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Improvement in Crop Production in Ghana: Is it due to Area Expansion or Increased Productivity?

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Abstract

Agriculture continues to be the mainstay of the economy of Ghana contributing more than a third of the country's Gross Domestic Product. As such, successive governments in Ghana and their development partners continue to formulate and implement policies, programmes and projects in the sector in order to spur productivity. As a result, some improvements in agricultural production in the country have been recorded in recent years. This paper examines whether or not these improvements are due to expansion in cultivated land area or increased productivity. Time series data covering the period between 1999 and 2009 from Ghana's Ministry of Food and Agriculture were used for the study. Two main estimations were carried out. The first was a set of estimations of the growth rates of output, area cultivated, and productivity of selected staple crops produced and consumed across the country. The second was an estimation of the relationship between area under cultivation and output of the selected staple crops. The results revealed that improvements in the production of most staple crops in Ghana in recent years are largely due to area expansion rather than improvements in productivity. The results further showed that though output is generally increasing, productivity is decreasing. The conclusion is that improvements in agricultural production, particularly staple crops recorded in Ghana in recent times are due to area expansion rather than productivity increases. This has negative implications for the country's drive towards self-sufficiency in food production and the attainment of the Millennium Development Goals. It is recommended that policy interventions that aim at improving agricultural production in the country should focus on enhancing productivity rather than area expansion.

Key Words: Agriculture, Ghana, Growth Rates, Staple Crops, Productivity

1. Introduction

The agricultural sector is a dominant player in overall economic growth and development in Ghana. It plays a singular role of leading the growth and structural transformation of the economy of the country by ensuring food security, supplying raw materials for industry, creating employment and generating foreign exchange earnings, all of which are essential for the country's socio-economic development (Ministry of Food and Agriculture, 2007). To be able to continue to play the critical role of being the engine of socio-economic development, the empirical literature suggests that Ghana's agricultural sector has gone through a lot of transformations especially during the post-colonial era (see for example Asuming-Brempong, 2003; Epstein and Heintz, 2006; Agyeman-Duah, 2008; among others).

Before the advent of colonialism, agricultural production in Ghana was essentially rudimentary with only food crops and animals traditionally consumed being produced. The farming methods were basically slash and burn methods with the use of simple farm tools such as hoes and cutlasses. Shifting cultivation was very much practised because of the availability of large stretches of land with low population densities. The arrival of the Europeans and consequently colonialism however, brought about structural changes in the agricultural sector. Cash crops such as cocoa and other staple crops such as maize and rice among others were introduced and commercialised. Farming, particularly of the cash crops, became an economic venture. Since then, agriculture has been and continues to be the mainstay of the economy of Ghana. This is consistent with the observation made by McKay and Aryeetey (2004) that agriculture has been the backbone of Ghana's economy in the entire post-independence history. The centrality of the agricultural sector in the development of the country has made successive governments continue to ensure that the appropriate interventions are put in place to make the sector flourish. As such, Ghana's agricultural sector has witnessed a number of policy shifts since independence and some level of

improvement in the sector has been recorded over the years. This paper examines whether or not the improvements recorded are due to expansion in cultivated areas or increased productivity with emphasis on staple crops.

Apart from the introduction presented in section 1, the rest of the paper is organised into four sections. A brief historical overview of Ghana's agricultural sector is presented in section 2. The methodology employed in examining the issues is presented in section 3. This is followed by the results and discussion in section 4. Section 5 which is the final section of the paper presents the conclusion and implications for policy and future research.

2. A Brief Historical Overview of Ghana's Agricultural Sector

After independence in 1957, the Nkrumah government embarked on industrialisation initiatives with agriculture being targeted to play a central role towards the attainment of the then development goals. To speed up industrialization and economic development, the government used state enterprises in production, foreign exchange licensing and internal price controls, combining policy instruments such as minimum wage legislation, controlled interest rate, an overvalued exchange rate and duty free import of capital equipment to encourage capital intensive choices of technology and industry (Leith, 1971; In Asuming-Brempong, 2003). Agriculture was therefore expected to play some critical roles amongst which were direct and indirect transfers from the sector to the manufacturing and services sectors using state agencies so as to speed up the development process. To do this, state agencies were setup to purchase priority agricultural produce from farmers at institutionally determined prices that were well below the prevailing market prices. A current example of such state agencies is the Ghana Cocoa Board (COCOBOD) which is institutionally sanctioned by law to buy cocoa, coffee and shea-nuts from farmers for onward export to the world market. This way, resources are taken from the agricultural sector to promote activities in the industrial and manufacturing sectors so as to bring about rapid development. This is in line with classical and neoclassical growth models (see for instance Lewis, 1955; Solow, 1956; Rostow, 1960; Fischer, 1979; Jones, 1995) which posit that as an economy expands and agricultural productivity improves, surplus labour and other idle resources in agriculture which is a primary sector are expected to move to the secondary and tertiary sectors of the economy. At the time and even up till now, this initiative was very crucial as people expected improvement in their living standards. As observed by Bates (2005), nations of Africa seek rapid development so as to meet the demands of their people for larger incomes and higher standards of living. To this end, the government of Ghana and its development partners continue to formulate policies that seek to divert resources accumulated from agriculture through cash crops exports to sectors such as industry, services, constructions, and manufacturing.

Factories and industries were therefore built to absorb surplus labour from agriculture for socio-economic transformation of the country into an industrial hub of Africa. State farms were introduced to produce national priority crops for home consumption and exports. The overall objective of these state farms was not only to ensure self-sufficiency in food production but also to provide employment for the section of the labour force that was not considered skilled enough to be employed in the formal sectors of the economy. In fact, there appeared to be a high spirit of nationalism at that point in time, especially the early 1960s with renewed efforts by all to take their destiny as an independent state into their own hands. Agricultural inputs were subsidised so as to improve productivity. Asuming-Brempong (2003:6) reports that "agriculture was used to promote and preserve the system of mixed economy with private farmers and public organizations [state farms] each having well defined roles. Private farmers were encouraged to organize into co-operatives to enable them obtain access to machinery and modern techniques, which might otherwise have been beyond their resources and thus increase productivity". As part of the policy initiatives, the Agricultural Development Bank (ADB) was established in 1965 to provide financial services to actors in the agricultural sector.

With the first coup d'état in February 1966, a lot of policies and development strategies had to be put on hold or change altogether and that also included those in agriculture. The drive towards industrialisation with agriculture playing the lead role was therefore slowed down. When the second Ghanaian Republic was born in 1969, a number of agricultural policies were once again introduced. These were aimed at ensuring that agriculture

continued to play its lead role in the socio-economic development of the country. These new policies could be described as being "*ad hoc"* measures and could not make their desired impacts because of another coup d'état which was staged in 1972 overthrowing the second republic. The military regime also introduced a number of policies in the agricultural sector notable among which was the re-ignition of the import substitution policy known as "Operation Feed Yourself". Indeed, Ghana is said to have recorded one of the highest agricultural outputs in its history during the years of this import substitution policy, in which Ghanaians were encouraged to 'grow what they ate and eat what they grew'. To continue to ensure agricultural finance deepening and widening, the concept of rural banking was conceived in the mid-1970s leading to the establishment of the first rural bank in Ghana in 1976. The rural banks in addition to ADB were mandated to provide financial services, particularly credit to rural dwellers the majority of whom were dependent on agriculture for survival.

The achievements in the agricultural sector in the 1970s however, did not last long as a result of another coup d'état ousting the then military regime in 1979. With a new government (the third Republic) in place in late 1979, the agricultural sector just as the other productive sectors of the Ghanaian economy had to undergo some policy and strategy shifts and redirections once again. Before such policies and strategies could develop roots or be well implemented, another coup d'état was staged in 1981 overthrowing the third Republican government of Ghana. According to Asuming-Brempong (2003), the third Republican government led by Dr. Hilla Limann prepared a five-year Government Economic Programme (1981/82 to 1985/86), which was never implemented because of a coup d'état staged in December 1981.

The coup d'état of 1981 just as the earlier coups d'état came as a major setback to the agricultural sector in particular, and the economy as a whole. As a result, agricultural production and productivity continued downward trends. This culminated in insufficient food production as a result of policy failures coupled with droughts and bushfires throwing the country into a state of hunger and starvation in 1983. In the years leading up to the economic crisis in 1983, the government of Ghana played a dominant role in agricultural markets. Agricultural input and output prices were largely determined by government policies. Policy reforms implemented in Ghana's agricultural sector since the 1980s have changed the production and marketing context within which Ghanaian farmers find themselves (Dewbre and Borot de Battisti, 2008). Prominent among the economic stabilisation policies were the Economic Recovery Programme (ERP) and later on, the Structural Adjustment Programme (SAP) with support from the World Bank and the International Monetary Fund (IMF). This had serious implications for Ghana's agricultural sector because subsidies on farm inputs such as fertiliser were removed. The removal of subsidies and liberalisation of agricultural input markets as part of the World Bank's conditions marked a turning point in Ghana's agriculture. The private sector was encouraged to invest in the productive sectors, particularly agriculture which had hitherto been the responsibility of government.

As part of SAP, the Financial Institutions Sector Adjustment Programme (FINSAP) was also introduced in the late 1980s with the view of expanding delivery of financial services to the different sectors of the economy with emphasis on agriculture (see for instance Sowa and Acquaye, 1999; Aryeetey, 2003; and Epstein and Heintz, 2006; among others). This had serious implications on agricultural production and productivity in the country because the sector then had to compete among the other productive sectors of the economy for allocation of credit by financial institutions. Unfortunately, the sector did not, and still does not have the competitive edge as a result of the high levels of risks associated with it. This is because production systems in the sector remain largely rudimentary and dependent on natural factors such as rainfall. This assertion is consistent with a number of studies (examples include Soyibo and Adekanye, 1992; Ngugi and Kabubo, 1998; Bravo-Ortega and Lederman, 2004; Dewbre and Borot de Battisti, 2008; Kassie *et al.*, 2011; Akudugu *et al.*, 2012; Akudugu *et al.*, 2012; Burney and Naylor, 2012) carried out across the developing world, particularly Africa which indicate that agriculture continues to be rudimentary, depending largely on climatic conditions including rainfall and dominated by small scale farm holders.

After returning to multi-party democracy in 1993, the country had to chart a new path of economic growth and wealth creation. Agriculture continued to play its role as the leader of the productive sectors of the Ghanaian

economy. Since the late 1990s to date, a number of agricultural policies and programmes have been formulated and implemented in Ghana. Some of these include the Agriculture Services Sub-Sector Investment Programme (AgSSIP); and most recently the Food and Agriculture Sector Development Policy (FASDEP I and II) among others. All these policies and programmes have (had) the objectives of enhancing agricultural productivity in Ghana. Despite the different interventions and policy shifts implemented over the years, agricultural production in Ghana is still rudimentary and dominated by small scale farmers most of whom view farming as a way of life rather than a business. This assertion is consistent with the observation made by the Government of Ghana (2008) that agriculture in the country is dominated by smallholder farmers who operate family farms for consumption purposes using traditional production technologies. About 90 per cent of such farmers cultivate less than 2 hectares in size (ibid).

The country's food production potential remains below optimal. According to Wolter (2008), Ghana's agricultural production remains largely rain-fed and traditional farming systems are still dominant across the country. The country's irrigation potential is almost untapped. Thus crop production is dependent on weather conditions which determine production and productivity levels. There is widespread poor adoption of modern production technologies (Ministry of Food and Agriculture, 2010). Most staple crops are currently being produced at sub-optimal yield levels. For example, yields of rice and maize are said to be at just about 30 per cent of their potential yield levels per hectare (Dewbre and Borot de Battisti, 2008). This clearly indicates that Ghana's agriculture is yet to make major advances in commercialisation and improvement in productivity through the use of modern agricultural production technologies.

3. Methodology

The data used for this paper are the outputs of selected staple crops that are consumed across the country and the area put to their cultivations from 1999 to 2009. These staple crops are maize, millet, rice, sorghum, cassava, cocoyam, plantain and yam. The secondary data were obtained from the Ministry of Food and Agriculture (2010). A series of estimations was carried out to examine whether or not improvements recorded in the production of these staple crops over the years are due to productivity increases or area expansion. These estimations were divided into two main components. The first component was the estimation of output and productivity growths of each staple crop and the growth in area to which the crops are planted using the growth model specified as:

$$Y_i = \alpha_i e^{X\beta_i} + \varepsilon \quad (1)$$

Where $Y_i = Y_1$ (output), Y_2 (area) and Y_3 (productivity); X = Time; α and β are parameters to be estimated; and ε is the stochastic term of the model.

Transforming equation (1) by taking the natural logarithm, three empirical models for output and area are obtained as:

$$Log(Output) = \alpha_1 + \beta_1 X + \varepsilon_1 \quad (2)$$

Where output is measured in metric tonnes and time measured in years.

$$Log(Area) = \alpha_2 + \beta_2 X + \varepsilon_2 \quad (3)$$

Where area is measured in hectares and time measured in years.

$$Log(Productivity) = \alpha_3 + \beta_3 X + \varepsilon_3 \quad (4)$$

The models were estimated by Ordinary Least Squares (OLS) using Microsoft Excel. The estimated β_1, β_2 and β_3 are the average annual growth rates of output of the staple crops, area planted and the productivity of these crops respectively. These estimations also gave the trends of output of the selected staple crops, the area to which they are planted and their productivities over the period.

The second component was estimation of the relationship between output and area among other factors. The aim of this was to find out what happens to output of staple crops when changes to area under cultivation and rainfall occur. The lagged output, area cultivated and rainfall recorded were included in the estimation because they were hypothesized to influence current year's output. The estimation was done using simple double-logarithmic linear regression model specified as:

$$Log(Y_t) = \delta_1 + \delta_2 LogA_t + \delta_3 LogA_{t-1} + \delta_4 LogR_t + \delta_5 LogR_{t-1} + \delta_6 LogY_{t-1} + \varepsilon_3 \quad (5)$$

Where:
Y_t = Output of staple crops measured in metric tonnes at time t.
Y_{t-1} = Output of staple crops measured in metric tonnes at time t-1.
A_t = Area under cultivation measured in hectares at time t.
A_{t-1} = Area under cultivation measured in hectares at time t-1.
R_t = Rainfall measured in millimeters at time t.
R_{t-1} = Rainfall measured in millimeters at time t-1.

The estimated δ_2, δ_3, δ_4, δ_5 and δ_6 are the elasticities of the various included variables and represent the percentage change in output when there is a percentage change in the corresponding variables. This model was estimated through the Ordinary Least Squares (OLS) method using STATA (Version 11).

4. Results and Discussion

The results showed positive output and cultivated area growths of most staple crops cultivated and consumed across Ghana. In terms of output at individual crop and aggregate levels, most of the crops recorded positive growth rates but in terms of productivity, negative growth rate is recorded. Maize which is one of the widely cultivated and consumed staples in the country posted positive average annual growth rates in both output and area under cultivation (Figure 1). Whereas output experienced an annual growth rate of about 3.8 per cent from 1999 to 2009, the area experienced an average annual growth rate of about 2.1 per cent. This implies that the growth in output may not only be as a result of increase in productivity but also growth in area under cultivation.

Millet posted positive growth rate for output and negative growth rate for area under cultivation (Figure 2). The area put under millet cultivation experienced an average annual negative growth rate of about 1 per cent with a corresponding positive annual output growth rate of about 2.1 per cent. This means that increases in output of millet recorded during the period can be largely attributed to productivity improvements rather than area expansion.

Rice recorded a positive annual output growth rate of about 3 per cent with the area growing at about 2 per cent per annum (Figure 3) over the period. The implication here is that though the rice sector posted positive annual output growth rate during the 1999 to 2009 cropping seasons, this positive growth rate may not be as a result of only productivity improvements in the sector but also area expansion. This is particularly so given that area growth and output growth appear to be moving in tandem (Figure 3).

Sorghum which is both a household crop and an industrial crop experienced negative average annual growth rates in both output and area under cultivation (Figure 4). Whereas the output of the crop grew negatively at an average annual rate of about 0.4 per cent, the area also grew negatively at the rate of about 2.3 per cent. This means that farmers are continuously reducing their area allocated to the cultivation of sorghum and this may be partly due to the declining growth rates of output being experienced.

Cassava which is also an important crop for consumption and production of starch for industrial use experienced positive growth rates both in output and cultivated area during the period (Figure 5). The output of cassava experienced an annual average growth rate of about 3.5 per cent from 1999 to 2009 with a corresponding increase in area of about 2.6 per annum during the same period. This means that gains made in terms of output of cassava cannot be attributed entirely to productivity increases but also to land area expansion.

Cocoyam which is another important staple crop in the country experienced negative growth rates in both output and area under cultivation during the period of 1999 to 2009 (Figure 6). Whereas output grew negatively at an average annual rate of about 0.7 per cent, the area under cultivation grew negatively at the rate of about 2.3 per cent. The declines in land area devoted to the cultivation of the crop may be partly responsible for the declines in output observed.

Also, plantain which is consumed across the country but largely grown in the southern part of the country posted positive growth rates in both output and land area cultivated (Figure 7). The results revealed that from 1999 to

2009, the output of plantain grew at an annual rate of about 6.3 per cent. During the same period, the area under cultivation also grew at a rate of about 2.6 per cent per annum. Though the output grew at a higher rate than land area expansion, it cannot be concluded that the growth in output experienced during the period is due entirely to improvements in productivity of the crop.

Yam which is also an important crop cultivated and consumed across the country posted positive growth rates in both output and land area during the period (Figure 8). The output of yam grew at an annual average growth rate of about 4.8 per cent and that of the area under cultivation grew at about 3.5 per cent per annum. The implication here is that output growth may not be entirely attributed to improvements in productivity of the crop but also expansion in the land area devoted to it.

When output of all crops and area devoted to their cultivations across the country were combined and estimated, it was found that during the period from 1999 to 2009, the country experienced general increases in the output of staple crops and area under cultivation (Figure 9). The output of staple crops from 1999 to 2009 grew at an average annual growth rate of about 3.7 per cent. On the other hand, the area under cultivation of these staple crops grew at an annual growth rate of about 5.4 per cent. The implication here is that the increases in output of staple crops in the country during the period are more likely due to land area expansion rather than productivity improvements.

It was also found that staple crop productivity (output per unit area) in Ghana is generally declining (Figure 10). The results revealed that from 1999 to 2009, productivity of staple crops that are consumed across the country declined at an annual average growth rate of about 8.5 per cent. This means that crop productivity in the country is declining at such an alarming rate that requires immediate attention. This is particularly so given that the population is growing at positive rates with crop productivity growing at negative rates. This ultimately undermines the capacity of the country to fight food and nutrition insecurity and to attain the Millennium Development Goals.

Further econometric estimations revealed a positive relationship between output and area under cultivation (Table 1). The regression results gave a significant F-statistic which is an indication that the variables captured in the model jointly influence the output of staple crops in Ghana. The adjusted R-Squared of about 0.95 implies that the variables included in the model are able to explain about 95 per cent of the variations in output of staple crops in Ghana. Area was found to be an important determinant of output of staple crops in Ghana and was found to be significant at the 1 per cent level. It was also found that a 10 per cent increase in land area under cultivation leads to about a 6.3 per cent increase in output of staple crops. This means that about 63 per cent of the growth in output of most of the staple crops in Ghana is actually due largely to area expansion rather than productivity improvements. Rainfall had no significant influence on the output of staple crops.

5. Conclusion and Implications for Policy and Future Research

It is concluded from the findings that the improvements observed in output of staple crops in Ghana are due largely to the expansion of land area devoted to their cultivation rather than improvements in productivity. The policy implications are that government and its development partners, civil society organisations and philanthropic individuals and organisations that work to improve agricultural production and rural livelihoods should focus their interventions, projects, programmes and policies on improving crop productivity rather than area expansion. This is because focusing on increasing crop and general agricultural output through area expansion is not a sustainable way to go in that it is not possible in areas with high population densities. In such areas, this approach can lead to land conflicts with its devastating consequences. For future research, there is the need for a more detailed study of the issues covered in this paper using farm level panel data rather than the national level time series data used in this paper.

References

Agyeman-Duah, I. (2008). An economic history of Ghana: Reflections on a half-Century of challenges and progress. Oxfordshire, U.K., Ayebia Clarke Publishing Limited.

Akudugu, M. A., S. Dittoh and E. S. Mahama (2012). "The implications of climate change on food security and rural livelihoods: Experiences from northern Ghana." Journal of Environment and Earth Science **2**(3): 21-29.

Akudugu, M. A., E. Guo and S. K. Dadzie (2012). "Adoption of modern agricultural production technologies by farm households in Ghana: What factors influence their decisions?" Journal of Biology, Agriculture and Healthcare **2**(3): 1-13.

Aryeetey, E. (2003). "Recent developments in African financial markets: Agenda for further research." Journal of African Economies **12**(2): ii111- ii152.

Asuming-Brempong, S. (2003). Agricultural policy reforms in Ghana. Roles of Agricuulture Project International Conference. Rome, Italy, Agricultural and Development Economics Division (ESA), Food and Agriculture Organization of the United Nations**:** 28pp.

Bates, R. H. (2005). Markets and states in tropical Africa: The political basis of agricultural policies with a new preface, University of California Press. **Date Accessed: 14th October, 2011**.

Bravo-Ortega, C. and D. Lederman (2004). "Agricultural productivity and its determinants- Revisiting international experiences." Estudios de Economia **31**(002): 133-163.

Burney, J. A. and R. L. Naylor (2012). "Smallholder irrigation as a poverty alleviation tool in Sub-Saharan Africa." World Development **40**(1): 110–123.

Dewbre, J. and A. Borot de Battisti (2008). "Agricultural progress in Cameroon, Ghana and Mali: Why it happened and how to sustain it." OECD Food, Agriculture and Fisheries Working Papers **9**: 60pp.

Epstein, G. and J. Heintz (2006). "Monetary Policy and Financial Sector Reform for Empoyment Creation and Poverty Reduction in Ghana." Political Economy Research Institute Working Paper Series(113).

Fischer, S. (1979). "Capital accumulation on the transition path in a monetary optimizing model." Econometrica **47**(6): 1433-1439.

Government of Ghana (2008). National investment brief. High-Level Conference on Water for Agriculture and Energy in Africa: the Challenges of Climate Change. Sirte, Libyan Arab Jamahiriya, 15-17 December 2008.

Jones, C. I. (1995). "R & D-Based models of economic growth." Journal of Political Economy **103**(4): 759-784.

Kassie, M., B. Shiferaw and G. Muricho (2011). "Agricultural technology, crop income, and poverty alleviation in Uganda." World Development **39**(10): 1784–1795.

Leith, J. C. (1971). "Export Concentration and Instabiltity: The case of Ghana." The Economic Bulletin of Ghana **1**(1).

Lewis, A. W. (1955). The theory of economic growth. London, Allen and Unwin.

McKay, A. and E. Aryeetey (2004). Operationalizing pro-poor growth: A country case study on Ghana. A joint initiative of AFD, BMZ (GTZ, KfW Development Bank), DFID, and the World Bank. <http://www.dfid.gov.uk/pubs/files/oppgghana.pdf.>: Date Accessed: 24th October, 2011.

Ministry of Food and Agriculture (2007). "Food and Agriculture Sector Development Policy (FASDEP II)." Government of Ghana publications: 1-63.

Ministry of Food and Agriculture (2010). "Agriculture in Ghana: Facts and figures." Government of Ghana publications: 1-41.

Ngugi, R. W. and J. W. Kabubo (1998). "Financial Sector Reforms and Interest Rate Liberalisation: The Kenya Experience." African Economic Research Consortium Research Paper Series (72).

Rostow, W. W. (1960). The five stages of growth - A summary. The stages of economic growth: A non-communist manifesto. Cambridge, Cambridge University Press**:** 4-16.

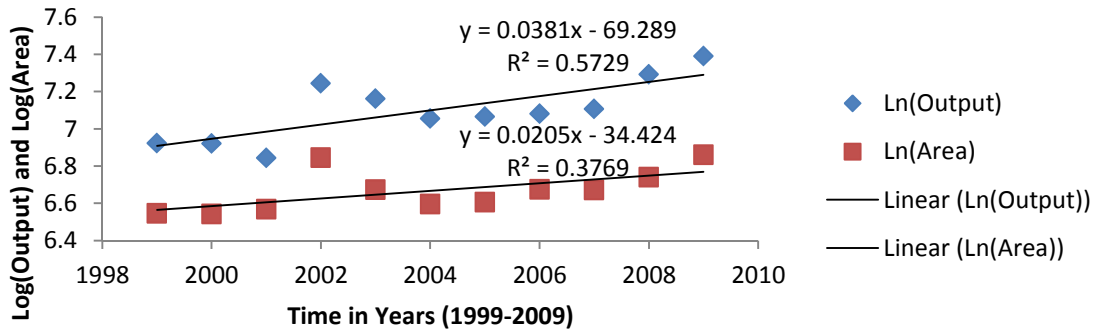
Solow, R. M. (1956). "A contribution to the theory of economic growth." Quarterly Journal of Economics **70**(1): 65–94.

Sowa, N. K. and I. K. Acquaye (1999). "Financial and Foreign exchange markets liberalization in Ghana." Journal of International Development: 385-409.

Soyibo, A. and F. Adekanye (1992). "Financial System Regulation, Deregulation and Savings Mobilisation in Nigeria." Africa Economic Research Consortium Research Paper(11): 1-32.

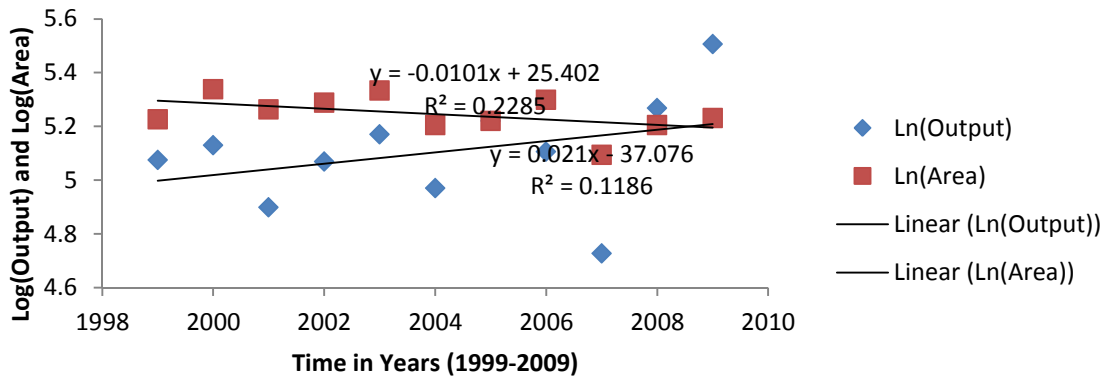
Wolter, D. (2008). "Agriculture is becoming a business in Ghana." OECD Publications: pp.34.

Figure 1: Area and output growth of maize



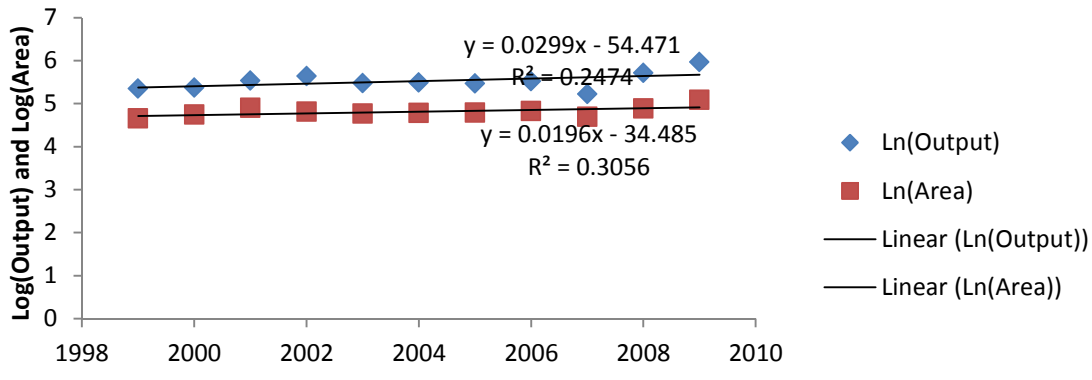
Source: Authors' computations, 2012.

Figure 2: Area and output growth of millet



Source: Authors' computations, 2012.

Figure 3: Area and output growth of rice



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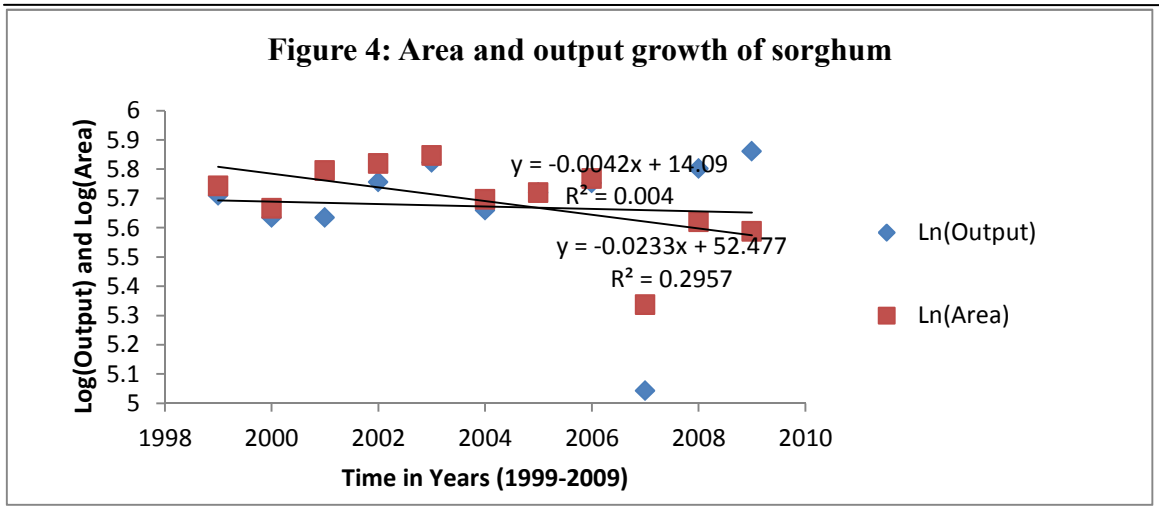

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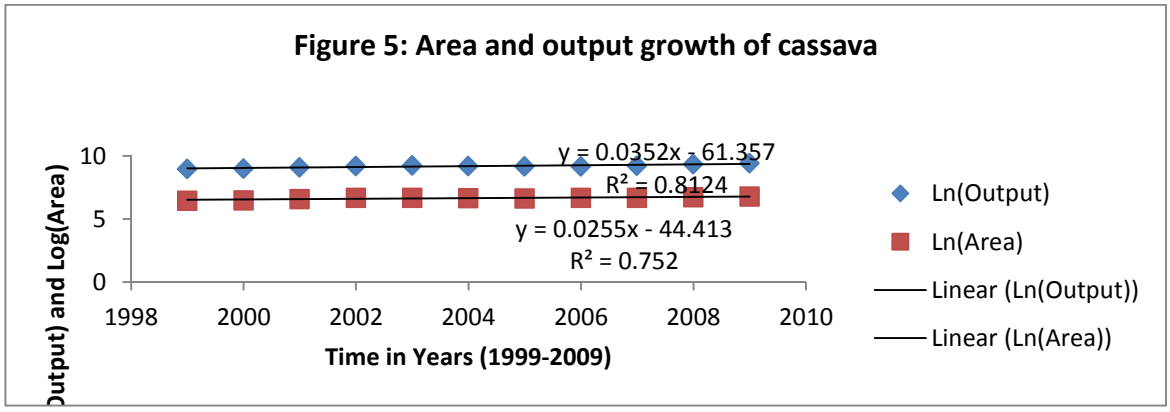

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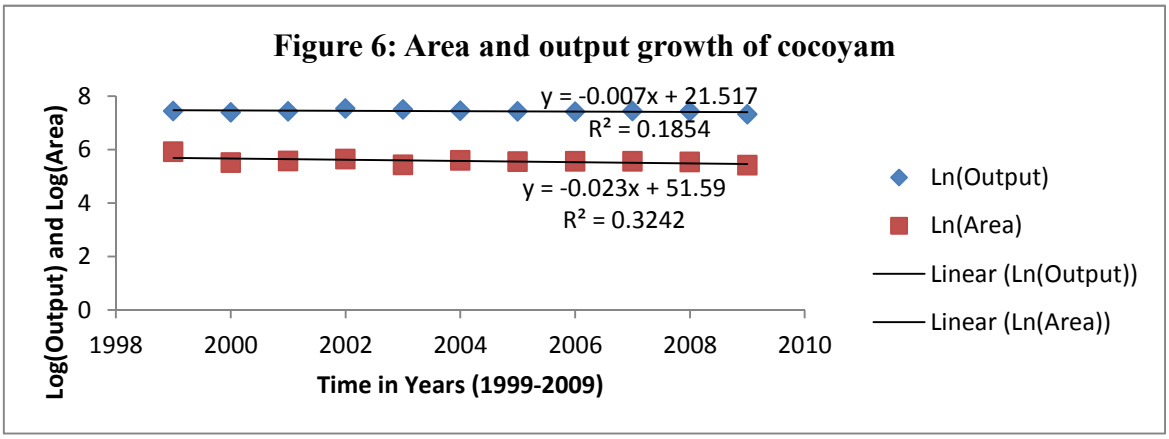
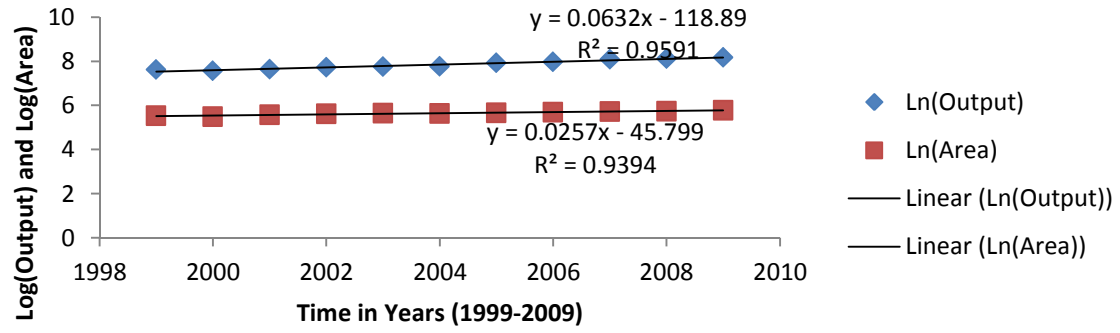


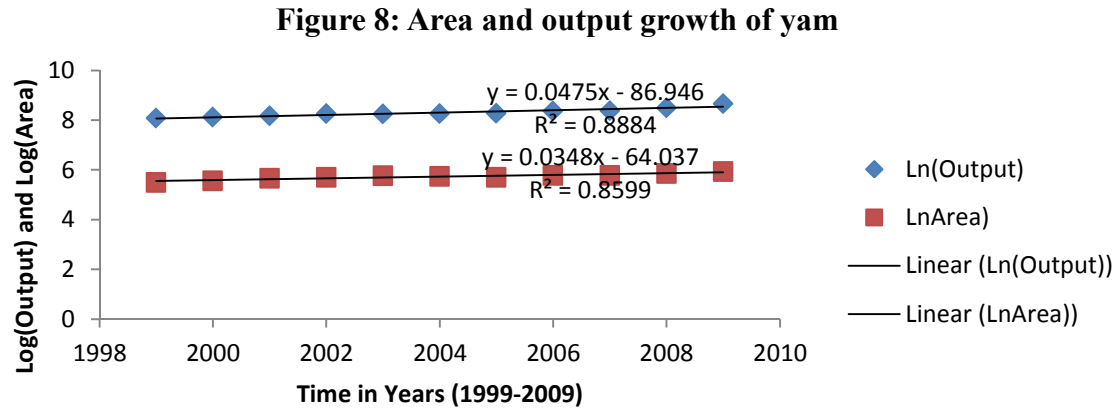
Source: Author's computations, 2012.

Figure 7: Area and output growth of plantain



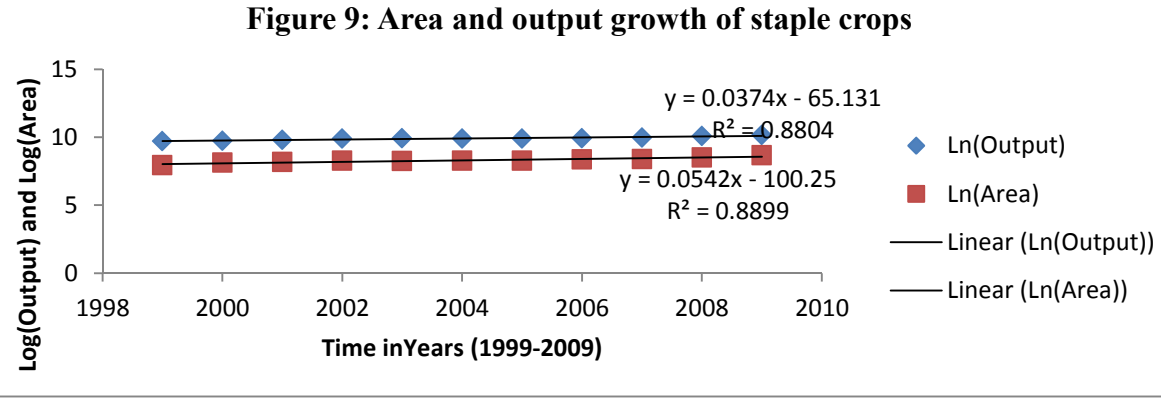
Source: Authors' computations, 2012.

Figure 8: Area and output growth of yam



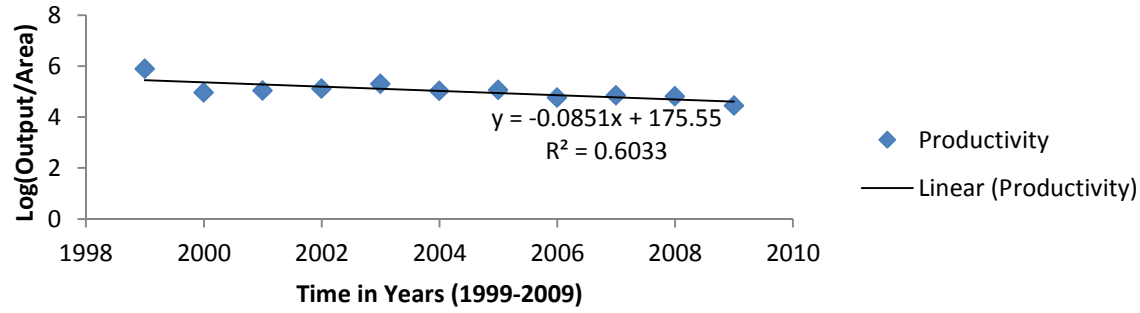
Source: Authors' computations, 2012.

Figure 9: Area and output growth of staple crops



Source: Authors' computations, 2012.

Figure 10: Crop productivity growth



Source: Authors' computations, 2012.

Table 1: Regression results of output and area relationship

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. regress lnoutput lnarea lnarea1 lnrainfall lnrainfall1 lnoutput1
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Source	SS	df	MS
Model	.170726061	5	.034145212
Residual	.004428648	5	.00088573
Total	.175154709	10	.017515471

Number of obs = 11
F(5, 5) = 38.55
Prob > F = 0.0005
R-squared = 0.9747
Adj R-squared = 0.9494
Root MSE = .02976

lnoutput	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnarea	.6298581	.1103087	5.71	0.002	.3463005	.9134156
lnarea1	.3211477	.2173774	1.48	0.200	-.2376386	.879934
lnrainfall	.0819025	.1191017	0.69	0.522	-.2242581	.3880631
lnrainfall1	.0384921	.1310186	0.29	0.781	-.298302	.3752862
lnoutput1	-.3091658	.2146729	-1.44	0.209	-.861	.2426684
_cons	3.955085	1.26555	3.13	0.026	.7018843	7.208286

Source: Authors' estimations, 2012.

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