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The role of Agricultural Policies in improving production in Rwanda. A Case study of Maize production (1995- 2018)

*VédasteHabamenshi&**Sylvie Nibeza

University of Tourism, Technology and Business Studies (UTB)
**Head of Departments of Business Management and Finance at*
Christian University of Rwanda (CHUR); Director of Administration and Finance at
Sylvie&Associates Consultancy Company Ltd (SACC Ltd)

ABSTRACT :
According to Corral, Díaz, Monagas andGarcía (2017),the objective of increasing agricultural incomes in developing countries ranks high on the political agenda. Especially, in Sub-Saharan Africa (SSA), the majority of the population lives in rural areas with higher levels of poverty than in urban areas, and almost all rural households depend directly or indirectly on agriculture. Rwanda's agricultural policies are embedded in a frame work of conventions and protocols such as the Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs), the New Partnership for African Development (NEPAD), Common Markets for Eastern andSouthern Africa (COMESA), the East African Community (EAC), Vision 2020, the Economic Development and Poverty Reduction strategy(EDPRS) and finally the Plan for Strategic Transformation of Agriculture (PSTA). The government has initiatedCrop Intensification Program (CIP) to increase productivity for six priority crops namely Maize, Wheat, Rice, Irish potato, Beans and Cassava.

Taking Maize as a case study, the present research analyzed the role of agriculture policies in improving maize production in Rwanda during 1995 to 2018. The data were provided by the National Institute of Statistics of Rwanda (NISR) and Index Mundi and they were analyzed using Eviews 8 software. The research found that agriculture policies have led to important achievements: Maize production passed from 57 metric ton to 660 metric tons; The individual consumption of maize passed from an estimation of 9.87 kg per year to 43.24 kg; Maize importation passed from 4 metric tons to 107 metric tons; Rwanda started exporting maize since 2010 starting from 5 metric tons to 10 metric ton since 2012 up to 2017. However, despite such impressive achievements, the research noted that many efforts have to be engaged because the production remains lower that required to satisfy the food security for the population.

Key words: Agriculture, Agriculture policy, Maize, Production, Rwanda.

I.   BACKGROUND OF THE STUDY

According to the data provided by the National Institute of Statistics of Rwanda 2016, agriculture sector contributed 33% of Gross Domestic Product (GDP) in 2016. Rwanda's economy, as for the majority of African countries, relies of agriculture sector employing currently around 73% of the labor force from 90% in 1995 (NISR, 2014). Since 2000, Rwanda has set to become middle income economy by 2020. To achieve that goal, the Country is embarked for structural transformation aiming at modernizing all sectors of economic activities. The Government has initiated a set of policies aiming at transforming traditional subsistence agriculture to modern and market oriented. Crop intensification program is among those policies.The program prioritizes to improve six major food crops in Rwanda which are maize, rice, banana, irish potatoes, sweet potatoes and cassava. In order to intensifying agricultural production and raise farmers' income on existing small lands, heavy efforts and investments are put in place to render exploitable marshlands, improving irrigation systems, facilitate access to high quality seeds, introducing mechanization, and facilitating access to finance (Ngabitsinze, 2014).Focusing on maize production, the present research aims at analyzing the evolution of maize production due to effects of policies and programs designed to improve it. The research will find out the level of satisfaction of the population by the maize produced; This will go together with analyzing import and

export situation during the period under study; and the research will end by providing recommendations for improvement.

II.   PROBLEM STATEMENT

Since 1995, Rwanda has initiated a series of programs, policies and strategies aiming at improving agricultural sector from subsistence to knowledge- based. In this line, the Government of Rwanda continues allocating a big portion of the national budget to improve agriculture including maize production. For example, on 2015/2016 budget, the Country allocated 10.6 billion to improve crop intensification program on maize crop including fertilizers imports (MINECOFIN, 2015). Despite continuous budget allocation and a series of policies designed in line with increasing production, the production of maize in Rwanda is still low compared to its domestic demand. The current research aims at analyzing the level of performance of agriculture policies on improving maize production.

III.   RESEARCH OBJECTIVES

The overall objective of the research is to ass the role of agricultural policies in improving maize production in Rwanda during the period 1995- 2018.
Specifically, the research aims at:
  ➢ Assessing the evolution of maize production in Rwanda during the period 1995- 2018.
  ➢ Assessing the level of food satisfaction by comparing increase/ decrease in production with increase of the population.
  ➢ Assessing the level of import and export of maize as indicators of improved production.
  ➢ Assessing challenges faced by farmers in Rwanda while implementing agricultural policies.
  ➢ Providing recommendations as a way forward.

IV.   MATERIALS AND METHODS

The present research aiming at assessing the role of agricultural policies in improving production taking into account a case study of maize in Rwanda, used quantitative and qualitative research design. By quantitative design, the researcher collected the data provided by National Institute of Statistics of Rwanda (NIRS) and Index Mundi. Those data were analyzed using Eviews 8 software. The findings were interpreted using qualitative data collected through documentary review.

V.   SIGNIFICANCE OF THE RESEARCH

The present research is relevant at all levels:
  ➢ Individual level: The findings from this research will light farmers on the benefits of implementing government policies and this will change their behavior in farming.
  ➢ Community: Most of the time, the Community resists on implementing policies especially in agriculture sector where they are asked to make effort passing from traditional agriculture to modern. The findings from this research will demonstrate the fruits of defined policies and future implementation will be facilitated by such shared experience.
  ➢ Government: The government of Rwanda has defined policies and it allocates continuously the budget to support agricultural production in general and of maize in particular as the first of six major food crops prioritized by Crop Intensification Program. The present research will present scientifically the output of such efforts and this will be an effective tool for the government to plan for a better future.
  ➢ Researchers: The definition of policies is an assignment for policy makers and politicians; Analysis of effectiveness is reserved for scientists. By this research, the scientists will get knowledge on how agriculture of maize in Rwanda has been improved through well designed policies. The challenges that will be outlined by this research will be important for researchers to analyze them and light the policy makers on how to handle them.

VI.   LITERATURE

a. Theoretical Literature Review
Fortune of Africa (2018) states that Maize was introduced in Rwanda in 1960, the main maize growing areas in Rwanda being Gicumbi, Nyagatare, Gisagara, Nyaruguru, Rukomo Site, Musanze, Rutsiro, Ngoma, and Gatsibo. Maize is important in several ways: It plays an important role in food security; it contributes to poverty reduction; It is used in the production of animal, poultry and fish feed; Maize production can be competitive with imports of foodstuff; It is a good crop for fighting hunger as it is easier to store. In this line, Nkurikiye (2016) lists the following main varieties of maize planted in Rwanda: M081; RHM102; M104; M102; Z607; KH500-46A; KH500-31A; RHM103.

International Funds for Agriculture Development (2011) affirms that maize is one of the major crops in Rwanda and IFAD ranks maize second purposes the sorghum among cereals and third to all crops, covering 10% of the

total cultivated land after beans (25%) and banana (22%). The maize growing on hillsides usually offers poorer results. Maize possesses the advantage of being grown in all agro-ecological zones of the country and in developed marshlands. IFAD (2011) states that Rwanda's maize production is concentrated in valley areasand many of them have been recently drained for crop production. Best production areas in terms of climate are found in eastern Rwanda, where temperatures are higher and there is a longer dry season for drying the thick grain. The production in valley areas is greater during the rainy season A (September to December), due to the risk of flooding in rainy season B (February to March), whereas hillside production predominates in the heavier rainy season B. Some valley areas with adequate moisture are used for maize production in the long dry season, season C (June to September).

Thornton, Jones, Alagarswamy and Andresen (2009) on one hand and Faostat(2010) qualified maize as an important food crop in developing world. According to the cited studies, maize plays an important role in the livelihoods of millions of poor farmers. Maize is a preferred crop for about 900 million farmers and consumers from low- and middle-income countries of whom over 90% live in tropical and sub- tropical areas of Africa, Asia, and Latin America (Thornton et al., 2009; Faostat, 2010).

Having analysed the importance of maize in developing countries, Rosegrant, Msangi, Ringler and Cline (2012) projected that in 2050, the demand for maize in the developing world will double, and by 2025, it will become the crop with the greatest production.

b.   Empirical Literature Review

Michael Keating (2010) analyzed the effect of subsidies on improving maize production in three countries: *Tanzania, Zambia* and *Zimbabwe*. The research outlines that when, in the 1970s and 1980s, public agencies in Africa promoted maize production in cited countries, with heavy subsidies on the costs of transporting inputs to farms and shipping produce back, the response from farmers was strong, especially in remote areas. As a result, increased production helped reduce the real cost of staples on domestic markets.Example: From 2005/06 the government of Malawi embarked on a national programme of subsidised fertilizer. In 2006/07 two million seed and three million fertilizer vouchers were distributed to targeted households. As a result, since the introduction of the subsidies maize production has increased remarkably: In 2008 and 2009 the maize harvest has again increased, estimated to reach 3.77 million tons   for 2009, giving a surplus over domestic requirements of 1.32 million tons.

Deijl, Djurfeldt&Jirström (2017) analysedAgricultural policy in *Kenya* and itsrelevance for smallholderfarmers, women and youth. The researchfound that in Kenya, maize is the main staple crop and the use of hybrid maize seed and fertilizers is relatively widespread compared to other countries in sub-Saharan Africa. The government of Kenya has a long history of direct intervention in agriculture, which has left a legacy of strong public agricultural institutions focusing on particular commodity chains including National Cereals and Produce Board for Maize.

Msafiri, Mkonda and Xinhua (2016) analysedproduction trends of food crops focusing on opportunities,challenges and prospects to improve tanzanianrural livelihoods. This paper highlights the opportunities, challenges and prospects of agriculture with the aim of transforming it from subsistence to commercial farming. The research found that Tanzania Agricultural Policy defined 1997 aimed at stimulating agricultural growth from 3.6% to at least 6%. The dominant cereal crops produced in Tanzania are maize, beans, millet and rice. The policy and its implementation programs have been fruitful. In fact, the production trends of the staple food crops such as maize, rice, paddy sorghum sweet potatoes and beans have increased significantly from 590m/kg in 1961 to 4,341 m/kg in 2011. In 2010, in the context of implementing Comprehensive Africa Agriculture Development Programme (CAAP),Tanzania developed Tanzania Agriculture and Food Security Investment Plan (TAFSIP).Regarding smallholder productivity, the TAFSIP prioritizes the following food crops which are maize, rice, cassava, wheat, beans, sorghum, sugar and oil seed crops. However, the research found that inadequate market systems, transportation and storage infrastructures among others things, have been the major hindrances to make agriculture a commercial industry.

HanzwidaNyanga(2006) analyzed impact of agricultural policy changesonhousehold food security among small-scale farmersinsouthern zambia. The research found that the government agencies of Zambia monopolized the supply of credit and inputs, as well as the marketing of hybrid maize. Farmers were provided with readily available credit through a parastatal National Agricultural Marketing Board (NAMBoard) and government supported agencies such as Lima bank, Provincial Cooperative Marketing Unions and Zambia Cooperative Federation. Small-scale farmers in remote area had access hybrid maize market by creation of primary cooperatives and building deports in rural areas. The maize prices were stable and NAMBoard guaranteed

market for farmers' produce. Such a policy enabled small-scale farmers to have easy access to credit, hybrid maize seed and fertilizer.As a result, from the 73 heads of households interviewed, number of households growing maize for the purpose of consumption has declined from 55 in 1980-1990 to 22 in 2001- 2005. The majority of these households are from the resource poor and extremely resource poor categories. The research outlined challenges such as expensive fertilizers, expensive seed, poor access to credit, persistent livestock diseases and unreliable maize market.

VII.   RWANDAN EFFORTS IN IMPROVING MAIZE PRODUCTION

Before having an overview of agricultural policies promoting maize production, this section will start providing a brief evolution of agricultural policies in Rwanda and in its second part it will list key agricultural policies that properly are inline with maize production.

a.   An Overview of Historical Evolution of Agricultural Policies in Rwanda
i.   Colonial Period

NewBury (1988: 161- 171) places the prototype of current agriculture policies in colonial period. They have been defined with the aim of facing famine by increasing agricultural production, instructing and diffusing modern agricultural techniques, promoting commercialization and effective land use to prevent erosion. The research outline four main agriculture policies: (i) The regulation number 96 of the Resident of Urundi stipulating to cultivate food crops in at least 30 ares is seen as the first agriculture policy formulated in Rwanda. Export crops promoted at that time were coffee, cotton and oil palm.(ii) The second agriculture policy was about the development of wetlands when the church and colonial authority initiated the exploitation of swamp with thedrainage of 20, 000 ha of swamp in 1934. (iii) The third agriculture policy was attempting to foster modern peasants, known as "Paysannat". It aims at making Rwandans settle in fixed blocks and instructing them about new agricultural techniques. By the beginning of 1955, already 4, 209 blocks have been developed in a plain located in east Ruzizi river and such block reached an area of 50, 000 ha.(iv) The fourth agriculture policy was about land to face soil erosion and excessive use of land by overpopulation during 1930s. Anti- erosive measures covered an area of 220, 000 ha by 1952.

ii.   After independence

Bart (1993: 499- 503) summarize agricultural policies developed under independence period as the following:
➢ The first policy developed was "Plan Intérieurd'Urgence" developed for 1966- 1970 period. The main objective of its formulation was coping with economic pressure caused by rapid growth of the population. The main focus was: (i) land preservation; (ii) general improvement of the yield; (iii) amelioration of cattle management; (iv) more rationale use of banana plantation; (v) development of new land; (vi) promotion of industrial crops.
➢ In 1977, the government of Rwanda developed agricultural program to achieve food self- sufficiency. The main objectives of the policies were: (i) prioritization of measures about food crops and livestock; (ii) improved storage and processing; (iii) organization of crop marketing; (iv) alleviation of food dependency aid.
➢ After the mid- 1980s, cited policies failed to face famine. The food shortage prevalent in Southern of Rwanda and the genocide against Tutsi destroyed all in 1994.

iii.   Post Genocide Period
➢ In 1998, the government of Rwanda developed two major agricultural policies: Land reform policy and Villagization policy (GoR, 1998: 55- 60). The two policies aimed at rationalizing agriculture by promoting more efficient land use and land accumulation by selective exploitation. Villagization targeted to develop village (agglomerations) in order to save land for cultivation.
➢ Since 2000, the Government developed several agricultural policies under Vision 2020. Those policies are developed below.

b.   Agricultural policies towards improved Maize Production in Rwanda

In line with agriculture transformation towards middle income country, Rwanda has set a series of policies and programs aiming at increasing the production. Such policies include:

(i) Vision 2020 (2000): Modern agriculture is listed among six key pillars of Vision 2020- good Governance and an Efficient State; Skilled human capital; Vibrant private sector; World class physical infrastructure; and Modern agriculture and livestock. According to the Vision, subsistence agriculture has to give place to high productive agriculture leading to agro- processing, industry development and exports. Vision 2020 acknowledges that the most important issue retarding Rwanda's agricultural development is not land size, but low productivity associated with traditional peasant-based subsistence farming. It intends to overhaul agricultural policies in order to promote agricultural intensification. The Crop Intensification Program (CIP)developed in 2007 under vision 2020attempts to address the concerns reflected in Vision 2020 on the

reduction of productivity due to lack of simultaneous application of fertilizer use by emphasizing that intensification should be accompanied by the use of appropriate inputs (GoR, 2012).

(ii) *National Agricultural Policy*: Developed in 2004, the policy views maize as important food cropas food liked by the population, used in animal feeding and its high response to fertilizer in agro- bio- climatic zones in Rwanda (GoR, 2004).

(iii) EDPRS II (2013- 2018): The Economic Development and Poverty Reduction Strategies of Rwanda aims at increasing economic growth by investing in modernizing agriculture. The strategy recognizes maize as food reserve that can enhance food security once improved. Maize is listed among priority crops to increase productivity especially in districts Ruhango, Ngororero, Rutsiro, Nyabihu, Gatsibo (GoR, 2013a).

(iv) *Agricultural Mechanization Policy 2010*: The policy list on the first rank maize as major food crop crowing and processed in Rwanda. The policy describes mechanization systems to improve the production and shifting from subsistence agriculture to knowledge based (GoR, 2010).

(iv) *Crop Intensification Program*: The Government of Rwanda under the Ministry of Agriculture and Animal Resources (MINAGRI) has developed the Crop Intensification Program (CIP) in 2007 in order to increase agricultural productivity and food security in Rwanda. CIP undertook a multi-pronged approach that includes facilitation of inputs (improved seeds and fertilizers), consolidation of land use, provision of extension services, and improvement of post- harvest handling and storage mechanisms. CIP program focuses on six priority crops namely Maize, Wheat, Rice, Irish potato, Beans and Cassava.

To overcome the constraints of lack of demand for inputs, CIP took a 'supply-push' approach whereby the government initially supplies the inputs and the farmers are persuaded to use them. For augmenting increases in productivity of crops, CIP imported improved seeds from neighboring countries such as Kenya and Tanzania. For example, in 2008, 765 tons of seeds of maize and wheat were imported for cultivation in season A. The amount gradually increased from 1200 t in 2009A to 3512 t in 2011 A. Under CIP, the use of improved seeds by farmers has risen from 3% to 40%. CIP imported fertilizers and distributed to farmers through various service providers. Estimates suggest that as a result of these efforts, the national average fertilizer used per year has increased from 8 Kg/Ha to 23 Kg/Ha in 20101 (MINAGRI, 2010).

(v) *Strategic Plan for the Transformation ofAgriculture in Rwanda II (2009) & III* (2013- 2017): PSTA III aims at transforming Rwandan agriculture from substance to knowledge based; to grow rapidly in production and commercialization, increase rural income and reduce poverty. Maize is cited among exported crops to the region. PSTA III targets quality in production including maize.

(vi) *National Post-Harvest Staple Crop Strategy 2011*: It is a policy framework to assist with strengthening the harvesting, post-harvest handling, trade, storage, and marketing within staple crop value chains; strengthening markets and linkages for farmers, and reducing post-harvest losses. According to the strategy, maize area has increased by 300% compared to 10 years ago (MINAGRI, 2011a).

VIII. DATA ANALYSIS AND INTERPRETATION

a. Evolution of Maize Production (1995- 2018)
The data provided by the National Institute of Statistics of Rwanda 2016 shows the evolution of production of maize as summarized by the following figure:
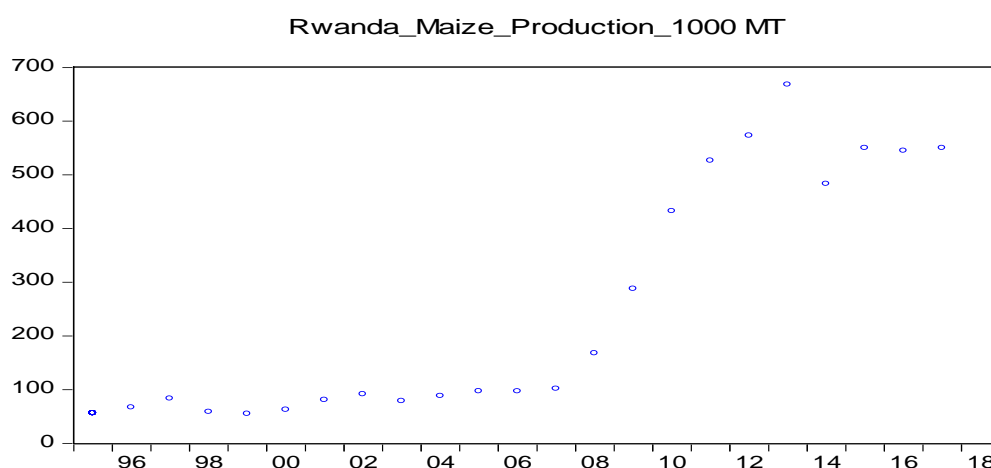
Rwanda_Maize_Production_1000 MT

Source: Author's computation of data provided by the National Institute of Statistics of Rwanda, Annual Reports and Index Mundi, 2018 using Eviews 8 Software.

The figure above shows an admirable achievement of governments' efforts in improving maize production. Such efforts include policies, programs and allocated budget. In fact maize production passed from 56,000 tons in 1995 to 62, 501 in 2000, and the production continues increasing to 97, 251 in 2005 up to 432, 404 in 2010 and the current production is 550, 000.During 1995- 2006 period, the production of maize was too low: The maximum production was 97 metric tons in 2005 and 2006, the minimum was 54.9 metric tons in 1999 and the average production for the period was 73.3 metric tons. This situation is justified by the absence of policies promoting maize production. People cultivate maize naturally for family subsistence.Due to the implementation of several agricultural policies, the production has increased considerably during the 2007- 2018 period: The maximum production reached 668 metric tons in 2013, the minimum became 102 metric tons in 2007 and the average production for the period became 444 metric tons . By agricultural policies in place, farmers were encouraged to produce high quantity of maize; they used modern seeds and modern technologies such as fertilizes, mechanization etc.

The figure shows that the year 2013, six year after the introduction of Crop Intensification Program (CIP) in 2007, has marked the culminant point in maize production in Rwanda. This means that six years led to maturity.

The year 2013 has followed the fluctuation in production until now. This situation can be mainly justified the effects of climate change that nowadays affect heavily agricultural production in general.

According to Rwanda by itself could not lead to described improvement. Under the Ministry of Agriculture and Animal Resources (MINAGRI) which collaborate with other public institutions such as Rwanda Agricultural Board (RAB) and National Agriculture Export Board (NAEB), the Government of Rwanda attracted and continues to attract international co-operations. Among the partners include the Belgian Government, World Bank, Food and Agricultural Organization (FAO), IFAD, Belgium Technical Cooperation (BTC), Japan International Cooperation Agency (JICA), Department of International Development (DFID), European Union (EU), World Food Program (WFP), United Nations Development Program (UNDP), and Canadian International Development Agency (CIDA) among others. The partners are mainly international development agencies who initiate and fund projects that contribute directly and indirectly to agricultural productivity and growth.

b. Food Security Analysis

The data provided by the National Institute of Statistics of Rwanda (NISR) and Index Mundi give the following situation about the distribution of the production of maize over the population of Rwandese as summarized by the following table:

Table 1: Estimation of Individual Annual Consumption of Maize

Year	Maize_Production_Kg	Rwandan_Population	Annual_Consumption_ per_Individual
1995	56,000,000	5,928,078	9.45
1996	66,595,000	6,115,000	10.89
1997	83,427,000	6,522,000	12.79
1998	58,618,000	7,060,000	8.30
1999	54,912,000	7,593,000	7.23
2000	62,501,000	8,025,703	7.79
2001	80,979,000	8,329,000	9.72
2002	91,686,000	8,536,000	10.74
2003	78,886,000	8,680,000	9.09
2004	88,209,000	8,818,000	10.00
2005	97,251,000	8,991,735	10.82
2006	96,662,000	9,207,000	10.50
2007	101,659,000	9,447,000	10.76
2008	167,853,000	9,708,000	17.29
2009	287,946,000	9,977,000	**28.86**
2010	432,404,000	10,246,842	**42.20**
2011	526,679,000	10,520,000	**50.06**
2012	573,038,000	10,790,000	**53.11**
2013	668,000,000	11,070,000	**60.34**
2014	483,000,000	11,350,000	**42.56**
2015	550,000,000	11,629,553	**47.29**
2016	545,000,000	11,917,508	**45.73**

2017	550,000,000	12,208,407	**45.05**

Source: Author's computation of data provided by the National Institute of Statistics of Rwanda (NISR) and Index Mundi, 2018 using Microsoft Office Excel 2010.

According to the table 1, trying to distribute the production achieved per year to the whole population, the estimation of annual consumption of maize per individual, since 1995, has increased. The minimum consumption has been 7.23 kg per year in 1999. The maximum consumption per individual was 60.34 kg per year in 2013. In average, for the whole period of 1995- 2017, the consumption of maize is 24.37 kg per individual per year.

The period pre agricultural policies (1995- 2007) is characterized by a very little quantity. During that period, the maximum annual consumption per individual was 9.85 kg, the minimum was 7.23 kg. The average annual consumption per individual for the period was 9.85 kg.

The situation has changed with the implementation of agricultural policies. In fact, the period 2008- 2017 has known considerable improvement. The maximum annual individual consumption attained 60.34 kg, the minimum reached 17.29 kg, while the average annual consumption per individual is evaluated at 43.24 kg.

Such situation reveals that agriculture policies have been fruitful. However, considering the level of food satisfaction, the research found that despite the Government has made enormous efforts to improve the production of maize, such production remains far below the quantity needed to satisfy the food security. The maximum consumption per individual has been about 5 kg per month in 2013.

This finding reiterates the work of Alinda and Abbott (2012) who found that due to the country's high population density, land remains scarce while labour is Rwanda's most abundant resource. Consequently, farm production is characterized by lower-than-average farm sizes (inadequate to support a household) coupled with deteriorating soil fertility, which poses severe challenges to increasing crop production.

c. Analysis of Evolution of Maize Importation (1995- 2018)

Importation supports the local production in order to satisfy the needs on the market. The present section will analyze the evolution of maize importation during the period under study. Such evolution is summarized by the following figure:
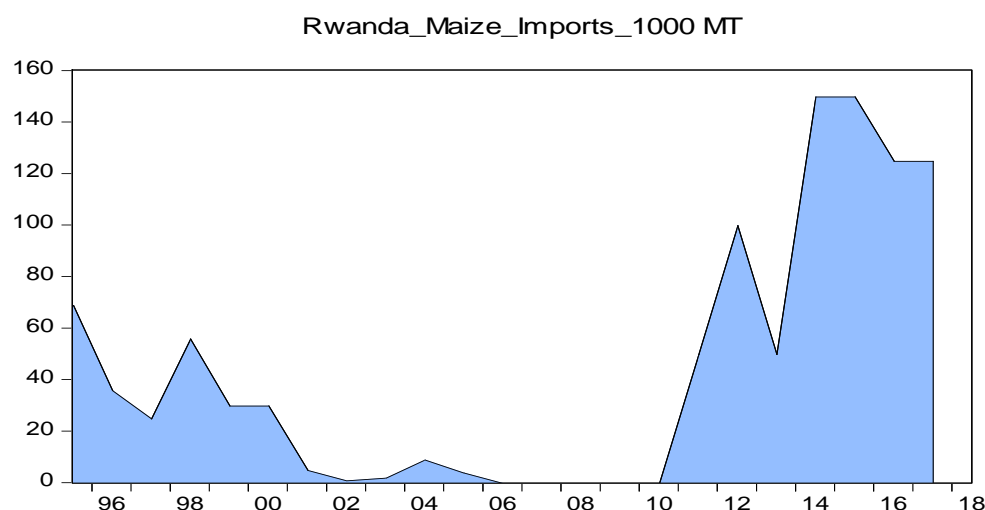
Source: Author's computation of data provided by the National Institute of Statistics of Rwanda and Index Mundi 2018 using Eviews 8 Software.

The figure above shows that the importation of maize was fluctuating while decreasing until reaching the point zero during 1995- 2005 period. This situation is more linked to Rwandan history where the genocide against Tutsi and the period that followed it have been marked by several refugees who came into the country. The Country imported such maize for feeding such population. As the time passed, such importation decreaseduntil disappearing because people restarted working by themselves.

The period 2006- 2010 is marked by zero importation of maize. The reasons of such situation can be: (i) People consumed only their own local production; (ii) There were no culture of consuming maize at that time; (ii) There were no policies promoting maize production and consumption.

The period 2011- 2017 demonstrate a big change. Maize importation has passed from zero importation to a culminant point of 150 metric tons in 2014 and 2015. In 2013, the importation has decreased because the local production reached its culminant point. The period after 2015 marked a decrease in importation that can be justified by increase in local production.

The government'sefforts in improving the production of cereals, mainly maize, through several agricultural policies, has resulted in a re-importation of maize since 2011. The figure however, shows that the level of importation of maize is low in general: During 2011- current period, the maximum importation has been 150 metric tons in 2014 and 2015 and the minimum was 50 metric tons in 2011. Such low quantity of importation can be justified by the fact that the culture of consuming maize is still not inculcated in all Rwandese.

d.   Analysis of Situation of Maize Exportation (1995- 2018)
Export is an indicator of local market satisfaction directing extra production to abroad. The present section will analyze the evolution of exportation of maize production in Rwanda during the period under consideration. The situation is summarized by the following graph.
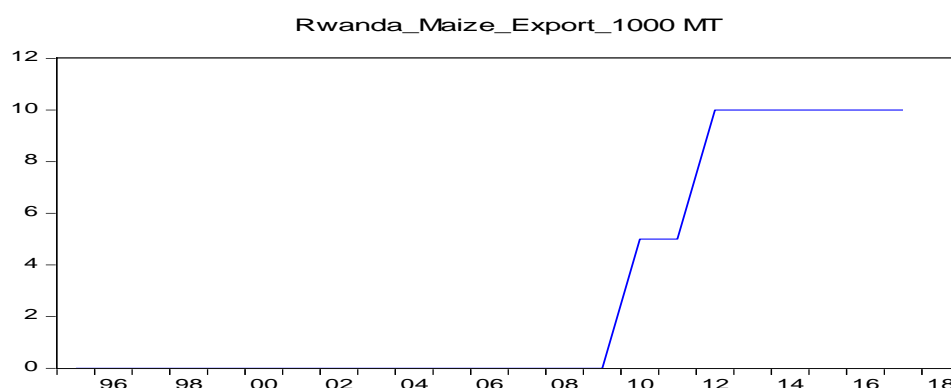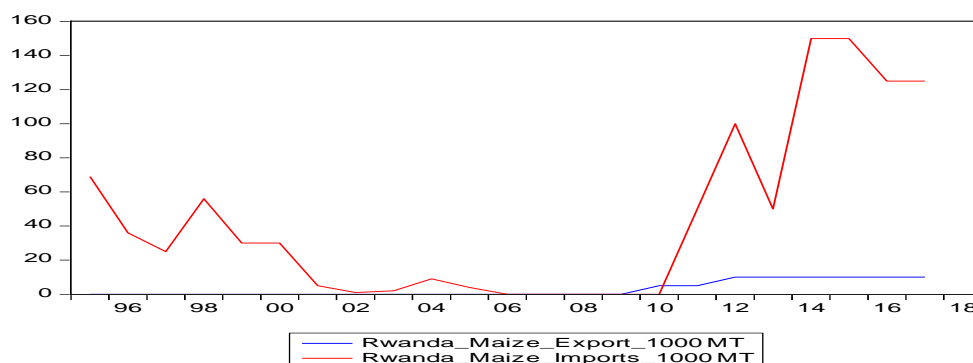

Source: Author's computation of data provided by the National Institute of Statistics of Rwanda (NIRS), Annual Reports, and Index Mundi, 2018 using Eviews 8 Software.

The figure above shows that since 1995 to 2009 Rwanda has never exported the maize. This can be justified by the period of national insecurity caused by the genocide against Tutsi and its consequences of movement of refugees that affected agriculture.

Exportation of maize started in 2010 up to now. This is the fruit of agricultural policies that increased the production of maize and lead to its exportation.

Considering the quantity exported until now, the figure shows that it is too low: The quantity passed from 5 metric tons in 2010 to stagnate to 10 metric tons for a long period of time since 2012 up to 2017. This situation shows that the production of maize is still low compared to the local market demand. The tendency is that people consume locally the production and exportation is affected.

e.   A Comparative Analysis of Import and Export of Maize Production (1995- 2018)

Source: Author's computation of data provided by the National Institute of Statistics of
Rwanda (NIRS), Annual reports, and Index Mundi, 2018 using Eviews 8 Software.

The figure aboveshows clearly that both importation and exportation are increasing. Considering the quantity,
the figure shows that import is higher than export. Import was 10 greater than export in 2011 and it has
increased to 12.5 in 2017. It has fallen to 5 in 2013 when maize production achieved its culminating point.

IX.   KEY CHALLENGES TO FARMERS IN RWANDA

The National Agriculture Policy and Strategic Plan for the Transformation Agriculture in Rwanda III list a
number of challenges summarized in the following:(i) Lack of appropriate techniques for climate mitigation:
Rwandan agriculture is affected by heavy rains (in the Northern) and lack of rain (in Eastern); (ii) Low
productivity of lands resulting from excessive use of land and low application of inputs including fertilizers,
improved seeds and pesticides: Despite Rwanda made efforts in importing fertilizers and seeds, the majority of
the population are not aware of their importance and prefer traditional cultivation. Another factor is the cost and
cultivators hesitate to invest loans in agriculture because of fear of failure of the production due to the climate
that affects negatively the crops; (iii) Lack of appropriate laboratories to control quality of pesticides: Some
imported inputs for agriculture do not match with Rwandan soil and produce the unwanted production; (iv)
Long practice of subsistence farming coupled with limited knowledge for the population affect maize
production by decelerating exports; (iv) Weak infrastructure that affect the transport of crop: Most of farmers
are paid low because of difficulties to transport their harvest to the markets (MINAGRI, 2004 &GoR, 2013).

To these cited challenges, Bizimana, Usengumukiza, Kalisa, and Rwirahira (2012) added the following: (i)
Small farm size due to population pressure; (ii) Low involvement of private sector investment in agriculture;
(iii) Insufficiency of skilled agronomists; (vi) Quality deficiency: Ntirenganya (2018) stated that Africa
Improved Food (AIF), one of the major agro-processing companies in Rwanda, imports about 80 percent of
some 28,000 tons   of maize it needs per year, mainly from Zambia because the local maize has high level of
aflatoxins.

X.   POLICY IMPLICATIONS

In order to achieve sustainable agriculture satisfying the needs for food for Rwandan population and export
agriculture harvest, especially for maize, a number of policies should be oriented in the following key areas:

- (i)   Climate mitigation: By international cooperation, Rwanda should source from other countries
especially countries having deserts and sources techniques to handle the case for the region's most
vulnerable to such issue.
- (ii)   Exploitation of natural resources: Some regions in Rwanda, likeBugesera, present a lot of lacs but
suffer from hungry due to the lack of rain. Rwanda should plan to exploitthose lacks and irrigate the
region. In fact, Bugesera is a region of high fertility that requires fewer fertilizers.
- (iii)   Promoting professionalism in agriculture sector: More incentives are required to attract farmers
adopting new technologies in agriculture including the participation of agronomists in agricultural
planning at Cell level; facilitating access to loans for cooperatives that need long- term credits related
to the transport of harvest from rural to urban; reducing the cost for seeds and fertilizers for
cooperatives aiming at modern techniques of agriculture; providing regular trainingsto agricultural
cooperatives.
- (iv)   Encouraging private sector participating intensively in production, processing, conservation and
marketing of agricultural products especially maize. In fact, at farmers' level, maize production
corrupts easily due to inefficacy of storage systems. By suggested participation, investors and farmers
can plan together about the quality, storage and commercialization of the maize crop.

(v)   Improving infrastructure especially in rural areas: Districts should allocate in their annual budget a big portion for improving infrastructure such as roads, communication infrastructure for facilitating trading of harvests. Poor infrastructure led to lower pricing that in turn affect the use of modern technologies that are costly; It affect also loans return on farmers' side and led to loss.

(vi)   Improving local agronomists' skills in agricultural technologies: By reviewing curricula related to agriculture in the universities and promoting and financing trips in developed countries, graduates in agriculture should be well equipped with enough skills to face on- field problems in agriculture sector. In turn skilled agronomists will inculcate into the population the vision of market oriented agriculture. Maize is needed locally and abroad.

XI.   CONCLUSION

The present research was about analyzing the role of agriculture policies in improving production in Rwanda. The case study was maize. The time scope of the study was 1995- 2018. The data used were provided by the National Institute of Statistics of Rwanda and Index Mundi. The collected data was analyzed using Eviews 8 software.

The research found that during the period under consideration, agriculture policies are built onRwanda Vision 2020 defined in year 2000. In implementation of the vision, the government has developed several policies such as:Strategic Plan for Agriculture Transformation (PSTA) completed in 2004 and executed in different phases; Rwanda agriculture policy developed in 2004; Land policy in 2005; Agriculture Guarantee Fund in 2005 to encourage bank lending to the agriculture sector; Crop Intensification Program (CIP) initiated in September 2007 focusing on six priority crops namely Maize, Wheat, Rice, Irish potato, Beans and Cassava. By the program, farm inputs such as improved seeds and fertilizers were imported and distributed to farmers through public-private partnerships, and extension services on the use of inputs and improved cultivation practices are rendered to farmers. Economic Development and Poverty Reduction Strategies of Rwanda initiated since 2008 with aim of increasing economic growth by investing in and modernizing agriculture recognizes that food crops constitute a major component of agriculture and national GDP.

The research found that the results of those cited policies are the following:

Considering the quantity of the production of maize, the period 1995- 2006, was characterized by too low production fluctuating between 56 and 97 metric tons per year. This is seen as a period of defining policies and initiating their implementation including training farmers. Since 2007 the situation changed. The production increased considerably and attained a pick of 660 metric tons in 2013. Such increase demonstrates admirable achievements of agricultural policies in improving maize production. The decrease in production that characterizes the period post 2013 is a result of climate change affecting agriculture seasons and production in general. Despite such decrease, agricultural policies continues facing the crisis and that is why the production fluctuates during this period.

Considering food security for the population, the research found that despite considerable efforts made, the way is still long. In fact, annual individual consumption of maize is evaluated at having passed from an average of 9.85 kg per year and per individual during the period pre- policies (1995- 2006) to current average of 43.24 kg per individual per year. Such results are promising for the future.

Considering import situation, the research found that during the period 1995- 2000, Rwanda imported maize for covering the food insecurity due to genocide against Tutsi and its consequences mainly for refugees and local population unable to exploit lands in insecurity period. Importation is estimated at an average of 41 metric tons per year. With the security peace established, since 2000 to 2005, the importation of maize fallen to an average of 4 metric tons per year. During 2005- 2010, there is zero importation of maize. This means that people consumed only what they harvested from their own land, and they was no culture of consuming maize and there was no motivation to cultivate maize for market. Agricultural policies played an important role because from 2011 to 2017, the average of importation of maize reached 107 metric tons per year. By encouraging people consuming maize, the needs of consumers increased, the local production became insufficient and then the government re- started importing maize from abroad.

Considering exportation situation, as an indicator of market oriented production, the research found that since 1995 to 2009, Rwanda exported zero maize. All production was consumed locally. Catalyzed by agricultural policies, the production of maize increased and then since 2010 exportation of maize started from 5 metric tons and it reached 10 metric tons since 2012 up to 2017.

All cited indicators allow the researcher to conclude that agriculture policies played important role in improving production of maize in Rwanda. Since 1995 Rwanda is embarked for middle income economy by 2020. Such vision implies economic structural transformation where the economy migrates from traditional and subsistence agricultural based to knowledge- based economy characterized by modern agriculture, improved services and industry. Rwanda has done a lot in improving agriculture by intensification, where the Country aims to increase land and crop productivity through increased use of inputs (selected seeds, organic and mineral fertilizers, pesticides etc.) and improved agricultural techniques bearing in mind to first improve water supply (irrigation, runoff water collection). The case study of maize production has shown impressive achievements. However, more efforts are required for satisfying the needs in food for the population and developing strong imports- exports of maize.

Recommendations
For achieving food security in term of maize, the present research recommends the following:
To the farmers
  ➢ Flexibility in implementing government programs targeting improving the crop especially for maize.
  ➢ Adopting modern storage system for maize harvest in order to face aflatoxins that damage the production and led to loss.
  ➢ Profiting local market demand for maize production for local and regional market and use modern agricultural technologies allowing shifting from subsistence agriculture to modern agriculture which increase the production in quantity and in quality.

To researchers
  ➢ Doing more research on appropriate technologies of agriculture that can be easily affordable for the current farmers.
  ➢ Translating researches conducted on maize production into a language that is understandable and readable for local farmers. In fact, most of researches conducted are not adapted to the level of understanding of local farmers.

To the Policy makers
  ➢ To provide enough and qualified agronomists to the level of Cells in rural areas so that they can be near farmers and train them and monitor their daily farming activities.
  ➢ To import agricultural technologies for climate mitigation: In fact, if the Government of Rwanda cannot stop climate change, modern technologies can allow exploiting the regions like Bugesera affected by continuous sunny seasons.
  ➢ Improving infrastructure for facilitating harvesting and marketing maize in rural areas.
  ➢ Providing more training to farmers' cooperatives and providing to them accurate and updated information about the marketing situation for they maize production.In fact, most of farmers are not open to the regional and wide world marketing.

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APPENDICES

Table 1. Maize Production Compared to Rwandese Population

Year	Maize_Production_1000 MT	Population
1995	56	5,928,078
1996	67	6,115,000
1997	83	6,522,000
1998	59	7,060,000
1999	55	7,593,000
2000	63	8,025,703
2001	81	8,329,000
2002	92	8,536,000
2003	79	8,680,000
2004	88	8,818,000
2005	97	8,991,735
2006	97	9,207,000
2007	102	9,447,000
2008	168	9,708,000
2009	288	9,977,000
2010	432	10,246,842
2011	527	10,520,000
2012	573	10,790,000
2013	668	11,070,000
2014	483	11,350,000
2015	550	11,629,553
2016	545	11,917,508
2017	550	12,208,407

Table 2. Maize Import and Export (1995- 2017)

Year	Rwanda_Maize_Export_1000 MT	Rwanda_Maize_Imports_1000 MT
1995	0	69
1996	0	36
1997	0	25
1998	0	56
1999	0	30
2000	0	30
2001	0	5
2002	0	1
2003	0	2
2004	0	9
2005	0	4
2006	0	0
2007	0	0
2008	0	0
2009	0	0
2010	5	0
2011	5	50
2012	10	100
2013	10	50
2014	10	150
2015	10	150
2016	10	125
2017	10	125