What does the future hold for the poor in Ghana?

An assessment of the impact of climate change

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Abstract

Ghana is considered a 'success story' of development in Africa. A growth rate of more than four per cent over the last two decades has resulted in an almost doubling of GDP and a dramatic improvement in poverty and food security. As a consequence, the country is on track to achieve MDG1 – halving the proportion of poor and hungry people – before 2015 and there is a strong likelihood that Ghana will achieve its goal of becoming a middle income country by 2020. Nevertheless, the government has recently identified climate change as a
major threat to economic growth and development. The exact impact of climate change depends on the size of the shock which is subject to uncertainty. This paper examines climate change as a potential threat to Ghana's development by evaluating the impact of a range of climate change scenarios.

The effect of climate change shocks on the lives of people will differ across households, depending on income, occupation, gender and location. It is expected that climate change will be particularly damaging to the agricultural sector, which, at 36 per cent of GDP, is a major contributor to economic growth. It is likely to negatively impact the cocoa sector which is an important source of export earnings. Climate change could therefore disproportionally affect the livelihoods of the rural poor and small scale (cocoa) farmers. Furthermore, through the effects of higher food prices and diminishing economic growth, climate change may also have a negative impact on income and food security of the urban population. Finally, since climate change is a global phenomenon, poverty and food conditions in Ghana will be affected by developments in other countries transmitted through international trade and foreign direct investment. This may offer opportunities, e.g. in terms of increased exports to countries whose agricultural production is negatively affected, but may also pose threats if crucial imports or investments fall away.

This paper presents the likely impact on poverty and food security in Ghana of differing degrees of climactic challenge. We consider three ranges of challenge: low, medium and high, where the low challenge corresponds to the IPCC shared socio-economic pathway, SSP1 'Sustainability', medium to SSP2 'Middle of the Road' and high to SSP3 'Fragmentation'. By examining this range of possible futures, we can provide a picture of the bounds of the impact on food security and poverty and highlight possible areas for policy intervention.

We conduct the analysis using the Modular Applied GeNeral Equilibrium Tool (MAGNET), a GTAP-based global economic simulation model. The model is extended to include several Ghana-specific features including cocoa as a separate crop, Ghana's main neighbouring and trading partners and most importantly, nine household types distinguished by location. The paper presents a SAM-based method for disaggregating the single representative household into multiple households types and integrates the households into the model using the MyGTAP approach. Capturing the heterogeneous effects on household groups in this way allows for a richer understanding of the impact on the three aspects of food security: availability, access and utilisation. In addition, we compute the standard Foster-Greer-Thorbeke poverty measures to indicate the change in poverty within each household group. The result is a Ghanaian-focused global CGE model that produces a detailed picture of the economy in 2030 and the degree to which climate change will threaten and potentially undo the development of the last two decades.

We expect to find that the high climate challenge lowers GDP growth compared to the reference scenario; with negative effects for poverty and food security. The results provide a vision of the future for which policy interventions can be identified as part of Ghana's mitigation and adaptation planning for the future. Furthermore, the results are likely to be of value not only to Ghana but also to surrounding countries with similar climates and economic structures.

1 Introduction

1.1 Motivation

Ghana is considered as a 'success story' of development in Africa. A growth rate of more than four per cent over the last two decades has resulted in almost a doubling of GDP and a dramatic improvement in poverty and food security. As a consequence, the country is on track to achieve MDG1 – halving the proportion of poor and hungry people – before 2015 and there is a strong likelihood that Ghana will achieve its goal of becoming a middle income country by the year 2020. Nevertheless, the government has recently identified climate change as a major threat to economic growth and development. Climate models predict an increasing variability in temperature and rainfall in all climatic zones, and a higher occurrence of extreme weather events such as droughts, which will adversely affect the economy (EPA, 2011). The World Bank (2010) estimates that GDP will be between 2 and 7 per cent lower in 2050 compared with a 'business as usual' projection without climate adaptation. Furthermore, Ghana's coastal zone, which is home to a quarter of the population, is expected to suffer from flooding as a consequence of rising sea levels.

In anticipation of these events, the government of Ghana has begun to incorporate climate change into key development policies and strategies and started the drafting of the National Climate Change Policy Framework (NCCPF) in 2010. The main aim of the NCCPF is "to ensure a climate resilient and climate compatible economy while achieving sustainable development and equitable low carbon economic growth for Ghana" (MEST, 2010, p. 8). The government also recently submitted Ghana's Second National Communication (SNC) to the United Nations Framework Convention on Climate Change (UNFCCC) which provides the latest outlook of climate change in Ghana and outlines the country's efforts to address its impacts (EPA, 2011). Both documents identify potential strategies and policies to facilitate climate change adaptation and mitigation, in particular the adoption of drought-tolerant crop varieties and participation in the Reducing Emissions from Deforestation and forest Degradation (REDD) initiative.

The effect of climate change shocks on the lives of people will differ across households, depending on income, occupation, gender and location. It is expected that climate change will be particularly damaging to the agricultural sector, which, at 36 per cent of GDP, is a major contributor to economic growth. It may in particular negatively impact on the cocoa sector which is an important source of export earnings. Climate change could therefore disproportionally affect the livelihoods of the rural poor and small scale (cocoa) farmers. Furthermore, through the effects of higher food prices and diminishing economic growth, climate change may also have a negative impact on income and food security of the urban population. Finally, since climate change is a global phenomenon, poverty and food conditions in Ghana will be affected by developments in other countries transmitted through international trade, foreign direct investment, migration and exchange rate mechanisms. This may offer opportunities, e.g. in terms of increased exports to countries whose agricultural production is negatively affected but may also pose threats if crucial imports or investments fall away.

Both the preparatory document for the NCCPF and the SNC highlight the urgent need for in-depth research and analysis to support the formulation of climate adaptation and mitigation change strategies. There is a necessity to fund the development of "robust climate scenarios for Ghana at the right scale" (SNC, p. 161) and a "pressing need for better projections on possible impacts, backed by effective knowledge systems to inform strategy, planning and practice" (MEST, 2010, p. 32). This paper aims to address these gaps by looking at the impact of climate change and climate change strategies on poverty and food security in Ghana using an applied modeling approach.

1.2 Objectives

The main objective of this paper is to assess the impact of climate change on economic development, poverty and food security in Ghana and to examine trade-offs between various climate change strategies.

Key research questions:

1. How will the economy grow and develop, and in particular in the agricultural sector, between 2010 and 2030, under various assumptions on climate change?
2. What is the impact of climate change on poverty and food security at the household level?
3. In the presence of climate change, what is the incremental impact of mitigation and adaptation policies on the economic development, poverty and food security at the household level?

Policy responses to climate change involve mitigation, reducing greenhouse gas emissions or increasing carbon sinks via for example forest plantation, or adaptation, adapting the economy and in particular the way humans behave, to climate change. In addition to the impact on economic development, this study will also examine the effects of these climate change policies on poverty and food security by combining macroeconomic outcomes with detailed household level impacts.

2 Methodology

2.1 Combining methodologies to get from macro policies to micro impacts

The methodological framework used in this study is designed to quantify the impact of both global and national impacts of climate change and policies on economic development, poverty and food security in Ghana. This requires a combination of methodological tools capable of translating policies defined and implemented at the macro level to impacts at the micro level. Figure 2.1 summarizes the methodology applied in this study.

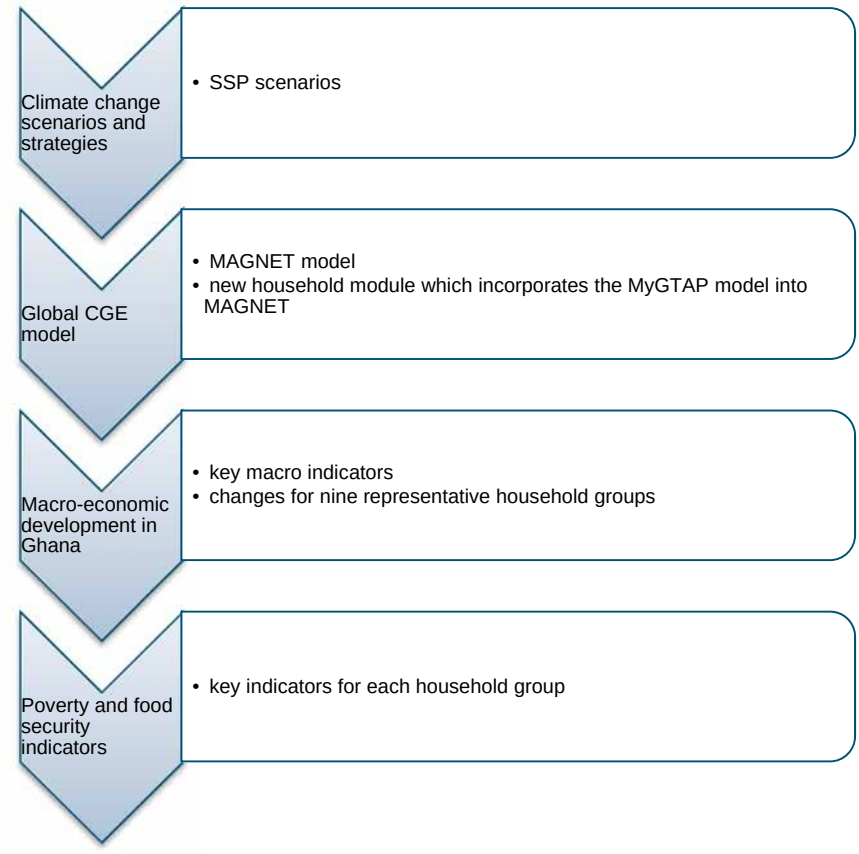

Figure 2.1: Representation of methodology

The first step is the development of climate change scenarios and strategies. Scenario analysis is commonly used in environmental impact assessment studies which need to take into account the complex and uncertain interplay between climatic, economic, technological and political factors (e.g. Nakicenovic et al., 2000). In such a setting, simple projections based on historical trends are of limited use. Scenarios are storylines with a coherent set of assumptions that together describe potential but plausible futures. We define two scenarios, a 'business as usual' or reference scenario and a pessimistic climate scenario to examine the impact of climate change on economic development in Ghana. In addition we define policy scenarios to assess the possibilities for policies mitigating unwanted developments. These scenarios are defined in detail in Chapter 3.

The scenarios provide inputs (shocks) for a global CGE (Computable General Equilibrium) model that quantifies the impact of the global and national developments on the Ghanaian economy. There is a rich history of CGE applications to aid policy formulation, both in developed and developing countries. CGE models can provide ex-ante numerical estimates of policy measures, capturing the salient mechanisms in the economy within a rigorous analytical framework (Devarajan and Robinson 2013). Numerous variations of CGE models exist, varying from highly stylized (for example the 1-2-3 mode with one country, two activities and three commodities, de Melo and Robinson 1989) to extremely detailed ones (for example the USAGE model with over 500 sectors, Dixon, Koopman, and Rimmer 2013). A balance needs to be found between complexity and tractability of outcomes. In other words, the "[...] modeler's version of "Occam's Razor": always use the simplest and smallest model that is adequate to the task" (Devarajan and Robinson 2013, 284).

In this study, we use a tailor made version of the Modular Applied GeNeral Equilibrium Tool (MAGNET), a global economic simulation model that that has been used extensively to analyse the medium and long run effects of global and EU agricultural and biofuels policies (Banse et al., 2011) as well as trade and food security issues (Rutten et al., 2013) and land use (van Meijl et al., 2006; van Dijk et al., 2012). Further details of the CGE model are discussed below.

The CGE model results in key macro level indicators summarizing the impact of projected developments and policy measures. Indicators include macro-economic figures that reflect changes in socio-economic conditions such as changes in production, prices, employment, land use, income, consumption, and trade in Ghana, West Africa and the rest of the world, as well as income and consumption for nine representative household groups, categorised by location within Ghana.

The remainder of this chapter details the CGE model. The next chapter describes the data used for calibrating the models and quantifying the scenarios.

2.2 MAGNET, a tailor-made CGE model

The model is based on the GTAP (Global Trade Analysis Project) model, a widely used tool for global trade analysis, which is extended in various directions in a modular fashion. In this context, MAGNET is used to identify the effects of climate change on Ghana while at the same time taking into account global trajectories of economic growth, population growth and technological change. The model also incorporates the relations between the manufacturing, services and agricultural sectors that indirectly affect the demand for land. The model has been estimated (calibrated) using the most recent GTAP database version 8, final release, which contains data for 2007. Ghana is identified as a separate country in the modeling framework, as is its most important neighboring and trading partners (including Nigeria and Cote d'Ivoire). The sectoral division distinguishes 12 agricultural (land using) sectors available in GTAP at the highest level of detail, including paddy rice, wheat and other grains, various other crops and livestock and animal produce sectors as well as a (commercial) forestry sector, a fishing sector, manufacturing and services.

2.2.1 Extending MAGNET with MyGTAP

The single representative household common in many global CGE models can obscure the impact of economic and climatic change on the most vulnerable households. The effect of climate change shocks on the lives of people will differ across households, depending on income, occupation, gender and location. It is expected that climate change will be particularly damaging to the agricultural sector, which, at 36 per cent of GDP, is a major contributor to economic growth. It is likely to negatively impact the cocoa sector which is an important source of export earnings. Climate change could therefore disproportionally affect the livelihoods of the rural poor and small scale (cocoa) farmers. Furthermore, through the effects of higher food prices and diminishing economic growth, climate change may also have a negative impact on income and food security of the urban population. Finally, since climate change is a global phenomenon, poverty and food conditions in Ghana will be affected by developments in other countries transmitted through international trade and foreign direct investment. This may offer opportunities, e.g. in terms of increased exports to countries whose agricultural production is negatively affected, but may also pose threats if crucial imports or investments fall away.

To capture the impact of climate change on different types of households, we include the MyGTAP model (Walmsley & Minor, 2013; Minor & Walmsley, 2013) as a module within MAGNET and use it to model impacts on nine Ghanaian households, grouped by location. The process of incorporating the household level data from a national Ghana SAM in MAGNET is detailed in Kuiper & Shutes (*forthcoming*). Capturing

the heterogeneous effects on household groups in this way allows for a richer understanding of the effects of climate change, and especially upon vulnerable household groups.

3 Data

3.1 Tailoring datasets to the question at hand

CGE models require a large amount of data and global CGE models even more. GTAP (Global Trade Analysis Project) provides the only regularly updated global database allowing the calibration of CGE models. The GTAP database is therefore also the starting point for this study. CGE models require a consistent database describing all economic transactions in the economies being studied. Consistency in this context means that all expenditures should match all incomes. And in a global database like GTAP this needs to hold not only at national level but also for all global flows of goods and capital. In practice data are not consistent and quite some adjustments are needed to arrive at a database suitable for global CGE models.

These adjustments can lead to incorrect flows for specific sectors in specific countries. As long as these sector and/or countries are aggregated they are unlikely to affect model results. In the case of country-specific analyses, however, the GTAP database should be compared with national level data to assure that the economies of the countries of interest are properly represented. We start from the GTAP Version 8.1L (May 2013) database with 2007 as a reference year (Narayanan, Aguiar, and McDougall 2013). We compare the data from GTAP with the most recent SAM (Social Accounting Matrix) available for Ghana for 2005, made available through IFPRI (Breisinger, Thurlow, and Duncan 2007) to add household detail for nine household groups.

Combining these databases, and cross checking with other sources where needed, we construct a dataset describing the Ghanian economy in 2007. This dataset provides the starting point of our modelling exercises. In the remainder of this chapter we describe key features if the dataset related to our research questions and the major adjustments done to reconcile data from different sources.

3.2 Macro-economic indicators

3.2.1 GDP

GDP is an commonly used economic indicator. In the update of GTAP databases the GDP (current US $) is targeted. This is reflected by the value in the GTAP database (24633 billion) and the WDI value (24758 billion) for 2007 (baseyear of the GTAP database). The GTAP value is 0.5% lower due to the reconciling process needed for constructing a global database. Since the GTAP database is based on the WDI GDP data we can use these data to get a feel for the developments in Ghana. Figure 3.1 presents historical data for GDP growth in total and per capita.

GDP growth in Ghana has accelerated since the late 1990s. The population at first grew faster than GDP causing a decline in per capita GDP from the mid ‘70s to the mid ‘80s. From then on GDP growth exceeded population growth causing an accelerated growth of GDP per capita. From 2007 to 2012 GDP grew by 51% to 37421 million (constant 2007 USS). In the same period GDP per capita grew from 1099 to 1475 (constant 2007 US $).

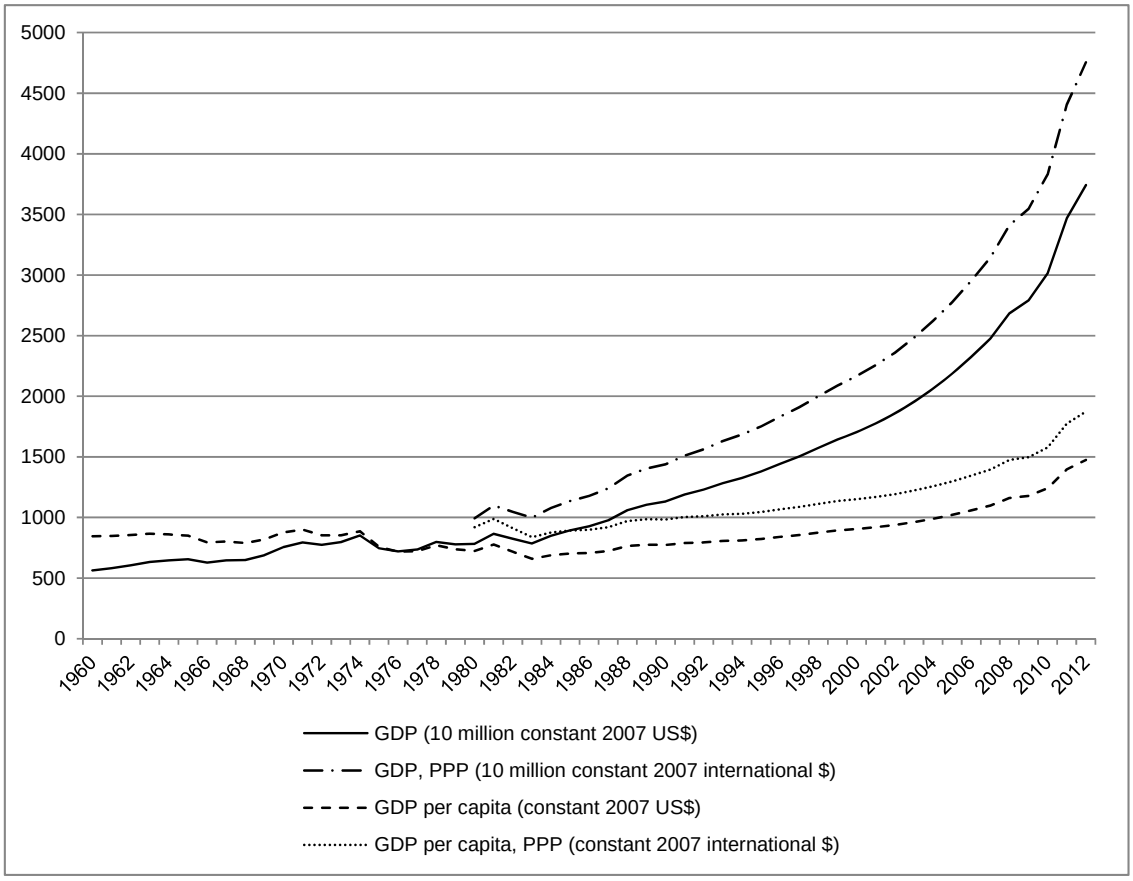

Figure 3.1: Historical developments of GDP in Ghana

Source: World Development Indicators (2013), author's calculations

Projected GDP growth rates are a major ingredient for long term projections. Resemblance between projections and actual developments vary, especially if structural changes occur in an economy which are seldom captured by long term projection models. Figure 3.2 compares historical and projected GDP growth rates from various sources.

It is clear from the graph that the projections do not capture the strong fluctuations observed in the past. The World Bank projections show a lower estimate than any of the other projections. It seems that any structural changes that have spurred Ghana's growth in the past 20 years are not captured. The projections are even lower than the most pessimistic of the SSP scenarios.

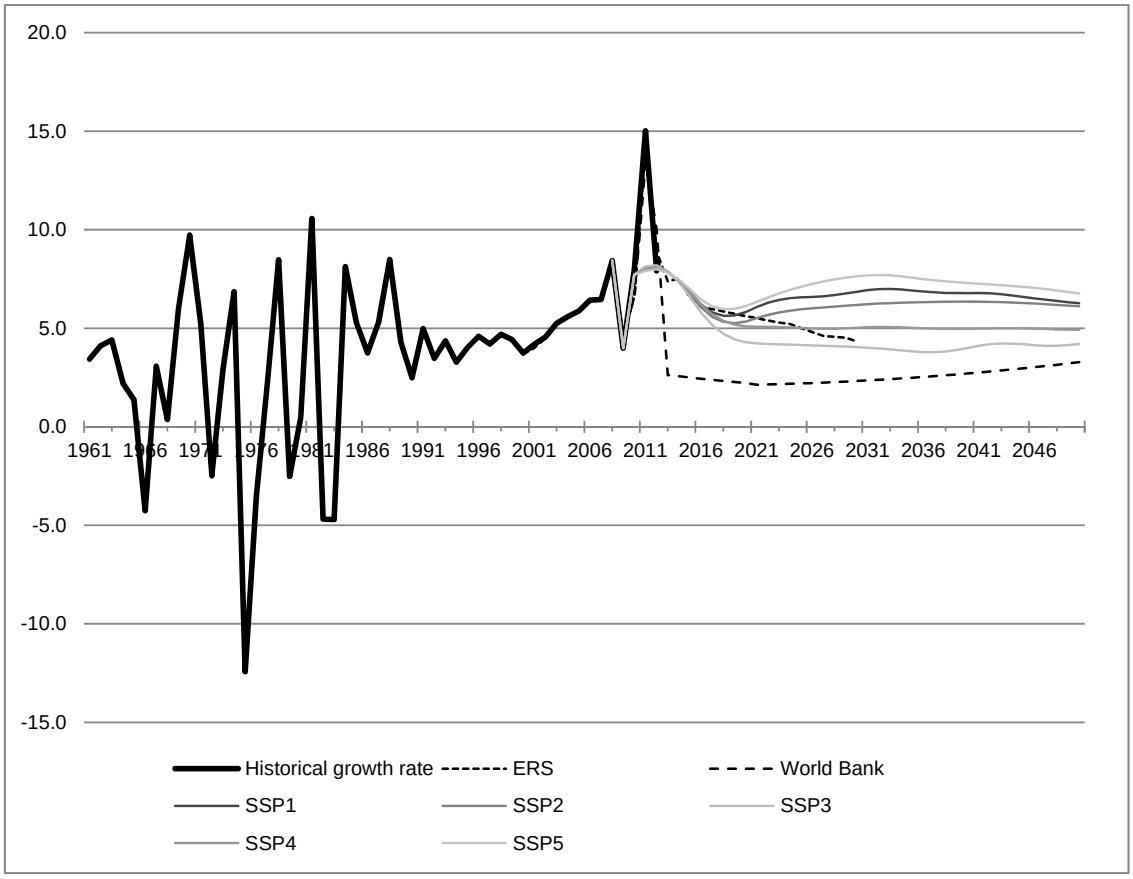

Figure 3.2: Historical and projected annual growth rates GDP for Ghana (1961-2050)

Source: ERS, World Bank, OECD (SSP scenarios), author's calculations

3.2.2 Macro-economic structure in Ghana national and GTAP SAM

Although the GTAP SAM is based on the Ghana SAM, several adjustments are needed to get the data consistent with the GTAP classifications and the links with the other regions. When comparing SAMs it is helpful to start from an aggregated macro SAM to get a first idea of possible differences. Table 3.1 presents the structure of such a macro SAM.

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Apart from referring to 2005 (as opposed to 2007) the national Ghana SAM is in the local currency and therefore not directly comparable to the GTAP SAM. Since we are interested in whether the national SAM represents the structure of the Ghanaian economy we scale the Ghanaian SAM to be consistent with the 2007 GDP in US$.

Table 3.1: Structure of a macro SAM

	Activities	**Commodi-ties**	**Factors**	**Households**	**Government**	**Taxes**	**Investment**	**Rest of the World**	
Activities	---	Marketed outputs	---	---	---	---	---	---	*Activity Income*
Commodi-ties	Intermediate inputs	International margins	---	Private con-sumption	Government consumption	---	Investment, change in stocks	Exports	*Commodity demand*
Factors	Value-added	---	---	---	---	---	---	---	*Factor Income*

Households	---	---	Household factor income	---	Government transfers to household	---	---	Transfers of households to Rest of the World	*Household income*
Government	---	---	---	---	---	Tax revenue	---	Transfers of government to Rest of the World	*Government income*
Taxes	Activity taxes	Sales taxes, import tariffs	Government factor income	Direct household taxes	---	---	---	---	*Tax Income*
Savings	---	---	---	Household savings	Government savings	---	---	Foreign savings	*Savings*
Rest of the World	---	Imports	---	---	Government transfers to Rest of the World	---	---	---	*Foreign exchange outflow*
	Activity expenditures	*Commodity supply*	*Factor expenditures*	*Household expenditures*	*Tax payments*	*Government expenditures*	*Investment*	*Foreign exchange inflow*	

3.3 Structure of production

3.3.1 Structural transformation of the Ghanaian economy

The period of sustained growth that started in the mid ‘80s (figure 3.1) coincides with a steady decline in the contribution of primary agriculture to GDP (figure 3.3). However, this structural transformation has not been a linear process. Shares of services in GDP have decreased from the early ‘90s to early 2000s, driven by an increased importance of natural resource extraction.

There seems to be a structural break in the WDI data with a rather sudden drop in importance of agriculture in 2006. This might be due to a change in the collection of data. The Ghana SAM is for 2005. Although it is used as the basis for the GTAP database it seems some changes in the composition of the economy are made when these data are incorporated in the global dataset. The shares computed from the GTAP database are in between those of the WDI data for 2005 and 2007. The share of manufacturing is markedly larger than occurring in any WDI year.

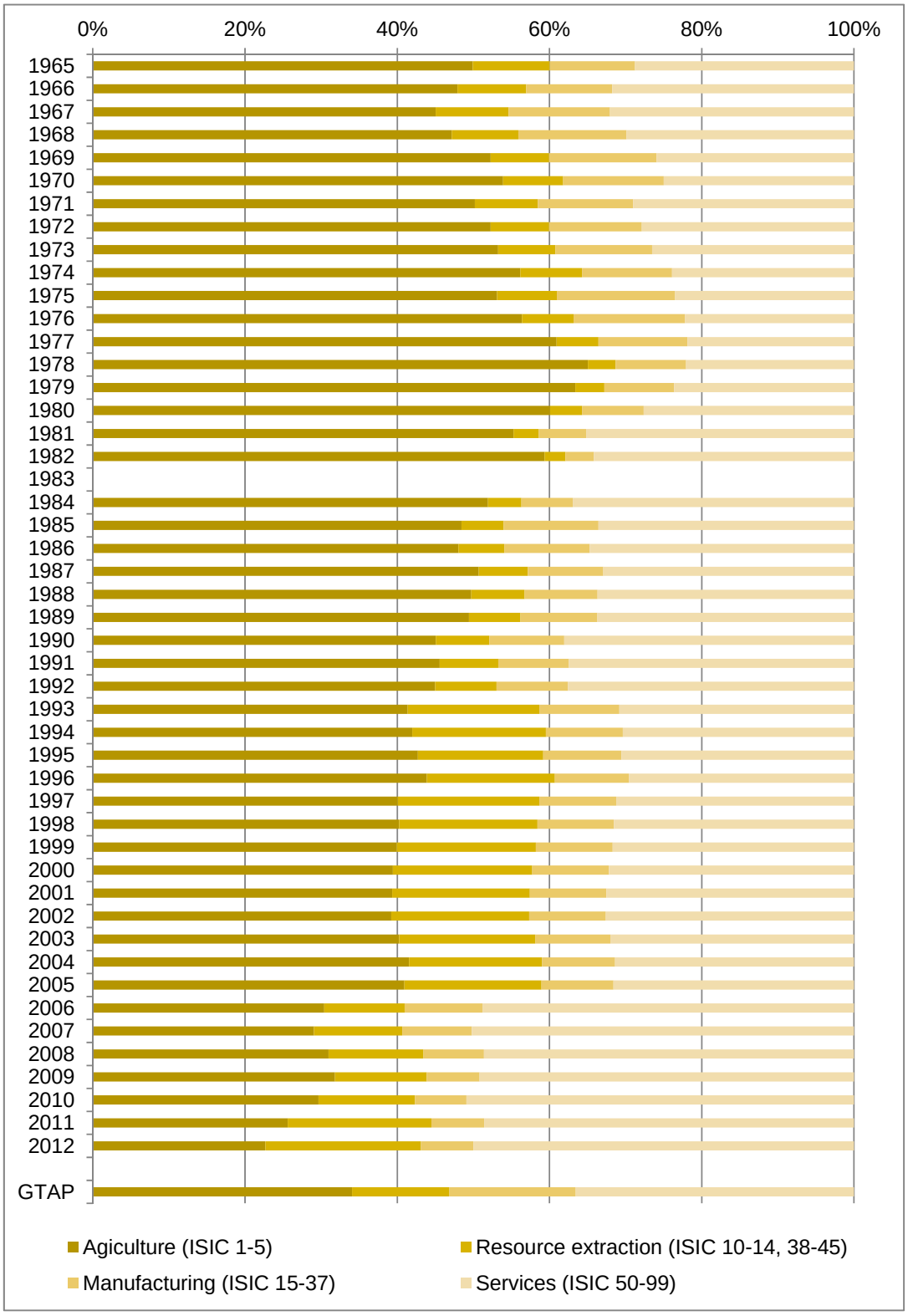

Figure 3.3: Share in value-added by main sector classification for Ghana (1960-2012)

Source: WDI (2013), GTAP V8, author's calculations

3.4 Household typology

The SAM for Ghana (Breisinger, Thurlow, and Duncan, 2007) provides a first disaggregation of the single representative household in the GTAP database. Table 3.4 and 3.5 summarize the income and expenditure patterns of these two household types.

The Ghana SAM distinguishes self-employed labour as a specific category which provides a major source of actor income for the rural households. All of this labour is employed in either crop or livestock production and thus seems to refer to agricultural self-employed labour. This implies that urban households, who obtain a small share of their income from self-employment, are also active in agricultural production. In terms of factor earnings the pattern is as expected: the rural households earn more from self-employed labour.

Table 3.4: Household income from Ghana SAM, 2005 (share of total income)

		Rural households	Urban households
Factor payments	Self-employed labor	0.28	0.03
	Unskilled labor	0.32	0.49
	Skilled labor	0.04	0.16
	Capital (agriculture)	0.06	0.00
	Capital (other)	0.09	0.22
	Land	0.15	0.00
	Total factor payments	*0.95*	*0.91*
Transfers	Rural households	0.00	0.01
	Urban households	-0.01	0.00
	Government	0.05	0.05
	Rest of world	0.01	0.03
	Total transfers	*0.05*	*0.09*
Total income		**1.00**	**1.00**

Source: Breisinger, Thurlow, and Duncan (2007), author's calculations

Table 3.5: Household expenditures from Ghana SAM, 2005 (share of total expenditures)

		Rural households	Urban house-holds
Primary agriculture	Maize	0.03	0.01
	Rice	0.04	0.04
	Sorghum and millet	0.03	0.00
	Other cereals	0.00	0.00
	Cassava	0.05	0.02
	Yams	0.05	0.04
	Cocoyams	0.01	0.01
	Cowpea	0.00	0.00
	Soyabean	0.00	0.00
	Palm oil	0.01	0.00
	Groundnuts	0.01	0.00
	Tree nuts	-	-
	Fruit (domestic)	0.00	0.01
	Fruit (export)	-	-
	Vegetables (domestic)	0.07	0.04

	Vegetables (export)	-	-
	Plantains	0.03	0.02
	Cocoa beans	-	-
	Other crops	0.00	0.00
	Export industrial crops	-	-
	Chicken broiler (mostly imported)	0.01	0.01
	Eggs and layers (domestic)	0.01	0.01
	Beef	0.01	0.01
	Sheep and goat meat	0.00	0.01
	Other meats	0.01	0.01
	Subtotal primary agriculture	*0.39*	*0.25*
Natural resource extraction	Forestry	-	-
	Fishing	0.03	0.02
	Mining	-	-
	Subtotal natural resource extraction	*0.03*	*0.02*
Processed food	Formal food processing	0.07	0.08
	Informal food processing	0.03	0.03
	Cocoa processing	0.00	0.00
	Dairy products	0.01	0.01
	Meat and fish processing	0.05	0.03
	Subtotal processed foods	*0.16*	*0.16*
Manufactured goods	Textiles	0.02	0.02
	Clothing	0.04	0.05
	Leather and footwear	0.01	0.02
	Wood products	0.01	0.02
	Paper products, publishing and printing	0.00	0.00
	Crude and other oils	-	-
	Petrol	0.01	0.02
	Diesel	0.00	0.00
	Other fuels	0.03	0.01
	Fertilizer	0.01	0.00
	Other Chemicals	0.05	0.05
	Metal products	0.01	0.01
	Capital goods	0.07	0.11
	Subtotal manufactured goods	*0.25*	*0.29*
Services	Construction	-	-
	Water	0.00	0.00
	Electricity	0.03	0.05
	Trade services	-	-
	Other services	0.01	0.02
	Transport services	0.01	0.03
	Communication	0.01	0.02
	Business services	0.00	0.01
	Real estate	0.02	0.03
	Community services	0.02	0.03
	Public administration	0.00	0.00
	Education	0.00	0.00
	Health	0.00	0.00
	Subtotal services	*0.10*	*0.20*
Transfers	Rural households	-	-0.01
	Urban households	0.01	0.00
Taxes	Direct taxes	0.02	0.05
Savings	Savings-investment	0.05	0.03

Total expenditures	**1.00**	**1.00**

Source: Breisinger, Thurlow, and Duncan (2007), author's calculations

In many African countries women make up the largest proportion of small scale farmers. They are responsible for earning a substantial part of the rural households' income and producing food to meet a large part of household food needs. Women are therefore essential in combating poverty and ensuring sufficient availability and access to food both in rural areas and at the national level. This is also the case in Ghana, where women account for 52 per cent of the labour force, produce 70 per cent of subsistence crops and contribute 46 per cent to GDP (MEST, 2010).

At the same time, there is ample evidence that women suffer from serious gender inequalities and do not enjoy the same rights as men. Women particularly suffer from unequal access to resources. Several studies show that they have difficulties in accessing extension services and credit, are less likely to own land than men and men, and often do not have decision-making power within the household. For example, it was found that women owned land in only 10 per cent of Ghanaian households, as opposed to 23 per cent in the case of men. This also implies that women will be more vulnerable to climate stress as they are not able to access new technologies (e.g. irrigation and drought resistant crop types), subsidies and other interventions to harness against the impact of climate change. It is therefore important that social protection policies and other support measures to increase the resilience to climate change explicitly take into account gender inequality.

4 Scenarios

The scenarios are defined using Shared Socio-economic Pathways (SSPs), which have been recently developed to assess the impact of global climate change by a consortium of researchers (Kriegler et al. 2012; O'Neill et al. 2011; O'Neill et al. 2014). The SSPs are a set of plausible and alternative assumptions that describe potential future socioeconomic development in the absence of climate policies or climate change. They consist of two elements: a narrative storyline and a quantification of key drivers, such as population growth, economic development and technological change. The SSPs can be combined with assumptions on climate outcomes to derive a matrix that reflects an elaborate scenario framework to assess the impact of climate change under a variety of socio-economic conditions (Vuuren et al. 2014).

The three SSPs that are currently available can be summarised as follows:[1]

- The Sustainability scenario (SSP1) describes a world that makes relatively good progress towards sustainability, with sustained efforts to achieve development goals, while reducing resource intensity and fossil fuel dependency. Elements that contribute to this are an open globalised economy, rapid development of low-income countries, a reduction of inequality (globally and within economies), rapid technology development, low population growth and a high level of awareness regarding environmental degradation.
- The Middle of the Road scenario (SSP2) is a business as usual scenario. In this world, trends typical of recent decades continue, with some progress towards achieving development goals, reductions in resource and energy intensity at historic rates, and slowly decreasing fossil fuel dependency.
- The Fragmentation scenario (SSP3) describes a world, which is separated into regions characterized by extreme poverty, pockets of moderate wealth and a bulk of countries that struggle to maintain living standards for a strongly growing population. Regional blocks of countries have re-emerged with little coordination between them. Countries focus on achieving energy and food security goals within their own region. The world has de-globalized, and

[1] See O.Neill (2012) et al. for elaborate summaries and full versions of the narratives. They also present a table with brief descriptions of SSP elements and directions.

international trade, including energy resource and agricultural markets, is severely restricted. Population growth in this scenario is high as a result of the education and economic trends.

 # to be completed

5 Results

5.1 # to be added

6 Conclusions

6.1 # to be added

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