AN ASSESSMENT OF AGRICULTURAL PRODUCTIVITY AND MAJOR DRIVING FACTORS IN THE REPUBLIC OF BENIN

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Abstract

Under different reforms that occurred since 1961, Benin agricultural productivity has changed and decreased significantly after the country's agricultural liberalization in 1990. This paper used simple linear regression to explore major driving factors that change and propose policies which will contribute to improve the country's agricultural productivity in the long term. Results reveal that Agricultural land and rainfall had a positive effect on productivity while labor and government effectiveness had a negative effect. Moreover, agricultural research, extension and country openness doesn't any significant effect. Therefore, government should manage effort to improve agricultural labor management and develop effective actions to addressed agricultural productivity goals.

Key words: *Agriculture, Total productivity factors, Major factors, Benin.*

Introduction

The Republic of Benin is a West African country that situated between Niger and Burkina Faso to the north; Federal Republic of Nigeria to the East; Togo to the West and the Atlantic Ocean to the south with a 120 km² wall (UNAIDs, 2010). This is illustrated by the Figure1 below. It has a surface area of 114,763 Km².Geographically its landscape is comprised of a sandy coastal strip followed by two massive plateau areas of Atacora to the north where the rivers have their source. The country's total population is close to 9 million inhabitants (World Bank, 2010).

The country is characterized administratively by 12 provinces from north to south and following natural condition, there are ecological eight zones (Deng, 2007).The north is constituted by 2 zones with lesser favorable conditions for agricultural production, zone extreme Nord Benin (1) and zone Ouest Atacora (4) , respectively and 2 zone with favorable production condition, cotton zone at Nord Benin(2) and fishpond zone at Sud of Borgou (3). However, all the eight are characterized by one cropping season per year and relatively low. The center is the big zone with favorable production condition. It was commonly recognized by everybody as cotton production zone (5). In this transnational zone, the cropping intensities go up from one to two cropping seasons, depending on length of the local growing season. The local growing season in turn is regulated by the transition between unimodal and bimodal rainfall. The south has one zone with production potential (zone of depression (8)), one zone with medium production potential (Earth bars zone (6)) and one zone with low production potential (fishery zone (7)) all are characterized by 2 cropping seasons and high population density. These are illustrated by Figure 2 below.

In Benin, agriculture contributes more than 45% of the country's GDP and involves at least 48% of the country's population (World Bank, 2010) mostly women who have access to small pieces of land (1.7 ha per 7 persons) (IFAD, 2011). Furthermore over decades, the country's agricultural production is characterized by intensive labor used, lack of mechanizations, producer's non-sufficient financial credit accessibilities, non-sufficient investment, producer's non-appropriate technology used, and producer's limited access to market due to lack of road.

The country has gone through 3 important periods of political regime since the independency in 1961. From 1972 the country went through Marxism followed by democracy in 1992. From 1990, major reforms have been implemented regarding Structural Adjustment Programmes (SAP) supported by international bodies as International Monetary Fund (IMF) and World Bank (Naiman and Watkins, 1999). In line with the SAP policies, Benin's government has proceeded to move toward a

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market-driven economic system with less government intervention and liberalize the agriculture sector to private partnership control as the government agricultural supports through research and extension were misdirected and expensive (Modest , 2000; MAEP-MDEF, 2006).

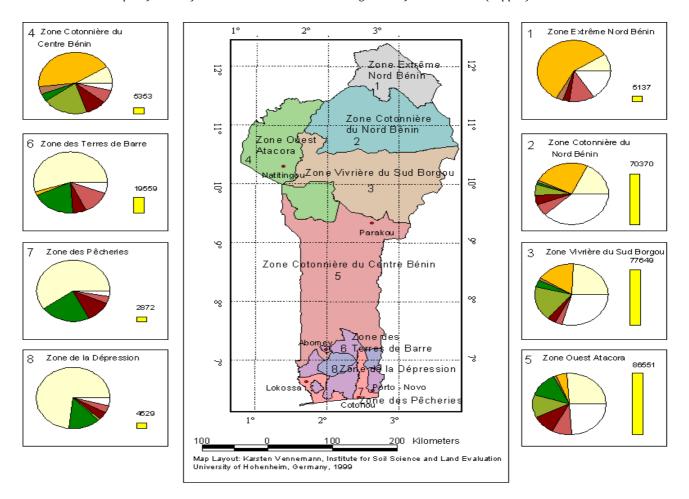Figure1 Benin Localization Map, Source (childrenforlife.wifeo.com)

Figure 2 Benin Agro-ecologic Region Cartography
Sources: Deng Zhixin (2007). Vegetation Dynamics in Oueme Basin, Benin, West Africa

Indeed important projects followed the country's movement towards open economy policy. Among these projects, there are the Agricultural Services Restructuring Project (PRSA), the Community-Based Food Security Project (PILSA) and the Second Rural Savings and Loans Cooperatives Project (Rural Credit II). Indeed, the PRSA Aimed to restructure the country's agricultural institutions in order to support government to have control over rural development activities, to improve sustainable agricultural services, and to create employment through privatization of several nationalized enterprises. The PILSA aimed for poverty alleviation, food security and for nutrition improvement in vulnerable area while the Rural Credit II aimed to rehabilitate and strengthen rural savings and cooperatives loans network in line with

First Rural Savings and Loans Rehabilitation Project.

However, Analysis of indexes measuring changes in Profitability (PROF), Total Factor of Productivity (TFP) and the Terms of Trade (TT) in Benin Agricultural over the period 1961-2008 showed that, there have been significantly change in the country TT .This is illustrated by Graph1 below. Terms of Trade have been an important driver in Benin agricultural profitability and TT's effects on profitability have been moderated by compensating changes in TFP. The country's agricultural terms of trade has decreased by 12.19% between 1961 and 1990 and increased by 79.58% between 1990 and 2008.Profitability decreased by 77.55% before the agriculture liberalization and increased after the liberalization (between 1990 and 2008) by 22. 67%

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while Productivity increased by 77. 99% between 1961 and 1990and decreased by 31.68% between 1990 and 2008.

This is consistent with the inverse relationship between productivity and terms of trade. The improvement of terms of trade in Benin explains the lack of competitiveness in the sector and the increase in agriculture profitability while the productivity decreases significantly. This situation explains that after the liberalization competitiveness has decreased and monopolization increased. Most private stakeholders involved in the sector have been earning more profit than investors and did not contribute at all to the sector's productivity growth. Indeed, it creates polarized debate as the liberalization has been implemented for the purpose of stimulating the agriculture sector growth with private management which can create more investment in the sector. However the real question then is which major factors are key sources of the agriculture productivity in Benin.

Materials and Methods

To analyze major factors influencing the country TPF, the study uses Ordinary Least Square (OLS) estimation techniques to examine the effect of the above selected variables using the following linear relationship:

$$LnY_t = \alpha LnX_{1t} + \beta LnX_{2t} + \gamma LnX_{3t} + \rho LnX_{4t} + \mu LnX_{5t} + \eta LnX_{6t} + \phi D_1 + \varphi D_2$$

Where:

Y_t is the annual TFP for each year t from 1960 to 2008

X_{1t} is for **agricultural research**, within-country, is recognized as a prime potential source of technical change that raises productivity and sustains output growth (Ruttan and Vernon ,1996 ;Chang and Zepeda, 2001). It increases the stock of knowledge, which either facilitates the use of existing knowledge or generates new technology. Here agriculture research is quantified by the number of agriculture research staff in the country including Agriculture University. This data will be collected from Agricultural Science & Technology Indicator（ASTI）.

X_{2t} is for **agricultural extension** which involves a dissemination of research results to farmers through information distribution, training and demonstration. It may also indirectly influence the

agricultural research process by conveying feedback from farmers to researchers that may improve future research. Effective agricultural extension should improve productivity. In this study, agriculture extension is quantified by agriculture total annual investment. In Benin as in most African countries most investment is assumed by foreign investment so-called agriculture investment in R&D .Data exist at ASTI database.

X_{3t} is for **infrastructure** which is considered as a fixed factor that contributes positively to agricultural growth and productivity (Evenson and Pray, 1991; Antonio and Robert, 2001). It is typically not included among the conventional inputs in growth accounting and its effect on agricultural growth is thereby captured in the residual TFP. Infrastructure is quantified as number of rural roads. Indeed, road construction is very important for farmer market access. Data are available at world resources institute database.

X_{4t} is for r**esource reallocation** which can raise TFP at the aggregate level by allowing factors to move from lower to higher marginal productivity sectors. For instance, movement of labour from the agricultural sector to a higher productivity sector like manufacturing or services can increase TFP growth in the overall economy (Jorgenson, 1988).Within a sector, productivity growth can result from reallocation of resources among subsectors and among commodities when their levels of TFP differ and this does not necessarily require any new technology. Here resource allocation is for land used and labor. Data are available at world resources institute database.

X_{5t} is for **weather**. In fact drought or flow intensity can influence productivity. This can be evaluated by the annual rainfall. Data are available at world resources institute database.

X_6 is **rural health situation**. Number of epidemic disease.

D_1 is for **country Openness**. Indeed country Openness could play positive as role in productivity. It will need further policies to create more Foreigner Direct Investment, technology transfer and increase country competeness. It's a dummy variable and takes the value 0 from 1960 to 1990 and 1 after 1999. Data are available at world resources institute database.

D_2 is for ***government effectiveness***. Effectiveness action means targeting sustainable projects to real people who need them. Furthermore, this also means realization of a project which has positive socio-economic and environmental impact on poor people. Is also dummy variable which takes a value between 0 and 1. Data are available at world resources institute database.

Result

Table 1 and Table 2 below illustrate respectively the summary of the regression data used and summary of statistical test (correlation test and stability test).

Table1 Summary of Second Series of Regression Data Used

	LnY	LnX1	LnX2	LnX3	LnX4A	LnX4B	LnX5	LnX6	D1	D2
Mean	-1.193	4.487	1.356	8.929	7.702	1.155	7.047	12.142	0.395	0.409
Median	-1.454	4.488	1.335	8.822	7.659	1.192	7.029	11.438	0.000	0.631
Maximum	0.082	4.787	2.197	9.852	8.179	2.903	7.319	13.666	1.000	0.650
Minimum	-2.113	4.290	0.741	8.822	7.273	-1.249	6.586	11.438	0.000	0.000
Std. Dev.	0.688	0.197	0.392	0.317	0.273	1.227	0.156	0.965	0.494	0.306
Skewness	0.414	0.205	0.370	2.591	0.305	-0.293	-0.771	0.688	0.426	-0.607
Kurtosis	1.756	1.314	1.764	7.716	2.009	1.882	4.318	1.554	1.181	1.372
Jarque-Bera	4.465	6.015	4.153	98.216	2.707	3.186	8.243	7.964	8.065	8.251
Probability	0.107	0.0494	0.125	0.000	0.258	0.203	0.016	0.0186	0.017	0.0161
Sum	-57.299	215.398	65.133	428.639	369.697	55.464	338.259	582.832	19.000	19.633
Sum Sq. Dev.	22.270	1.831	7.229	4.746	3.513	70.850	1.157	43.771	11.479	4.407
Observations	48	48	48	48	48	48	48	48	48	48

Table 2 Correlation Test Results

	LnY	LnX1	LnX2	LnX3	LnX4A	LnX4B	LnX5	LnX6	D1	D2
LnY	1	-0.870	-0.827	-0.401	-0.851	-0.961	0.198	-0.743	-0.764	-0.719
LnX1	-0.870	1	0.949	0.414	0.895	0.883	-0.006	0.888	0.915	0.748
LnX2	-0.827	0.949	1	0.566	0.875	0.848	0.013	0.870	0.892	0.701
LnX3	-0.401	0.414	0.566	1	0.552	0.415	-0.076	0.538	0.421	0.271
LnX4A	-0.851	0.895	0.875	0.552	1	0.864	-0.147	0.885	0.834	0.764
LnX4B	-0.961	0.883	0.848	0.415	0.864	1	-0.072	0.815	0.818	0.625
LnX5	0.1983	-0.006	0.013	-0.076	-0.147	-0.072	1	0.072	0.135	-0.178
X6	-0.7433	0.888	0.870	0.538	0.885	0.815	0.072	1	0.9100	0.551
D1	-0.764	0.915	0.892	0.421	0.834	0.818	0.135	0.910	1	0.602
D2	-0.719	0.748	0.701	0.271	0.764	0.625	-0.178	0.551	0.602	1

After doing the autocorrelation test student test and stability test the log of productivity function can be written as follow:

$$LogY(t) = -7.010 + 0.410 Log X_{4A}(t) - 0.533 Log X_{4B}(t) + 0.494 Log X_5(t) - 0.514 D2$$

(-4.17)   (2.29)   (-16.22)   (3.78)   (-5.01)

$R^2 = 0.963$ DW= 1.53

Discussion

From the regression results, we can conclude that resource reallocation; weather and government effectiveness has, at 96% significance, impact on the productivity factor since the country independence in 1961. In contrast, agricultural research, agricultural extension, agriculture foreign direct investment, infrastructure, population health and country openness doesn't have any effect on the productivity. It means that they do not contribute to any change in the productivity.

Agricultural resources have significant effect in different direction. Indeed, Land effect has been negative while labor effect has been negative. From the previous chapter, it has been shown that land and labor resources have increased. This is supposed to improve the agricultural productivity but in contract it is not the case for labor in this context. Furthermore, weather effect has been positive and government effectiveness effect has been negative.

Land's positive effect can be explained by the country's ability and will to increase agricultural land availability. This has also been shown by the country's dynamism to mitigating negative impact of climate change on land and water resources management. This includes soil erosion and new land used technical. Holding labor, rainfall and government effectiveness constant, a 1% increased in land input will contribute to 0.41% of productivity improvement.

Labor's negative effect can be explained by inefficiency of the agriculture labor force. It has been shown that the sector is characterized by intensive low skill labor. From the same regression equation, it can be concluded that a 1% increase in labor input will contribute to 0.53% of the productivity reduction.

Similarly, rainfall's positive impact on productivity can be explained by the good agro-climatic condition that the country has. Indeed compared to most Sub-Sahara Africa countries, Benin has great water resources potentiality due to good rainfall and is not exposed to any water stress risk even if there is disparity of rain distribution among the country. However with climate change risk, more effort should be done to vulnerable areas in extreme event cases such as drought. It can be seen that a 1% increase in rainfall will contribute to increase the productivity by 0.44%.

Nonetheless, government effectiveness has significantly been negative on productivity and that can be explained that different policies and reforms have not been implementation well. Indeed, a 1% increase in current government effectiveness input (policies) will reduce the productivity by 0.51%. As in most Sub-Sahara Africa countries, inefficiency in public project monitoring cope with corruption problems have always been major factors limiting the country government effective actions effects. It is known that agricultural extension, agriculture research, agriculture foreig direct investment, agricultural land, road access, people's health and country openness are very important driving factors for productivity but in Benin, with the lack of country government effectiveness action, all those factors don't have significant a effect. There is need to promote agriculture infrastructure development, agriculture extension and research, country openness and agricultural investment. For agricultural investment, sustainable financial resources mobilization should be developed. It is imperatively important to encourage more national or local investment. New agricultural investment strategy should be found and implemented as donor support capacity will reduce due to the global economic crisis and probably will not exist in coming years. Government should implement policies to create more agricultural investment.

Conclusion and policy implications

Benin agricultural productivity has considerably decreased after the country's agriculture liberalization in 1990 while the profitability has increased. It has been found that major drivers of the productivity in the sector are agricultural research, labor allocation, and weather and government effectiveness. These findings show the non-achievement of the country agriculture liberalization goals underscoring the importance of policies to encourage younger people's involvement in the agriculture production and agricultural studies. In the same vision, government should invest more in agricultural education, researches and staff training. For the very intensive labor force in agricultural, transfer of technology and mechanization are needed to improve labor productivity. All the actions should be coordinated with more government

involvement in agriculture sector coupled with private partnership development and sustainable agricultural development project investment in order to target better population's needs.

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