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Economic Importance of Agriculture for Sustainable Development and Poverty Reduction: Findings from a Case Study of Ghana

Xinshen Diao, IFPRI,
X.diao@cgiar.org

TABLE OF CONTENTS

Tables

Figures

THE ECONOMIC IMPORTANCE OF AGRICULTURE FOR SUSTAINABLE DEVELOPMENT AND POVERTY REDUCTION: FINDINGS FROM A CASE STUDY OF GHANA[1]

Executive summary

1. Ghana has become a success story in Africa in the recent years. After more than 20 years' steady economic growth and significant poverty reduction, Ghana is aiming to become a middle income country in next 10 years. Outcome of transformation in many Asian countries is often characterized by a declined share of agriculture in GDP and increasingly important role of manufacturing in leading growth in the transformation process. Will it also be the case for Ghana when Ghana is becoming a middle income country? What will be the role of agriculture in Ghana's new development process in the future? To answer these questions, in this report we adopt a forward looking approach by applying a dynamic CGE model to a series of possible growth scenarios. Moreover, the role of agriculture for poverty reduction is analyzed both for the past and the future. We focus on the relationship between poverty and income generation, based on the three runs of national representative household surveys, to understand the role of agriculture in the past poverty reduction. By linking the economywide CGE model with a micro simulation model, we simulate the poverty outcome of accelerated agricultural growth in the future. The following conclusions can be drawn from the analysis of this report.

- The forward looking analysis of the dynamic CGE model shows that, even with much higher growth in the non-agricultural sector, agriculture will continue to be an important sector in terms of its size in the economy. Rapid growth in the manufacturing and export services can only occur when these sectors significantly improve their international competitiveness. However, with high dependency on imports for manufacturing, such growth also implies to lower prices for manufacturing goods produced domestically, which leads to lower the share of this sector in total GDP. Domestically oriented industry (*e.g.* construction) and services can only grow with income growth for a majority of households and rapid urbanization. Hence, rapid growth in non-traded industry and services is rather an outcome of broad-based growth, including growth in agriculture, and it will be unlikely to become a main driver to lead the economywide growth. Moreover, the initial conditions of the structures and competition capacity of industry and services indicate that Ghana will unlikely become an African "Tiger" in next 10 years and will unlikely to observe rapid structural change in its economy. Agriculture will continue to be an important and big economic sector even when Ghana manages to become a middle income country in the next 10 years.
- Broad-based agricultural development is a key for transformation in Ghana. Due to the agricultural sector’s important role in the economy and for people’s incomes, accelerating agricultural growth is a must for reaching the MIC target. Experiences from all successfully transforming countries suggest that agricultural growth must be broad-based. In reality, more than 20% of GDP and almost two-third of agricultural GDP in Ghana are staple crops and livestock production. While most staples are "self sufficient" products in the country, and hence

1. This report is the first draft of Ghana country case study of an OECD project "The Economic Importance of Agriculture for Sustainable Development and Poverty Reduction." The work should be considered as work in progress. The principal authors accept responsibility for any errors.

their growth has to match with income growth for both rural and urban households, imports have been increasingly competing with domestic production for cereals and livestock products. To be able to compete with imports, productivity-led growth must lower domestic prices for these products. The model results show that import-substitution is possible for rice, for which 70% of domestic consumption has currently be met by imports. Ghana's potential in competing for poultry imports seems to be much limited and realization of such import substitution will unlikely occur.

- Exploring agricultural potential is a key for agricultural growth. Land expansion, which is the dominant source of recent growth, should not be seen as a main engine of further agricultural growth. Continuous expansion of land implies a growing risk of environmental degradation when land quality has been deteriorated by over-farming and the low application rates of fertilizer. It is possible for Ghana's agriculture to grow through productivity increase. Simulation results show that by closing the existing yield gaps in crops, together with comparable productivity growth in the livestock sector, Ghana will be able to reach 6% average annual agricultural growth over the next 10 years, a growth rate consistent with the CAADP goal set by African policymakers.

- Contribution of agricultural growth to the overall economic growth is often invisible, which leads to underestimate the role of agriculture. Experiences of Asian countries show that unleashing a green revolution has often required massive public investments, and it is often a question about the cost of such growth acceleration in Africa. By taking into account both visible and invisible transfers from agriculture to the non-agricultural economy the modelling analysis shows that agricultural growth will provide huge benefits to the economy. Measured in monetary terms, total financial transfers from agriculture to the rest of the economy is equivalent to 15% of increased GDP in the next 12 years. Invisible transfers such as achieved through lowering food price are the dominant source for this substantial contribution. This finding provides further evidence on the important role agriculture that can play in economic development and the urgent need to support agricultural growth through raising investment.

- Agricultural growth has played the key role in past poverty reduction, which allows the country to become one of few African countries that will achieve MDG1 of halving 1990s poverty rate early than targeted year of 2015. Analysis based on the last three runs of national representative household surveys shows that, agricultural crop production is the most important activity for a majority of rural households both as income-generating activity and as a source of income. The importance is particularly higher for the poor than for the non-poor. While income share of crop production in total income has been declining over time between 1992 and 2006, considering crop and livestock together, agriculture still provides more than or close to 50% of total income for most rural households and only in the coastal zone share of agricultural income for the rural households as a whole fell to 40% in the most recent survey. Existence of spatial difference in the importance of crop production as a source of rural household income indicates the need to have different policies among different zones in poverty reduction.

- The analysis of the three runs of household surveys also shows that non-farm employment opportunities provided by the non-agricultural sectors to the rural households are still very limited even in the most recent survey. This is particularly true for households in the two savannah zones. Moreover, share in the total income generated from non-farm employment activity is lower than the non-farm employment participation rate. Further breaking down into the poor and non-poor household groups within each zone, it shows that only for the non-poor households in coastal and forest zones such opportunity provide slightly more than 10% of total income for the rural households, while for all poor household groups and for the other two non-poor groups, non-farm wage employment provided only 1.4%-7.3% of total income. Thus, it is unrealistic to consider non-agricultural growth as a main source to further reduce poverty nationwide.

- The forward looking analysis shows that further poverty reduction should focus on reducing regional income gap between north and south. Results from the modelling analysis show that broad-based agricultural growth benefit the poor everywhere. At the national level, the poverty rate will be halved one year earlier under the agricultural scenario compared to that under the base-run. This translates into additional 400 000 people (mostly from rural areas) moving out of poverty by 2015. However, additional poverty reduction in the North is unlikely to be more than that in the other regions. Given the high initial poverty rate in the North, level of income for a majority of the poor in the north is far below the poverty line defined for the country as a whole. Increased income for the North poor, even their income growth rate can be as high as for the households elsewhere, is still not enough for lifting many of them out of the poverty. The poverty rate in this region will remain at a high level of 56% by 2015, further increasing the poverty gap between North and South. Difficulty to lower poverty rate in the poorest area of the country (*i.e.* in the North) calls a special attention that should be paid to populations whose income is far below the poverty line and more targeted policies and investments that are urgently needed. Thus, while halving the 1990s poverty rate earlier than targeted year of 2015 will be a big success for Ghana's development, the continuous fight against poverty in this country will have to increasingly concentrate on the poorest of the poor, and most of them live in the North.

- Agricultural development requires a comprehensive long term strategy and such a strategy needs to be supported by long term commitment both from the government and international development partners. While opportunities for agricultural growth are there, challenges to realize them are huge. For example, the achievable yields underlying the simulation results are based on field trials that have been conducted with an optimal package of inputs. However, the analysis based on the recent household survey (GLSS5) indicates that the use of modern inputs at the farm level is still low in Ghana, and the difference in yields (*e.g.* in the case of maize) between households that use and do not use these inputs is small. The tomato case study shows that low land productivity is not only an issue for staple crops and it is the first important challenge for the promotion of high value crop. While tomato productivity is critically affected by the choice of varieties more than by other factors, many factors have influenced the choice of varieties by farmers such as access to seeds, growing technologies, available markets, yield potential, prices and risk.

- While productivity of crop production is associated with the intensive use of input, yield can be increased through better land management and farming practices, and weed and pest controlling. A number of poor practices have been identified from this regard, which suggests poor land husbandry are common to farmers through the country. The inappropriate ways to apply tools and modern inputs and lack knowledge for chemical inputs and how to get a good price also constrain farmers for profitability. The modest impact of fertilizer on maize yields is also confirmed by Branoah Banful *et al.* (2009), who assess the recent government's fertilizer subsidy program in Ghana. These results caution against overemphasizing the importance of fertilizer as a silver bullet. Rather they confirm the findings from other studies that stress the importance of a comprehensive approach for raising agricultural productivity sustainably, which includes a focus on rural roads to reduce input prices (fertilizer and pesticides), extension services and training of extension agents to spread knowledge of improved land management and farm practices, and more R&D to provide high-yield seed varieties to the market.

- Labour constraint should also be considered when promoting intensive farming practice in Ghana. The analysis of GLSS5 data shows that almost 50% of rural households need to hire labour, particularly during land preparation, weeding and harvest. Herbicide is thus a popular input in crop production. While it is a substitute for labour for weeding, it is also important for improving yields (or preventing yield losses). In a relatively land abundant country like Ghana with smallholder dominant agriculture, labour constraints will become increasingly important due

to both demand for and supply of labour. Increasing crop yields often requires additional labour inputs for certain farm practices. At the same time, a significant increase in yields often requires additional labour for harvesting. Labour supply side factors are related to rural-urban migration that is expected to further speed up in the process of transformation. To address both seasonal and permanent labour constraints, mechanization has a long history in Ghana and has recently been revived by the government as a possibility to foster intensification. Moreover, Ghana's recent policy of advancing mechanization emphasizes the importance of public-private partnerships. The government supports the imports of equipment by providing credit to private tractor service centres and the service centres provide fee-based tractor services to farmers. However, given that there has been an intense debate about the merits of mechanization and how it should be promoted in Africa (see, for examples, Pingali *et al.* 2007 and Mrema *et al.* 2008 for extensive reviews on this topic), it is worth to revisit the main arguments from this literature in order to provide practical policy suggestions.

- Growth in agricultural productivity also results from promoting new activities and exploring additional market opportunities that increase the value addition of agricultural production. For example, the recent spike in global energy prices has led to foreign investments in biofuel production, the FAO projects that Ghana will be among the biggest producers of Jatropha in Africa by 2015 (FAO and IFAD 2010). At the same time, the spike in global food prices has encouraged the private sector to invest in agro-industries in Africa, including Ghana. As in the case of manufacturing, it is important to enhance the linkages between foreign investment in agriculture and the rest of the sector and the rural economy in order to foster spillover effects. For example, out-grower schemes have stronger linkage and poverty reduction effects than plantations, a finding that needs to be considered when governments negotiate with investors (Arndt *et al.*, 2008). Supporting rural producer groups is another field where the government can play an important role, including through capacity building for leaders to manage and participate in high-level negotiations and for the weaker members of the groups to achieve a voice within the groups. Promoting modern information and communication systems helps enabling producer groups to access market information and acquire professional advice necessary for modern supply chain management and effective participation in the policy dialogue (World Bank 2008).
- Opportunities for structural change within the agricultural sector and hence increasing agricultural productivity through diversification also exist. With rising rural and urban incomes and rapid urbanization, many agricultural products move from subsistence to marketed crops. The tomato case study synthesized in Section 4 of this report shows that while imports of tomato paste have threaten the development of agro-processing industry, rapid increases in demand for such processed products by domestic consumers will offer market opportunities for developing various high value crops that will support diversification in agriculture and more income to farmers. An important policy question is what supportive role the state can play in this process and how to attract foreign investment and private enterprises to develop these products along the value chains both in manufacturing and in agriculture. Lessons from successful examples of public-private initiatives in other developing countries, such as the development of salmon industry in Chile (Rodrik, 2007), may help to provide practical policy advice.

1. Introduction

2. Sustained growth and significant poverty reduction over the recent two decades have made Ghana an African success story. Many factors have contributed to this impressive performance, including improvements in policies and the investment climate, increases in investments and aid inflows, and favourable world cocoa and other commodity prices (Bogetic *et al.* 2007; McKay and Aryeetey 2004). The 2005–2006 Ghana Living Standards Survey suggests that, based on the trends indicated by the previous three runs of surveys, the country will reach the first Millennium Development Goal (MDG1) of halving its

1990s poverty rate by 2008 (Ghana Statistical Services 2007). While the ongoing global economic crisis has impacted economic performance in Africa and poverty rate may rise in many countries after 2008 (possibly for Ghana too), that Ghana will become one of only a few African countries able to achieve the MDG1 earlier than the target year of 2015 is still expected firmly by the development community.

3. Ghana has not only achieved sustainable growth and significant poverty reduction in the recent years, state and institution building has made rapid progress in the same period. Ghana has become a stable democratic state as demonstrated in a peaceful transition of power in two consecutive free and fair elections in 2000 and 2008. Governance indicators have been steadily improving over the past years and in 2007, Ghana ranked ahead of regional averages of Asia, Latin America and Africa in most important governance indicators, including government effectiveness, regulatory quality and control of corruption (Kaufmann *et al.* 2008). The country is ranked among the top ten African countries in terms of freedom of the press and academic freedom (Freedom House, 2008). Financial market institution development has made remarkable progress over the past years, including improvements in the banking sector, increasing trade volumes in the stock exchange and the launch of government bonds (Yartei 2006, IMF 2008). The domestic tax base has been broadened significantly over the last years marking an important step towards reducing dependence on cocoa for government revenues. Decentralization has improved the allocation of public resources and the provision of services to address regional disparities (World Bank 2007). Perhaps most importantly, Ghanaians are determined to reach middle income status and catch up with successful transformation countries in Asia such as Korea, Malaysia and Thailand, all of which started out at lower per capita income levels in the early 1960s than Ghana.

4. The strong commitment of the government to pursuing its new vision is expressed in several recently published policy documents. Ghana's Second Growth and Poverty Reduction Strategy emphasizes the need for a "rapid and radical transformation of the structure of Ghana's internal production and foreign trade" (National Development Planning Commission 2005). Policies and programs required for achieving these objectives include reforms of the financial sector, investments in the transportation and energy sectors, and a focus on agricultural modernization. The emphasis on agriculture is further underlined by Ghana's commitment to the Comprehensive African Agricultural Development Program (CAADP) of the New Partnership for Africa's Development. The policies the government is currently implementing and the continued strong performance of the economy provide optimism to support the ambitious goal of reaching MIC status.

5. In spite of this success, several key challenges remain for Ghana to accelerate the transformation process. First, agriculture still dominates its economy contributing more than 30% of total GDP, and the urbanization process remains slow since about 60% of the population still live in rural areas (Breisinger *et al.* 2008). Agricultural output growth (and hence a large share of GDP) is not driven by productivity growth. Yields of most crops are still far below their potentials, and the level of modern technology adoption in agricultural production and processing is still extremely low. Agriculture remains highly dependent on rainfall and irrigation in Ghana is only 3% of total crop area and less than 20% of the irrigation potential is used. On the other hand, land expansion potential has been reaching its limits in most agro-ecological zones, urging a rapid shift towards a green revolution type of productivity-led growth. Second, high dependence on a few agricultural products and mineral resources for export continue to make the internal and external macroeconomic balances vulnerable to international price volatility and external shocks. For example, cocoa and gold contribute about two thirds to Ghana's export revenues (Breisinger *et al.* 2007). Third, manufacturing's contribution to growth, measured as the sector's shares of GDP or exports, has declined after the implementation of structural adjustment program (SAP) in the 1980s and as a consequence of the failed the state-led industrialization pursued in the 1960s and 1970s. Manufacturing share of GDP was more than 10% in the mid-1980s and it falls to less than 9% in the recent years (WDI 2009). Finally, accelerating the process of transformation will require functioning markets, including the development of an effective and efficient service sector. Trade, transport, finance and communication are

all key elements to further improving market access and efficiency in Ghana (World Bank 2008). Addressing these challenges and creating incentives and opportunities for the private sector to drive growth in agriculture, manufacturing and services require strong policy support and massive public investments to create an enabling environment.

6. We try to understand the economic importance of agriculture in sustainable growth and poverty reduction in Ghana against this broad background discussed above. More specifically, the report addresses the following questions:

- What does Ghana's own post independence history suggest and what changes have taken place to provide a basis for more effective role of agriculture in transformation and design of development strategies?
- Given Ghana's progress in institutional development and macroeconomic stability and its current socioeconomic structure, what are the country's broad options to economic transformation through accelerate growth including growth in agriculture?
- What role the agricultural sector particularly will play in Ghana's economic transformation, is productivity-led agricultural growth (Green Revolution) feasible and what potential impacts does it have?
- What are the implications of these results for development strategies in Ghana?

7. This report is organized as follows. After the introduction section, Section 2 reviews major lessons learned from the past and derives implications for future development strategies. The broad literature on Ghana's economic history and particularly a recent book that documents interviews with Ghanaian experts provide a rich source of knowledge for us to draw lessons in this section. Section 3 turns to the recent performance of Ghana's economy and provides an overview of its current economic structure and discusses opportunities and challenges for future economic transformation. Section 4 first introduces the dynamic computable general equilibrium model developed for this analysis, and then lays out the data used and the main limitations of the model, followed by the scenarios designed for the modelling analysis. Section 5 discusses the model results of five selected scenarios, in which the roles of different economic sectors in transformation, equality and poverty reduction are quantitatively measured and compared. Section 6 summarizes the main findings of the report and discusses the implications for Ghana's development strategies.

2. Overview of Ghana's economic history

8. When Ghana gained independence in 1957, it was the world's leading producer of cocoa and had one of the highest GDP per capita incomes in the region. The new nation inherited the fortunes of the Gold Coast, well-endowed with the proceeds of previous cocoa booms and a relatively advanced infrastructure and social services. Thus, as the first African country that gained independence, Ghana was seen as the hope and example for the whole continent. However, 25 years later by 1983, per capita GDP in Ghana fell to USD 170, half about its pre-independent level. It is important to draw lessons from this rather failure development process in order to accelerate the country's transformation in the future. While a rich body of literature exists on this post-independence period of development in Ghana, there is no consensus that has been reached on the lessons and experiences learnt from this development process. To focus on the factors that are likely to become more important for Ghana's future economic transformation, we draw from opinions of some distinguished Ghanaian experts who were interviewed by Agyeman-Duah, published in a most recent book "*An Economic History of Ghana – Reflections on Half-Century of Challenges and Progress*" (Agyeman-Duah 2008). Many of these Ghanaians have personally witnessed or participated in

the country's development process as scholars or officials.[2] Notwithstanding the celebratory spirit of the document and somewhat partisan assessment by some of the contributors of the role of the last two democratic regimes that have governed the country, the collection of the book does provide a balanced assessment of the situation and of changes that have occurred in the country. We first focus on the lessons regarding the development visions and strategies of the post independence period, and then move on to the role of institutions, policies and policy implementation through which the visions and strategies have been (or not been) achieved.[3]

Development vision and strategies

9. While many criticize the policies pursued by Dr. Kwame Nkrumah, Ghana's first President, his vision to unite the country and build a modern industrialized country are widely recognized. Measured by per capita income, Ghana was at similar development levels as South Korea, Thailand, Malaysia and Indonesia after independence in the late 1950s and early 1960s. Moreover, Ghana was rich in foreign exchange reserves due to its global dominance in cocoa exports (and exports of gold). With these initial conditions, the leadership of Ghana deeply believed in a modernization strategy that was industry-biased and led by the state, a strategy that was commonly accepted by almost all developing countries at the time. Thus, it is understandable that until the late 1980s, the dominating role of the state in transforming the economy through government-pushed industrialization was unquestioned by the governments following Nkrumah, many of which took power through a series of coups d'états.

10. After five decades of post independence experience and asked to draw lesson from this development period until late 1980s, few Ghanaians interviewed by Agyeman-Duah question Nkrumah's vision for Ghana to become a developed and modern country. Yet many also agree that the state-led modernization strategy failed and was indeed it was infeasible for Ghana given its initial conditions. The failure of this strategy to create a modern industrial sector in Ghana (as in many other African countries) has made people realize that while modernization needs huge capital investments to create the physical foundation of a modern industrial sector, modernization goes beyond capital accumulation. Many contributors also agree that the strategy of stabilization and privatization in the 1980s and early 1990s has improved macroeconomic stability, yet without complimentary measures, it has not yet sparked broader modernization.

11. Modernization is a process of development in which the country develops its social, institutional, human, and physical capacity to manage (not only by the public sector) and operate (mainly by the private sector) its growing economy. In this process, the state will have to play an important role, but this role is often constrained both by its capacity and by the relationship between the state and the private sector. Against this broad background and the key lesson learnt from the past failure, we present some specific lessons drawn from the literature on the design and implementation of development strategies.

Political, institutional and macroeconomic instability delayed modernization

12. The frequent changes of governments in Ghana, many of which came to power by military coup d'états – although this experience is not very different from that of many other countries in post independent Africa – damaged Ghana considerably by preventing it from moving from the inappropriate strategies that were adopted immediately after independence. However, in the recent two decades starting

2. Please see the list of names of the 20 interviewees in appendix.

3. We first prepared this historical overview for an IFPRI publication (Breisinger *et al.* forthcoming). Considering that such overview provides a broad picture on Ghana's development process in which agriculture has played important role, we include it in this report by synthesizing what we have written for that IFPRI report.

in 1990s, Ghana has been able to overcome the political, institutional and macroeconomic instabilities that impeded development.

13. The state led approach to modernization adopted immediately after independence undermined macroeconomic stability. It contributed to a rapid rise of macroeconomic imbalances and a vicious circle of policies inimical for modernization. Massive public investments in infrastructure, health, education and SOEs under the Nkrumah government had quickly gone beyond the capacity of the state to generate revenues from the narrow base of export sectors. Moreover, the capital intensive investment strategy exacerbated the need for additional capital and foreign exchange. Since neither domestic savings nor foreign capital (through either FDI, or foreign loans and grants) was sufficiently available to support this capital intensive development strategy, the government resorted to introducing import tariffs and printing currency, resulting in a rise in inflation and increased costs for imported inputs. To avoid further raising the costs of imports, the exchange rate was held at highly overvalued levels. To generate more domestic capital, the government established new banks and raised taxes. Efforts to correct the negative employment effects of these mechanisms led to strong interventions in the labour market. In addition, the government actively generated employment by expanding the public sector, which resulted in a 250% increase of publicly paid employees between 1957 and 1966. Subsequent governments failed to correct these imbalances despite several "traditional" adjustment measures, including the devaluation of the currency, liberalization of trade, balancing of the budget and attempts to privatize SOEs.

14. State-led development policies continued through various regimes despite their rhetoric. A change in the development path of state-led modernization has been complicated by the frequency and disruptiveness of government changes until 1992. The two governments following the Nkrumah administration from 1967 to 1972 attempted to reverse some of Nkrumah's import substitution (ISI) policies and intended to implement a more market- oriented and private sector driven approach. However, their industrialization strategy continued to be biased in favour of capital intensive sectors and the attempts at privatizing state owned enterprises (SOE) largely failed. In the agricultural sector, a shift of focus from large scale agriculture towards smallholders was also short-lived and ineffective. The Acheampong (1972-1978) administration refocused on national self-sufficiency to address the accelerating economic decline and the rise in poverty. It then took two more presidents and one military coup before the government under Lieutenant Rawlings decided for an Economic Recovery Program (ERP)[4] and shifted away from state-led development. Political stability under democratic governance was finally restored in a new constitution in 1992, the year in which Rawlings was elected as President in the first free and fair election since 1960.

15. Political instability also eroded institutional memory and capacity in the civil service. The political instability and discontinuity also weakened and politicized the civil service. Ghana's first president, Nkrumah inherited a capable civil service on independence. Nkrumah's perception that the civil service was not loyal to him led him to *Africanize* the service by placing Ghanaians in leadership positions (Cato p. 23, in Agyeman-Duah, 2008). The frequent change in governments thereafter often went hand in hand with changes in top civil service positions. These frequent changes in staff eroded the civil service from "custodians of institutional memory" (Chinery-Hesse p. 36, in Agyeman-Duah 2008) to an often demoralized staff with deteriorating skills. It has also cultivated a climate, where the loyalty to specific governments became more important than competence and the assignment of civil service positions a way to reward political supporters. This has produced a class of opportunistic policy advisors with fear that their "wings would be clipped" (Cato p. 25, in Agyeman-Duah 2008) and civil servants with deteriorating skills. Finally, this politicization of the civil service has exacerbated the disruption created by transfers of power by holding back of documents, files and information from one government to the other.

4. The Economic Recovery Program was Ghana's version of a structural adjustment program (SAP) under the IMF and World Bank.

16. Macroeconomic stability alone has not been enough to accelerate modernization. The Economic Recovery Program (ERP) in 1983 marked the first comprehensive attempt to macroeconomic stabilization and to increase the role of the private sector in transformation. The ERP was Ghana's version of an IMF/World Bank structural adjustment program (SAP) and started with a series of macroeconomic stabilization measures. The exchange rate was adjusted from a highly overvalued rate of 2.75 cedis per USD in 1982 to USD 36.97 in 1984 (IMF 2008). The increasing cost of imports was partly offset by the abolition or reduction of import taxes from an average level of 40% down to 10% (Leechor 1994 p.164). The elimination of subsidies combined with a tax reform based on a broadening of the tax base restored fiscal discipline and led to a small budget surplus in 1986. Inflation came down from more than 100% in 1983 to levels around 30% in the following years (IMF 2008). However, a lack of full commitment from the government to fully implement ERP (Omtzigt p.49, in Agyeman-Duah 2008) and the one-sided focus on correcting price discrepancies and improving price incentives limited the impacts of the ERP on modernization (see sections on agriculture and industry). The country has failed to attract foreign direct investment into manufacturing; the response to whatever effort that the government has made to improve the investment code and strengthening property rights has been limited particularly in manufacturing, which in central to Ghanaian desire to transforming the economy (Aryeetey in Agyeman-Duah 2008).

Development goals have often been too ambitious

17. Ghana has often been impatient and set ambitious development goals that it has failed to aggressively pursue. The approach of various governments has not been consistent. Governments in Ghana have often been too ambitious and untargeted in pursuing their goals and there has often been a "rush to claim success" (Aryeetey 2008, p. 86). For example, Nkrumah's government converted a 10 year plan inherited from the colonial government into a 5 year plan with the consequence of rapid depletion of reserves and massive accumulation of public debt. It is also argued that Ghana prematurely tried to industrialize and pursued this course for several decades unsuccessfully. Sir Arthur Lewis was the first to advise the government to be more patient with industrialization in his report to the government in 1953. Along the line of his dual economy theory, Lewis argued that due to the land abundance labour was too expensive and unless surplus labour was available industrialization was not feasible.

18. Setting realistic development goals adapted to local conditions has not been the case. The development of realistic policies also requires knowledge of local conditions. Yet, many governments in Africa (including Ghana) have not done their "home work" in understanding and analyzing the country's situation before designing their strategies (Aryeetey p. 82, in Agyeman-Duah 2008). In many cases, governments have simply implemented policies that have proved successful in other countries or used policies proposed by outsiders as a blueprint for development without taking their own judgment and the country's local conditions sufficiently into account. While there is a debate on how much choice governments had, given the conditionalities attached to the SAP loans, it is widely accepted that the development of capacity and culture to design and implement policies owned by the country and the ability to negotiate with donors on an equal intellectual level is critical for success.

The earlier strategies did not seek broad-based agricultural development

19. Agricultural development in the immediate post-independence era narrowly focused on foreign exchange earnings from cocoa and public investments in large-scale farming. Revenues from cocoa exports were key to finance state-led industrialization and continue to play an important role for the government budget. However, the Cocoa Marketing Board (CMB) originally founded to administer the notoriously volatile world market prices has often been used to extract unsustainably high taxes from cocoa farmers for the general government budget rather than for price stabilization. In addition, agricultural policies have often been biased against small scale farmers and non-cocoa export agriculture. Public investments and policies favoured the creation of state owned farms and cooperatives and subsidies for

agricultural mechanization, services and inputs explicitly targeted large-scale farms. Overvalued exchange rates reduced the competitiveness of export agriculture and thereby discouraged agricultural export diversification.

20. Piecemeal approaches to agricultural development offered limited benefits The first government with an explicit focus on agriculture and rural development was the Busia government (1972-75), which shifted away from the focus on cocoa and large farms by investing in rural infrastructure such as roads, electrification, and rural water. In an attempt to focus more on small-scale agriculture, agricultural SOEs were dismantled and their machinery and equipment sold to private farmers. However, the lack of linking these programs to support the increase in agricultural productivity rendered them largely ineffective. In addition, these policies were short-lived and instead of continuing and complementing the agricultural policies of his predecessor with Green revolution type of measures, Acheampong (1975-78) reversed much of the smallholder focus, reduced agricultural spending[5] and returned to large-scale production bias and mechanization under the "Operation Feed Yourself".

21. Agriculture sector has not developed without a comprehensive long term strategy and public investments. The ERP increased producers' incentives to raise cocoa output through the devaluation of exchange rates and a reduction of export taxes. However, the lack of a comprehensive agricultural development and investment strategy limited the positive impacts on other agricultural sectors. Public investments remained low and tended to focus on single measures. For example, the Sasakawa Global 2000 project started in 1986 to promote integrated maize packages for small farmers. It reversed the earlier mechanization strategy by promoting animal traction as a substitute for tractors and also by providing technological transfer, farm inputs and credit. Another example is the cocoa rehabilitation during the 1980s, which provided improved planting materials to many farmers and thus helped the sector respond to improved incentives during the reform period (Edwin and Masters, 2005). While these and other single measures such as cassava disease control and mechanization of rice production might have had localized impacts, they did not transform agriculture and bring about a Green Revolution type of growth seen in Asian countries. Major causes for the limited success of these programs have been the unfinished privatization of input suppliers, poor infrastructure (especially storage and roads) and limited marketing opportunities for outputs.

Important role of the private sector in industrialization

22. State-led and capital intensive industrialization did not work for Ghana. The absence of a strong private sector in Ghana has been used as an argument to modernize the economy on the back of state owned enterprises (SOE). However, the performance of these SOEs has often been disappointing and hundreds of state-owned enterprises (SOE) never managed to operate profitably or even never started operating at all. While some efforts have been made to determine market demand with consumer surveys based on which factories have been built, many examples of bad planning and implementation exist in the process. For example, a mango cannery has been built that had a capacity to several times the world demand for canned mangoes (Omtzigt p. 50, in Agyeman-Duah 2008). Despite these failures and the change in rhetoric that emphasized more market oriented strategies in the 1970s, it was until the 1990s when an intensive program of state divestiture of the SOEs got under way. Some of the few remnants from the heights of SOEs development still operating today are the Akosombo hydropower dam and the VALCO aluminum smelter.

23. Experiences from Asian countries have shown that private sector-led manufacturing and service sector growth that is "homegrown" is likely to be more consistent with a country's initial conditions.

5. Spending on agriculture declined by about 26% per annum despite the government's objective of reaching food self-sufficiency under the "Operation feed yourself" program.

Hence, homegrown manufacturing and service sectors take full advantage of the country's comparative advantage in the expansion process and are also likely to lead to a broad-based growth (Breisinger and Diao 2008). This type of transformation has proved to be most important during the early period of transformation, as shown in Thailand's success during the 1960s and 1970s and China's rapid rise in the 1980. This path to industrialization often requires less investment in physical capital, depends on local knowledge and "know-how," and more efficiently uses a country's abundant resources (*e.g.*, low-skilled labour). Moreover, this industrialization path usually quickly creates strong linkages with the rest of the economy, including agriculture, by enhancing mutual demand (to enhance market oriented activities) and mutual supply such as agricultural products as inputs. In fact, in the early stage of industrialization, small manufacturing factories/shops have often first operated in rural areas as rural non-farm activities. With rising market demand these small entities often grow in scale, and then combined with international expertise and capital can become leading export sectors (Breisinger and Diao 2008).

24. Ghana's comparative advantage in low skilled labour favours a similar development path. In addition, failed state-led attempts to "create" large-scale consumer-good industries, such as tomato processing, juices, bottles, textiles, strongly suggest that the private sector has to take the lead in manufacturing and service sector development.

25. The public sector has to play an active role in providing incentives in modernization. The ERP in 1983 focused on macroeconomic stability and indirect measures to attracting private capital for industrial development. Re-establishing fiscal stability required a reduction and reallocation of the government budgets and hence, development strategies focused on indirect measures to stimulate growth. Priority in public investment allocation was given to transportation, communication and electrification sectors. In addition, new regulations such as the facilitation of the repatriation of profits, tax breaks on intermediate inputs etc. attempted to attract capital for investments. These measures were most successful in the mining sector (gold), an enclave sector with few linkages and employment opportunities, yet failed to spark private investments in manufacturing. In addition and despite the improvement of the macroeconomic environment and institutions, Ghana has not attracted significant amounts of foreign direct investments in manufacturing, a major "source of worry" (Aryeetey p. 77, in Agyeman-Duah 2008).

26. Looking forward to the future, all twenty contributors to Agyeman-Duah's book on the economic history of Ghana generally paint an optimistic picture of Ghana's future. On the macroeconomic outlook, the recent launch of Ghanaian government bonds at the London market has been a great success. The bonds were issued for USD 750 million and oversubscribed with USD 3 billion, a "mark of confidence" in the country's creditworthiness (Cato p. 31). The perspectives for both private and public investments are also seen as promising: foreign direct investments (FDI) are likely to increase due to improved political and economic stability and improvements in the business climate index and property rights. Ghana is no longer seen as a country "where investment may prosper under one regime at best, but could not be guaranteed under the next one" (Gyimah-Boadi p. 223). In addition, 3 million Ghanaian expatriates or about 14% of the population are likely to sustain the inflow of remittances in the future. Finally, the debt relief under HIPC in 2002 and the recent discovery of oil improve the fiscal scope for public investments to support productivity-led economic transformation.

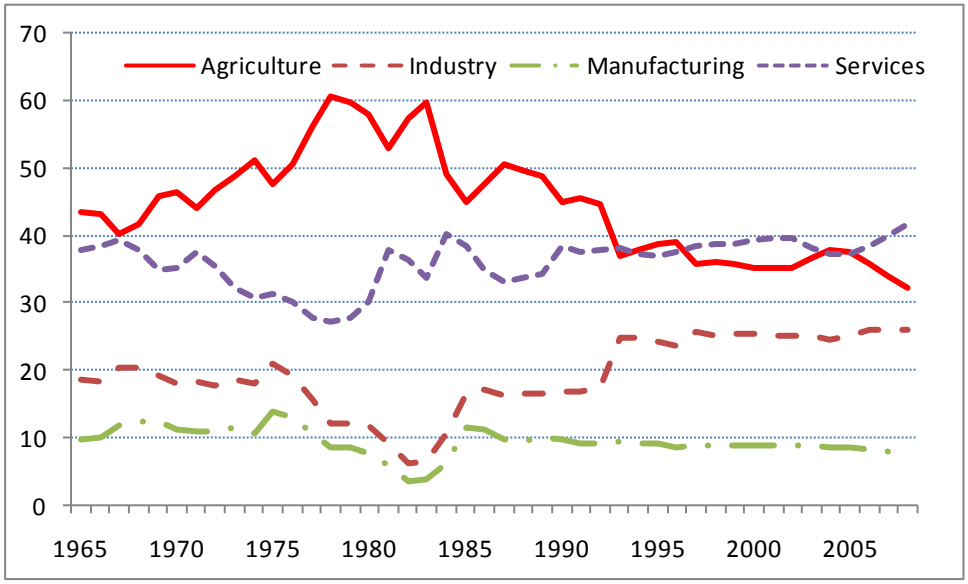
27. In conclusion, the period of post-independence economic development in Ghana until 1980s had been characterized by political and macroeconomic instability, a narrow-based agricultural strategy and state-led industrialization. Ghana started to walk out the vicious circle after late 1980s. in a sharp break with its past, sustained growth and significant poverty reduction since the early 1990s have made Ghana an African success story in terms of political stability, economic growth and poverty reduction. Before we take a forward looking approach to assess opportunities and challenges for accelerating growth and poverty reduction and the role of agriculture in this process, it is necessary to describe the initial conditions that the country stands. We specifically focus on agriculture in such assessment in the next section.

3. Position of agriculture in the current economy

Ghana's current economic structure

28. Agriculture has been the backbone of Ghana's economy in the entire post-independence history (McKay and Aryeetey, 2004). While policy and political failure had caused per capita GDP growth declining until 1980s, the agricultural sector had been less affected than the non-agricultural sector because it was less intervened by the government than the non-agricultural sector and its growth is primarily led by smallholders for subsistence purpose of production. Figure 1 presents GDP shares of agriculture, industry, manufacturing (as part of industry) and services between 1965 and 2008. The figure indicates before the late 1980s when the economy growth rate was negative, agricultural growth rate, which was also negative, was less negative than the other sectors in the economy. Thus, GDP share of agriculture rose in this period and peaked at 60% in a few years in the late 1970s and early 1980s. When growth started to recover and turned into positive after 1983, the non-agricultural sector needs more recovery as it declined more in the previous period. While growth in the agricultural sector also turns to become positive, its share in GDP falls back to its level in the 1960s immediately after the independence. Agriculture is about 40% of GDP in the late 1990s and was still above 35% until 2007. Only in the recent two years of 2007 and 2008 share of agriculture falls to below 35% at 34% and 32%, respectively, in these two years. Recent decline in the agricultural GDP share is the result of faster growth in the services, which has increased the share in GDP to 40 or more than 40% in 2007 and 2008. Thus, it is first time in Ghana's history that agriculture is not more the largest sector in the economy and the service sector has taken this position. On the other hand, share of the industrial sector in GDP has not changed much after 1990s and share of the manufacturing sector has even declined to less than 10% of GDP in the recent ten years. Such growth patterns in the non-agricultural sector are not consistent with the transformation theory as well as experience of other developing countries in which the role of industry, especially of manufacturing has increased in the development process (Breisinger and Diao 2008). Factors contributed to such growth patterns will be further analyzed in the next section.

Figure 1. Sector share of GDP (1965-2008)



Source: World Bank (2009).

29. Table 1 further breaks the aggregated economic sectors into their main subsectors. Within the agricultural sector, root and tuber crops, including cassava, yams and cocoyam, account for more than 24% of agricultural GDP. Export crops, such as cocoa, oil palm, fruits, vegetables, rubber, and cotton, account for 22% of agricultural GDP. Cereals account for 10% and other staple crops 21%, while the livestock sector contributes 7%.

Table 1. Current economic structure by sector (2007)

	GDP	Exports	Imports	GDP share in sector total
Agriculture	34.0	36.3	7.3	100.0
Cereals	3.3		4.5	9.3
Roots	8.4			23.9
Other staples	7.0		0.1	22.7
Export crops	7.5	25.2		21.3
Livestock	2.5		2.7	7.1
Fishery and forestry	5.3	11.1		15.5
Industry	26.1	41.7	87.8	100.0
Mining	5.6			22.0
Construction	9.4			34.5
Agriculture-related manufacturing	6.0			21.1
Other manufacturing	2.0			12.0
Other industry	3.1			10.4
Services	40.0	22.0	4.9	100.0
Private	25.7	22.0	4.9	65.9
Export-oriented	0.7			2.1
Public	14.3			32.0
Total	100.0	100.0	100.0	

Source: 2007 Ghana social accounting matrix.

30. Industry accounts for 26.1% of total GDP in which construction (not manufacturing) is the largest sub-sector. Manufacturing accounts for 31% of industrial GDP, dominated by agriculture-related manufacturing, such as food and wood processing and textiles. Construction accounts for 36% of industrial GDP, and the sector's growth has been primarily driven by an urban housing boom and infrastructure developments. Mining is also important industrial sub-sector, accounting for almost 22% of industrial GDP. The service sector is the largest sector in the economy, however, more than one-third of the sector relates to the government provided services such as administration, health, and education. Private services include trade, transport, communication, hotels, restaurants, real estate, and business services. Part of private services, such as luxury hotels and restaurants (mainly providing services to foreigners) are export oriented, yet those services only account for a relatively small portion of private services.

31. Agricultural structure and the regional distribution of agricultural GDP significantly differ across Ghana's agro-ecological zones. These regional differences have important implications for sub-sector-level agricultural growth strategies, which will be explored further in Section 5. The Forest Zone remains the major agricultural producer, accounting for 43% of agricultural GDP, compared to about 10% in the Coastal Zone, and 26.5% and 20.5% in the Southern and Northern Savannah Zones, respectively (Breisinger *et al.* 2008). The Northern Savannah zone is the main producer of cereals and livestock. More than 70% of the country's sorghum, millet, cowpeas, groundnuts, beef and soybeans come from the Northern Zone, while the Forest Zone supplies a large share of higher-value products, such as cocoa and livestock (mainly commercial poultry). The heterogeneous agricultural production structure also indicates differences in the agricultural income structure across regions. The Forest Zone generates about half its

agricultural income from two of Ghana's major export goods (cocoa and forestry). Including non-traditional exports and fishery, export agriculture also plays an important role in total agricultural income for the Coast and Southern Savannah Zones. In contrast, 90% of agricultural income in the Northern Zone comes from staple crops and livestock.

Sources of recent economic growth

32. Productivity-led growth plays an important role in transformation processes and it has to improve such growth in Ghana in order to transforming the country to become a middle-income economy. For the economy as a whole, a growth accounting analysis shows that total factor productivity (TFP) has indeed become an increasingly important driver of growth and explains much of Ghana's recent economic growth. Before this recent increase in TFP, fixed capital accumulation has been a major contributor to growth, indicating a certain time lag between capital accumulation and productivity growth (Table 2). However, there have been other reasons to explain the recent increase in TFP. Bogetic *et al.* 2007 estimate that 27%-30% of this recent TFP growth came from inter- and intrasector labour reallocation, while technology advances may have contributed less than 10% of total growth. Results from Nin Pratt *et al.* confirm the results on inter-sector shifts (Table 3). Due to an increase in agricultural TFP, labour has shifted out of agriculture and into other sectors as predicted in Lewis dual economy model.

Table 2. Growth decomposition in Ghana

	1970–2005	1991–1995	1996–2000	2001–2005
Average annual growth rate (%)				
Real GDP	2.7	4.0	4.2	5.2
Fixed capital accumulation	2.1	4.3	5.9	3.9
Labour force	2.7	2.8	2.3	2.5
School years of the labour force	0.8	0.8	0.9	1.0
Total factor productivity	–0.26	0.05	–0.07	1.6
Contribution to growth (%)				
Fixed capital accumulation	31.6	43.7	56.2	29.8
Labour force	61.3	42.6	32.8	28.5
School years of the labour force	16.9	12.4	12.7	11.1
Total factor productivity	–9.9	1.3	–1.6	30.6
Total	100.0	100.0	100.0	100.0

Source: Bogetic *et al.* (2007). Note: The share of capital (α) in the Cobb–Douglas production function is assumed to be 0.4, while the depreciation rate is 4%.

33. While innovations have often been prevented by a system of political patronage in the past, improved political transparency, human capital and the spread of information technology are likely to improve incentives for private sector to lead growth. School enrolment rates have increased for primary and secondary schools, respectively. The net enrolment rate for primary school in Ghana is 78.6%, compared to the African average of 66.3%. Nearly 93% of those completing primary school in 2005/06 continued to the next level (World Bank, 2007). In addition, expatriate Ghanaians are expected to play an increasingly important role for innovation, and many have done so with "a confidence in the limitlessness of what one can achieve" (Ofori-Atta p. 234). For example, expatriate Ghanaians have been leading the setup of the Ghanaian stock exchange and further improving economic perspectives might attract more expats to follow this example and start businesses in their home country. Productivity-led growth is also likely to be supported by better economic management.

34. Institutional capacity building over the past two decades has also improved analytical and planning skills of the civil service and there are encouraging signs of improved coordination among government agencies, such as the setup of the Economic Policy Coordination Committee (Akoto-Osei p. 135). Given this generally positive outlook on institutional and macroeconomic matters, we focus on challenges for transformation of the real economy in the remainder of this chapter, particularly agriculture and manufacturing.

4. Assessing agricultural growth performance

35. Agricultural transformation is characterized as a process of sustainably modernizing agriculture and such a process is often measured by significant improvement in land and labour productivity, greater market-orientation and diversified production diversification, as well increased domestic and international competitiveness. To accelerate agricultural transformation it is first necessary to understand the agricultural sector's initial condition.

Assessing agricultural potential in Ghana at national level

36. While agricultural productivity growth has started to pick up in the recent two decades (Table 3), the main driving factor behind the rapid agricultural growth is the crop subsector (excluding cocoa), the largest subsector in agriculture, accounting for more than two-thirds of the agricultural economy (Table 4). Staple crops such as maize, sorghum, rice, cassava, yam, plantain, pulses, and oilseeds dominate this subsector. Some high value crops such as vegetables and fruits are also included, but they play a relatively modest role in overall agricultural growth given their small size.

Table 3. Agricultural TFP growth decomposition in Ghana

	1961-1991	**1991-1999**	**2000-2006**
Agricultural TFP (annual growth rate)	0.29	2.31	2.71
	1990	2000	2006
Share of agricultural worker in total workforce	68.98	64.06	63.46

Source: Nin Pratt and Yu. 2008.

37. Cocoa is Ghana's most important traditional export crop and has received special attention from the government in terms of financial and policy supports. As a result, together with favourable world prices in recent years, the cocoa sector has grown most rapidly except for the period of 1996-2000 (Table 4). Thus, cocoa's contribution to agricultural growth is almost three times of its size in the economy (Table 4).

Table 4. Sub-sector contribution to agricultural GDP growth in Ghana

	1991-95	1996-2000	2001-05	2006
Growth (annual %)	2.0	3.9	5.5	5.6
Crops other than cocoa	1.5	3.4	4.5	5.8
Cocoa production and marketing	7.0	6.0	14.8	8.3
Forestry and logging	1.9	10.8	5.1	2.5
Fishing	1.8	0.6	3.0	3.6
Share of AgGDP (%)				
Crops other than cocoa	69	68	68	66
Cocoa production and marketing	8	9	10	13
Forestry and logging	7	9	10	10
Fishing	15	14	12	11
Contribution to agricultural GDP growth (%)				
Crops other than cocoa	51	60	55	69
Cocoa production and marketing	28	14	28	19
Forestry and logging	7	24	9	4
Fishing	14	2	7	7

Source: Calculated using Ghana Statistical Service data.

38. As in most African countries, agricultural growth in Ghana has been mainly driven by land expansion and productivity-led growth remains a challenge. Table 5 shows that cultivated land has expanded by 60% over the last 12 year period from 4.5 million hectares in 1994 to 7.2 million hectares in 2006. Land expansion has slowed down in recent years, but continued to expand at an annual rate of 2.8%. The cocoa sector has been the main driver of land expansion. Cocoa area has increased by 1.7 times over the last 12 years, accounting for 60% of total increase in areas, while the remaining 40% of total increase in cultivated land is for all other crops.

39. Measured by the crop GDP in constant terms, land productivity did not increase in the last 12 years. Compared with the initial level in 1994, total land productivity actually fell between 1997 and 2002, and recovered only in recent years, primarily driven by the growth in cocoa (Table 5).

Table 5. Land expansion and land productivity in Ghana (1994-2006)

				Annual growth rate		
	1994	**2000**	**2006**	**94-06**	**94-99**	**00-06**
Land productivity (cedi per hectare)*						
Crop and cocoa	155	112	159	0.91	-4.77	5.97
Cocoa	162	87	188	1.56	-	13.67
Crops other than cocoa	154	121	149	0.69	-4.97	3.62
Land allocation (in 1 000 hectares)						
Cultivated land	4 500	6 100	7 195	4.10	5.39	2.79
Cocoa land	687	1 500	1 835	7.01	13.62	3.42
Crops other than cocoa	3 813	4 600	5 360	3.31	3.59	2.58

Note: * Land productivity is calculated as GDP at constant 2000 prices divided by hectares of cultivated land. The value is reported in new Ghana cedi.
Source: Calculated using data from FAO 2008, IMF (various issues of Ghana statistics), and Ghana Statistical Services.

40. While structural change in crop production helps to improve land productivity, the dominant factor to measure land productivity is yield growth. In contrast to rapid land expansion, national yield levels of major food crops in Ghana have only improved modestly over the last 12 years (Table 6). When looking at the agro-ecological zone level, in several cases yields even fell in recent years from their levels in the mid 1990s. For example, maize yield only increased in the Coast zone and was stagnant and even fell in the other three zones of the country.

Table 6. Yields of major crops by agro-ecological zone (1994-2005)

	Maize		**Rice**		**Cassava**	
	1994-1997	2002-2005	1994-1997	2002-2005	1994-1997	2002-2005
Coast	1.32	1.69	3.64	2.16	10.46	13.02
Forest	1.45	1.48	1.79	1.99	7.37	8.25
Northern Savannah	1.21	1.16	1.94	2.22	7.07	9.26
Southern Savannah	1.53	1.44	2.09	2.24	9.01	7.54
National	1.51	1.56	1.94	2.18	11.87	12.53

Source: MOFA (2007) for zonal level data and FAO (2008) for national.

41. The actual yields are much lower than the achievable yields for many crops in most zones of Ghana, which provides an opportunity for agricultural growth. According to the Ministry of Food and Agriculture, yields for most crops are 20%-60% below their achievable level under existing technologies combined with the use of modern inputs such as fertilizers and improved seeds (Table 7).

Table 7. Yield gaps in Ghana

Crop	Average yields (1990-2006) Mt/ha	Achievable yields (Mt/ha)	Yield gap (Mt/ha)	Yield gap (%)
Maize	1.5	2.5	1.0	40.0
Rice	2.1	3.5	1.4	40.0
Millet	0.8	1.5	0.7	46.7
Sorghum	1.0	1.5	0.5	33.3
Cassava	11.9	28.0	16.1	57.5
Cocoyam	6.7	8.0	1.3	16.3
Yam	12.4	20.0	7.6	38.0
Plantain	8.1	10.0	1.9	19.0
Sweet Potato	8.5	18.0	9.5	52.8
Cowpea	1.0	1.3	0.3	23.1
Groundnut	0.8	1.0	0.2	20.0
Soybean	0.8	1.0	0.2	20.0
Cocoa	0.4	1.0	0.6	60.0

Note: According to MOFA's definition, achievable yields are derived from on farm observations, where recommended technologies have been used together with more effective extension services.
Source: Ministry of Food and Agriculture (MOFA) 2007.

42. On the demand side, opportunities also exist to support agricultural growth in Ghana. Like many other African countries, Ghanaian households spend 40% to 50% of incomes on food.[6] Food demand from the domestic market is expected to further grow with income and population growth and the process of urbanization (Diao *et al*. 2007). There are also considerable potentials for import substitution through increased competitiveness. Ghana imports 60% of rice and 90% of poultry meat consumed domestically. Demand for these two commodities is highly income elastic, indicating a rise in imports in the future without improvements in domestic competitiveness. Moreover, as Thailand, Malaysia, Brazil, and many other developing countries have demonstrated, rapid diversification of agricultural exports is possible and can help to accelerate growth in agriculture and economic transformation in general (Breisinger *et al.* 2008).

Assessing agricultural potential in Ghana at farmer level

43. The above analysis on the agricultural performance is based on the aggregate data, and it is also necessary to assess current agricultural potential at farmer level by understanding its production patterns, marketing and other factors that will either constrain or provide opportunities for agriculture' future growth, and thus, to be better understanding the role of such growth in overall economic growth and poverty reduction. According to the national level analysis, the crop subsector contributed to 75%–85% of agricultural growth between 1991 and 2006, and within the crop subsector cocoa alone contributed to 15%-30% of total agricultural growth. The rest of crop subsector constitutes a wide range of staple and high value crops, reflecting diversified agricultural production and consumption patterns in Ghana. Growth in most crop production has primarily been the result of land expansion, together with modest improvement in crop yields. Obviously, further growth in Ghana's agricultural sector requires more sustainable growth sources other than land expansion. Realizing this, a central component of Ghana's development strategy has emphasized productivity-led and high-value-led agricultural growth as a means

6. We use the recent national household survey, GLSS5 2005/06 for the analysis. See appendix A1 for expenditure patterns.

to transforming Ghana's agricultural sector in the next 10 to 20 years (National Development Planning Commission, 2005).

44. To understand the agricultural sector's initial condition, it is crucial to understand current land and labour productivity levels at farm level, whether modern inputs have been broadly applied in agricultural production, and the structure of production. The Ministry of Agriculture (MoFA) reports production and area information at the district level on a yearly basis for about 10 staple crops. However, production of many high value crops other than cocoa is not monitored by the country's statistical system. Similarly, the Ghanaian government has recently intensified its promotion of mechanization and fertilizer use for crop production, while there is a lack of systematically collected information to be able to assess the outcome of such policy interventions including crop production patterns and yields, changes in the use of modern inputs, and the employment of labour in production.

45. To fill knowledge gaps in understanding of the current level of agricultural transformation in Ghana, we pay particular attention to the use of intermediate inputs and modern farming practices drawing on a recent nationally representative household survey. We conduct a thorough descriptive investigation of the Ghana Living Standards Survey 5 (GLSS5) conducted from 2005 to 2006 to see what we can learn from it about current levels of agricultural productivity and use of inputs. It is well known that agricultural production activity is not the focus in a typical living standards survey, and thus it is extremely challenging to conduct a comprehensive, agriculturally-focused analysis using the GLSS5 data. However, given the importance of providing a general picture about the level of agricultural transformation in Ghana and the lack of any other comprehensive data source available in the country, we provide a snap-shot assessment of the current agricultural production and transformation situation in Ghana using this data. We specifically focus our analysis on crop production not only because it is the dominant catalyst of Ghana's recent growth (as mentioned previously), but also because so little quality, representative information is available about other agricultural activities, such as livestock and fishery in the GLSS5 (and other sources). The detail discussion about the findings from GLSS5 can be found in a forthcoming IFPRI publication (Quiñones and Diao, forthcoming), we synthesize major findings of it below.

How many households are engaging in agricultural crop production?

46. We first assess who are crop producing farmers in Ghana. GLSS5 data shows that not only 70% of surveyed rural households reported owning agricultural land, but also more than one-quarter of urban households own agricultural land. The number of rural households who are engaged in crop production is more than the number of rural households who own the agricultural land, accounting for 86% of survey rural households. On the other hand, it is an opposite situation for the urban households, for which the number of households who are engaged in crop production is slightly less than those who own agricultural land (Table 8). The fact that there are still 24% of urban households engaged in crop production seems to indicate that agriculture is also an income source for some urban households, though it is not necessary a main source of income.

Table 8. Household agricultural landholding and engagement in crop production (Ha – hectares)

	Total number of households	Number of households with land	Number of households engaged in crop production	Average holding for households with land (Ha/per household)
Rural	5 069	3 594	4 350	4.33
Urban	3 618	924	859	2.69
National	8 687	4 518	5 209	3.96

Source: Authors calculation using GLSS5 data.

47. We also calculate the average holding size of those households who own the land. As shown in Table 8, the average holding size per household is 4.33 hectare in the rural areas and 2.69 hectare is in the urban areas (column 5, Table 8). Among rural households that do own land, Table 9 shows that nearly half of landholders own less than two hectares, the size of land smaller than that for an average urban household. On the other hand, about one third rural households own land between two and five hectares, and the remaining 18% own more than five hectares. This 18% of households disproportionately own 64% of total agricultural land; meanwhile the other 82% of households own 36% of total agricultural land (Table 9).

Table 9. Number of rural households by landholding size

	Number of rural households that own land	% of total rural households with land	% of total land owned by rural households
Less than 2 Ha	1 803	49	11
2 to 5 Ha	1 201	33	25
5 to 10 Ha	339	11	16
More than 10 Ha	251	7	48
Rural Total	3 594	100	100

Source: Authors calculation using GLSS5 data.

A majority of rural households grow a wide range of crops

48. The second finding from the data of GLSS5 is that a majority of rural households grow a wide range of crops. There are more than 20 crops for which more than 10% of rural households reported harvesting crops (Table 10), while there are 20% of rural households that reported 10 or more than 10 crop production (Table 11).

Table 10. Number of households reporting crop production

	Rural		Urban	
	Number	**%**	**Number**	**%**
Maize	3 291	63.0	565	15.7
Cassava	2 837	61.3	549	16.6
Pepper	2 285	42.5	292	8.3
Plantain	1 813	40.2	400	12.5
Okra	1 773	28.1	203	5.3
Yam	1 770	33.2	256	7.4
Tomato	1 466	27.7	173	4.8
Cocoyam	1 358	29.8	293	9.3
Groundnut	1 254	17.6	106	2.3
Leaf Vegetables	1 060	18.2	127	3.7
Oil Palm	1 023	22.4	175	5.2
Beans & Pulses	1 006	13.7	65	1.5
Millet	986	12.1	69	1.1
Sorghum	980	12.4	45	0.7
Cocoa	848	19.3	128	4.0
Rice	736	8.7	39	0.8
Banana	605	12.4	94	2.7
Pawpaw	598	11.9	88	2.5
Eggplant	594	12.7	115	3.5
Orange	479	10.3	81	2.4
Pineapple	447	9.5	67	1.9
Avocado	337	6.8	66	2.0
Mango	268	5.0	44	1.2
Other Vegetables	268	5.2	46	1.2
Other Staple Crops	231	3.4	31	0.9
Sheanut	180	1.8	1	0.0
Onion	178	3.4	27	0.6
Potato	158	2.1	12	0.3
Coconut	141	3.0	14	0.4
Other Fruits	131	2.6	26	0.9
Cashew	71	1.2	20	0.6
Cotton	67	0.9	1	0.0
Colanut	62	1.1	4	0.1
Sugarcane	39	0.8	13	0.3
Lime/Lemon	29	0.7	1	0.0
Tobacco	29	0.6	0	0.0
Ginger	20	0.4	0	0.0
None	719	17.2	2 759	75.8
Total	5 069	100	3 618	100

Source: Authors calculation using GLSS5 data.

49. The GLSS5 questionnaires account for 43 different crops of which we rank 37 crops from most to least frequent by rural households (and do not consider a few crops that only 1 or 2 households reported producing). Table 10 reports both numbers and frequencies for rural and urban households. As demonstrated in Table 10, maize and cassava are the two most dominant crops produced by most rural households (63% and 61%, respectively, of total rural households) and quite a lot of urban households (16% and 17%, respectively, of total urban households). Obviously many households must grow both crops, given that the percentage of rural households that grew either maize or cassava is greater than 60%.

50. The third and fourth most popular crops are pepper and plantain, both common ingredients in Ghanaian cooking. Besides the aforementioned four crops, no single crop is grown by more than 40% of rural households, indicating a diverse crop production pattern in the country. There are eight crops grown by more than (or close to) 25% of rural households, three of which (including pepper) are vegetables. The other two important vegetables are okra and tomato, which are grown by roughly 28% of rural households. This high incidence rate indicates that they are both staples serving to meet household own-consumption and cash crops produced for domestic market. Moreover, both crops are important sources of vitamins and nutrient in the Ghanaian diet. In the case of the tomato, it also serves as a high value crop providing inputs for a variety of processed tomato products. Thus, we will focus on tomato as a case to further assess the potential for high value agriculture in Ghana in a separated subsection later.

51. Another question is how many crops, on average, do Ghanaian households grow? To address this question we present Table 11 in which the incidence of crop harvests is considered at household level. As demonstrated in the second to last row of Table 11, 14% of rural households grow more than 10 crops; an additional 6% grow 10 crops. Considering that about 80% of rural households report harvesting more than three different crops, it is clear that rural households predominantly diversify their agricultural production across numerous crops, as opposed to specializing in fewer more lucrative options. Given that the majority of rural farmers are smallholders, it is obvious that for many rural households a diversified crop mix represents both a subsistence pattern of crop production and a means to reduce the production risks associated with concentrating on a few crops.

Table 11. Crop diversification

Number of Crops Harvested	Number of Households	%	Cumulative %
1	154	4	4
2	338	9	13
3	370	9	21
4	445	11	32
5	439	10	43
6	479	11	54
7	472	10	64
8	419	9	73
9	309	7	80
10	278	6	86
More than 10	647	14	100
Rural Total	4 350	100	100

Source: Authors calculation using GLSS5 data.

Labour-constrained agriculture?

52. The third Finding from the assessment of input use is that 46% of rural households reported hired labour, while, respectively, only 19% and 7% of households report use of inorganic fertilizer and renting equipment, respectively (Table 12). Such high rate of labour hiring indicates a possible labour constraint in Ghana's agricultural production. Possible labour constraint may also be a reason for more use of herbicide, which can substitute for labour use in weeding, a necessary work both for land preparation and during crop growing period in Southern part of Ghana.

Table 12. Input use

	Number of rural households	%
Any type of input use	3 289	65
Use of inputs by type:		
Hired Labour	2 306	46
Credit	1 547	32
Agricultural Credit	382	8
Seed Purchased	1 124	22
Inorganic Fertilizer	981	19
Insecticide	797	17
Herbicide	744	17
Rented Equipment	392	7
Organic Fertilizer	341	6
Rented Transport	301	7
Storage	119	3
Irrigation	19	0
Owned Mechanization	12	0

Note: expenditures on hand-tools have been excluded, because they are capital inputs.
Source: Authors calculation using GLSS5 data.

Spatial patterns of crop production

53. In terms of spatial patterns of crop production and input use, we find that, while some crops, such as rice, sorghum, millet, and cocoa, have significant spatial patterns, some other crops, including maize, cassava, tomato, are grown by many households in all the four agro-ecological zones. In terms of spatial patterns of input use, we find that hired labour carries the highest percentage of households across all the four zones, while the percentage is highest in Forest and South Savannah zones. On the other hand, a strong spatial difference is observed in fertilizer use, as more than 30% of North Savannah households use inorganic fertilizer, while the share is 15% for the Coast and Forest Zones. Mechanization of agriculture is a policy aimed at agricultural intensification, which has a long history in Ghana and has recently been reemphasized by the government. However, number of affirmative responses to mechanization related questions in the GLSS5 is extremely low: for instance, only 392 households (among almost 7 000 households that reported crop production in rural and urban locations) respond yes to questions concerning expenditures for equipment rental. Most households renting equipment are in Forest and North Savannah zones. In North Savannah zone the average land holding size of households using mechanization as a group doubles that of households without mechanization. Households reporting mechanization also appear to be more likely to hire labour, purchase fertilizers and other chemical inputs, which indicates a possible income factor (not necessarily land size) associated with mechanization.

Input use and land productivity - the case of maize

54. While it is important to assess land and labour productivity and the relationship between land productivity and input use, such assessment is constrained by the data limitations of the GLSS5. After thoroughly investigating the strengths and weaknesses of the data, we decide to use maize as an example for assessing land productivity and the relationship between the productivity and input use for three reasons. First, maize is widely grown in the country, by more than 60% of rural households according to the GLSS5. Second, a sufficient number of observations are available with output and land harvest

information and thus for yield calculation. Finally, the calculated yield using GLSS5 data is close to the statistic number reported by MoFA. However, it is still impossible for our analysis to directly link maize yield with input application because input use is reported at household level instead of the plot and crop level.

55. Although input use cannot be identified at the crop level, we observe insignificant land productivity differences for maize between households that do and don't use inputs, such as fertilizer, herbicide and purchased seed, on national and agro-ecological zone levels (Table 13). The only significant different yield gaps are observed in the cases of herbicide use (Table 14), which is the only instance that maize yield near or reaches an average yield of two metric tonne per hectare, which is still 20% below the yield potential defined by MoFA. However, there is not enough information to help us assess the reasons why fertilizer use is not associated with higher maize yield and why it occurs in the use of herbicide. The limitation of the GLSS5 in assessing agricultural productivity further emphasizes the importance for the country to conduct a nationwide agricultural survey, which will make it possible to fully assess the outcome of modern input use, and thus, to provide policy suggestions on how to improve the returns of input use and how to promote their use in agricultural transformation.

Table 13. Household maize yield and fertilizer use by agro-ecological zone

	Qualified maize households		Maize households using fertilizer		Maize households using inorganic fertilizer		Maize households without use of fertilizer	
	Number of households	Yield (tonne/ ha)	Number of households	Yield (tonne/ha)	Number of households	Yield (tonne/ ha)	Number of households	Yield (tonne/ ha)
Coast	203	1.64	31	0.47	28	0.51	172	1.85
Forest	773	1.35	179	1.12	153	1.21	594	1.42
S. Savannah	262	1.48	65	1.56	60	1.61	197	1.45
N. Savannah	797	0.83	355	0.95	260	0.9	442	0.72
Rural Total	2 035	1.27	630	1.06	501	1.09	1 405	1.36

Source: Authors calculation using GLSS5 data.

Table 14. Household maize yield and herbicide use

	Herbicide users		Without use of herbicide	
	Number of maize households	Average yield (tonne/ha)	Number of maize households	Average yield (tonne/ha)
Coast	39	1.26	164	1.76
Forest	284	1.97	489	1.00
Rural Total	388	2.05	1 647	1.02

Source: Authors calculation using GLSS5 data.

The case of tomato - a diagnostic analysis

56. High value agriculture has been emphasized in Ghana's development strategy for many years. To increase agricultural value addition, to diversify agricultural export structure and to transform agriculture from its subsistence mode to market-driven commercial activity, it requires the country identify its comparative advantage in many different agricultural products other than cocoa and hence promote rapid

growth in their production and marketing. Tomato can be one of such products. Tomato has been grown in many places of Ghana and services both as a staple crop as important sources of vitamins and nutrient in the Ghanaian diet and a high value crop providing inputs for a variety of processed tomato products. A diagnostic study on tomato coordinated by IFPRI as the result of contributions of many different stakeholders provides us rich inside information for understanding potential and constraint of high-value agriculture in Ghana. The following findings are drawn primarily from a series of IFPRI forthcoming publications (Robison and Kolavalli 2010a and 2010b) as the outputs of this study.

The tomato sector has failed to reach its potential

57. Data for the tomato sector have not been collected consistently at national level since 1980s and so it is difficult to describe the trends over area farmed to tomato, yields or productivity at the national level. However, the available data suggest the peak level of the production achieved in 1990s, around 200 thousand tonnes per year (from 50 thousand tonnes in 1980s but 100 thousand tonnes in the early 1970s), and it started to fall gradually in the 2000s, primarily due to import competition from neighbour countries such as Burkina Faso from which Ghana imports about 100 thousand tonnes per year.

58. In terms of productivity, the average yield of tomato in Ghana was around 4.8 tonnes per hectare during the 1970s and 1980s when the data were being collected. In the 1990s, average yields were estimated to be about 13 tonnes per hectare (Wolf 1999). More recent country-wide estimates (albeit based on limited samples) suggest average yields of 7.5 tonnes/ha in the early 2000s (ISODEC 2004, quoting SRID 2003 data) and 6.7 tonnes/ha more recently (Asuming-Brempong and Asuming Boakye 2008). The recent three-region survey done by IFPRI and its collaborators suggests average yield for these three regions of 10.6 tonnes per hectare. All recent estimates of yield, though higher than data from the 1970s and 1980s, are lower than Wolf's 1990s estimate, suggesting little if any yield increases over the past two decades and possibly falling yields.

59. While the average yields are low, about one fifth of surveyed farmers in Robison and Kolavalli (2010a) achieved yield of over 20 tonnes/ha, 5% even achieving yields greater than 25 tonnes/ha. On the other hand, one third of farmers have yields less than 5 tonnes/ha. This big yield gap suggests that under realistic current best practices farmers could nationally achieve average yield of around 17.5 tonnes/ha, a 70% increase.

60. The spatial difference in achieved tomato yield level is significant. According to the three-region survey in Robison and Kolavalli (2010a), the high average regional yield can be 14 tonnes/ha in Brong Ahafo and Upper East, while the low yield is 5 tonnes/ha in Greater Accra. Moreover, such spatial yield gap is unlikely to be explained by irrigation condition, as Greater Accra is the only region in which tomatoes are grown under both rainfed and irrigated conditions. Choice of varieties seems to explain most such regional yield gaps, as two varieties that have relatively high level of yield are widely grown in the two regions that have relatively high regional average yields.

Productivity and production costs

61. Tomato productivity is affected by choice of varieties more than by other factors. During the Green Revolution in Asia, farmers embraced the purchase of improved seeds, yet farmers in Ghana have historically appeared reluctant to purchase seeds (Orchard and Suglo 1999). This is, however, changing. Although seed "recycling" has been reported to account for up to 85%-90% of seed supply in the past (Orchard and Sglo 1999; Horna *et al.* 2006), recent surveys suggest that only one third of farmers were exclusively using their own seed (extracted from tomatoes, washed, and dried), with another 20% using both recycled and purchased seeds, or seed from other farmers; with the remaining 47% purchasing all

their required tomato seed (Monney *et al.* 2009). Similar situation found by Robison and Kolavalli (2010a) in their recent survey.

62. Many factors influence the choice of varieties by farmers such as access to seeds, growing technologies, available markets, yield potential, prices and risk. Robison and Kolavalli (2010a) find that tomato growers in Ghana are constrained by the absence of national seed strategy that provides farmers with a reliable source of appropriate seeds and technical support. Farmers have a dichotomous choice between costly hybrids sold by private companies and inexpensive local varieties that have emerged out of uncontrolled crossing. Although some improved varieties are available, many farmers are still choosing to use local varieties, as in some places, yields for the local varieties are better than for the improved and also expensive improved varieties.

63. While production cost is one of the important factors to affect farmers' decision on modern technology adoption, other factors also play their important roles. Farmers in the areas close to urban centre seem to have more options in choosing different technologies and farming patterns. For example, in Greater Accra area with rainfed farming, farmers can choose a low input and low yield strategy, so that the production carries low risk but still can be profitable at relatively low output prices. Irrigated tomato farming in the same area applies more inputs, but not necessary high yield, and the profitability is from harvesting during the lean season when output price for tomato is high. Targeting local fresh market, farmers in Brong Ahafo can be described as low input and high yield. Here, where there is little irrigation, farmers are typically growing local varieties with mainly for local fresh markets. Low input use, together with relatively high prices, lowers production risk with relatively high profit level of farmers in this region. In the Upper East region, where nearly all production is irrigated, most farmers use improved varieties that are suitable for processing. Profitability is mainly due to high yields achieved though cost is also high with irrigation cost and purchased improved varieties. However, level of the profit is low in this region due to the low output prices.

64. While productivity of tomato production is associated with the intensive use of input, yield can be increased through improved land husbandry and disease management that often add little to the costs of production. Focus group discussion during the survey conducted by Robison and Kolavalli (2010a) has identified a number of poor practices suggesting poor land husbandry are common to tomato farmers through the country. The inappropriate ways to apply tools and modern inputs and lack knowledge for chemical inputs and how to get a good price also constrain farmers for profitability. In contrast, farmers in Burkina Faso seem to be better in husbandry practices than Ghanaian farmers, which allow the yield level is higher in Burkina Faso and hence tomato production is more profitable and competitive than that in Ghana.

Tomato processing - an internationally competitive business that has not yet worked in Ghana

65. Processing is a sector to convert tomato - a non-tradable good - into paste, which is an internationally traded commodity and so exposes Ghana's tomato sector to international competition. At current productivity level with existing domestic market prices for tomato, domestically produced paste typically will not be competitive with imported paste from the EU and China.

66. As briefly mentioned in Section 2, agro-processing industry had been chosen as part of industrialization strategy right after independence. Three state-run enterprises were built by a Yugoslavian company in 1967 as part of President Nkrumah's government's overall development plan for Ghana (Ablorh-Odjidia 2003). By the late 1980s, due to frequent breakdowns resulting from a lack of spare parts and obsolete machinery, lack of technical competence and financial management, and poor marketing, in a combination of structural reforms promoted by the World Bank and IMF, it resulted in the closure of these three factories.

67. Currently there are also three plants, two of which are refurbished old plants that the other one is a new investment. The Ministry of Food and Agriculture (MoFA) is planning to set up another plant in Brong Ahafo. The newly invested plant is a private company established in 2003 in Tema, Greater Accra and was set up to supply the west African market, including Nigeria, with tomato paste. Although it sources some tomatoes from the Upper East region and more from nearby farms, it has predominantly been importing and repackaging bulk tomato paste. Currently fresh tomato from Ghana comprises only 7% of the company's tomato inputs, the rest coming from bulk paste imports. The rest two companies are formally the state enterprises that were closed in 1980s. One of the two is owned by the government and the other one was re-opened through a private-public partnership in mid 2000s. The government owned one has been frequently closed down. While with a new agreement between growers and the processor, this one reopened in 2010, its future remains uncertain. The private-public partnership one ceased processing because it was not able to source sufficient high quality tomatoes from Ghana at competitive prices. The company is now exploring sourcing inputs for the factory through its own dedicated high tech farm using technical expertise from South Africa, and supplemented possibly with contract farmers or tomatoes purchased on the open market.

68. Processing of highly perishable non-storable crops such as tomato is promoted as a way of developing high-value agriculture and enhancing the value chain of such products through a value-added process. On the other hand, many processed agricultural products such as tomato paste are commodities for which consumer preference is a low price rather than high quality or differentiation in products. To make Ghana's tomato competiveness with low-cost bulk tomato paste imports, it requires significantly reduction in fresh tomato cost, which is equivalent to raising tomato production at 30 tonnes per hectare, from current 10 tonne/ha (Robison and Kolavalli, 2010b).

69. Findings of tomato case study indicate that while to promote value-chain approach and to increase value addition of agriculture are important components of agricultural transformation, without significantly increasing agricultural productivity before farm gate, direct public support to developing large-scale processing sector will generally not be able to have expected outcome. While potential is huge in Ghana's agriculture, Ghanaian farmers have not yet been able to compete with imports for many agricultural or agro-processing products, often due to low productivity within agriculture, together with many other factors outside agriculture. With the more recent emphasis of the government's agricultural policy on the creation of competitive private sector businesses, policy focus on increasing agricultural productivity should not only be for the food supply to direct meet domestic demand, but also should include the high-value agriculture that provide inputs to processing and to compete with imports for processed food products.

5. Agricultural growth and poverty reduction - past experience

70. Steady, persistent and sectoral balanced economic growth has also helped Ghana significantly reduce poverty. Ghana’s national poverty rate has fallen from 51.7% in 1991/92 and 39.5% in 1998/99 to 28.5% in 2005/06, a total decline of 23.3 percentage points over 14 years (Table 15). More poverty reduction has been achieved in rural areas, both in absolute and relative terms. The rural population accounts for more than 60% of total population and the rural poverty rate fell from 63.6% in 1991/92 to 39.2% in 2005/06, a decline of 24.4 percentage points. In the same period, the urban poverty rate came down from 27.7% in 1991/92 to 10.8% to 2005/06, a decline of 16.9 percentage points. However, regional inequality significantly increased mainly due to a more modest decline of poverty in the poorest Northern regions. The poverty rate remained as high as 62.7% in the North by 2005/06, while the poverty rate has reached 20% in the rest of Ghana.

Table 15. Poverty headcount (%), 1991-2006

	1991/92	1998/99	2005/06
Urban	27.7	19.4	10.8
Rural	63.6	49.5	39.2
National	51.7	39.5	28.5
Accra	23.1	4.4	10.6
Urban Coastal	28.3	31.0	5.5
Urban Forest	25.8	18.2	6.9
Urban Savannah	37.8	43.0	27.6
Rural Coastal	52.5	45.6	24.0
Rural Forest	61.6	38.0	27.7
Rural Savannah	73.0	70.0	60.1

Source: Ghana Statistical services (2007).

Crop production is the dominant economic activity and income source for both the poor and non-poor in the rural area

71. Agriculture is a dominant economic activity for the rural household, particularly crop production, as 87%-89% of rural households engaged in such activity in the country (Table 16, first panel). Moreover, the participation rate of crop production is relatively stable over the last three household living standard surveys that conducted in 1991/92, 1998/99 and 2005/06. Obviously, with such high participation rate in crop production, reducing poverty among rural households in the period of 1991 and 2005 is highly related to the performance of agriculture discussed in the previous section. While livestock is less important than crop production for the rural households as a whole, there still are 48%-54% of households engaged in such activities. However, the participation rate had been declining in this period, an alarm sign that should be paid attention in the country's agricultural development strategy.

72. While agriculture provides the most important income source for rural households as a whole, as a share of total rural household income, the role of agriculture has declined in this period. Putting agricultural crop and livestock income together, own farming agricultural activities accounted for 66.3% of total rural household income in 1991/92, and the share fell to 54.1% in 2005/06 according to GLSS5 (Table 16, second panel). Although the agricultural income share in 2005/06 is still higher than 50%, incomes from other sources, particularly from non-farm self employment, have become increasingly important. Non-farm self employment accounted for 15.7% of total rural household income in 1991/92, and increased to 23.1% in 2005/06. The other significant change in terms of the importance for income generation is income transfers, including received from the government and remittance. Share of such income doubled in this period, rising from 5.6% to 9.3%. While as sources of income, non-farm self-employment and income transfers have become more important in income generation for the rural households as a whole, the participation rates of rural households in these two types of income-generating activities actually fell in this period. For example, there were 45% of rural households that reported non-farm self-employment activities in 1991/92 and it fell to 40% in the most recent run of the survey (2005/06). Such inconsistency between participation rate and share of income needs to be further investigated in order to assess the importance of such economic activity to rural poverty reduction.

Table 16. Rural households' participation in income-generating activities and share of incomes

	Agriculture - Crops	Agriculture - Livestock	Agricultural wage employment	Non-farm wage employment	Non-farm self-employment	Transfers	Others
Participation rate							
1991/92	87.2	54.0	3.8	13.8	45.0	36.7	39.4
1998/99	89.1	51.5	3.5	15.6	36.6	42.1	43.3
2005/06	87.5	47.9	3.6	11.7	40.2	35.8	36.2
Income share							
1991/92	66.3	2.6	1.7	7.8	15.7	5.6	0.3
1998/99	59.2	4.4	1.5	7.8	17.9	8.8	0.5
2005/06	54.1	3.6	2.1	7.5	23.1	9.3	0.3

Source: Authors' calculation using data from GLSS3, GLSS4 and GLSS5.

73. Besides these two types of non-farm income generating activities, the participation rate for non-farm wage employment as well as the share of income from such activity had been stable in this period. While 12%-16% of rural households reported participation of non-farm wage employment activities, such employment opportunity only provided 7.5%-7.8% of income for the rural households as a whole, indicating a limited and stagnant role of formal non-agricultural sectors (in either industry or services) to rural household income generation.

74. To further investigate the relationship between engagement of economic activities and rural poverty, we further break down the rural households into two groups, the poor and the non-poor and provide similar information for these two groups of households in Table 17 as we did in Table 16 for the rural households as a whole. As shown in Table 17, the agricultural participation rate is higher for the rural poor households than for the rural non-poor households, and this is true both for crop production and livestock production. However, there are still more than 80% of rural non-poor households engaged in crop production (and it is 94% of the rural poor households engaged in crop production, first panel in Table 17). This indicates that agriculture is the most important economic activity both for the poor and non-poor households, and it is more important for the poor households.

Table 17. Rural poor and non-poor households' participation in income-generating activities and share of incomes

	Agriculture - Crops	Agriculture - Livestock	Agricultural wage employment	Non-farm wage employment	Non-farm self-employment	Transfers	Others
Participation rate							
1991/92							
Rural non-poor	80.5	47.9	4.0	17.4	47.0	39.6	8.6
Rural poor	93.6	59.7	3.6	10.3	43.1	34.0	3.7
1998/99							
Rural non-poor	85.2	45.9	4.0	19.3	39.6	43.3	13.1
Rural poor	94.7	59.5	2.8	10.2	32.2	40.5	12.6
2005/06							
Rural non-poor	83.6	43.0	4.4	15.1	42.0	36.2	5.2
Rural poor	94.4	56.8	2.3	5.4	37.0	35.2	3.2
Income share							
1991/92							
Rural non-poor	57.0	2.4	2.1	10.9	19.9	7.2	0.5
Rural poor	75.0	2.7	1.3	4.9	11.7	4.2	0.2
1998/99							
Rural non-poor	52.8	4.0	1.8	10.1	21.0	9.7	0.5
Rural poor	68.3	5.1	1.0	4.5	13.3	7.3	0.4
2005/06							
Rural non-poor	44.7	3.7	2.6	10.0	27.6	11.0	0.4
Rural poor	71.1	3.3	1.4	2.9	15.1	6.1	0.2

Source: Authors' calculation using data from GLSS3, GLSS4 and GLSS5.

75. The second panel of Table 17 indicates that more than 70% of income is from agricultural activities for the rural poor, while as a source of income, agriculture generated 60% of total income for the rural non-poor households as a group in 1991/92, but generated 48.4% of total income for the same group of households in 2005/06. While the importance of agriculture as a main source of income has declined for the rural non-poor households as a group, it is still the most important income for this group of households.

76. Table 17 also shows that, while the rural non-poor households have more opportunities to participate in non-farm activities both as wage earners and self-employed than the rural poor households, the difference is much larger in the case of wage earning opportunity than in the non-farm self-employment. Surprisingly, the participation rate of wage earning activity fell both for the poor and non-poor rural households, it fell more for the poor households. Although the participation rate of wage earning employment is relatively high for the rural non-poor households, such activity only provides 10% of total income for the rural non-poor as a group. Moreover, such share is extremely low and declining for the rural poor as a group (second panel of Table 17). Such information seems to imply that, while it is possible for some individual rural households to move out of the poverty through participation of non-farm wage earning opportunities, given that such income accounts for only 10% of total income even for the rural non-poor as a group, also given that the rural poverty rate had declined by 24.4%age points in this period (between 1991 and 2005), the most important reason for such rapid rural poverty reduction in this period at the national level must be the increased income from the agricultural sector, particularly from crop production. For the same reason, agriculture will continue to be a more realistic poverty reduction measure for most rural households that are still living below the poverty line.

Differential income patterns across agro-ecological zones

77. We further assess the regional patterns of economic activities and source of incomes in Table 18. While crop production is the most important economic activity for rural households across four agro-ecological zones, it is more important in the two savannah zones than in the coastal zone. The spatial patterns in livestock activity are more significant as 60%-70% of savannah rural households engage in livestock activity, there are only 36%-39% of coastal and forest rural households engaged in such activity in 2005/06. On the other hand, the engagement rate of crop production had declined in coastal and southern savannah zones, between 1991/92 and 2005/06, and the rate has been constant for the other two zones in the same period. However, in terms of livestock activity, the engagement share had fallen over time in all four zones (Table 18).

Table 18. Households' participation in income-generating activities and share of incomes across zones

	Agriculture - Crops	Agriculture - Livestock	Agricultural wage employment	Non-farm wage employment	Non-farm self-employment	Transfers	Others
Participation rate							
1991/92							
Coastal	77.5	42.9	5.3	15.4	54.2	39.0	12.8
Forest	87.9	48.0	4.1	15.6	37.5	42.2	5.8
S. Savannah	92.4	65.3	2.4	13.7	39.2	34.7	1.5
N. Savannah	95.4	77.2	1.7	7.1	56.0	20.7	0.6
1998/99							
Coastal	75.2	37.6	6.2	20.9	49.9	44.7	8.5
Forest	91.3	49.3	3.8	17.3	36.4	44.4	14.3
S. Savannah	95.8	56.5	1.1	7.9	29.9	39.3	10.5
N. Savannah	98.5	76.1	0.2	6.7	21.2	32.7	16.4
2005/06							
Coastal	72.0	35.7	6.3	17.3	39.3	36.7	3.4
Forest	88.5	36.9	5.1	14.5	38.8	38.2	5.3
S. Savannah	86.1	58.2	0.6	9.0	39.3	29.0	7.7
N. Savannah	95.1	66.5	1.1	5.6	43.0	34.3	3.0
Income share							
1991/92							
Coastal	48.3	1.5	3.1	9.8	28.6	8.1	0.6
Forest	67.8	1.8	1.8	8.6	13.6	6.0	0.4
S. Savannah	73.2	2.8	0.4	6.8	11.5	5.1	0.1
N. Savannah	82.0	5.7	0.3	3.8	6.5	1.7	0.0
1998/99							
Coastal	36.2	4.9	3.2	11.3	30.7	13.3	0.4
Forest	62.7	3.1	1.4	8.3	15.7	8.2	0.6
S. Savannah	66.7	5.9	0.2	4.1	14.4	8.8	-0.2
N. Savannah	77.0	7.4	0.1	3.3	7.8	3.9	0.4
2005/06							
Coastal	34.6	5.3	4.6	10.9	29.3	15.1	0.2
Forest	46.9	2.2	2.8	9.6	26.6	11.5	0.4
S. Savannah	47.8	11.7	0.5	6.2	25.3	8.1	0.6
N. Savannah	76.4	2.1	0.4	3.1	14.4	3.4	0.1

Source: Authors' calculation using data from GLSS3, GLSS4 and GLSS5.

78. While non-farm self-employment is either the second (in the case of coastal zone) or third (in the other three zones) important economic activity, the engagement share is quite close across zones. Surprisingly, the participation rate in non-farm self-employment is highest in North Savannah in the last run of the survey (2005/06), but the rate was highly fluctuated in this zone among the three surveys, indicating the possible incomparable problem for the sample selection in this zone across the three surveys.

79. More rural households in coastal and forest zones have opportunities to participate in non-farm wage employment activities than the households in the two savannah zones, given that most non-agricultural economic activities concentrate in the south and along the coast. On the other hand, only 5.6%-7.1% of North Savannah rural households engage in such activity and the share has fallen over time in this period.

80. As a source of income, agricultural crop production accounted for less than 50% of coastal rural households' total income and this share had fallen to 34.6% in 2005/06. In contrast, crop production accounted for 76%-82% of northern savannah's household income and the share is much stable in this zone, particularly in the last two runs of surveys. Income share of crop production had also declined in Forest and South Savannah and became less than 50% in 2005/06 in both zones. However, if livestock income is included, agricultural income is still more than or close to 50% of total income in these two zones. it should point out, while more than two-third rural households reported engagement in livestock activity in the northern savannah, income from such activity accounted for only 2.1% of total income there in the last run of survey (2005/06). While it is possible that livestock, particularly cattle raising, is primarily as capital assets for farming purpose, a further investigation is necessary in order to fully understand the role of livestock sector and hence to develop a proper livestock promotion policy in the region.

81. While share of non-farm self-employment in total rural household income is much smaller than the reported participation rate, because extremely small share of livestock income in total income, non-farm self-employment is the second most important income source in all the four zones. In the coastal zone, the share is around 30% in the three runs, while the same share had increased from 11.5% and 13.6% to 25.3 and 26.6% in South Savannah and Forest between 1991/92 and 2005/06. Increasing from a extremely low base of 6.5%, non-farm self employment still only accounted for 14.4% of total rural income in North Savannah in 2005/06, about half the share in the other three regions.

82. Consistent with the participation rate, non-farm wage income employment plays more important role in income generation for rural households in the costal and forest zones than those in the other two zones. However, even in the first two zones, such income accounted for only 10.9% and 9.6% of total rural income, respectively, in the most recent run of survey, the share is equivalent to one-third or one-fifth of crop income, respectively, in these two zones. In the two savannah zones, such activity generated insignificant income to the rural households, accounting for, respectively, 6.2% and 3.1% of total rural income in the south and north savannah zones.

83. In Section 4, we have reported that, according to GLSS5, 46% of rural households hired labour in crop production (Table 12), and the per cent is as high as 55% and 57% in forest and south savannah zones (Quiñones and Diao, 2010). While it seems that such income should be treated as agricultural wage income, only less than 4% of rural households reported the engagement in agricultural wage employment and such activity only generated around 2% of total income for the rural households as a whole (Table 16). At the zonal level, the participation rate for agricultural wage employment is high in the coastal and forest zones (6% and 5%, respectively) and low in the other two zones (around one%). As a source of income, such activity generated 3.1%-4.6% of total rural income in the coastal zone, and less than or around 0.5% in the two savannah zones. Given that 46% of rural households reported to hire labour in crop production, it is possible that such activity as an income-generating activity has been significantly under reported in all runs of surveys either because seasonal or in-kind incomes of labour services were not reported by many households as agricultural wage employment activity.

84. We also report income generating activities and sources of income by the two household groups, the poor and non-poor, at the zonal level in tables 19 and 20. Table 19 seems to indicate that the spatial difference plays a dominant role in determining the participation rate of crop and livestock production rather than the poverty status in the coastal and north savannah zones. That is, the crop and livestock production participation rates are consistently more than 20 percentage points higher for the rural households in north savannah zone than in coastal zone regardless whether households are poor or non-poor. Moreover, the difference in participation rates between the poor and non-poor as two groups are quite small in all the three runs in the north savannah as well as in the last run in coastal zone. While the participation rate of crop production is high for both the poor and non-poor groups in forest and south

savannah, the difference in this rate between the poor and non-poor is often more than or close to 10 percentage points in these two zones.

Table 19. Poor and non-poor households' participation in income-generating activities across zones

	Agriculture - Crops	Agriculture - Livestock	Agricultural wage employment	Non-farm wage employment	Non-farm self-employment	Transfers	Others
1991/92							
Rural non-poor							
Coastal	72.4	39.0	4.6	16.8	55.9	40.0	15.4
Forest	81.7	45.3	4.4	18.8	40.1	42.6	8.0
S. Savannah	84.2	56.4	2.3	18.8	45.9	37.6	0.8
N. Savannah	92.3	73.4	2.4	12.4	55.0	27.8	0.6
Rural poor							
Coastal	84.7	48.4	6.3	13.2	51.9	37.6	9.1
Forest	94.5	50.9	3.8	12.2	34.8	41.8	3.5
S. Savannah	98.0	71.4	2.6	10.2	34.7	32.7	2.0
N. Savannah	96.8	79.1	1.4	4.6	56.4	17.2	0.6
1998/99							
Rural non-poor							
Coastal	69.3	33.3	6.9	22.2	50.0	46.6	7.8
Forest	89.2	48.2	3.7	20.4	38.1	44.8	15.3
S. Savannah	94.7	51.1	0.9	8.4	32.4	38.2	12.4
N. Savannah	97.6	69.0	0.0	15.1	22.2	21.4	15.1
Rural poor							
Coastal	85.4	45.0	5.0	18.6	49.7	41.3	9.6
Forest	95.9	51.7	3.9	10.7	32.8	43.5	12.2
S. Savannah	97.7	65.9	1.6	7.0	25.6	41.1	7.0
N. Savannah	98.7	77.9	0.2	4.5	21.0	35.8	16.7
2005/06							
Rural non-poor							
Coastal	71.4	37.7	6.9	18.5	40.1	37.7	3.7
Forest	86.6	36.4	5.0	16.0	41.8	39.9	5.5
S. Savannah	83.7	56.4	0.9	10.1	41.5	29.7	9.8
N. Savannah	91.1	64.3	1.0	10.7	45.7	26.2	3.1
Rural poor							
Coastal	74.8	26.5	3.4	11.6	35.4	32.0	2.0
Forest	95.8	39.1	5.3	8.6	27.2	31.6	4.4
S. Savannah	92.2	62.8	0.0	6.2	33.3	27.1	2.3
N. Savannah	96.9	67.5	1.1	3.2	41.7	38.0	2.9

Source: Authors' calculation using data from GLSS3, GLSS4 and GLSS5.

85. The spatial dominance in determining participation opportunities is also observed for non-farm self-employment, in which the spatial difference in participation rate is larger than the difference in this rate between the poor and non-poor groups in a same zone. While there seems to be a declining trend in the participation rate of non-farm self-employment across all zones between 1991/92 and 2005/06, this rate declined more for the poor household group in each zone. For example the participation rate of non-farm self-employment was 55.9% and 51.9%, respectively, for the non-poor and poor rural household groups in Coastal zone in 1991/92's survey, and they declined to 40.1% and 35.4% in 2005/06 for the same two groups of households in this zone.

86. In the case of non-farm wage employment, the participation rate only increases for the non-poor household group in coastal zone, while the rate falls for the non-poor groups in the other three zones and for the poor household groups in all the four zones.

87. Table 20 reports the shares of different income sources in rural households' total income by zones and the poor and non-poor groups. While crop production is the most important income source for both the poor and non-poor rural household groups across zones, it is more important for the poor than for the non-poor. Comparing to 1991/92, crop production in 2005/06 generated less income as a share of total rural income both for the poor and non-poor groups, while the decline in this share is more rapid for the non-poor than for the poor. However, the spatial difference is still a more dominant factor than the poverty status. This is particularly true for coastal and north savannah zones. In coastal zone, for example, crop production accounted for 43.9% of total income for the rural non-poor group and 54.5% for the poor group. This share declined to 33.2% for the non-poor group and 41.6% for the poor group by 2005/06. On the other hand, the share was 73.2% for the non-poor group and 86.2% for the poor group in the north savannah in 1991/92 and it only modestly fell to 67.6% for the non-poor and 80.4% for the poor in 2005/06 in this zone.

Table 20. Share of different income sources for the poor and non-poor households across zones

	Agriculture - Crops	Agriculture - Livestock	Agricultural wage employment	Non-farm wage employment	Non-farm self-employment	Transfers	Others
1991/92							
Rural non-poor							
Coastal	43.9	1.5	3.2	11.2	30.1	9.4	0.7
Forest	59.6	1.9	2.1	11.6	16.8	7.4	0.5
S. Savannah	62.5	2.9	0.8	12.2	15.0	6.4	0.2
N. Savannah	73.2	5.9	0.4	6.9	11.6	1.9	0.0
Rural poor							
Coastal	54.5	1.5	3.0	7.8	26.5	6.3	0.4
Forest	76.4	1.8	1.5	5.5	10.1	4.6	0.2
S. Savannah	80.5	2.8	0.2	3.1	9.1	4.3	0.1
N. Savannah	86.2	5.6	0.3	2.4	4.0	1.6	0.0
1998/99							
Rural non-poor							
Coastal	30.0	5.4	3.8	13.3	32.2	15.0	0.3
Forest	59.0	2.8	1.4	10.2	17.7	8.2	0.7
S. Savannah	64.9	5.3	0.3	3.8	16.2	9.9	-0.4
N. Savannah	68.4	7.7	0.0	7.4	13.6	2.3	0.6
Rural poor							
Coastal	47.0	4.0	2.0	7.9	28.2	10.4	0.6
Forest	70.6	3.6	1.4	4.3	11.5	8.2	0.5
S. Savannah	70.0	6.9	0.0	4.7	11.2	7.0	0.1
N. Savannah	79.3	7.4	0.1	2.2	6.2	4.3	0.4
2005/06							
Rural non-poor							
Coastal	33.2	4.8	5.0	11.7	29.2	15.9	0.3
Forest	43.1	2.1	2.5	10.8	29.1	11.9	0.4
S. Savannah	43.5	11.8	0.7	7.1	28.0	8.3	0.7
N. Savannah	67.6	2.1	0.3	6.7	20.0	3.1	0.1
Rural poor							
Coastal	41.6	7.7	2.4	7.3	29.4	11.5	0.0
Forest	61.5	2.5	3.6	4.8	17.2	10.1	0.4
S. Savannah	58.6	11.3	0.0	3.9	18.6	7.4	0.3
N. Savannah	80.4	2.1	0.5	1.4	11.9	3.6	0.1

Source: Authors' calculation using data from GLSS3, GLSS4 and GLSS5.

88. In terms of income from non-farm self-employment, there is no significant difference between the poor and non-poor in coastal zone, particularly in the most recent run of survey in 2005/06. For the other three zones, there are more than or close to 10 percentage points of difference for this share between the non-poor and the poor in 2005/06. While as an income source the non-farm wage employment provides less than 10% of total income for most poor and non-poor household groups across zones (except for the non-poor groups in coastal and forest zones), the poor has less income from such activity than the non-poor, particularly for the poor in the three zones other than the coastal.

89. In summary, the following findings can be drawn from above discussions:

- Agricultural crop production is the most important activity for a majority of rural households both as income-generating activity and as a source of income. The importance is higher in terms

of participation rate than in terms of share of income; is higher in the north than in the coast; and is higher for the poor than for the non-poor.

- As an income source to the rural households, income share of crop production in total income has been declining over time. However, considering crop and livestock together, agriculture still provides more than or close to 50% of total income for the rural households in the three zones other than in coastal zone, where share of agricultural income for the rural households as a whole fell to 40% in 2005/06.
- While as a share of total income, crop production is more important for the poor than for the non-poor, the difference in this share between the poor and non-poor is smaller than its difference across zones spatially.
- Non-farm employment opportunities are provided by the non-agricultural sectors and such opportunities are still limited for a majority of rural households. This is particularly true for households in the two savannah zones.
- While the participation rate of non-farm employment is not high across zone, share of income generated from such activity in total rural household income is particularly low. Further breaking down into the poor and non-poor household groups within each zone, it shows that only for the non-poor households in coastal and forest zones such opportunity provide slightly more than 10% of total income for the rural households, while for all poor household groups and for the other two non-poor groups, non-farm wage employment provided only 1.4%-7.3% of total income in 2005/06.
- Livestock is an important economic activity for most rural households, particularly for households in the two savannah zones. However, it generates very limited income to rural households. It requires a further investigation into livestock income generation in order to develop a proper livestock promoting policy in the country.
- Agricultural wage employment as an income-generating activity and a source of income seems to be under-reported in all runs of surveys, given that 46% of rural households reported to hire labour in crop production in the most recent survey (2005/06). The under-reporting may relate to seasonal agricultural labour services and in-kind payments, which may dominate agricultural labour hiring arrangement. Thus, it deserves a further investigation in agricultural labour market in order to understand the determination of agricultural wages.

90. As a conclusion, the above findings, together with the discussion in Section 4, further emphasize the importance of agriculture for rural income growth and poverty reduction in the recent history. We will further assess the role of agriculture in the forward looking scenarios in the rest of the report, which requires a general equilibrium model that will be introduced in Section 6.

6. Agriculture's contribution to economic growth and poverty reduction - an economywide assessment

91. Sections 4 and 5 have assessed agricultural performance and contribution to poverty reduction in the past. The analysis suggests that great potential for agricultural growth exists in Ghana, while alternative growth options may have different outcomes. Thus, in the following sections, we develop an economy-wide model to quantitatively assess these potentials and measure the possible outcome of realizing these potentials in helping Ghana achieve its development goals of economic transformation and MDGs.

A dynamic computable general equilibrium model

92. The ability to capture inter-sector synergies, trade-offs and linkages has made general equilibrium models an important tool to analyze the impacts of growth accelerations. We therefore apply a recursive dynamic general equilibrium (DCGE) model that has been developed recently for Ghana to assess the sector-specific growth options and their structural impact on the Ghanaian economy over the period of 10-15 years. While this model does not attempt to make precise predictions about the future development of the Ghanaian economy, it does measure the role of different sectors, including the agricultural sector, for economy-wide growth, transformation and poverty reduction.

93. The DCGE model is constructed consistently with the neoclassical general equilibrium theory. The theoretical background and the analytical framework of CGE models have been well documented in Dervis, de Melo and Robinson (1984), while the detailed mathematical presentation of a static CGE model is described in Loefgren *et al.* (2002). The recursive dynamic version of the CGE model is based on this standard CGE model with the incorporation of a series of dynamic factors. The early version of this dynamic CGE model can be found in Thurlow (2004), while its recent application to Ghana includes in Breisinger *et al.* (2009).

94. Similar to other CGE models, the DCGE model for Ghana is an economywide, multi-sectoral model that solves simultaneously and endogenously for a series of economic variables including commodity and factor prices. However, unlike traditional CGE models that focus on national economies with multiple production sectors, the DCGE model for Ghana considers sub-national heterogeneity in agricultural production by assigning a series of different production functions for producing a similar agricultural product, for example, maize or cassava, to different zones (regions). In this regard, four agro-ecological zones mentioned above in Section 3, *i.e.*, coastal, forest, southern savannah and northern savannah, are considered. The setup of such a model requires more information about a country's agricultural production than a traditional CGE model; for instance, information about the distribution of land across zones for each individual type of crop or livestock production, which significantly increases the complexity of calibrating the model to the real economy. However, once such information is available and the model is constructed, the model can better capture the economic inter-linkages at both sub-national and national levels, including both linkages across regions and those between sectors. The specific sub-national structure of the agricultural production of the model will be further discussed in detail later when we introduce the dataset, the Ghana social accounting matrix (SAM), and agricultural structure in this section.

95. Like any other CGE model, the DCGE model captures, with its general equilibrium feature, economic activities on both the supply and demand sides. On the supply side, the model has defined specific production functions for each economic activity, such as agricultural production, for which functions are defined at the sub-national level, or non-agricultural production, which is defined only at the national level. As in any other quantitative economic analysis, certain assumptions have to be applied before calibrating the model to the data. In a typical general equilibrium model, a constant return to scale technology with constant elasticity of substitution (CES) between primary inputs is a fundamentally necessary assumption in order for the model to have an equilibrium solution.[7] However, as both primary

7. The constant returns to scale assumption is a commonly used assumption in the general equilibrium theory as well as in most applied general equilibrium models (including CGE models). This assumption follows the more fundamental assumption in neoclassical economics theory, *i.e.*, firms act in a perfectly competitive market and cannot gain market power to determine input or output prices (all prices are the result of a market clearing mechanism (equilibrium), rather than the results of the choice of any individual firms). In some general equilibrium models, especially the models based on the new (or endogenous) growth theory, externality exists through the accumulation of common knowledge (as the results of research and development activities conducted by individual firms (see Romer, 1990; and Grossman and Helpman, 1994) or through the accumulation of human capital (see Arrow, 1962, for the famous learning

and intermediate inputs are considered in the production functions of a CGE model, a Leontief technology with fixed input-output coefficients is often assumed for intermediate inputs, such as fertilizer and seeds in crop production, feed in animal production, and raw materials in the food processing industry, as well as for the relationship between intermediates and primary inputs in aggregation.

96. The demand functions in the CGE model are derived from well-defined utility functions. In our model, the consumer demand functions are solved from a Stone-Geary type of utility function in which the income elasticity departures from one (which is a typical assumption in a Cobb-Douglas (C-D) type of utility function), and hence, the marginal budget share of each good consumed differs from its respective average budget share.[8] Moreover, we include highly disaggregated representative households in the model. Specifically, there are 90 representative households, 40 in the rural areas and 50 in the urban areas. The 40 rural households represent rural households in the four disaggregated zones and 10 income decile groups within each zone. For the urban households, beside the 40 zonal representative households, we also consider 10 income decile groups for the Greater Accra area, as households' income level and consumption patterns in Great Accra are quite different from other urban households in the other urban centres.

97. Similar to other general equilibrium models, consumers' income that enters the demand system is an endogenous variable. Income generated from the primary factors employed in the production process is the dominant income source for consumers, while the model also considers incomes coming from abroad (as remittance received) or the government (as direct transfers). Information on income distribution from labour and land derived from GLSS5 is used to calibrate the initial income distribution of the model. In general, most returns to land, labour and capital employed in agricultural production at the regional level go to the region's rural household groups, while returns to capital employed in non-agricultural production and wage income of skilled labour go to urban households. Rural households also earn labour income from non-agricultural activities, which can occur either in the rural (*i.e.*, rural nonfarm) or in the urban areas.

98. With highly disaggregated demand systems derived from non-homothetic functions, together with endogenous income growth, the DCGE model is able to partially capture the Engel Law effect of structural change led by the consumers' preferences, while supply side factors to lead the structural change are primarily productivity growth that will be discussed later.

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by doing model). The existence of such externalities is the driving force of productivity growth in the endogenous growth theory, but it is irrelevant to the market power of any firm. The increasing returns to scale assumption from microeconomics theory (which also relates to the creation of externalities from one firm to others) is not suitable to the general equilibrium theory, unless this assumption is accompanied by the imperfect competition assumption, such that the choice variable for these firms is the price or market power instead of output (and inputs). Hence, we follow the commonly used and theoretically consistent assumption in CGE model.

8. Marginal budget share (MBS) relates the allocation of incremental income spent on different consumption goods for a consumer, while average budget share (ABS) is the current (total) budget allocation among different goods. For example, a consumer currently spends 2% of her (his) income on rice consumption, indicating that the ABS for rice is 2%. When this consumer's income increases in the next year, for each increased one dollar of income, she (he) prefers to spend 3 cents on rice. In this case, the value of MBS for rice is 3%. When MBS is greater than ABS for a particular consumption good (in this case, rice), demand for this good is called income–elastic (Wilhelmsson 2002). On the other hand, if MBS value is lower than ABS for a particular good, like sorghum, demand for this good (sorghum) is said income inelastic. The MBS is obtained by estimating income elasticities using the household survey data (GLSS5), as the ratio of ABS or BMS equal to the income elasticity for this particular commodity. The estimation of income elasticities will be discussed later in this chapter.

99. The DCGE model explicitly models the relationship between supply and demand, which determines the equilibrium prices in domestic markets. Given that a CGE model reflects an open economy and hence also captures the trade flows - both imports and exports - the relationship between domestic and international markets is included explicitly. Generally speaking, any commodity produced or consumed in the domestic market can also be exported or imported. However, in a CGE model, the commodities produced or consumed domestically are not perfectly substitutable for internationally traded goods. Thus, the international price for any product, regardless of whether this product is exportable or importable, is not fully transmitted into domestic markets; rather changes in domestic supply and demand will finally determine its price. However, if a product is exportable or importable, its price in domestic markets can be affected by international prices and by the export and import demands. To capture the linkages between the domestic and international markets, the model assumes price-sensitive substitution (imperfect substitution) between foreign goods and domestic production. With such an assumption, if domestic demand increases more than the supply of this good, the domestic price for this good rises relative to the export/import prices. Exports of this good fall and imports rise. On the other hand, if productivity improves for domestic production and rising supply outpaces the increases in demand for the product, the domestic price falls relative to the border prices, exports rise and imports fall. Imperfect substitution also implies that agricultural productivity improvements by itself may not be enough to expand agricultural exports, and improving marketing conditions is also important.

100. While the linkages between demand and supply through changes in income (an endogenous variable) and productivity (often an exogenous variable) are the most important general equilibrium interactions in an economy-wide model, production linkages also occur across sectors through the intermediate demand and competition for primary factors employed in production sectors. Many primary agricultural products need to be processed before reaching consumers and export markets. Food processing is often an important component of the manufacturing sector in developing countries. Productivity-led growth in the agricultural sector can stimulate growth in food processing by providing cheap inputs (forward linkages) and creating more demand for processed goods (backward linkages through rising income of farmers). On the other hand, growth in an export-oriented agricultural product, for example, cocoa in Ghana, often creates increased demand for cocoa processing, which increases labour demand, and hence create job opportunities for both rural and urban households. Clearly, without a general equilibrium framework and detailed subsector structure in both agriculture and non-agriculture, this economywide impact of agricultural growth might not be captured.

101. The focus of this report is the role of agricultural sector in growth and poverty reduction. Thus, it is important to clarify what a DCGE model can do in such assessment and where the model's weaknesses are. It is well known rapid economic growth is often led by productivity change and capital investment. As in most recursive dynamic models, productivity growth is an exogenous variable, while investment in capital formation has to be determined through the choice of a macro closure for the equilibrium between savings and investment. In our DCGE model for Ghana, investment is saving driven and savings, which include domestic private and public savings, as well as by foreign inflows, are used to finance the investment. A Solow type of saving decision is assumed such that the private savings of each representative household are proportional to this household's income. While the savings rate is constant, with income increases over time, the amount of private savings grows. The government savings are a residual term that is given by the difference between total government expenditure (which is an exogenous variable) and total government income, an endogenous variable. Foreign inflows to finance domestic investment (either through FDI or other financial inflows) are considered as an exogenous variable in the model through the choice of a macro closure for the foreign account balance. We choose the growth rate for foreign inflows in the model's base-run to be consistent with inflows observed in recent years. In the scenarios, we have considered possible increases in foreign inflows when accelerated growth is led by the expansion and growth in the industrial or service sector. These increases are compatible with Ghana's

expected better access to ODA and private foreign funds in the future. This will be further discussed once we introduce the model simulations later in the next section.

102. While productivity and capital accumulation have led overall economic growth, such growth is often accompanied by changes in economic structure. Two forces drive the economic structural change in the model: changes in domestic demand structure led by the Engel's Law (by introducing a non-homothetic utility function in the model) and differential growth rates (led by productivity change) across sectors. Moreover, in the general equilibrium model, these two forces work together through interactions between demand and supply in domestic markets. Differential growth rates at sector level are not only purely determined by the productivity increase within each sector, but also constrained by the demand side, especially if the sector does not export. For example, while we can exogenously set a high productivity growth rate for a particular agricultural product (*e.g.* cassava), under the Engel Law, demand for cassava may not grow proportionally to growing incomes. Thus, in the absence of export opportunities or new ways to process and use cassava in the manufacturing sector, the price for cassava falls due to over-supply in the domestic market. As a consequence of falling prices, production factors (labour, land and capital) leave cassava production until growth in supply match consumer demand.

103. Demographic transformation is characterized by the population shift from rural to urban areas, but this process is unlikely to be endogenously determined in the model. Thus, we exogenously determined the annual growth rate for different types of labour supply based on the country's historical trends in labour growth. Three types of labour are considered based on the employment information of GLSS5: family labour that is employed in agricultural production only and specific to one of the agro-ecological zones. Unskilled labour and skilled labour are economywide factors, which can move freely between regions and sectors following the highest returns. According to FAO, the agricultural labour force currently accounts for 60% of the total economically active population in Ghana, while the agricultural labour share has declined over time. We conducted a simple regression between the change in agricultural labour share and agricultural total factor productivity (TFP). The regression results show that a one per cent growth in agricultural TFP is associated with 0.07% decline in the share of agricultural labour in the total labour force. Using this elasticity, together with projected total labour growth between 2007 and 2020 (drawn from FAO), we first calibrate the growth rate in total agricultural labour supply, which declines over time. We then allow the supply of agricultural family labour and unskilled labour to grow relatively more slowly than the growth in the skilled labour such that overall labour growth rate is consistent with its growth rate in FAO's projections. In total, labour supply will grow around 2.4% per year.

104. While supplies of labour grow exogenously in each time period as discussed above, demand for all types of labour at sub-sector level is endogenously determined by the sector's profitability at given wage rates. Individual producers in both agricultural and non-agricultural production sectors treat wages as given. The wage rate is an endogenous variable determined by the market equilibrium between total labour supply and total labour demand. Accordingly, there are four different wage rates for family labour (one for each agro-ecological zone), and one wage rate for skilled and unskilled labour, respectively. Wage rates change over time driven by changes in labour demand across sectors. For example, if overall economic growth is led by labour intensive sectors (*e.g.* textiles) additional demand for labour from these sectors can cause wage rates to rise relative to the returns to the other factors (*e.g.* to capital). On the other hand, if growth is led by sectors that are highly capital intensive (*e.g.* oil extraction), demand for labour may not increase much during growth process ("jobless growth"). Given similar labour supply growth, wage rates may thus fall or rise less than the returns to capital depending on the driving sector of growth. Whether or not the wage rate rises during periods of growth affects income distribution and poverty reduction during transformation. This will be further discussed in the description of the simulations and results.

105. The movement of economywide labour (skilled and unskilled labour) between agricultural and non-agricultural sectors is an important factor to endogenously capture the rural-urban (or agriculture-to-

non-agricultural) labour mobility. In general, we expect more demand for non-agricultural labour than for agricultural labour in the transformation process due to both demand and supply side factors discussed above. On the demand side, given that most agricultural consumption goods are generally income-inelastic and most non-agricultural goods are income-elastic, demand for non-agricultural products (including services) grows more rapidly. On the supply side, productivity growth in the agricultural sector generally releases labour from agriculture to non-agricultural, as agricultural growth is also constrained by the natural resource conditions (particular land). Productivity growth in non-agricultural sectors, particularly manufacturing and services, face few natural resource constraints and may thus hire new labourers (given they are not constrained by capital). In the next section of the report, we will further analyze this labour shift process in Ghana.

A social accounting matrix (SAM) for Ghana

106. The DCGE model is calibrated to a 2007 social accounting matrix (SAM), which is recently updated from the Ghana 2005 SAM. A detailed description of the data sources and the balancing procedure of the 2005 Ghana SAM can be downloaded from IFPRI's website (IFPRI 2007). A wide range of data was used for building the 2005 SAM, including national accounts provided by Ghana Statistical Services (GSS), crop and livestock data provided by the Ministry of Food and Agriculture (MOFA), mining, manufacturing and energy sector data from 2003 Industrial Census (GSS), household income and consumption data from 2005/06 Ghana Living Standards Survey (GLSS5), and export and import data provided by Bank of Ghana, MOFA and GSS. To update this SAM to 2007, we use national account data of 2007 provided by Ghana Statistical Services (GSS), balance of payments data provided by the Bank of Ghana, and government budget data provided by the Ministry of Finance.

107. The newly developed Ghana SAM provides information on the demand and production structure of 70 detailed sectors, including 27 agricultural sub-sectors, 33 industrial sub-sectors and 10 service sub-sectors (see Table A1 in Appendix for the list of the sub-sectors). This detailed sector structure allows the DCGE model to analyze sector- and sub-sector specific growth strategies and their contribution to growth and transformation. As we briefly mentioned above and also consistent with the DCGE model, the SAM considers the existence of different types of labour forces, such as agricultural family labour (or self-employed agricultural workers), unskilled workers employed in both agriculture and non-agriculture, and skilled non-agricultural workers. Information on sector level inputs and output is further derived from MOFA's 2006 crop-level farm budgets for the agricultural sectors and the 2003 Industrial Census for industrial production. Additional information on employment and wages by sector and region is taken from GLSS5 (MOFA 2007). The SAM and the DCGE model include a government account, which collects direct taxes from households and indirect taxes from imports, exports and domestic sales, and then supplements its revenues with foreign grants from development partners that are used for investment expenditures. Information on government revenues and expenditures was provided by the Ministry of Finance and Economic Planning.

Elasticities and parameters

108. In addition to the SAM as the main data source to calibrate to a set of parameters in both production and demand functions, a DCGE model also requires several elasticities. The main elasticities include the substitution elasticity between primary inputs in the value-added production function, the elasticity between domestically produced and consumed goods and exported or imported goods, and the income elasticity in the demand functions. While we briefly discuss the main assumptions and the sources for these elasticities, a sensitivity test is conducted in order to assess the robustness of these elasticities (which is further discussed in the Appendix).

109. The assumption of a constant elasticity of substitution (CES) technology in the production function requires a substitution elasticity that is generally not possible to estimate using country-specific econometrics, given the highly disaggregate production structure of a DCGE model. This substitution elasticity is not needed if a C-D technology is chosen as the production functions. However, C-D functions implicitly implies the substitution elasticity between two inputs (*e.g.*, labour and land) to be one, which is not a suitable assumption in a general equilibrium model with a highly disaggregated production structure. Thus, the CES elasticity in the production function has to be pre-determined and drawn from the CGE literature on other African countries (see Table A2 in Appendix). The other parameters or coefficients in the production functions of the model (*e.g.* the marginal product of each input) can be directly calibrated using the country data of the Ghana SAM (*e.g.* the share of value-added for each input used in the total value-added of this sector).

110. For the use of intermediate inputs in the production function, we use a Leontief technology. With this assumption, a set of fixed input-output coefficients can be directly derived using the data of the Ghana SAM.

111. As we briefly discussed above, with a Stone-Geary type of non-homothetic utility function applied in the model, the marginal budget share (MBS) is the parameter applied in the demand system, which can be derived from the SAM given that the income elasticity of demand is known. The income elasticity is estimated from a semi-log inverse function suggested by King and Byerlee (1978) and based on the data of GLSS 5 (2005-06).[9] The estimated results, together with the average budget share (ABS) for each individual commodity consumed by each individual household group directly calculated using the data of the Ghana SAM, we derive a series of MBSs that are applied in the model (see Table A3 in Appendix for a the income elasticities, ABSs and MBSs in the model).

112. For commodities that are sold both domestically and abroad, a constant elasticity of transformation (CET) function is applied, while for commodities that have both domestic and foreign supply, a constant elasticity of substitution (CES) or Armington function is used. In both functional forms, the elasticity of substitution that represents the ease at which producers or consumers are willing to shift supply or demand between domestic and foreign markets is required. With minor modifications, these elasticities have been adopted from Hertel *et al.* (2007), who estimated average import substitution elasticities for 40 commodities from a large set of countries.

Limitations of the DCGE model

113. Like any other economic model, the CGE model has its limitations. Of these, there are at least four limitations or caveats that are important to note when interpreting the results. The first caveat is the way to construct the dataset (the SAM) for CGE modelling analysis. Difference from a typical econometric analysis in which either time series or cross section data are used to estimate the causality relationship between economic and social variables, the dataset (the SAM) used in any CGE model analysis is constructed from one year's data. Given that the agricultural sector is one of the most important economic sectors in many African countries and agricultural production is predominantly influenced by patterns of rainfall and other weather related factors that often fluctuate over time, the choice of year to construct the SAM matters. To avoid the possible bias in the choice of the base year, it is necessary for CGE modelling researchers to assess a longer time period of data for main economic activities, particularly for agricultural production, to ensure that the year chosen for the study is a "normal" year. While the original SAM for Ghana was constructed for the year 2005, we have carefully checked whether the year of 2005 is a "representative" year for Ghana's agriculture and have used the average production data over several years

9. We greatly thank Bingxin Yu who provided econometric estimation for income elasticity of demand in the study.

for most crop and livestock subsectors. We also considered trends in total GDP, agricultural GDP and agricultural production for major crops to ensure a proper reflection of the structure of the Ghanaian economy in the SAM at sector level.

114. The second caveat applies to the model's treatment consumers' demand. While income elasticities of demand in the model are econometrically estimated and subsistence consumption is taken into account in the demand functions, the use of a Linear Expenditure System (LES) to specify household demand can only partially capture demand dynamics. Marginal budget shares in such a demand system remain constant over time. While rapid demand shifts can be better captured by using an AIDADS demand system (Yu *et al.* 2003) or by applying latent separability (Gohin, 2005), the highly disaggregated demand structure in the model constrains our choice of methods. This relatively linear demand system can be questioned, particularly in the context of economic transformation, on the grounds that it might be too rigid to reflect rapid change. However, while the functional form, parameters and elasticities applied to the demand functions are given, the level of consumption and relative demand, and hence, consumption shares for individual commodities, do change over time and thus reflect changes in incomes and relative prices (both income and prices are endogenous variables in the model). The major concern is thus whether these changes are big enough in times when the economy experiences periods of rapid structural change.

115. Third, similar to most other CGE models, production technologies that are calibrated to the initial economic conditions remain constant over time. That is to say, similar to the demand system, the production functional forms, including the parameters and elasticities of the functions, are given. That does not imply a constant economic structure over time, as the share of each production sector in the overall economy changes with productivity growth and price evolution varying across sectors and over time. However, with given production functions, the model simulations cannot capture the substantial technological changes and innovations that may be embodied in new investments, especially foreign direct investments, which technically involve changes in the functional forms for some more dynamic production sectors. Given that foreign investments currently only account for an insignificant portion of Ghana's GDP, this caveat may be less relevant to the study.

116. Fourth, while the model captures the market equilibrium and linkages between domestic and foreign markets, it does not consider the role of market institutions and other players along the supply chains (besides producers and consumers), as well as spatial characteristics of the markets. While including detailed service sub-sectors (*e.g.*, trade, transport) helps the model partially capture the linkages between service activities and other production sectors, and between consumption and export/import activities, these linkages are mainly treated as a sort of production linkages (*i.e.*, services are inputs in other productions) or directly consumed by households. Because of this caveat, the model may underestimate the important role of service sectors in supporting growth in the other sectors and hence the sector's contribution to broad economic growth. Transformation is also a process of institutional change. However, given the model neoclassical nature, it cannot properly reflect institutional change both as one of the most important conditions for and as an outcome of transformation.

117. We have to point out that the four caveats discussed here are common for most CGE models and some of them are rooted in the general equilibrium theory from which a numerical model is constructed. However, it is still worth to explicitly point them out in order to help readers fully understand the model results and interpret them accordingly.

7. Agriculture's contribution to economic growth and poverty reduction - forward looking scenarios

118. Literature and other country experiences suggest that agriculture has often played an important role for development, notably the Green Revolution in Asia. On the other hand, the experiences of successful countries in Asia and Latin America suggest that contribution of various sectors during each

country's transformation process depends on, among other factors, unique initial economic structures, existing and new market opportunities, other initial conditions embodied in social and political institutions and government policies, and external conditions in the region and the world. Ghana has made great progress in economic development over the past years, which might herald a new era of rapid growth and transformation.

119. We design seven scenarios and use the DCGE model introduced in Section 6 to quantitatively assess Ghana's medium-term development goals in the context of economic transformation and poverty reduction. Scenario 1 is a base-run, from which the other scenarios will be compared. We then focus on the agricultural sector first to simulate the contribution of productivity-led agricultural growth to overall economic growth and poverty reduction. The agriculture-focused scenarios also show that accelerated growth in agriculture is important given Ghana's current economic structure and lessons from other countries. Specifically, in scenario 2 we first examine growth acceleration in staple agriculture, which includes staple crops and livestock, while in scenario 3 we turn to the growth in export agriculture. Then in scenario 4 we combine the two scenarios to assess the overall agricultural growth. In addition to agriculture-led growth, we also simulate the effects of rapid growth in industry (excluding mining), especially in "homegrown" and agriculture-related manufacturing sectors in scenario 5 and the impacts of private service (both domestic and export-oriented) led growth in scenario 6. Finally, in scenario 7, we combine the above scenarios and focus on the possible structural change facing Ghana. In all scenarios, we exogenously assume additional growth in affected sectors' total factor productivity (TFP). In the base-run, choice of growth rate for the sector level TFP is based on the calibration such that the economy will continue to grow along its historical path. After the base-run, any additional growth is an assumption, *i.e.*, we do not try to model the growth in TFP. Instead, by exogenously changing the growth parameters in the TFP equation sector by sector, we analyze TFP growth-led economic structural change further through resource shift (*e.g.* labour and land re-allocation), capital accumulation, and changes in demand structure. Table 21 provides an overview of the assumption on TFP growth rate across sectors for different scenarios, which are further explained in the discussion of the results below.

Table 21. Overview of scenario assumptions

	Affected subsector	Additional annual growth in subsector's TFP (as exogenous changes)
Scenario 2: Staples-led growth	Cereals	0.2-4.0
	Root crops	1.0-1.5
	Other staple crops	1.0-2.0
	Livestock	1.5-2.0
Scenario 3: Export crop-led growth*	Export crops	1.5-4.0
Scenario 4: All agriculture	Combined 2 and 3	
Scenario 5: Industry-led growth	Manufacturing	1.0-4.0
	Other industry (excluding mining)	1.0-3.0
Scenario 6: Service-led growth	Private services	1.0-3.0
Scenario 7: Broad-based growth	Combined scenarios 4-6	

Note: *Additional land expansion also assumed for affected sectors.
Source: Ghana computable general equilibrium model.

120. Obviously, productivity change should either be a result of innovation/adoption of technology applied in the production process or improvement of efficiency in the use production inputs with given technology. In addition to human and physical capital as important sources of productivity growth, institutional factors (including market development) are frequently seen to relate the improvement in productivity. While they are all important aspects to understand "how" productivity can grow, they are

beyond the scope of this report. Moreover, financing mechanism of productivity growth is also an important aspect in development literature. In a general equilibrium theory, such financing mechanism also affects the macroeconomic balance and hence possibly results in certain unexpected outcomes in terms of growth. In this report, we ignore this issue and do not model the required investment and financing in order to have productivity growth.

Base-run: Ghana will fail to become an African 'Tiger' by 2020

121. The DCGE model is first applied to a scenario (the base-run) in which the sectoral level growth rate is close to the growth trends observed in recent years between 2001 and 2008. However, we consider a relatively higher growth rate for agriculture compared to its historical trends and a lower growth rate in the service sector to achieve a more balanced growth path in the base-run. Along the base-run growth path, Ghana's economy will continue to grow at an annual rate of 5.2% until 2020 (Table 22, part A). Given the average annual population growth of 2.4%, per capita GDP grows at 2.76% annually (which is slightly less than the 3.2% of annual growth rate in 2001-08). With such growth, per capita GDP increases from USD 655 in 2007 to USD 836 by 2020 (Table 22, part D). While more than three decades of steady growth (two decades in the history and 13 years in this forward looking scenario simulation) will allow Ghana to more than double its per capita GDP from around USD 350 - USD 360 in the late 1980s to more than USD 800 by 2020, such growth performance is much less impressive than either the growth performance of the Asian tigers (such as Malaysia and Thailand) when they achieved a middle income status in the 1980s or the recent growth experience of the newly catching up Asian countries such as India and Vietnam, which have achieved a middle income status recently in a period of 12 to 14 years. Vietnam's per capita income was USD 350 - USD 370 in the late 1990s, a level lower than that in Ghana in that period. However, after 12 years by 2008 Vietnam reached per capita income more USD 1 000, USD 360 more than Ghana's per capita income in that year and even higher than our simulation result for 2020 in base-run. In the mid 1990s, India's per capita income was similar as that in Ghana, while 14 year late by 2007, India had achieved a middle income status to reach per capita income more than USD 1 000, USD 390 more than Ghana's per capita income in that year.

Table 22. Base-run and accelerated growth scenarios

			Scenarios with growth in:					
	Initial value	Base-run	Staples	Export agriculture	All agriculture	Industry	Services	Combined
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Part A. Annual growth rate of 2008-2020 (%)								
Total GDP	5.5	5.2	5.5	5.4	5.7	6.0	6.0	7.3
Agriculture	3.0	4.5	5.4	5.2	6.1	3.9	4.0	5.8
Industry	4.8	5.0	4.9	4.8	4.8	7.8	5.0	7.8
Services	7.5	6.1	6.2	6.1	6.1	6.1	8.4	8.2
Part B. Sector's contribution to GDP growth (%)								
Agriculture		30.0	34.2	35.5	39.0	22.3	23.0	27.2
Industry		28.1	26.1	25.3	23.7	41.2	24.6	32.1
Services		41.9	39.7	39.2	37.4	36.5	52.4	40.7
Part C. Sector share of GDP by 2020 (%)								
Agriculture	35.1	35.0	34.9	37.3	37.0	33.1	33.3	33.9
Industry	30.5	29.1	28.9	27.7	27.6	31.4	28.6	29.7
Services	34.4	35.9	36.2	35.1	35.4	35.5	38.1	36.4
Part D. Per capita income by 2020 (real term USD)								
Total GDP	655	824	857	845	879	907	910	1 061
Agriculture	230	263	297	290	324	246	249	309
Industry	200	243	242	239	238	344	243	409
Services	226	318	318	316	317	317	418	409

Source: Ghana DCGE model results.

122. The base-run scenario also show that the agricultural sector continues to be an important contributor to overall growth in Ghana, accounting for 30% of total growth (Table 22, part B). Consistent with the historical trends of sector shares in GDP, share of the services in GDP continues to rise, while the industrial share falls modestly (Table 22, part C).

123. We further investigate the sources of growth in the base-run scenario. Growth is the outcome of increased labour supply, expansion of agricultural cropland, accumulation of capital, and improvement in total factor productivity (TFP). As discussed above in Section 6, increases in labour supply are set exogenously in the model. This results in the average growth in total supply of labour to be 2.4% annually in base-run. Land expansion is defined at the zonal level and varies between 1.2% and 3.1% across the four zones according to recent historical trends. This results in an average land annual expansion rate of 2.3% for the total cropland in the country. Total factor productivity growth is exogenously defined for each sector and varies across sectors. The increase in labour and land supply, combined with improvements in total factor productivity, stimulate investment and result in an average annual capital accumulation growth rate of 5.6%.

124. Table 23 summarizes the contribution of each factor to GDP growth. Increases in labour explain 28% of the base-run growth over the next 12 years (2008–2020), while land expansion explains 10% and capital 28%. About 35% of growth is explained by productivity growth in the base-run, which is slightly higher than World Bank estimates using data from the last five years (Bogetic *et al.* 2007).

125. According to the information reported in the national accounts, the investment-to-GDP ratio was 28.5% in Ghana in 2007. The model calibrates to this ratio as an initial condition. In the base-run scenario, the ratio declines slightly and averages at 26.0% in the next 12 years. The data show that the government is a primary investor in Ghana and that the major source of government investments are inflows of foreign aid and grants. According to national accounts, the government is responsible for 43.5% of investment spending, while private savings account for 53.4% of total investment. The remainder comes from non government related foreign inflows, including FDI, which accounts for a minor share (3.1%) of total investment. Along the base-run growth path, which is consistent with Ghana's past record, the structure of investment remains relatively constant, with the exception that the share of private savings and foreign inflows in total investment increases slightly.

126. The base-run results underline the situation to call for acceleration in growth in Ghana in the next 10–15 years. While Ghana is a success story in Africa in the recent two decades in terms of maintaining political stability in an improved democratic environment and steady economic growth with reduced poverty, to become a real Africa "Tiger" and by more than doubling per capita income in a period of 10 to 15 years, it requires higher development goals in the future. To assess what will be the role of agriculture to contribute to those goals and how economic structure will change with accelerated growth across sectors, we exogenously and sequentially increased growth in various sectors in the remaining six scenarios discussed in Table 21. We start with agriculture and assess the role of staple sector in the agriculture-led growth in scenario 2.

Table 23. Sources of GDP growth as in model results (2008-2020) – total growth is 100

		Scenarios with growth in:					
	Base-run	**Staples**	**Export agriculture**	**All agriculture**	**Industry**	**Services**	**Combined**
Labour	27.9	26.4	26.7	25.3	24.4	24.3	20.2
Land	9.5	8.9	11.2	10.6	8.0	8.0	8.1
Capital	27.7	26.2	27.0	25.5	26.5	25.3	23.4
Productivity	34.9	38.5	35.0	38.6	41.0	42.4	48.2

Source: Ghana DCGE model results.

Staples-led growth improves rice import-substitution but not poultry

127. More than 20% of GDP and almost two-third of agricultural GDP can be classified as staple crops and livestock production, which include cereals (9% of agricultural GDP), root crops (24% of agricultural GDP), and livestock (8% of agricultural GDP, Table 24). The model also includes pulses and oilseed crops, which are both cash and staple crops in the country. In the second scenario, we focus on staple-led growth by focusing on improving competitiveness of this sector in the growth. While most staples are "self sufficient" products in the country, imports have been increasingly competing with domestic production for cereals and livestock products. Domestic demand for rice and poultry, for example, are used to be possible to be met by domestic supply, supply of these two products has been declining due to international competition. In the simulation, we only consider improving competitiveness through productivity, which, as highlighted in the previous section, is one of the most important key factors for many agricultural products that Ghana is unable to compete with imports.

128. Realistic and modest growth is considered for the staple crops (except for rice and poultry) in the scenario given income elasticity is generally low in domestic demand for them. For example, value added for the root crops as a whole grows at 3.8% per year in the base-run and increases to 4.8% in this scenario. However, we assume much higher additional growth in rice and livestock products, given that these products are highly income-elastic and the country has increasingly depended on imports to meet domestic demand for them. Rice and poultry grow at 12.4% and 13.1%, respectively, in this scenario, and their growth rates are 5.7% and 5.2% in the base-run.

129. With growth at subsector level discussed above, agricultural GDP annual growth rate is 5.4% in this scenario, an additional 0.9% growth from the base-run. This results in total GDP to grow at 5.5%, increasing from 5.2% in the base-run (Table 22, part A), and per capita GDP increases to USD 870 by 2020 - USD 34 more than the base-run's result (Table 22, part D).

130. To be able to compete in the international market and to promote import substitution, productivity-led growth must lower domestic prices for import-competitive products. As shown in Table 25, imported rice accounts for 70% of domestic rice consumption, and import poultry accounts for 53% of consumption currently. With increased productivity in rice and poultry production in this scenario, it is possible to allow domestic rice substituting with imports but the substitution for imported poultry is modest. As shown in Table 25, the import to consumption ratio falls to 36% in the case of rice and still keeps at 50% for poultry. While both rice and poultry are income elastic commodity, the estimated income elasticity of demand for poultry is much higher. Thus, with income growth, demand for poultry increases more than demand for rice, indicating a difficulty to realize import substitution in the case of poultry.

Table 24. Sub-sector level value-added in base-run

	Value (mil. Cedis)		Share of GDP (%)		Share of AgGDP (%)	
	2007	**2020**	**2007**	**2020**	**2007**	**2020**
Total GDP	12 965	25 129	100	100		
Agriculture	4 551	8 343	35.1	33.2	100	100
Cereals	424	769	3.3	3.1	9.3	9.2
Maize	269	471	2.1	1.9	5.9	5.6
Rice	99	205	0.8	0.8	2.2	2.5
Sorghum and millet	56	93	0.4	0.4	1.2	1.1
Root crops	1 090	1 763	8.4	7.0	23.9	21.1
Cassava	474	771	3.7	3.1	10.4	9.2
Yams	496	802	3.8	3.2	10.9	9.6
Coco yams	120	190	0.9	0.8	2.6	2.3
Other staples	958	1 584	7.4	6.3	21.1	19.0
Cowpea	51	81	0.4	0.3	1.1	1.0
Soybean	9	17	0.1	0.1	0.2	0.2
Groundnuts	78	156	0.6	0.6	1.7	1.9
Other nuts	38	72	0.3	0.3	0.8	0.9
Fruit (domestic)	93	145	0.7	0.6	2.0	1.7
Vegetables (domestic)	476	752	3.7	3.0	10.5	9.0
Plantains	195	321	1.5	1.3	4.3	3.8
Other crops	19	39	0.1	0.2	0.4	0.5
Export-oriented crops	1 046	1 793	8.1	7.1	23.0	21.5
Palm oil	77	130	0.6	0.5	1.7	1.6
Fruit (export)	36	99	0.3	0.4	0.8	1.2
Vegetables (export)	10	26	0.1	0.1	0.2	0.3
Cocoa beans	903	1 489	7.0	5.9	19.8	17.8
Other export crops	20	49	0.2	0.2	0.4	0.6
Livestock	325	1 055	2.5	4.2	7.1	12.6
Chicken broiler	2	102	0.0	0.4	0.0	1.2
Eggs and layers	50	151	0.4	0.6	1.1	1.8
Beef	69	163	0.5	0.6	1.5	2.0
Sheep and goat meat	77	319	0.6	1.3	1.7	3.8
Other meats	127	319	1.0	1.3	2.8	3.8
Fisheries	205	405	1.6	1.6	4.5	4.9
Forestry	503	975	3.9	3.9	11.0	11.7
Agric-related Manufacturing	657	1 288	5.1	5.1		
Formal food processing	49	114	0.4	0.5		
Informal food processing	127	234	1.0	0.9		
Cocoa processing	58	128	0.4	0.5		
Dairy processing	55	143	0.4	0.6		
Meat processing	176	421	1.4	1.7		
Wood products	192	247	1.5	1.0		
Other industry	3 293	6 122	25.4	24.4		
Services	4 465	9 693	34.4	38.6		

Source: Ghana DCGE model results.

Table 25. Relationship between trade and domestic production/consumption in model results (2020)

	Initial value in 2007	Base-run	Scenarios with growth in: Staples	Export agriculture	All agriculture	Industry	Services	Combined
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
Part A. Exports (%)								
Total exports/GDP	36.3	38.0	36.9	39.7	38.6	37.3	41.8	40.0
Agricultural exports/production	26.4	26.7	25.6	32.8	31.6	20.8	24.9	25.5
Cocoa exports/production	87.3	85.6	85.0	87.5	87.0	83.4	87.0	85.8
Forestry exports/production	73.2	80.7	80.4	85.1	84.5	57.8	77.7	67.2
Non-agricultural exports/ production	15.9	16.6	16.3	15.3	15.1	18.2	19.1	18.0
Manufacturing exports/ production	14.9	13.3	13.8	11.5	11.8	21.1	11.9	18.1
Agriculture-related manufacturing exports/ production	27.6	24.3	24.7	21.6	21.8	34.4	22.3	30.3
Part B. Imports (%)								
Total imports/GDP	61.9	60.8	59.4	61.4	60.0	58.6	62.6	58.6
Agricultural imports/ production	30.0	29.6	29.5	30.2	30.1	28.3	29.3	28.6
Rice imports/ consumption	69.6	63.9	36.1	68.4	41.4	80.0	73.4	51.3
Poultry imports/ consumption	53.2	53.3	50.3	53.8	51.3	54.3	54.0	53.3
Non-agricultural imports/ consumption	30.0	29.6	29.5	30.2	30.1	28.3	29.3	28.6
Manufacturing imports/consumption	56.6	55.2	55.1	56.2	56.1	52.3	55.6	53.2
Agriculture-related manufacturing imports/ consumption	40.9	39.0	38.1	41.3	40.4	29.7	40.8	31.8

Source: Ghana DCGE model results.

Staples-led growth has stronger growth multiplier effects than export-led growth

131. In scenario 3 we turn to export agriculture. Export agriculture includes both traditional ones such as cocoa and forestry and non-traditional ones for which we include palm oil, exportable fruits and vegetables and other export crops as a group. This subsector in total accounts for 7% of GDP and 23% of agricultural GDP. In this scenario, we assume that there is little market constraint for the expansion of non-traditional exports, and hence exportable vegetables, fruits and other non-traditional export crops grow at 13%-14% annually, rising from their base-run growth of 7.5%-8.0%. Growth in traditional export crops, particularly cocoa, and in forestry products also increases, from 4%-5% annually in the base-run to 6.4% in this scenario. Besides forestry, growth in export agriculture is assumed to be an outcome of land expansion and productivity increase. The model assumes that additional 6% of land (about 600 thousand hectares) will be newly developed for export agriculture and thus raises land expansion annual growth rate from 2.31% in the base-run and staple-led scenarios to 2.74% in this scenario. With this assumption, together with assumed productivity growth, export agriculture as a whole grows at 7.1% per year in this scenario, rising from 4.2% in the base-run.

132. Despite such rapid growth in export agriculture, the relatively small size of the sector in the economy and weak links of many export sectors with the rest of economy result in a limited overall growth impact. Agricultural GDP and total GDP growth rises to 5.4% and 5.2%, respectively, only 0.7 and 0.2 percentage points higher than growth in the base-run (Table 22, part A). Per capita GDP increases to USD 858 by 2020, USD 21 more over the base-run scenario's 2020 level of USD 836 (Table 22, part D). However, increased GDP is primarily the result of increased value added of the export agriculture and other economic sectors do not benefit from such growth. Instead, growth in both agricultural GDP excluding export agriculture and non-agricultural GDP is slightly slower than their growth rate in the base-run. For example, as shown in Table 22, part D, compared with the base-run, agricultural per capita GDP increases by USD 27 by 2020, more than the increase of USD 21 in per capita total GDP, indicating a decline in the non-agricultural GDP (which can be seen in the same table). Moreover, value-added of export agriculture, in per capita term, increases by USD 29 from the base-run in 2020, and increases more than the total increase in agricultural per capita GDP.

Productivity-led growth is possible by closing existing yield gaps

133. In the fourth scenario, we consider the whole agriculture by combining scenarios 2 and 3 in which exogenous increases in productivity across all agricultural sub-sectors are the driving forces for overall growth. On the other hand, land expansion remains the same as in scenario 3. The productivity growth rates for crop sectors are chosen to target achievable yields at the zonal level, and are consistent with the gap between current and achievable yields within each zone.[10] Under this scenario, Ghana's agricultural sector will grow at an average annual rate of 6.1% over the next 13 years, a growth rate consistent with CAADP target.

134. Under this agricultural growth scenario, growth accelerates in all sub-sectors, and productivity improvement, rather than land expansion, has been the main contributor to growth. At the crop level,

10. In the CGE model producers in crop sectors (similar as in the other production sectors) choose inputs (such as land, labor, capital, and a set of intermediate inputs) simultaneously to maximize their profits using a given technology. As both outputs and inputs (including land) are endogenous variables in the model, it is impossible to directly target crop yield levels exogenously. Thus, total factor productivity (TFP) is an exogenous variable in the CGE model's production functions, and the exogenous "shock" on this parameter in the simulation is imposed in order to target specific yield levels.

productivity growth becomes the dominant factor in the production growth for maize, sorghum, cassava and yam, contributing 50%-75% of output growth in these crops (Table 26).

Table 26. Productivity contribution to crop growth in the agricultural growth scenario (2008-2020 average)

	Annual growth rate under agriculture scenario (%)			Additional percentage in yield	Contribution to growth from	
	Output	Land	Yield	growth from base-run	Land	Yield
Maize	6.9	3.2	3.6	1.1	46.4	53.6
Rice	10.9	6.8	3.8	1.0	62.3	37.7
Sorghum	5.3	2.5	2.7	0.6	47.6	52.4
Cassava	4.6	1.1	3.4	1.0	25.1	74.9
Yam	4.5	1.1	3.4	1.0	24.4	75.6
Cocoyam	4.4	1.2	3.2	0.8	27.8	72.2
Cowpeas	4.7	1.3	3.3	1.3	27.5	72.5
Soybeans	7.6	4.4	3.1	1.1	57.7	42.3
Oil palm	5.3	2.0	3.2	0.8	37.9	62.1
Groundnuts	5.7	1.9	3.8	1.2	33.0	67.0
Other nuts	6.4	3.1	3.3	0.8	47.4	52.6
Fruits (domestic)	5.2	2.5	2.6	0.2	47.8	52.2
Fruits (export)	13.6	9.0	4.2	0.8	66.2	33.8
Vegetables (domestic)	4.5	1.9	2.6	0.3	41.4	58.6
Vegetables (export)	12.4	8.0	4.0	0.6	64.7	35.3
Bananas	4.6	1.3	3.2	0.5	29.1	70.9
Cocoa	6.4	3.6	2.7	0.5	56.3	43.7
Other crops	6.8	3.5	3.2	0.8	51.1	48.9
Other export crops	11.5	7.6	3.6	0.7	66.0	34.0

Source: Ghanaian DCGE model results.

Invisible transfers: the most important contribution of agriculture to overall growth

135. There is no doubt for the role of agriculture in economic growth, improving income distribution and reducing poverty in most developing countries in their early development stage, while experiences of Asian countries show that unleashing a green revolution has often required massive public investments. Therefore, it raises the question about the cost of such growth acceleration. While a cost and benefit analysis at project level can help prioritizing investment among different agricultural activities, benefit of agriculture investment often goes beyond the agricultural sector. Financing agriculture is beyond the scope of this report, while it is necessary to quantify the economy-wide benefit of agricultural growth, which can be monetarily measured as the transfers from agriculture to the rest of the economy. Such measurement of agriculture's contribution to economy-wide growth is not only helpful for a better understanding of the role of agriculture, but can also provide powerful arguments for developing and implementing pro-agriculture policies and increasing agricultural investments. Thus, we apply a method developed by Winters *et al.* (1998) to the general equilibrium simulation results of scenario 4 in which agriculture growth is accelerated to lead more growth in the economy. In this measure, the agricultural sector's contribution to the economy is defined as a surplus transferred from agriculture to non-agriculture. This definition is based on the insights of development economists in 1950s and 1960s who characterized the dynamics of the economic development process as a dual system. According to this theory, agriculture supports the rest of the economy by transferring a surplus from agriculture to non-agriculture. Some of these transfers are visible, *i.e.* they can be directly observed. Visible transfers are often those that can be observed from a country's statistics such as agricultural trade surplus, which is

often a main provider of foreign exchange needed to finance imported capital and intermediate goods used by non-agricultural sectors. However, the majority of the surpluses transferred from agriculture to non-agriculture are often invisible and not recorded in country statistics. An important invisible transfer stems from decreases in domestic agricultural prices, which often result from improved agricultural productivity. The invisible nature of these transfers has frequently led to the underestimation of the role of agriculture in economic development. As a consequence, the policy and investment priorities of governments have typically focused on promoting agricultural exports to generate visible surpluses.

136. Here we apply a method developed by Winters *et al.* (1998) to quantitatively measure the monetary benefits that account for both visible and invisible transfers of agriculture to the non-agricultural economy. Based on the model results of the agricultural growth scenario and to assess surplus transfers under this scenario, we first disaggregate increased market demand for agricultural goods as consumer goods, intermediate and investment goods. In monetary terms (measured in million new cedi),[11] the total financial transfer out of agriculture amounts to about 1 445 million cedi over the next 12 years between 2008 and 2020, equivalent to 15.4% of increased total GDP over the same period. In 2020 alone, the transfer is equivalent to 1.33% of total GDP in this specific year (Table 27). However, the visible transfer in this period is actually negative. This transfer is defined as increased demand for agricultural goods by the non-agricultural sector minus increased demand for non-agricultural goods by the agricultural sector in the domestic market, as well as the agricultural trade surplus. With 8 476 million cedi of accumulated agricultural trade surpluses over the period of 12 years, the visible transfer through foreign markets is huge. However, the transfer in the domestic market as the value of increased demand for agricultural goods by the non-agricultural sector minus increased demand for non-agricultural goods by the agricultural sector in the domestic market is negative and substantial (-9 319 million cedi over the 12 years), which leads to an overall negative total visible transfer out of agriculture.

11. One New Ghana cedi is about 0.94 USD.

Table 27. Visible and invisible transfers of a financial surplus from agriculture under the agricultural growth scenario

	Million cedi, Accumulated in 2008-2020	As % of increases in GDP accumulated in 2008-2020	Million cedi, 2020	As % of GDP, 2020
Financial transfer out of agriculture	1 445	15.4	334	1.33
Net visible transfer from agriculture	*-843*	*-9.0*	*-146*	*-0.58*
Through domestic market	-9 319	-99.0	-1 598	-6.36
Through foreign trade	8 476	90.0	1 451	5.78
Net invisible transfer from agriculture	*2 289*	*24.3*	*480*	*1.91*
Through lowered agricultural prices	1 058	11.2	215	0.86
Through increased non-agricultural prices	596	6.3	124	0.49
Through increased factor prices	635	6.7	140	0.56
Corresponding monetary value of net physical flows out of agriculture	5 670	60.2	384	1.53
Product contribution	*6 215*	*66.0*	*492*	*2.28*
Net transfer through domestic markets	-2 261	-24.0	-471	-1.87
Net transfer through foreign markets	8 476	90.0	963	3.83
Factor contribution	*-545*	*-5.8*	*-109*	*-0.43*
from staples	72	0.8	15	0.06
from import substitutable	-134	-1.4	-26	-0.10
from export agriculture	-496	-5.3	-99	-0.39

Source: Ghana DCGE model results.

137. The invisible transfer out of agriculture can be decomposed into three parts: through lowered agricultural prices, through increased non-agricultural prices, and through increased returns to factors employed in the agricultural sectors. In total, the net invisible transfer from agriculture is 2 289 million cedi over the 12 year period and 480 million in 2020 alone. Almost half of net invisible transfer from agriculture is due to lowering agricultural prices, amount of 1 058 million over the 12 years. Increased non-agricultural prices contribute modestly as the invisible transfer (596 million cedi during 2008-2020). Because increased wage rates and returns to land with agricultural growth, they constitute a positive invisible transfer as agriculture has to pay a higher price for the increased factor employment (635 million cedi during 2008-2020).

138. We further evaluate the monetary value of the net physical flows in the forms of products and factors. For the products, we decompose the contribution into domestic and foreign markets, while for the factor contribution we disaggregate it according to the three sub-sectors it employs, *i.e.*, staples, import substitutable and export agriculture. The contribution of production is positive, mainly due to the increased agricultural trade surplus (visible transfer), while the factor contribution is negative, since more factors are employed in agriculture under the agricultural growth scenario.

139. By distinguishing factor employment in either export or staple agriculture we can further evaluate the different roles of these two agricultural sub-sectors in economic development. Productivity growth in staple agriculture implies that a country can produce more food and agricultural materials using less labour input. This further lowers the cost of labour and allows labour to migrate from staple agriculture to other economic activities such as rural non-farm or urban sectors, and hence, to engage in non-agricultural growth. As shown in Table 27, the factor contribution of staples is positive (*i.e.*, factor moving out off staple production) with 72 million in total between 2008 and 2020 in the scenario. This result is consistent with what has been observed in many Asian countries during their development process, *i.e.*, the supply of low-cost food and more labour moving out of agriculture is critical to support the development of labour-intensive manufacturing and services.

140. On the other hand, the factor contribution through export agriculture is negative (*i.e.*, more factor employed into export agricultural production) at -545 million cedis for the same period. Trade surplus created by export agriculture is often highly visible and helps to provide foreign exchange earnings to the non-agricultural sector for importing capital goods and intermediates, and hence, the export agriculture has played an important role in the development. However, without productivity growth in staple agriculture, growth in export agriculture can raise the demand for food, which can result in either higher food prices in domestic markets or the need for more food imports. Also, increased demand for labour and capital to support growth in export agriculture can inflate factor prices in a country like Ghana where supply of quality labour is not unlimited. Under these conditions, it often becomes difficult to develop labour-intensive manufacturing and services, a situation that could significantly slow the structural transformation.

Regional impacts of agricultural growth

141. As discussed in the previous sections, significant development gap exists in Ghana between the north and south. Such regional differences in agricultural growth remain under the agriculture scenario, but the growth gap becomes smaller compared to the base-run (Table 28, column 1). The combination of agricultural production activities differs substantially among the four zones, and land productivity improves differentially among the crops under this scenario. For example, at the national level, the yield growth rate reaches as high as 3.4% for cassava and yam (Table 26, column 4). However, since root crops only account for 8.4% of the Coast Zone's agricultural value-added, this growth in root crops has a relatively small impact on the zone's agricultural growth under this scenario (Table 29).

Table 28. Agricultural growth across zones under the agricultural growth scenario

	AgGDP annual growth (%)	Additional growth from base-run (%)	Contribution to agricultural growth (%)			
			Land	Labour	Capital	TFP
Coastal	6.6	2.1	15.2	20.6	6.2	58.1
Forest	6.3	1.9	24.7	15.0	7.6	52.7
S. Savannah	5.4	1.3	20.9	12.3	7.8	58.9
N. Savannah	6.6	1.4	31.6	10.8	5.4	52.3
National	6.1	1.7	25.1	13.2	6.6	55.1

Source: Ghanaian DCGE model results.

142. As a result of differences in agro-ecological conditions, the sources of growth in the agriculture scenario vary across the four zones. While productivity is the most important factor in explaining the regional agricultural growth in this scenario, the contribution of land expansion still accounts for one-third of agricultural growth in the North Savannah (Table 28). On the other hand, land continues to be the smallest factor for explaining agricultural growth in the Coast Zone, accounting for only 15.2% of zonal agricultural growth in this scenario.

143. The contribution of various sub-sectors to regional agricultural growth also differs across zones in this scenario. As shown in Table 29 (part B), export crops contribute the most to additional agricultural growth in the Coast and Forest Zone. In the South Savannah, contribution of root crops is the highest, though other staples also play similar important roles. In the North, additional growth in agriculture mainly comes from cereals, livestock and other staple crops as group, while export crops play insignificant role in this zone.

Table 29. Additional sub-sector growth across the four zones under the agricultural growth scenario

Part A. Additional annual growth from the base-run (%)				
	Coastal	Forest	S. Savannah	N. Savannah
Cereals	3.7	4.4	2.5	2.5
Root crops	1.0	1.2	0.9	0.8
Other staple crops	1.1	1.3	0.5	0.9
Export crops	4.5	2.6	0.5	0.9
Livestock	2.0	1.8	2.0	2.4
Fishery and forestry	0.7	0.8	0.8	0.8
Part B. Sub-sector's contribution to additional AgGDP growth from base-run				
Cereals	22.9	15.7	20.7	29.9
Root crops	4.2	11.2	29.0	19.1
Other staple crops	11.4	11.3	13.1	23.2
Export crops	39.5	45.3	11.3	0.6
Livestock	9.6	7.0	10.1	26.3
Fishery and forestry	12.5	9.5	15.8	0.9

Source: Ghanaian DCGE model results.

Poverty in the North remains at a high level

144. Accelerating agricultural growth and its spillover effects to non-agricultural sectors also accelerate poverty reduction. Our model results suggest that both the national and rural poverty rates will be halved one year earlier under the agricultural scenario compared to that under the base-run. By 2015, the national poverty rate will fall to 18.3% under the agricultural scenario, compared to 20.2% in the base-run (Table 30). The rural poverty rate will fall to 26.7% by 2015, substantially lower than the 29.6% in the base-run's 2015 solution. This translates into an additional 400 000 people (mostly from rural areas) moving out of poverty by 2015 under the agricultural scenario.

Table 30. Poverty reduction under the agricultural growth scenario

	Initial poverty rate	Poverty rate under	
		Base-run	Agricultural growth scenario
	2005/6	2015	2015
National	28.5	20.2	18.3
Urban	13.4	7.6	7.1
Accra	10.6	6.1	5.6
Coast	5.5	2.7	2.1
Forest	6.9	3.3	3.0
South Savannah	21.6	12.9	12.9
North Savannah	31.9	23.4	22.4
Rural	41.0	29.6	26.7
Coast	24.0	13.5	11.5
Forest	27.7	17.8	14.3
South Savannah	36.7	19.7	16.1
North Savannah	68.3	58.1	56.1

Source: Ghanaian DCGE model results.

145. The model results show that poverty reduction is the result of increased incomes and lowered food prices driven by productivity growth in the agricultural sector. Thus, urban households share the gains from agricultural growth acceleration, with rural and urban incomes growing at similar rates; sector linkages and price effects mean that income growth rate is similar for total rural and total urban households (Table 31). However, rural households benefit more than urban households in terms of additional income growth (0.30% vs. 0.54%, respectively, Table 31). Among the urban household groups, urban households in the two savannah zones are the major beneficiaries from agricultural growth. While annual income growth rate is not necessarily higher in this two regions than that in the other regions, additional income growth is the highest for these two groups of households (Table 31). Growth in total income for the rural households is led by the more rapid increases in agricultural income. As shown in Table 31, agricultural income grows more rapidly than the total income growth, except for the Southern Savannah zone, and additional income growth is higher in the agricultural income growth than in the total income for all zones.

Table 31. Growth in household income under the agricultural scenario

	Agricultural income		Total income	
	Annual growth under agricultural scenario	Additional growth from base-run	Annual growth under agricultural scenario	Additional growth from base-run
Urban			5.34	0.30
Accra			5.28	0.30
Coast			5.41	0.30
Forest			5.45	0.27
S. Savannah			5.37	0.34
N. Savannah			5.38	0.35
Rural	5.61	1.04	5.33	0.54
Coast	6.17	1.71	5.53	0.65
Forest	5.85	1.47	5.34	0.75
S. Savannah	5.11	0.77	5.21	0.37
N. Savannah	5.61	0.33	5.40	0.30

Note: Income is measured in current prices.
Source: Ghanaian DCGE model results.

146. Relatively high income growth rate for the Northern rural households suggests that poverty reduction in the North might speed up. However, as shown in Table 30, compared with the base-run, additional poverty reduction is only 2.0 percentage points in the North, while it is 2.9 percentage points for rural households nationally and 3.5 percentage point for the forest rural households. Given the high initial poverty rate in the North, the poverty rate in this region will remain at a high level of 56% by 2015, increasing the gap between poverty levels in the North versus the rest of the country, and further exacerbating regional divergence.

147. It is important to emphasize the need for further poverty reduction in the North, but this discussion has often concentrated on a single poverty line. In order to better understand the challenge of reducing poverty in the North and design more appropriate policies, an analysis should go beyond the poverty line definition in order to better understand the size and nature of this challenge. Cross-country empirical studies show that the elasticity of poverty reduction to income growth is lower for low initial per capita income groups (Easterly, 2007). This finding is supported by the case of poverty reduction in Ghana. While a majority of poor households benefit from broad and agricultural led growth, for the poor whose income far below a nationally defined poverty line, such as most poor households in the North, increased income from agricultural growth is unable to lift them out of the poverty. The difficulty to lower poverty rate in the poorest area of the country (*i.e.* in the North) emphasizes the special attention that should be paid to populations whose income is far below the poverty line, *i.e.*, the group of population that can be classified as extremely poor. Obviously, broad income growth will not be sufficient to lift the poorest of the poor out of the poverty, indicating that more targeted policies and investments are urgently needed. Thus, while halving the 1990s poverty rate earlier than targeted year of 2015 will be a big success for Ghana, the continuous fight against poverty in this country will have to increasingly concentrate on the poorest of the poor, and most of them live in the North.

8. The role of non-agricultural growth in the forward looking scenarios

148. Experiences in successfully transformed countries show that accelerated growth in the industrial sector, particular manufacturing sector, is often an important driver of overall growth on the way from

realization of economic transformation. For example, when Thailand's per capita GDP increased from about USD 400 in 1976 to USD 970 in 1987, its average annual manufacturing growth rate was twice as high as agricultural growth. A similar situation occurred in Brazil, where the manufacturing growth rate was three times the agricultural growth rate (Breisinger and Diao, 2009). In addition, lessons from many countries suggest that labour-intensive and "homegrown" manufacturing, *i.e.* sectors in which most developing countries have a comparative advantage in the early stage of transformation, are most likely to become drivers of growth. Moreover, recent development experience of India shows that the service sector can be a leading driver of economy-wide growth. Therefore, we consider two non-agricultural growth scenarios in this section. Scenario 5 focuses on industrial sector while scenario 6 is for the service sector. In both scenarios we try to evaluate how accelerated growth in either industrial or service sector will contribute to the overall growth and structural transformation in Ghana. To finance growth acceleration in manufacturing, we also assume that foreign inflows will rise to finance the increased demand for capital goods.

The initial conditions limit the role of industrial growth in Ghana

149. The industrial sector as a whole accounts for 30.5% of the economy in 2007 (Table 22, Part B). If mining is excluded (and construction and utilities included), the share falls to 21%. Manufacturing alone accounts for less than 10% of total GDP and the share has been declining in the recent years. However, both shares of industry and manufacturing are similar to the corresponding shares in Malaysia in 1965. Industry's share of GDP is also similar to that of Thailand in 1976, India's in 1992, and Vietnam's in 1997. On the other hand, the share of manufacturing in these three countries' economies then was much higher compared with Ghana's in 2007. Ghana's manufacturing accounted for less than 30% of industrial GDP and was dominated by activities heavily dependent on agricultural inputs, such as food and wood processing. As a whole, agriculture-related manufacturing accounted for 64% of manufacturing GDP in 2007.

150. In scenario 5, we accelerate industrial growth, especially in the manufacturing sectors (*i.e.*, food and wood processing, textiles, clothing, and footwear). Most of the agriculture-related manufacturing sectors are labour intensive and are expected to generate more labour demand, which is an important factor explaining the structural change in employment among successfully transforming developing countries. Growth in the manufacturing sector is also expected to increase the sector's exports and lower its imports, such that more domestic demand is satisfied by domestic production rather than imports. This will further affect the trade structure of the country. In 2007, manufacturing as a whole exported only 14.9% of its production (Table 25, part A), generating 14.2% of the country's total exports (Table 32, part A). Agriculture-related manufacturing is more export intensive as exports are equivalent to 27.6% of the sector's output value (Table 25, part A). On the other hand, domestic demand for manufacturing was heavily dependent on imports, which accounted for 56.6% of domestic manufacturing consumption in 2007 (Table 25, part B), and 92.4% of total imports (Table 32, part B). However, the share of imports in the agriculture-related manufacturing consumption was relatively low, about 40.9% of domestic consumption (see Table 25). A precondition for accelerated manufacturing growth in Ghana is therefore to improve the sector's global or regional competitiveness such that its exports increase or imports decline.

151. With exogenously increased productivity, average annual growth rate for industrial GDP rises to 7.8% from 5.0% in the base-run. In particular, growth in manufacturing production accelerates to 9.7% and 11.2% for the agriculture-related manufacturing in this scenario (Table 33 part B). Compared with the base-run scenario, the growth rate for manufacturing in this scenario (scenario 2) is 3.8 percentage points higher and for agriculture-related manufacturing is 5.6 percentage points higher. Increased productivity in the country's manufacturing sector allows the sector to hire more labour relative to capital given its labour intensive structure. Competition with other sectors for hiring labour also attracts new capital investments

such that productivity-led growth results in capital accumulation, and hence, further enhances the sector's growth.

152. Productivity-led growth improves the country's competitiveness in the manufacturing sector, as the model results show that manufacturing exports grow more rapidly than the sector's production as a whole in this scenario. Total manufacturing and agriculture-related manufacturing exports grow at 10.2% and 10.3% annually, respectively, compared with 4.1% in the base-run scenario (see Table 34). This results in a surge of the share of manufacturing exports in manufacturing production increasing to 21.1% and agriculture-related manufacturing exports as a share of agriculture-related manufacturing production increasing to 34.4% (Table 25, part A). While increased manufacturing production stimulates demand for imported intermediates and capital goods, annual growth in manufacturing imports keeps at its base-run level in this scenario. One the other hand, productivity-led growth helps the domestic agriculture-related manufacturing substitute for imports, since most of these goods are produced for domestic markets. Annual growth rate of agriculture-related manufacturing imports declines from 4.9% in the base-run to 3.2% in this scenario (Table 34). With import substitution in the agriculture-related manufacturing sector, ratio of imports to domestic consumption of agriculture-related manufacturing products falls to 29.7% by 2020, down from 40.9% in 2007. For the manufacturing sector as a whole, however, imports still account for 52.3% of domestic consumption by 2020 - only a slight decrease from 56.6% in 2007, driven by increased imports of capital goods to meet investment needs (Table 25).

153. The surge in manufacturing exports significantly raises the sector's contribution to total export growth, yet it also reduces agricultural export growth. Rapid growth in the processing sectors increases their demand for raw materials (often agricultural goods) and hence reduces the availability of these primary agricultural products for direct export. Closer inspection shows that the increase in manufacturing exports is driven by growth in cocoa processing and wood products, which account for 24% and 57% of agriculture-related manufacturing exports in 2007, respectively. Growth in these sectors' exports leads to declines in the growth of cocoa and forestry exports (from 3.8% annually in the base-run to 2.8% in this scenario for cocoa and from 6.4% to 1.8% for forestry, Table 34). Average annual growth in processed cocoa exports increases from 6.4% (in base-run) to 7.3% in this scenario and from 3.3% in base-run to 8.8% in this scenario for wood and wood product exports. As a consequence, part of primary agricultural exports is replaced by exports of processing goods with higher value-added content. Other labour-intensive manufacturing that uses agricultural goods as inputs also grow, such as meat and fish processing, textiles, clothing, and footwear. Compared with the base-run scenario, scenario 5 shows the share of agricultural exports in total exports falling from 39.7% in 2007 to 29.3% by 2020, driven mainly by a slowdown in cocoa exports. Cocoa exports account for 25.7% of total exports in 2007 and fall to 19.5% by 2020 in this scenario (Table 32, part A). Under scenario 5, Ghana experiences a relatively large structural change within the industrial sector. The share of manufacturing in industrial GDP rises from 33.2% in 2007 to 44.9% by 2020 (Table 33, part A). However, the overall economic structure has only changed modestly. The share of industry in the overall economy increases from 30.5% of total GDP in 2007 to 31.5% by 2020. This result is not comparable with the historical experiences of the Asian countries that have successfully transferred their economies in 1980s or in the recent years. For examples, in Indonesia and Malaysia, the two countries with similar initial manufacturing share of GDP at the beginning of transformation as Ghana's today, the manufacturing's shares of total GDP increased 15 and 11 percentage points, respectively, during the country's transformation periods (1974–1995 for Indonesia and 1960-1977 for Malaysia), leading significantly increase the role of industry in the economy.

Table 32. Structure of Ghana exports and imports in model results (2020)

	Initial value in 2007	Base-run	Scenarios with growth in: Staples	Export agriculture	All agriculture	Industry	Services	Combined
Part A. Sector share in total exports (%)								
Agriculture	39.7	38.6	37.7	48.0	47.2	29.3	31.7	34.2
Cocoa exports	25.7	21.9	21.8	27.6	27.6	19.5	18.8	22.6
Forestry exports	12.2	14.1	13.3	15.7	14.9	7.6	10.6	7.7
Non-agricultural	60.3	61.4	62.3	52.0	52.8	70.7	68.3	65.8
Mining	30.9	30.8	30.6	27.2	27.2	31.0	25.1	24.1
Manufacturing	14.2	12.7	13.7	9.7	10.4	25.0	10.0	18.8
Agriculture-related manufacturing	13.8	12.3	13.3	9.4	10.1	24.6	9.7	18.5
Service net exports	15.2	18.0	18.0	15.0	15.3	14.7	33.2	22.9
Part B. Sector share in total imports (%)								
Agriculture	7.6	7.3	4.7	7.6	5.0	9.3	8.0	6.7
Rice	3.7	3.3	2.0	3.4	2.2	4.0	3.5	2.6
Poultry	1.0	1.2	1.2	1.1	1.1	1.2	1.3	1.3
Non-agricultural	92.4	92.7	95.3	92.4	95.0	90.7	92.0	93.3
Manufacturing	92.4	92.7	95.3	92.4	95.0	90.7	92.0	93.3
Agriculture-related manufacturing	18.6	19.1	19.3	19.6	19.9	14.8	19.6	16.0

Source: Ghana DCGE model results.

Table 33. Structure of industry and its sub-sectors' contribution to industrial growth in model results

			Scenarios with growth in:					
	Initial value in 2007	**Base-run**	**Staples**	**Export agriculture**	**All agriculture**	**Industry**	**Services**	**Combined**
Part A. Structure of industry, 2020 (%)								
Industrial share of GDP	30.5	29.1	29.0	27.7	27.6	31.5	28.6	29.7
Share in Industrial GDP								
Construction	34.5	28.7	29.0	30.7	31.0	23.1	32.1	27.0
Manufacturing	33.2	36.3	36.5	34.6	34.7	44.9	34.6	42.8
Agriculture-related manufacturing	21.1	23.9	24.5	22.3	22.9	32.6	22.4	30.7
Other manufacturing	12.0	12.3	11.9	12.2	11.8	12.3	12.3	12.1
Mining	22.0	23.6	22.9	23.0	22.4	21.4	21.6	19.1
Other industry	10.4	11.5	11.6	11.8	11.9	10.6	11.6	11.1
Part B. Average annual growth rate, 2008-2020 (%)								
Industrial growth rate		5.0	4.9	4.8	4.8	7.8	5.0	7.8
Construction		4.2	4.2	4.5	4.5	6.8	4.9	7.8
Manufacturing		5.1	5.1	4.5	4.5	9.7	4.5	8.9
Agriculture-related manufacturing		5.6	5.7	4.8	4.9	11.2	4.8	10.3
Other manufacturing		4.2	3.9	3.9	3.6	6.1	4.0	5.6
Mining		4.7	4.6	4.6	4.5	5.2	4.5	4.8
Other industry		7.2	7.2	7.2	7.2	9.1	7.2	9.3
Part C. Contribution to industrial growth, 2008-2020 average (%)								
Industrial growth contribution to GDP		28.1	26.2	25.3	22.1	41.3	24.6	32.1
Contribution to industrial GDP growth								
Construction		26.1	26.5	29.9	30.3	24.3	32.4	30.0
Manufacturing		36.2	36.2	31.9	31.9	49.1	31.7	44.3
Agriculture-related manufacturing		25.6	26.6	21.8	22.8	39.2	21.7	35.2
Other manufacturing		10.5	9.5	10.0	9.1	9.6	10.0	8.8
Mining		21.7	21.1	21.4	20.9	14.4	19.7	12.6
Other industry		16.0	16.1	16.7	16.9	12.3	16.1	13.0

Source: Ghana DCGE model results.

Table 34. Annual growth in exports and imports in model results (2008-2020 average) – per cent

		Scenarios with growth in:					
	Base-run	Staples	Export agriculture	All agriculture	Industry	Services	Combined
Total exports	5.2	5.1	5.9	5.8	5.6	6.7	7.3
Agriculture	5.0	4.7	7.5	7.2	3.2	4.9	6.1
Cocoa	3.8	3.7	6.5	4.7	2.8	3.3	10.2
Forestry	6.4	5.8	8.1	7.5	1.8	5.8	3.8
Others	8.1	7.9	14.1	13.9	7.4	8.3	13.8
Non-agriculture	5.3	5.3	4.7	4.7	6.9	7.8	8.1
Mining	5.1	5.0	4.9	4.8	5.7	5.0	5.3
Manufacturing	4.1	4.7	2.8	3.3	10.2	3.7	9.6
Agriculture-related manufacturing	4.1	4.7	2.8	3.3	10.3	3.6	9.7
Services	6.5	6.4	5.8	5.8	5.4	13.3	10.7
Total imports	4.7	4.6	5.2	5.1	5.0	5.7	6.1
Agriculture	4.3	0.7	5.1	1.7	6.6	6.1	5.1
Rice	3.7	0.0	4.4	1.1	5.8	5.3	3.1
Poultry	5.8	5.6	6.1	6.0	6.2	7.2	7.7
Non-agriculture	4.7	4.9	5.2	5.3	4.9	5.7	6.2
Manufacturing	4.7	4.9	5.2	5.3	4.9	5.7	6.2
Agriculture-related manufacturing	4.9	4.9	5.6	5.6	3.2	6.2	4.9

Source: Ghana DCGE model results.

154. There are four main reasons why the rapid growth in industry simulated in the model, especially in manufacturing, does not result in a significant change in Ghana's economic structure compared with the Asian experiences. First, the agricultural sector accounts for a relatively larger share in Ghana's economy than in most the Asian countries at the time they started to transform their economies from low- to middle-income-country status. Because of the difference in Ghana's initial economic structure, relatively rapid growth in the agricultural sector seems to be a precondition for the accelerated overall economic growth. Without agricultural growth, rapid growth in other sectors will not significantly increase per capita incomes in Ghana.

155. The second reason why industry's share only increases modestly in this scenario is the high dependency of manufacturing growth on material inputs from the agricultural sector. Agriculture-related manufacturing, such as food, cocoa and wood processing, accounts for more than 60% of Ghana's manufacturing industry. This implies that growth in these manufacturing sectors depends on growth in agriculture, which not only provides inputs to manufacturing production but also lowers the cost of inputs, especially if agricultural growth is driven by productivity increases. Textiles, clothing, and footwear also use agricultural raw materials as inputs but are considerably less dependent on agriculture because labour forms a much larger share of production costs than intermediate inputs. These sectors have played a key role in the rapid growth of the manufacturing industry in China and Vietnam. However, those subsectors are quite small in Ghana, accounting for 6% of total manufacturing output value. Therefore, even with more than 10% annual growth in production in these subsectors, their share in total manufacturing could not rise significantly under this scenario.

156. The third reason is related to demand constraints for certain food-processing products. Many food-processing products are produced for domestic markets. Without additional growth in other sectors, especially in agriculture, the incomes of most rural households that depend on agriculture for their livelihoods cannot grow at a similar speed as growth in the supply of processed foods. As a result, prices for some food-processing sectors fall. While this can benefit rural and urban households as consumers, it limits the growth potential of these sectors because their growth cannot deviate greatly from agricultural and other sectors' growth rates. The model includes two kinds of food-processing sectors, one of which includes informal or local foods and is located mainly in rural areas. This sector's growth is more constrained by rural income growth, for which the major source is agriculture. Accordingly, growth in informal food processing cannot departure too much from agricultural growth in total.

157. Finally, the mining sector plays a limited role in accelerating industrial growth. Under the base-run scenario, the sector grows around 5.1% on average each year. By factoring in the potential growth due to newly found oil resources, mining growth reaches 5.7% annually. Still, the contribution of this resource driven growth to the overall economic growth remains rather limited.

158. In summary, this scenario underlines the importance of the manufacturing sector for accelerating growth in Ghana and helping the country reach MIC status. However, it also shows that the manufacturing sector's growth capacity is constrained by agricultural and rural income growth. Agriculture has to support manufacturing growth by providing cheap raw materials and increasing rural incomes to expand domestic market opportunities for non-agricultural goods. To speed up manufacturing growth rates significantly beyond agriculture's growth rates, the country will have to develop more export-oriented manufacturing. Those sectors should be less reliant on agricultural inputs, like the labour-intensive manufacturing sectors that developed rapidly in China and Vietnam.

The role of the service sector: lowering service costs for productive sectors is a key

159. Development experiences show that the expansion of industry was often accompanied by growth in services. In China and Vietnam, for example, the rise in the contribution of services to GDP during the transformation periods mirrored the relative decline in agriculture's contribution. Moreover, the service sector in India has been a leading driver of economy-wide growth. Even during Malaysia's transformation period, when services did not grow as rapidly as agriculture and manufacturing, the large size of the service sector meant that its contribution to the economy was important for sustaining high overall growth. Therefore, we design scenario 6 to show how accelerated growth in Ghana's service sector can contribute to the overall growth and structural change in Ghana.

160. The service sector already forms a large part of the Ghanaian economy, accounting for more than one-third of total GDP. It is difficult to compare the service sectors of various countries given the diversity of its subsectors: public and private, traded and non-traded, technology intensive and unskilled labour intensive, and high and low value. In Ghana, the government forms a large component of service sector, accounting for one-third of the overall sector (Table 35, part A). By contrast, export-oriented services, such as luxury hotels, restaurants, tourism and finance, account for only 2.1% of service GDP. The remaining private services are domestic market oriented, such as trade, transport, communications, and business services. Although government administration is an important employer, it is generally not a productive sector and is unable to become a primary driver of real economic growth and structural transformation. Therefore, in this scenario, we did not increase the public sector, opting rather to focus on private sector services, both export and domestic oriented. The private services account for 23% of total GDP in Ghana, which is more than the size of manufacturing and construction together.

Table 35. Structure of services and its sub-sectors' contribution to service growth in model results

			Scenarios with growth in:					
	Initial value in 2007	**Base-run**	**Staples**	**Export agriculture**	**All agriculture**	**Industry**	**Services**	**Combined**
Part A. Structure of services, 2020 (%)								
Services share in GDP	34.4	36.0	36.3	35.1	35.4	35.5	38.2	36.4
Share in Service GDP								
Private	65.9	66.0	66.1	66.0	66.1	66.5	67.6	68.0
Export-oriented	2.1	2.1	2.1	2.0	2.0	1.9	3.0	2.3
Public	32.0	31.9	31.8	32.0	31.9	31.6	29.4	29.7
Part B. Average annual growth rate, 2008-2020 (%)								
Total services		6.1	6.2	6.1	6.1	6.1	8.4	8.2
Private		6.2	6.2	6.2	6.2	6.2	9.4	9.3
Export-oriented		4.8	4.6	4.3	4.2	3.8	8.1	5.8
Public		6.1	6.1	6.1	6.1	6.0	5.9	5.9
Part C. Contribution to services growth, 2008-2020 average (%)								
Service growth contribution to GDP		42.0	39.8	39.3	37.4	36.6	52.5	40.8
Contribution to service GDP growth								
Private		66.8	67.0	66.8	67.0	67.5	75.7	76.2
Export-oriented		1.6	1.6	1.5	1.4	1.2	2.4	1.6
Public		31.5	31.4	31.7	31.6	31.3	21.9	22.2

Source: Ghana DCGE model results.

161. Although services include the more labour-intensive trade and transport sectors, it also contains some of Ghana's more capital-intensive sectors, such as finance and communications. Therefore, in this scenario, we model an increase in both productivity and capital accumulation. As in the previous scenario, additional capital growth is financed through increased foreign inflows. However, since the service sector as a whole is less capital intensive than industry, the increase in foreign-financed investment is smaller than what was assumed in the previous scenario. Together these assumptions cause service GDP growth to increase from 6.1% in the base-run to 8.4% per year in this scenario (see Table 22, part A), similar as the increase in industrial growth in the previous scenario. Total GDP growth rises from 5.2% in the base-run to 6.0% per year.

162. The service sector is expected to have strong growth linkages in the economy. Private services, especially trade and transport, are important sources of employment, responsible for one in five unskilled jobs in Ghana. Trade and transport services are important inputs for other sectors in the economy, accounting for 7.4% of the overall cost of their production. Service-related spending also comprises 13.8% of the average cost of investment. Finally, according to GLSS5, private services make up 12.1% of the average household's consumption basket, and households tend to spend a greater share of their incomes on private services as their incomes rise. Therefore, expanding growth in private services has a significant effect on economywide growth that is beyond the service sector itself.

163. The most important channel through which rapid growth in services affects non-service sectors is to lower the service costs following improvements in the service sector's productivity. The domestic service price index falls by an average of 2.7% per year in this scenario. That lowers production costs for both agricultural and industrial sectors. However, growth in the export service sectors competes for resources with other sectors, particularly industrial sectors. This is partly due to the relatively stable prices for export services and may negatively affect growth in the other sectors. In total, contribution of services to GDP growth rises from 42.0% in the base-run to 52.5% in this scenario, while the service sector's share in GDP only rises modestly, from 36.0% in the base-run to 38.2% in this scenario (Table 22, parts A and C).

164. So far we have emphasized the growth-linkage effects of private domestic-oriented services as the main reason why service-driven growth generates more economywide growth. Export services also contribute positively to faster overall growth. Export services generated 15.2% of Ghana's export earnings in 2007 (Table 32, part A), and there is potential to expand services further, such as tourism, hotels, and business services. Under this scenario, we assumed that productivity in export-oriented services would increase such that the subsector's average growth rate would increase from 4.8% per year in the base-run to 8.1% per year (Table 35, part B). Service exports grow even more rapidly, accelerating from 6.5% to 13.3% per year (see Table 34). However, given the small initial size of this subsector in the economy, its contribution to the total service growth is modest, rising from 1.6% in the base-run to 2.4% in this scenario (Table 35).

165. In summary, the service growth scenario clearly demonstrates the significant contribution of the service sector. Ghana undoubtedly has the potential to expand export services, such as tourism and business services, and provide substitutes for imported services. However, this subsector is currently very small compared with domestic-oriented services. Thus, even if the growth rate of Ghana's export services were to match that of India, it is unlikely that such growth in its current form could engender significant economywide growth and structural transformation. The benefits of service sector growth are not limited to exports. The model demonstrates that higher economywide growth can be stimulated through expanding domestic services, especially in the trade and transport sectors. It is the strong growth linkages of the service sector that explain, at least in part, why countries like Thailand and China have experienced more rapid service sector growth alongside manufacturing-led transformations.

Agriculture will continue to be a large sector even with rapid growth in non-agriculture

166. The above analysis shows that, given Ghana's current economic structure and various initial conditions, accelerated growth in any sector will be constrained by required simultaneous growth in the other sectors. Therefore, broad based growth across sectors will be necessary for Ghana. In the final scenario (scenario 7) we combined the labour, land, capital, and productivity growth assumptions we applied in the previous three scenarios (Scenarios 4, 5, and 6) to evaluate the joint impact of accelerated growth for the economy as a whole. In this scenario, agriculture grows at 5.8%, industry at 7.8% and services at 8.2% (Table 22, part A). With this combined growth acceleration in all sectors, total GDP growth rises to 7.3% per year, and per capita GDP annual growth rate is 4.8%, both are higher than the growth performance of Ghana's economy in the recent years. With such growth, Ghana will achieve its goal of middle income country status and per capita income will be USD 1 077 by 2020, almost more than 60% higher than the 2007 level (Table 22, part D).

167. While simulated growth in this scenario will be much impressive than what Ghana has achieved in the recent years, structural change, in terms of sectoral composition, remains limited, despite differing growth rates across sectors. Although the annual growth rate of agriculture is the lowest among the three sectors, agriculture's share of total GDP remains at 33.8% (only 1.3%age point less than the share in 2007). With 7.8% annual growth, industrial sector's share in GDP remains constant and even falls slightly from 30.5% in 2007 to 29.7% by 2020. With the highest growth in the service sector, the sector's share of GDP increases by two percentage point, from 34.4% in 2007 to 36.4% in 2020.[12]

168. While the simulation result in terms of structural change is inconsistent with experiences of most Asian countries in their transformation process, it is indeed consistent with the country's situation in the recent years. The difficulty to change Ghana's economic structure even with rapid growth further emphasizes the path dependency of growth and the importance of initial conditions in development. High dependency on imports for manufacturing indicates that current domestic manufacturing is unable to compete internationally. Rapid growth in the manufacturing sector is possible by improving the sector's competitiveness, as assumed in our simulation, while it also requires to low prices for most manufacturing goods that are currently produced domestically. Thus, share of manufacturing in GDP will not necessary to rise when accelerated growth occurs. On the other hand, industry other than manufacturing and services are dominated by non-tradable goods. With increased household income and rapid urbanization, prices for such goods and services will either keep high or further increase. This implies that shares of non-tradable industry (such as construction and urban water and electricity supply) and services in GDP will continue to rise, which further affects the competitiveness of manufacturing sector. Thus, it can be expected that, different from experiences of rapid growing Asian countries, agriculture in Ghana will continue to be an important sector in terms of its size in the economy even when the country will become a middle income country with 4.8% of per capita annual growth in next 12 years.

9. Conclusions

169. Ghana has become a success story in Africa in the recent years. After more than 20 years' steady economic growth and significant poverty reduction, Ghana is aiming to become a middle income country in next 10 to 15 years. Outcome of transformation in many Asian countries is often characterized by a declined share of agriculture in GDP and increasingly important role of manufacturing in leading growth in

12. Recent discovery of oil and development of oil industry will change the structure of Ghana's GDP. While oil sector's value added is counted as part of Ghana's GDP statistically, given that oil industry is extremely high capital intensive and will be operated by foreign companies off shores, oil GDP will add little to households' income and only increase government revenue (Diao and Breisinger 2010). For this reason, we do not consider it as part of structural change in this report, *i.e.*, such oil value-added is not included in the simulations and hence GDP growth.

the transformation process. Will it also be the case for Ghana when Ghana is becoming a middle income country? What will be the role of agriculture in Ghana's new development process in the future? To answer these questions, in this report we adopt a forward looking approach by applying a dynamic CGE model to a series of possible growth scenarios. Moreover, the role of agriculture for poverty reduction is analyzed both for the past and the future. We focus on the relationship between poverty and income generation, based on the three runs of national representative household surveys, to understand the role of agriculture in the past poverty reduction. By linking the economywide CGE model with a micro simulation model, we simulate the poverty outcome of accelerated agricultural growth in the future. The following conclusions can be drawn from the analysis of this report.

170. First, the forward looking analysis of the dynamic CGE model shows that, even with much higher growth in the non-agricultural sector, agriculture will continue to be an important sector in terms of its size in the economy. Rapid growth in the manufacturing and export services can only occur when these sectors significantly improve their international competitiveness. However, with high dependency on imports for manufacturing, such growth also implies to lower prices for manufacturing goods produced domestically, which leads to lower the share of this sector in total GDP. Domestically oriented industry (*e.g.* construction) and services can only grow with income growth for a majority of households and rapid urbanization. Hence, rapid growth in non-traded industry and services is rather an outcome of broad-based growth, including growth in agriculture, and it will be unlikely to become a main driver to lead the economywide growth. Moreover, the initial conditions of structures and competition capacity of industry and services indicate that Ghana will unlikely become an African "Tiger" in next 10 years and will unlikely observe rapid structural change in its economy. Agriculture will continue to be an important and big economic sector even when Ghana manages to become a middle income country in the next 10 years.

171. Secondly, broad-based agricultural development is a key for transformation in Ghana. Due to the agricultural sector’s important role in the economy and for people’s incomes, accelerating agricultural growth is a must for reaching the MIC target. Experiences from all successfully transforming countries suggest that agricultural growth must be broad-based. In reality, more than 20% of GDP and almost two-third of agricultural GDP in Ghana are staple crops and livestock production. While most staples are "self sufficient" products in the country, and hence their growth has to match with income growth for both rural and urban households, imports have been increasingly competing with domestic production for cereals and livestock products. To be able to compete with imports, productivity-led growth must lower domestic prices for these products. The model results show that import-substitution is possible for rice, for which 70% of domestic consumption has currently be met by imports. Ghana's potential in competing for poultry imports seems to be much limited and realization of such import substitution will unlikely occur.

172. Thirdly, exploring agricultural potential is a key for agricultural growth. Land expansion, which is the dominant source of recent growth, should not be seen as a main engine of further agricultural growth. Continuous expansion of land implies a growing risk of environmental degradation when land quality has been deteriorated by over-farming and the low application rates of fertilizer. It is possible for Ghana's agriculture to grow through productivity increase. Simulation results show that by closing the existing yield gaps in crops, together with comparable productivity growth in the livestock sector, Ghana will be able to reach 6% average annual agricultural growth over the next 10 to 15 years, a growth rate consistent with the CAADP goal set by African policymakers.

173. Fourthly, contribution of agricultural growth to the overall economic growth is often invisible, which leads to underestimate the role of agriculture. Experiences of Asian countries show that unleashing a green revolution has often required massive public investments, and it is often a question about the cost of such growth acceleration in Africa. By taking into account both visible and invisible transfers from agriculture to the non-agricultural economy the modelling analysis shows that agricultural growth will provide huge benefits to the economy. Measured in monetary terms, total financial transfers from

agriculture to the rest of the economy is equivalent to 15% of increased GDP in the next 12 years. Invisible transfers such as achieved through lowering food price are the dominant source for this substantial contribution. This finding provides further evidence on the important role agriculture that can play in economic development and the urgent need to support agricultural growth through raising investment.

174. Fifthly, agricultural growth has played the key role in past poverty reduction, which allows the country to become one of few African countries that will achieve MDG1 of halving 1990s poverty rate early than targeted year of 2015. Analysis based on the last three runs of national representative household surveys shows that, agricultural crop production is the most important activity for a majority of rural households both as income-generating activity and as a source of income. The importance is particularly higher for the poor than for the non-poor. While income share of crop production in total income has been declining over time between 1992 and 2006, considering crop and livestock together, agriculture still provides more than or close to 50% of total income for most rural households and only in the coastal zone share of agricultural income for the rural households as a whole fell to 40% in the most recent survey. Existence of spatial difference in the importance of crop production as a source of income for rural households indicates the need to have different policies among different zones in poverty reduction.

175. Sixthly, the analysis of the three runs of household surveys also shows that non-farm employment opportunities provided by the non-agricultural sectors to the rural households are still very limited even in the most recent survey. This is particularly true for households in the two savannah zones. Moreover, share in the total income generated from non-farm employment activity is lower than the non-farm employment participation rate. Further breaking down into the poor and non-poor household groups within each zone, it shows that only for the non-poor households in coastal and forest zones such opportunity provide slightly more than 10% of total income for the rural households, while for all poor household groups and for the other two non-poor groups, non-farm wage employment provided only 1.4%-7.3% of total income. Thus, it is unrealistic to consider non-agricultural growth as a main source to further reduce poverty nationwide.

176. Finally, the forward looking analysis shows that further poverty reduction should focus on reducing regional income gap between north and south. Results from the modelling analysis show that broad-based agricultural growth benefit the poor everywhere. At the national level, the poverty rate will be halved one year earlier under the agricultural scenario compared to that under the base-run. This translates into additional 400 000 people (mostly from rural areas) moving out of poverty by 2015. However, additional poverty reduction in the North is unlikely to be more than that in the other regions. Given the high initial poverty rate in the North, level of income for a majority of the poor in the north is far below the poverty line defined for the country as a whole. Increased income for the North poor, even their income growth rate can be as high as for the households elsewhere, is still not enough for lifting many of them out of the poverty. The poverty rate in this region will remain at a high level of 56% by 2015, further increasing the poverty gap between North and South. Difficulty to lower poverty rate in the poorest area of the country (*i.e.* in the North) calls a special attention that should be paid to populations whose income is far below the poverty line and more targeted policies and investments that are urgently needed. Thus, while halving the 1990s poverty rate earlier than targeted year of 2015 will be a big success for Ghana's development, the continuous fight against poverty in this country will have to increasingly concentrate on the poorest of the poor, and most of them live in the North.

177. Agricultural development requires a comprehensive long term strategy and such a strategy needs to be supported by long term commitment both from the government and international development partners. While opportunities for agricultural growth are there, challenges to realize them are huge. For example, the achievable yields underlying the simulation results are based on field trials that have been conducted with an optimal package of inputs. However, the analysis based on the recent household survey (GLSS5) indicates that the use of modern inputs at the farm level is still low in Ghana, and the

difference in yields (*e.g.* in the case of maize) between households that use and do not use these inputs is small. The tomato case study shows that low land productivity is not only an issue for staple crops and it is the first important challenge for the promotion of high value crop. While tomato productivity is critically affected by the choice of varieties more than by other factors, many factors have influenced the choice of varieties by farmers such as access to seeds, growing technologies, available markets, yield potential, prices and risk.

178. While productivity of crop production is associated with the intensive use of input, yield can be increased through better land management and farming practices, and weed and pest controlling. A number of poor practices have been identified from this regard, which suggests poor land husbandry are common to farmers through the country. The inappropriate ways to apply tools and modern inputs and lack knowledge for chemical inputs and how to get a good price also constrain farmers for profitability. The modest impact of fertilizer on maize yields is also confirmed by Branoah Banful *et al.* (2009), who assess the recent government's fertilizer subsidy program in Ghana. These results caution against overemphasizing the importance of fertilizer as a silver bullet. Rather they confirm the findings from other studies that stress the importance of a comprehensive approach for raising agricultural productivity sustainably, which includes a focus on rural roads to reduce input prices (fertilizer and pesticides), extension services and training of extension agents to spread knowledge of improved land management and farm practices, and more R&D to provide high-yield seed varieties to the market.

179. Labour constraint should also be considered when promoting intensive farming practice in Ghana. The analysis of GLSS5 data shows that almost 50% of rural households need to hire labour, particularly during land preparation, weeding and harvest. Herbicide is thus a popular input in crop production. While it is a substitute for labour for weeding, it is also important for improving yields (or preventing yield losses). In a relatively land abundant country like Ghana that is dominated by smallholder agriculture, labour constraints will become increasingly important due to both demand for and supply of labour. Increasing crop yields often requires additional labour inputs for certain farm practices. At the same time, a significant increase in yields often requires additional labour for harvesting. Labour supply side factors are related to rural-urban migration that is expected to further speed up in the process of transformation. To address both seasonal and permanent labour constraints, mechanization has a long history in Ghana and has recently been revived by the government as a possibility to foster intensification. Moreover, Ghana's recent policy of advancing mechanization emphasizes the importance of public-private partnerships. The government supports the imports of equipment by providing credit to private tractor service centres and the service centres provide fee-based tractor services to farmers. However, given that there has been an intense debate about the merits of mechanization and how it should be promoted in Africa (see, for examples, Pingali *et al.* 1987 and Mrema *et al.* 2008 for extensive reviews on this topic), it is worth to revisit the main arguments from this literature in order to provide practical policy suggestions.

180. Growth in agricultural productivity also results from promoting new activities and exploring additional market opportunities that increase the value addition of agricultural production. For example, the recent spike in global energy prices has led to foreign investments in biofuel production, the FAO projects that Ghana will be among the biggest producers of Jatropha in Africa by 2015 (FAO and IFAD 2010). At the same time, the spike in global food prices has encouraged the private sector to invest in agro-industries in Africa, including Ghana. As in the case of manufacturing, it is important to enhance the linkages between foreign investment in agriculture and the rest of the sector and the rural economy in order to foster spillover effects. For example, out-grower schemes have stronger linkage and poverty reduction effects than plantations, a finding that needs to be considered when governments negotiate with investors (Arndt *et al.*, 2008). Supporting rural producer groups is another field where the government can play an important role, including through capacity building for leaders to manage and participate in high-level negotiations and for the weaker members of the groups to achieve a voice within the groups. Promoting modern information and communication systems helps enabling producer groups to access market

information and acquire professional advice necessary for modern supply chain management and effective participation in the policy dialogue (World Bank 2008).

181. Opportunities for structural change within the agricultural sector and hence increasing agricultural productivity through diversification also exist. With rising rural and urban incomes and rapid urbanization, many agricultural products move from subsistence to marketed crops. The tomato case study synthesized in Section 4 of this report shows that while imports of tomato paste have threaten the development of agro-processing industry, rapid increases in demand for such processed products by domestic consumers will offer market opportunities for developing various high value crops that will support diversification in agriculture and more income to farmers. An important policy question is what supportive role the state can play in this process and how to attract foreign investment and private enterprises to develop these products along the value chains both in manufacturing and in agriculture. Lessons from successful examples of public-private initiatives in other developing countries, such as the development of salmon industry in Chile (Rodrik, 2007), may help to provide practical policy advice.

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APPENDIX

Table A1. Sectors/commodities in the Ghana DCGE model

Agriculture	**Industry**	Industry (cont.)
Cereal crops	Mining	Electrical machinery
Maize, rice, sorghum/millet,	Gold	Television
other cereals	Other mining	Medical appliances
Root crops	Food processing	Vehicles
Cassava, yams, cocoa yams	Formal food processing	Vehicle parts
Other staple crops	Informal food processing	Other technical equipment
Cowpea, soybeans,	Cocoa processing	Other manufacturing
groundnuts,	Sugar processing	Other industry
fruit (domestic),	Dairy products	Construction
vegetables (domestic),	Meat and fish processing	Water
plantains, other crops	Other manufacturing	Electricity
Export crops	Textiles	**Services**
Palm oil, other nuts,	Clothing	Private
other nuts, fruit (export)	Leather and footwear	Trade services
vegetables (export),	Wood products	Export services
cocoa beans,	Paper, publishing and printing	Transport services
industrial crops	Crude and other oils	Communication
Livestock	Petroleum	Banking and business
Chicken broiler,	Diesel	Real estate
Eggs and layers,	Other fuels	Public and community
Beef	Fertilizer	Community, other services
Sheep and goat meat	Chemicals	Public administration
Other meats	Rubber products	Education
Forestry	Other non-metal products	Health
Fishery	Machinery	

Source: Ghana Social account Matrix 2007.

Table A2. Elasticities in value added, Armington import and CET export functions

	Elasticity in CES value added function	Elasticity for import substitution (in CES Armington function)	Elasticity for export substitution (in CET function)
Agriculture			
Cereals	0.75	2.6-8.9	
Roots	0.75		
Other staples	0.75	3.7	4.0
Export crops	0.75	6.5	6.5
Livestock	0.75	6.0	4.0
Fishery and forestry	0.75	2.5-5.0	4.0-5.0
Industry			
Mining	0.75	6.0	6.0
Construction	0.75		
Agriculture-related manufacturing	0.75	5.2-8.8	4.0-8.1
Other manufacturing	0.75	5.9-10.4	1.0-7.7
Other industry	0.75		
Services			
Private	0.75		
Export-oriented	0.75	6.5	6.5
Public	0.75	4.0	4.0

Source: Ghana DCGE model.

Table A3. Household budget shares and income elasticities

	Current budget share (%)		Marginal budget share (%)		Income elasticity	
	Urban	**Rural**	**Urban**	**Rural**	**Urban**	**Rural**
Foods	43.5	52.0	34.6	49.0	0.8	0.9
Maize	0.8	1.8	0.4	1.2	0.4	0.7
Rice and wheat	3.7	4.3	2.6	4.4	0.7	1.0
Roots	3.0	2.6	2.2	3.3	0.7	1.3
Other staples	7.2	8.6	5.2	7.3	0.7	0.8
Plantain	1.2	1.1	0.9	1.3	0.8	1.3
Chicken	1.6	1.1	2.0	1.5	1.2	1.3
Other livestock	10.8	15.6	8.5	14.4	0.8	0.9
Fish	1.9	2.1	1.8	2.3	1.0	1.1
Other foods	13.3	14.7	10.9	13.2	0.8	0.9
Non-foods	46.1	37.0	56.6	40.0	1.2	1.1
Clothing	10.4	11.0	8.9	11.0	0.9	1.0
Other manufactures	7.0	9.6	6.9	9.7	1.0	1.0
Fuels	3.8	5.1	8.0	3.5	2.1	0.7
Durable equipment	9.4	4.8	20.9	7.6	2.2	1.6
Water and electricity	0.5	0.1	0.7	0.2	1.4	2.1
Services	25.4	17.4	20.0	19.0	0.8	1.1

Source: Authors' estimates using 2005–2006 Ghana Living Standards Survey.

Sensitivity tests

We focused our sensitivity test on the model results of scenario 6, the combined scenario. Specifically, we conducted four sensitivity tests. In test 1, we cut the elasticity in the Armington functions for imports by 50% (*i.e.*, reducing the elasticity from its original value at the commodity level by half) to test how sensitive the import substitution is in explaining the model results. In test 2, we cut the elasticity in the CET functions for exports by 50% to test the sensitivity in export substitutions. In test 3, we doubled the elasticity of substitution between factor inputs in the production function (from 0.75 to 1.5). In the last test, instead of doubling the elasticity in the production functions as we did in test 3, we lowered the value by 50% to 0.4. For each test, we reran the model with all other assumptions the same as applied in the combined scenario.

Table A4 reports the test results for some variables expected to be most sensitive to the choices of various elasticities. As the table shows, however, the model is very robust to changes in the values of elasticities, both in the trade and production functions. For example, halving the elasticities used in the trade functions changes the GDP per capita of 2015 by about USD 0 or USD 5, compared with the results from the original scenario. Lowering elasticity values in the production function causes a decrease of GDP per capita of USD 15 by 2015 from the original simulation result. This is the largest deviation from original results observed in all tests, but the difference is only equivalent to 1.6% of the total. We observed similar modest changes for the other variables, as reported in Table A6. Given this robustness to changes of key elasticities to different levels in the model, we have confidence in the model results.

Table A4. Sensitivity analysis

	Original combined scenario	Trade function		Production function	
		Test 1 Armington	Test 2 CET	Test 3 High	Test 4 Low
		50% lowered substitution elasticities		Doubling substitution elasticities	50% lowered substitution elasticities
GDP per capita in 2015 (current USD)	956	956	951	970	941
Average annual GDP growth, 2006–2015 (%)					
Total	7.6	7.6	7.6	7.7	7.6
Agriculture	6.9	6.9	6.9	7.2	6.5
Industry	8.9	8.8	8.8	8.8	9.1
Services	7.4	7.4	7.4	7.4	7.4
Exports (sector share of total, %)					
Agriculture	48.9	49.3	50.7	50.7	47.0
Industry	36.9	36.5	37.3	36.0	38.0
Services	14.1	15.0	14.3	13.3	15.0
Imports (sector share of total, %)					
Agriculture	5.9	5.7	5.7	5.8	6.2
Industry	85.8	86.0	86.1	85.8	85.7
Services	14.1	15.0	14.3	13.3	15.0
Investment to GDP ratio (%)	38.3	38.7	38.5	37.6	39.5
Sources of growth (%)					
Labour	22.3	22.3	22.3	21.6	22.9
Capital	7.4	7.4	7.5	8.6	5.8
Land	24.5	24.7	24.6	23.5	26.2
TFP	45.8	45.6	45.7	46.3	45.2

Source: Ghana DCGE model.