu_i = 0$ or $\mu_i > 0$.) which is assumed to satisfy the usual properties of mean zero and constant variance and ε the error term or disturbance term with normal distribution with mean zero and a constant variance allowing to estimate the vector for the standard error; $i = 1, \dots, n$ and $t = 1, \dots, T$. Therefore, our econometric model is expressed as the follows:

$$(5) \quad GDP = \alpha_0 + \alpha_1 GEA_{it} + \alpha_2 AGVA_{it} + \alpha_3 PGS_{it} + \alpha_4 GS_{it} + \alpha_5 WS_{it} + \varepsilon_{it}$$

In regards to test the hypothesis of relationship between GEA and GDP we apply a modified version of the above specification (equation 2) which is often used by recent researchers and referred to as advanced versions¹⁹ of the regression Model on Wagner’s Law. Variables in our analysis were first transformed into logarithm to avoid problem of different time intervals between observations:

$$(6) \quad LGDP = \beta_0 + \beta_1 LGEA_t + \beta_2 LAGVA_t + \beta_3 LPGS_t + \beta_4 LGS_t + \beta_5 LWS_t + \varepsilon_t$$

Where, L is Natural Logarithm for variables, GDP is of Gross Domestic Product at period t , GEA : Government Expenditure on Agriculture at period, $AGVA$: Agriculture value added, PGS : Purchases of goods and services at period t , GS : Gross savings, WS : government expenditure on wages and salaries, ε : Error term, i and t variable observations and time period from 1997 to 2014.

¹⁹Literature detail six versions of the regression model on Wagner’s law.

β_0 : is Intercept and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are Parameters of model. The null hypothesis of simple linear specification is obtained: $H_0: \beta_1, \beta_2, \beta_3, \beta_4, \beta_5 = 0$

Test of data

In order to measure all economic relationship between the presented variables of a model, the researcher has to use time panels require the econometric tests. The theory of agricultural growth, considered as an engine for overall growth for developing countries, has dominated growth literature over the past half century. After demonstrating the expected signs in the following section, the following point emphasizes those tests in order to get econometric results which allow the researcher to make economic discussions, analysis and interpretations.

Using Ordinary Least Squares one calculates the restricted residual sum of squares ESSR associated with model. Where $\varepsilon_t = v + \mu_t$; v is the two-sided noise component, and μ is the technical inefficiency component. The second method to apply is the GMM, to the regression equation (1) discussed.

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5 > 0$: this means that the explanatory variables such as GEA, PGS, GS, AGVA, WS are positively related to GDP, that is to say that when there is an increase of those explanatory variables, we experience an increase in overall GDP.

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5 < 0$: this means that the explanatory variables GEA, PGS, GS, AGVA, WS are negative related to GDP, that is to say that when there is a decrease of those explanatory variables, we experience a decrease in overall GDP.

The study of the effect of GEA on GDP in Rwandacan't ignore that the growth is explained by many variables, but here we are going to analyse this effect in supply function by using GDP as endogenous variable and GEA as exogenous variable. With adjustments incorporated into the model in (4), it can therefore be specified in the form expressed decomposition of GDP growth linked to variables of interest which was formulated in the following relation:

$$(7) \quad GDP = f(GEA, AGVA, PGS, GS, WS)$$

Equation (7) models the selected determinants of economic growth (GDP). These are government expenditure on agriculture, Agricultural output, the purchase of good and services, expenditure on wages and salaries and the gross savings.

In regards to test the hypothesis of relationship between GEA and GDP we apply a modified version of the above specification (equation 4) which is often used by recent researchers and referred to as advanced versions of the regression Model on Wagner's Law. Therefore under this study, the effect of GEA on economic growth which is measured as GDP, is estimated with help of statistical software (EViews 7) with OLS equation expanded as follows.

$$(8) \quad LGDP = \beta_0 + \beta_1 LGEA_{it} + \beta_2 LAGVA_{it} + \beta_3 LPGS_{it} + \beta_4 LGS_{it} + \beta_5 LWS_{it} + \varepsilon_{it}$$

Where, $LGDP_t$: Logarithm of Gross Domestic Product in period t, $LGEA_t$: Logarithm of Government Expenditure on Agriculture in period t, $LAGVA_t$: Logarithm Agriculture Value Added in period t, $LPGS_t$: Logarithm Purchases of Goods and Services in period t,

LGS_t : Logarithm Gross savings in period t; LWS_t : Logarithm Wages and Salaries in period t, and

ε_t : Error term in period t, Number of observations and t time periods from 1997 to 2014. β_0 : is Intercept and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5 > 0$: parameters of model.

Equation (6), is adopted because data are specific over period 1997 to 2014 and many are often reported as subsets of the GDP. Thus, to examine effect of government expenditure to national output. Also given that literature was interested to relationship between the economic growth and the share of government expenditure had to influence its movement. The model assume that government expenditure on agriculture sector increases the production of food, expansion of export of cash crops as well as catalyze the manufacturing by agro-industries, increases farmers savings and the purchase of goods and services such as machinery. Also according to Barro (1990) and Kuzinets (1961), taken variables such as the size government expenditure, wages and savings form determinants of Growth (GDP).

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND INTERPRETATIONS

In this section, the researcher used to apply the econometric method in order to verify the hypotheses of the study. To reach on goal, the researcher has developed different points like: introduction to econometrics, specification of the model, expected signs, data processing, model estimation and diagnostic tests by using the data of Rwandan economy from 1997 to 2014.

4.1. Estimation and testing the results

To estimate the parameters, we applied the panel data method and different types of panel analytic models; which fit our model. Estimation techniques referred to are: OLS, Two stage Least Squares (2SLS) and GMM. Followed steps are:

- Data transformation or first-stage estimation into natural logarithm forms
- Estimation of the variables by using Ordinary Least Squares method
- Two stage LS with constant instruments: 1997-2014
- Estimation of the variables by using GMM method
- And testing stability diagnosis.

Table 5 and 6 report findings of estimation using EViews regression applying Ordinary Least Squares and 2 Stage LS results. Additional information and the GMM method findings are shown in Table 10 in appendix D.²⁰

²⁰Zhang and Fan (2004) used a dynamic GMM approach to estimate the effects of infrastructure on agricultural productivity using the Indian district level. The general methods of moment (GMM) has been introduced to reduce the potential endogeneity of many independent variables when panel data are available. There is an appendix table with all results obtained using also GMM.

Table 5: Descriptive statistics of variables

Variable Description	Mean	Std. Dev	Max	Min.	Prob.
GDP	7.4059	0.7736	8.5362	6.3248	0.4744
GEA	23.0414	0.9452	4.6434	1.4586	0.5778
AGVA	6.3818	0.7191	7.4871	23.35	0.4479
GS	5.4582	1.1986	6.9191	3.4242	0.3837
PGS	5.4582	0.6872	4.6434	3.0516	0.4533
WS	4.1987	0.6501	5.4012	3.3582	0.4863
Observations	18				

Source: Author's estimation using Eviews

In table 5 whose data are presented in appendix C, shows evolution of agriculture and Gross Domestic Product (GDP) in Rwanda (in billion Franc). The researcher used GDP and agriculture data for the year 2008-2014 to analyze the growth rate trend of Rwanda GDP. As it is depicted from the table, the GDP growth rate shows upward trend with same growth variations that were experienced in year 2009 and 2013. These upward growth is attributed the economic circumstances that characterized the economy over years. The downward s growth after are attributed to the global financial crisis that affected Rwanda's investment in agriculture sector. Subsequently low annual (agricultural) growth of 3% in 2013 was attributed to the budget cuts by donor countries to Rwanda which affected Rwanda's aggregate investment and the agriculture sector production investment in particular.

In above are computed means of data for model variables which are made of wages and salaries, saving and Agricultural output. By observing the logarithmic\ results the mean for GDP is 7.40 and minimum was 6.32.

The GEA variations can be explained by the levels of expenditures made by the government of Rwanda with decrease in spending in different periods. The table summarize variations in GEA data over years in 2003, 2007, 2010 and 2012. Means show low level of savings the country makes.

Table 6: Model estimation results of variables

Estimation method	OLS		2SLS	
Variables	Estimate	StdErr	Estimate	StdErr
Constant	2.2092	0.2942	2.2092	0.2942
GEA	0.0253***	0.6883	0.0253***	0.6883
AGVA	0.2869**	0.1666	0.2869**	0.1666
GS	0.0848**	0.02813	0.0848**	0.02813
PGS	0.3712***	0.1280	0.3712***	0.1280
WS	0.31059***	0.1833	0.3105***	0.1833
Obs.	108		108	
R ²	0.9606		0.9606	
F-value	555.4271		555.4271	
Prob(F-statistic)	0.0000		0.0000	
Breusch-Pagan- Godfrey	0.3343		0.3343	
Jarque-Bera	12.4379	(0.0019)		

Source: Author's estimation using Eviews

Levels of statistical significance: * indicates significance at the 10%; ** at 5% and *** at 1% level. In other words the Null Hypothesis is tested on 90%, 95% and 99% confidence level respectively.

Table 6 presents the regression results of the model, where it is indicated that under the period 1997-2014. Above estimations has yielded the same results for the two methods presented namely OLS and Panel 2LS estimates. The elasticity values for government spending on agriculture, GEA and Agricultural Value added (AGVA) are estimated to 0.0253 and 0.2869 respectively.

Also the results of the findings demonstrated in table 6, indicate 96% goodness of fit (R²), accordingly states that variations of the dependent variable are explained by the variables in the model as shown by R-Squared and that the government expenditure on agriculture has positive

effect on GDP. The estimated results summarized in Table 6 show that an increase of one unit in government expenditure on agriculture could have around 3% positive impact on economic growth. Also the GMM results (reported in Table 10 in appendix D) indicate that coefficient for GEA is significant at 1% level of significance, as 1 percent change in expenditure on agriculture induce 8% increase of GDP. Therefore, effect of government expenditure on agriculture sector on GDP in Rwanda cannot be ignored. From the results also, it is reflected that the growth is explained positively by all variables selected for our model. However, here were interested to analyse the effect of GEA in supply function (as defined in earlier part) by using GDP as endogenous variable and of GEA as exogenous variable.

The results show that in long run, GEA explains GDP at 1% at level of significant as the probability and T-statistic values are 0.7191 and 0.3682 respectively and the R squared=0.96. Basing on economic theories, GEA does explain GDP in long run, 1 unit increase in government expenditure on agriculture is reflected by 2.5% increase in GDP.

Alternatively other variables, selected to understand the role of government on growth such as AGVA, GS, PGS, and WS and based on that performance of the model is good (R^2 values for all methods are greater to 80%) all have positive effect on Growth. The 96 goodness of fit (R^2) indicated that explanatory variables could explain the 96% variations in the dependent variable.

Accordingly Wages as current government expenditure that are wages and non-agricultural employment are important sources of incomes to farmers and the incomes from wages them contribute to the growth.

The results show that government spending on agriculture as well as other non- agriculture spending for productivity-enhancing investments contribute positively to growth. However, for GS and PGS, the impact has not been significant based on their probabilities.

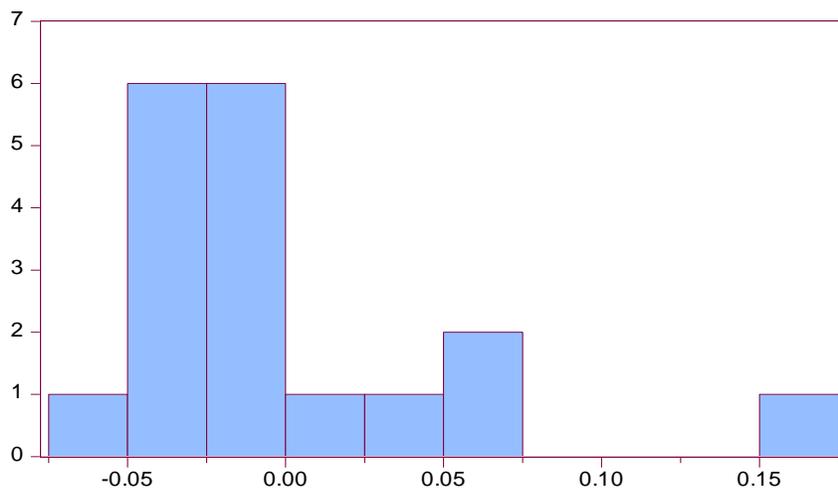
Government spending on wages and Salaries contribute 0.31 at every 1 unit increase whereas GEA effects 0.025 the GDP at each unit increase.

Diagnostic tests

Other tests are necessary to see whether the assumption of tradition regression is confirmed. These tests are related to residual panels: Normal distribution test, Heteroscedasticity test, Autocorrelation test and stability test

Residual Histogram Normality test: with the assumption of normality, the test of Jarque- Bera will show us if the residual at a given period of time are not only correlated but also distributed normally. The test for normality of residuals plays a crucial role, because it precise the statistic distribution of estimators. It's due to this hypothesis that inference statistic could be realized. The results of this test as well as forecasting for the model are indicated by the following graphs.

Figure 2: Normality distribution test



Source: EViews estimation

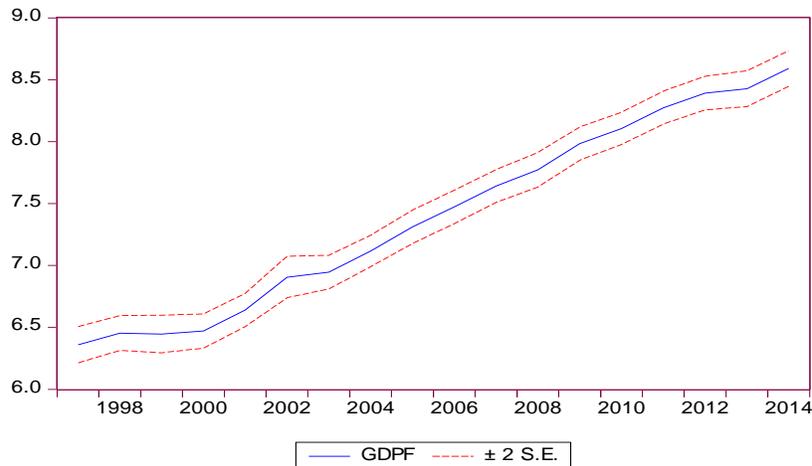
As probability of Jarque-Bera is equal to 0.0019, it is interpreted as that residuals are normally distributed, and this reflects the good quality of the model.

Hence as probability of Jarque-Bera equals to 0.69047 greater than 10% reference of significance level, we interpret it as our residuals are normally distributed, and this reflects the good quality of the model.

In addition, the autocorrelation and Heteroscedasticity were tested in order to assess the consistency of the estimation.

Heteroscedasticity test: thus referring to the Breusch-Pagan probability (0.8825) which was greater than 5%, hence observed estimations by OLS are optimal.

Figure 3: Forecast estimation



Source: Author's calculations using Eviews.

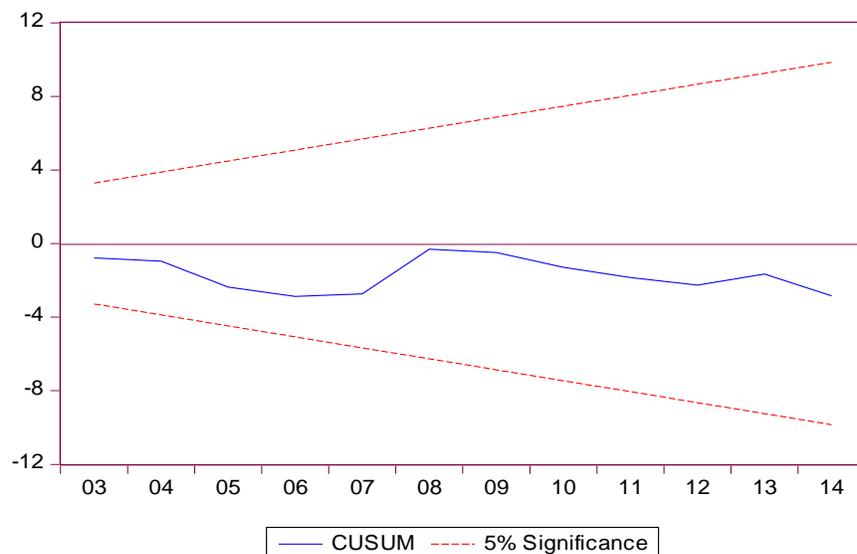
Autocorrelation test: this test shows whether the model contains problems of autocorrelations of residuals. It means that errors of the period t affect the errors of the next period t_{+1} . The researcher has used the view of probabilities, the Breusch-Godfrey Serial Correlation LM Test. The probability of obs*R-squared is 25% greater than 10% means that the model does not contain the problems of residuals autocorrelation.

H_0 = Absence of autocorrelation residuals this assumption is acceptable if the probability is greater than 5%. H_1 = Presence of autocorrelation Probability is less than 5%. These two tests applied to our model, the results that our hypotheses H_0 is accepted given the Prob was (0.4717). Also the Durbin Watson statistics for both OLS and GMM are greater than 2 that tending to zero which leads us to conclude that there is no autocorrelation.

Stability test: these tests are operated on dynamic models to test their stability; they are mainly for Ramsey Reset and Cumulative Sum test (CUSUM). For our model, there is a good specification of the model to the reference of significance at 1% but the probability is less than 10%. Log likelihood is less than 0.01 then the model is stable.

Recursive estimates CUSUM test: this cumulative sum test shows graphically navigation of variables of the method within a perspective of judging the stability of the model. When the curve goes out of the corridor, the coefficients of the model are not stable; otherwise, the coefficients of the model are stable.

Figure 4: CUSUM test



Source: Author's EViews stability diagnosis

By analysing Figure 4, it was clear that the model is stable because the navigating blue line of graph does not cross the red borders (the straight lines represent critical bounds at 5% significance level); this indicates that the GDP of Rwanda have been moving in a stable way from 1997 up to 2014. A structural break appears when it has seen an unexpected shift in a (macroeconomic) panel data. This can lead to huge forecasting errors and unreliability of the model in general. The CUSUM tests are shown to be consistent and their asymptotic behaviour under the alternative is similar to that of the economic tests such as Breusch-Godfrey serial correlation LM test in the sense that their divergence rate depend on the bandwidth parameter. The study shows that the modified CUSUM has asymptotic significance and has the same significance as the heteroskedasticity test that errors serially uncorrelated. Hence the parameters are stable because the navigating blue line of graph doesn't cross the borders.

4.3. Empirical results and interpretations

The results are in consonant with discussions literature, Thirtle et al. (2003), Benin et al. (2009) and Ebere and Osundina (2012), that public investment in agriculture has impact on agricultural productivity and hence on economic growth. For instance, Ele et al. (2014), Shuaib et al. (2015) and Ademola et al. (2013), found that government expenditure on agriculture and GDP are positively related in Nigeria. Most specifically according to Oyakhilomen, Abdulsalam and Rekwot (2013) when they analysed the link between agricultural budgetary allocations and economic growth, arrive to conclude that there is positive relationship which was significant in the long-run.

The impact of government support in agriculture and its impact on growth was studied by Lawal (2011) in Nigeria, Looney (1994) and Johnston and Mellor (1961). All these found that supporting agriculture was significantly related to the GDP growth. For Lawal, although government expenditure on agriculture did not follow regular pattern, there was observed a direct relationship between funding and the GDP growth. Looney and Mellor stated similar findings of contribution of agriculture to GDP growth in that five classes as it: (a) meet a rapidly growing demand for agricultural products associated with economic development (essentially a wage goods argument); (b) increase foreign exchange earnings by expanding agricultural exports; (c) supply Labour to the non-agricultural sector; (d) supply capital, particularly for its own growth, for overheads and for secondary industry; and (e) serves as a market for industrial output.

The results presented are consistent with discussions that agricultural growth in Rwanda is dependent to what government does, the public investments, much more on the production of food crops, and the promotion of exports crops as well as seeking to reduce poverty. (MINECOFIN, 2013; IMF, 2013; and Fan et al., 2000).

Given the model has other variables, selected to understand the role of government on growth such as AGVA, GS, PGS, and WS and based on that performance of the model is good (R^2 values for all methods are greater to 80%) all have positive effect on Growth, but for GS and PGS, the impact is not significant. The estimated results on agricultural output, savings and wages support different studies by previous researchers, e.g. on agricultural growth by (Ademola et al., 2013; Iganiga and Unemhilin, 2011; IMF 2013 and Mogue, Fan and Benin, 2015). In that, agricultural capital expenditure had a positive impact on agricultural output and economic

growth as well, (Ele, Okon, Ibok and Brown 2014, Iganiga and Unemhilin 2011 and Ebere and Osundina 2012).

Wages as current government expenditure by Egbetunde and Fasanya (2013), Yilgör, Ertuğrul and Celepcioğlu (2012), Danladi et al. (2015) and Fan et al. (2000), as for the latter, wages and non-agricultural employment are important sources of incomes to farmers and the incomes from them contribute to growth and poverty reduction. Whereas for savings and physical capital expenditures by literature according Barro (1990) and Mankiw, Romer and Weil (1992). Higher savings could lead to higher income, raise the total factor productivity, hence growth (Mankiw et al., 1992). Also Mankiw et al. are conclusive on the importance of current expenditures (in human capital) and capital (physical capital) as determinants of per capita growth.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary of results and usefulness

Agriculture accounts one third of Rwanda's economic activity and the sector has gained government attention over the last two decades. Beyond of being among most populous country, Rwanda accelerated growth of the economy by actively investing in Agriculture to ensure it achieves food security and its economic recovery after 1994 genocide. Because of the great importance of agriculture sector, it was deemed important to conduct this study with aim to examine significance of impact of government expenditure on the sector toward boosting the economic growth and the effects of these investments on the high growth progress realized by since 2000s to 2014. Also effects of other variables of growth such as agriculture value added in period; expenditure on purchase of goods and services in period; wages and Salaries and national savings were estimated.

The findings indicated the extent to which support to agriculture has played in the sector's growth. The findings inform the government which component of expenditures have been significant in enhancing the performance of the GDP and encourage economic restructuring to shift to growth oriented financing. Also enhance to stimulate and supplement the process of agricultural productivity growth. This contributes to clarifying and correcting what has been for long time prevailed as conventional wisdom regarding the support to agriculture and poverty alleviation linkages. Also add to existing knowledge to assisting policy analysts and their policymaker clientele in their considerations for related policies.

Findings are so important to the government to improve coordination of its programmes and expenditures it makes, to improve the targeting of funds to the most productive areas and encouraging activities that increase productivity. The results presented are consistent with the idea that agricultural growth in Rwanda is dependent to the public investment of the government, much more on the production of food crops, advancements that the government has been implementing in agriculture regarding land consolidation, soil conservation and irrigation, etc. Such findings may prove useful to policy analysts and planners concerned with development agenda and design of agricultural policies and programs as well as resource mobilization.

However, there was an issue of data that limited the study to estimating agricultural growth models in-depth and the importance of availing ready to use, consistent international and disaggregated central and decentralized level data has been raised. Thus, if resolved that will facilitate future researchers' ability to analyse and explain with full evidence agricultural sector the support and role of government to agriculture and toward growing economies of nations around the world.

The study resorts to economic theory to recommend for increased expenditures in this sector which is important pillar of the economy. Rationalization of the expenditure, streamlining of roles and responsibilities for a clearer division of the budget across sectors and a more effective means of targeting outcomes.

Rwanda could improve the effectiveness of investment especially in agricultural R&D and should continue to do as these investment can have high payoffs in achieving multiple wins increasing productivity and improving resilience and resource-use efficiency. However, climate change reduced returns from investments and population which is high where majority of farmers occupy less 0.5ha and recent studies shown that boosting agricultural growth through induced innovations can exacerbate landlessness and inequality for the poorer rural inhabitants.

To reduce the large donor dependence in the agriculture sector and increase public financing within the agriculture sector that empowers and benefit smallholders' women farmers.

Fair sharing concept of public private partnership, government should widen incentives to the private sector to increase mechanization with other-yield increasing types of inputs. Additional relevant expenditure which contribute directly to increased agricultural development. These include: applied agricultural research; multi-purpose development projects with agricultural benefits; effective food and nutrition security interventions; and agricultural climate change adaptations.

5.2. Summary and conclusion

As the aim of this study was to examine the effect of government support on agriculture to the economic growth in Rwanda for the period of 1997-2014, using variable data in local currency units (current prices) modelled after logs transformation. The analysis shown a general significance of government expenditure to agricultural sector and significant impact on economic growth.

Although, the performance of agricultural has been increasing, the share to national budget fluctuated time to time due to changes in government fiscal policies and sometimes to international factors or crisis. Agricultural support shown positive effect in accelerating the GDP.

The effect was explained by that the R squared scored 96%, and the sign for coefficient of parameter (0.0253; OLS estimation) is positive, which means, a one increase in government expenditure on agriculture is associated with a 2.5% increase in GDP. In summary, despite data limitations to extend the period under the study, findings support the assumption that effect of government expenditure on agriculture on GDP was significant over the period 1997 to 2014.

Rwanda has made progress in increasing the production form agriculture and since 1994, initiatives for increasing public support in the agriculture sector and the upward trend in this direction is required to continue. The faster rate of GDP growth realized in 2008 has fallen since afterward, due falling agricultural growth which became unpredictable. The upward trend could again happen if the country remains open to capturing investments in agriculture, R&D, infrastructure and remain consistent in funding agriculture.

Recently, works to examine the size of the support of government, the levels and quality of government expenditures in the agriculture sector in light of the commitment of the 10% expenditure target and enhanced quality of government expenditure on agriculture (GEA) has gained much attention.

5.3. Recommendations and suggestions for future data and researches

Although the study revealed the significant of government expenditure to stimulate the national growth, that could not be probably unique to agriculture sector, we suggest areas of investigation that could provide wide perspective about the role of government across other sectors to promote economic growth. These are proposed to see the efficacy of public expenditure within sectors

like education, ICT and communication and infrastructure sectors (Energy and Transport) as well as their role in fast growing the economy. These with regards to provide empirical evidence to inform policies and programmes leading to successful implementation of the SDGs and Vision 2050 for which Rwanda has adopted to shape its long-term agendas to realize full economic transformation and achieve free poverty.

Finally, limitations encountered that need to be addressed to allow better findings in the next, e.g. limitations of data availability and their reliability. Along the study, data on expenditure in agriculture, agriculture production were not enough disaggregated to agricultural zones nor at district levels yet. It is also difficult to allow regional analysis due to that data on expenditure in agriculture are not found to the World Bank source, but only found collected in local documentations.

In many cases, data were not consistent and difficult to find for the very early years such as before 1995 e.g. the necessary data on government expenditure on agriculture to include more years for the study were not available. Also data on decentralized, detailed budget executions, data of crop production structured by crops and by region though currently are being improved by NISR through its agricultural surveys with help of UNDP, were not enough and not available for lot of years for the period studied in order to be considered in the regression. The researcher was forced to use national data when examining relationship between government expenditure in agriculture and the economic impact on GDP growth.

- The GoR should increase public spending on agriculture sector-which is important pillar of the economy.
- Rwanda should remain open regarding the capturing of investments in agriculture, R&D, infrastructure.
- Government should ensure consistency while financing the sector (due to that share of spending fluctuated time to time)
- Impact of spending in other sectors like education, ICT and Communication and infrastructure sectors (Energy and Transport) should be examined too.
- The financing for agricultural development through applied agricultural research, food and nutrition security interventions and agricultural climate change adaptations.

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APPENDICES

A: A summary of literature review

Table 7: General summary of literature review on government expenditure and agriculture.

Name	Estimation method/technique	Findings
Ademola et al. (2013)	OLS and Confirmatory Unit root test	There is a significant relationship exist between government expenditure in the agricultural sector and the economic growth of Nigeria.
Egbetunde and Fasanya (2013)	ARDL	Negative impact of total public spending on growth, but little significant positive for recurrent expenditure.
Lawal (2011)	OLS	Spending on agriculture does not follow a regular pattern and that the contribution of the agricultural sector to the GDP is in direct relationship with government funding to the sector
Yilgör, Ertuğrul and Celepcioğlu (2012).	ADF and VAR	There is a one-way causal relationship from current transfer expenditure to economic growth. But no relationship between investment expenditures and economic growth.
Ele, Okon, Ibok and Brown (2014)	Johansen cointegration test	Agricultural capital expenditure had a positive impact on agricultural economic growth.
Looney (1994)	Engle Granger (Causality Test)	Deficiencies in several types of infrastructure of agriculture may be a moderate constraint on agricultural production.

Kumar, Kamble and Chaudhary (2014)	Hausman Test	Benefits of economic reforms by the government of India resulted into visible impact on the convergence process of per Net State Domestic Product (NSDP) agriculture among Indian states.
Kareem, Bakare, Ademoyewa, Ologunla and Arije (2015)	OLS	There is a fluctuating trend in government expenditure in agriculture over the years under review and Results also revealed a negative relationship between the public sector spending on agriculture agricultural output and economic growth.
Iganiga and Unemhilin (2011).	OLS and ADF and Phillips Perron tests	Federal government capital expenditure in Nigeria are positively related to agricultural output.
Landau (1986)	OLS	Government capital expenditures have weak positive impact on economic growth in Less Developed Countries (LDCs).
Muhammad, Xu and Karim (2015).	Confirmatory Unit root test	There is no any relationship in the long run between growth and expenditure in Pakistan.
Furceri (2007)	n/a	Countries with higher government expenditure business-cycle volatility have lower growth.
Oyakhilomen, Abdulsalam and Rekwot (2013)	VEC	The agricultural budgetary allocation and economic growth are positive, but not significant in the long-run.
Shuaib, Igbinosun and Ahmed (2015)	OLS	Agricultural sector has a direct relationship with economic growth
Danladi, Akomolafe,	ARDL	The aggregated effect of government

Olarinde and Anyadiegwu (2015),		expenditure on economic growth is positive and statistically significant..
Ebere and Osundina (2012)	OLS	Significant relationship exist between government expenditure in the agricultural sector and the economic growth in Nigeria
Al-Fawwaz (2016)	OLS	There is a positive impact for both total government expenditure and current government expenditure on economic growth.
Thirtle, Lin and Piesse (2003)	Causal chain	Research led technological investments in agriculture generates sufficient productivity growth to give high rates of return in Africa and Asia and has a substantial impact on poverty, reducing, whereas productivity growth in industry and services has no impact.

n/a: not available

Source: Reviewed Journals and reports by Researcher.

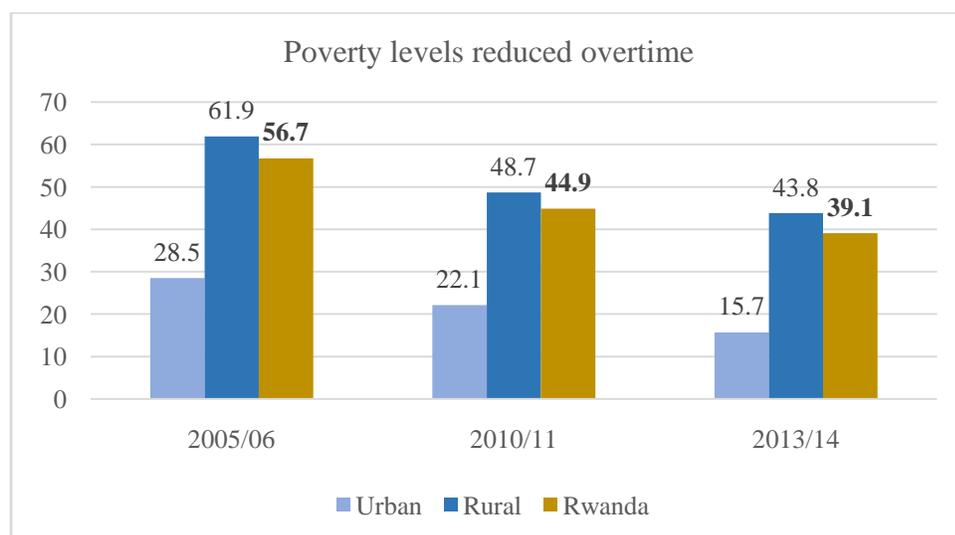
B. Poverty and Extreme poverty In Rwanda

Table 8: Percent of Rwandans living in extreme Poverty

	2000/01	2005/06	2010/11	2013/14
Poverty	58.90	56.7	44.9	39.13
Extreme Poverty	40.0 -	35.80	24.10	16.3

Source: NISR, Rwanda Poverty²¹ profile report (EICV 4, 2013/14), 2015

Figure 5: Percentage of the Rwandan population identified as poor



Source: NISR, EICV 4, 2015

²¹Incidence of poverty is defined as the share of the population whose total consumption is below the total poverty line (RWF 159,375 in January 2014 prices),

C: Table of data, additional information on variables and estimated results

Table 9: Evolution of Gross Domestic Product (GDP) and explanatory variables²²

YEARS	GDP	GEA	GS	PGS	AGVA	WS
1997	558.3	4.3	58.8	21.15	256	28.74
1998	621.3	6.2	49.7	25.52	282	28.92
1999	606.9	14.6	30.7	26.52	227	35.05
2000	676	8.3	42.9	24.25	251	36.69
2001	742	13	59.7	30.3	276	39.26
2002	993	13	580.9	35.22	282	40.58
2003	1206	9.8	92.9	45.08	379	44.07
2004	1206	13.3	178.6	47.58	465	48.54
2005	1440	12.7	218.5	64.45	553	51.2
2006	1716	13.4	226.7	71.55	675	62.2
2007	2028	17.9	456.9	77.51	725	73.36
2008	2556	38	502.3	80.32	858	84.17
2009	2960	44.7	586	104.8	1022	97.4
2010	3280	49	602.5	118.66	1082	116.3
2011	3846	66.9	814.5	139.11	1244	130.3
2012	4382	55.6	743.8	146.19	1483	158.6
2013	4819	85.6	1011.5	122.9	1624	179
2014	5096	103.9	856.6	151.76	1785	221.68

Source: NISR and MINECOFIN, 2016.

²²Government expenditure on agriculture (GEA) in billions, Agriculture value added (AGVA), Purchases of goods and services (PGS), Gross savings (GS), Wages and Salaries (WS) in Rwanda, in billions of Rwandan francs

D: Additional EViews estimation results

Table 10: Results estimated through OLS and GMM: EViews probability estimates

Dependent Variable: GDP (Values in logarithm)

Variables	Model	
Estimation method	Pooled OLS	GMM (Generalized Method of Moments)
Intercept	0.0000(7.5076)	0.0000 (10.6544)
GEA	0.7191(0.3682)***	0.3444(0.9842)***
AGVA	0.1108(1.72182)***	0.0416 (2.2816)**
GS	0.0108(3.0148)**	0.0001(6.04388)**
PGS	0.0133(2.9000)**	0.1390(1.5847)***
WS	0.1161(1.6935)***	0.3878(0.8961)***
R2	0.9956	0.9949
Adjusted R-Squared	0.9939	0.9927
Standard Error of regression	0.6040	0.0658
F-Statistic	555.4271	2.9336
Prob (F-Statistic)	0.0000	0.0867
Durbin-Watson stat.	2.2349	2.2377
Observations	108	108

Source: Author's calculations through EViews estimation

Note: * denotes significant as 10% confidence level; ** denotes significant as 5% confidence level; *** denotes significant as 1% confidence level.