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Foreign Direct Investments in Agricultural Land in Africa: 1-2-3-4 CGE Model Study for Ghana

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Abstract

This thesis studies foreign direct investments (FDI) in agricultural land in Africa. The paper aims at identifying effects of agricultural FDIs in host countries and finding answers for why the effects occur. A computable general equilibrium model, 1-2-3-4 CGE model, is constructed for Ghana and its results are compared to other studies and empirical evidence. Based on the 1-2-3-4 CGE model and other studies, the paper constructs policy tools and recommendations through which African recipient countries could benefit from agricultural FDIs.

The paper discusses first drivers and background behind growing interest in African farm land. Next, the paper presents extensive literature of FDIs, features of African agriculture and property rights. Third, the paper utilizes studies of 1-2-3 CGE model and presents a 1-2-3-4 case model study for Ghana. Actual numbers are used in the model and the data is mainly gathered from Bank of Ghana, Ghana Statistical Service and World Bank (WDI database). Adjustments are made to data and the 1-2-3-4 model relies also on assumptions made by the author. The model study focuses on biofuels (cash cropping) and model's results are compared to Ghana's actual development after oil production jump started in Ghana in 2010. Comparison is also made with studies of biofuel-related agricultural FDIs in Ghana and Tanzania. Policy tools and recommendations are then constructed based on the literature, results of the 1-2-3-4 model, the analysis of Ghana's realized development as well as FDI studies from Ghana and Tanzania.

Results from the 1-2-3-4 CGE model are welfare improving from Ghana's perspective. However, the results are conditional on the assumptions that are not entirely in line with empirical evidence and thus, the results cannot be generalized to cover FDIs in a broader perspective. As expected, positive resource shock (agricultural land from "unused land stock") yields positive results regarding trade and GDP. Ghana's realized development during study period 2010-2013 shows similar results to the 1-2-3-4 model, but there are also differences. Both of these show that exports and GDP growth is not transferred that well to private consumption and households' welfare. 1-2-3-4 model study results and literature indicates that there is potential in agricultural FDIs to yield positive host country impacts. When tools and recommendations are constructed, it becomes apparent that they are conditional on each other. Limitations and tools' requirements thus indicate that a comprehensive approach is needed from host countries. With a strategic approach and focusing on using multiple tools at the same time host countries should be more likely to securing benefits from agricultural FDIs.

Keywords FDI, property rights, CGE model, large-scale farms, outgrower schemes, contract farming, biofuels, cash cropping, agricultural land, host country effects, wages, job creation, productivity, capital, infrastructure, contracts, exports, unused land

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Abbreviations

ADB	= African Development Bank
AOI	= Agricultural Orientation Index
BOG	= Bank of Ghana
CES	= Constant elasticity of substitution
CET	= Constant elasticity of transformation
CGE	= Computable general equilibrium
CPIA	= Country Performance and Institutional Assessment (score)
FAO	= Food and Agriculture Organization of the United Nations
FDI	= Foreign direct investment
GIPC	= Ghana Investment Promotion Centre
GRA	= Ghana Revenue Authority
GSS	= Ghana Statistical Service
IFPRI	= International Food and Policy Research Institute
ILO	= International Labour Organization
IMF	= International Monetary Fund
JVC	= Joint venture company
LUCC	= Land use and land cover change
NGO	= Non-governmental organization
OECD	= Organisation for Economic Co-operation and Development
OPEC	= Organization of the Petroleum Exporting Countries
PES	= Payment for Environmental Services
PFIA	= Policy Framework for Investment in Agriculture
PPF	= Production possibility frontier
PRAI	= The Principles for Responsible Agricultural Investment
SAM	= Social accounting matrix
SSA	= Sub-Saharan Africa
TFP	= Total factor productivity
UNCTAD	= United Nations Conference on Trade and Development
UNFCCC	= United Nations Framework Convention on Climate Change
WCED	= World Commission on Environment and Development
WDI	= World Development Indicators

1 Introduction

This paper studies foreign direct investments (FDI) in agricultural land in Africa. It is recognized that FDIs have a reputation as destructive "land grabs" and that in the past they have not provided or induced the benefits to host countries as promised. It is also recognized that there lies potential in FDIs to positively affect host countries and result in growth and development effects as well as poverty reduction. Viewpoint in this paper is in the host countries and how to enable African countries to benefit from the recent and growing interest in their abundant resource, land.

Agricultural land in Africa has faced increasing interest from foreign investors in recent years. Food price crisis may have awoken developed countries and securing food supply is one of the main drivers behind the interest. Drivers such as biofuel production and speculative land purchases have also been named. Weak property rights, poor infrastructure and corruption prevail in many African countries. Investors can utilize the flaws for their benefit and host countries and households are often the parties suffering from land leases and purchases. Demand for African agricultural land has been forecasted to continue its growth and thus, it is important to change the course of agricultural FDIs so that they would benefit host countries.

The main objectives of the paper consist of two areas. First this paper focuses on identifying the effects of agricultural FDIs in host countries and the causes behind them. Second, the paper constructs a 1-2-3-4 computable general equilibrium (CGE) model study for Ghana and compares its results with other studies and Ghana's actual development. Based on model results and literature, the paper aims at identifying for policy tools and actions that can enable African recipient countries to benefit from agricultural FDIs.

Main controversies regarding FDIs in agricultural land in Africa can be found in two comparisons. In the first comparison there are locals, their rights and livelihoods that are often under threat on one side, and on the other side there are potential host country benefits in form of capital, new technology, productivity improvement and poverty alleviation. The second comparison is between foreign investors' requirements and promises, and host country's needs. Agricultural FDIs in Africa are often referred to as land grabs because of their realized discriminatory outcomes from small-scale farmers' perspective – and unrealized benefits to host countries. At the same time, FDIs can be seen as a viable option for breaking vicious circle related to smallholder agriculture.

This paper has a strong focus in welfare and thus, foreign direct investments' impacts on welfare of African countries and people are central. It is therefore useful to start with reminding the first

theorem in welfare economics, according to which: "If everyone trades in the competitive marketplace, all mutually beneficial trades will be completed and the resulting equilibrium allocation of resources will economically efficient." (Pindyck & Rubinfeld, 2009.)

While thinking about this theorem, three things should be noted. First, land markets in Africa are not fully competitive but the competition is increasing. Second, the theorem does not claim that unfavorable transactions would not realize. And third, even though the first two notes restrict theorem's applicability to Africa's conditions, it is clear that the allocation of resources is not economically efficient in Africa. There is underutilized land that could be used for more efficient production. And with more capital, agriculture in Africa could be more productive.

Many of the African countries have a large rural population engaged in agricultural activities which are typically small-scale and labor-intensive. Shortage of capital, fertilizers and irrigation are present in many rural areas and agriculture is often practiced for subsistence. Property rights are not secure and infrastructure is often weak. Corruption exists in many countries and for small-scale farmers it is often hard to get finance. These are common problems for many African countries and they underline the need for development of agriculture and rural areas.

Development in agriculture has been found very effective in reducing poverty and increasing growth by many (e.g. FAO, 2012). Despite the findings, government expenditure in agriculture has been low in many African countries. Host countries may not have the financial resources to provide the needed investment and with the above mentioned problems it constitutes a demand for FDIs from host countries' viewpoint. FDIs can provide capital and technology and to improve infrastructure and access to markets. FDIs can also create jobs and increase productivity in many sectors via spillover effects.

The supply of FDIs comes mainly from developed countries in Europe, North-America and South-East Asia. The interest in Africa's farmland has been growing for several years now and FDIs are usually made by large international companies or governments. Intentions are often in securing food supply and utilizing Africa's resources for production. Relatively recent trend is related to biofuels production, where investors are looking for farmland in Africa to acquire cheap land and provide feedstock for biofuels production. Challenging circumstances in host countries and foreign investors' negotiation power have caused outcomes where potential gains to locals from FDIs have not realized.

Global interest in African farmland is likely to continue growing in future. Rising middle classes in India and China shift food demand towards products requiring more land to produce, and biofuels are targeted to substitute a share of fossil fuels in transportation. European Union has RES directive regarding renewable energy and in US more than 40% of the grain is used for biofuels production. This emphasizes the importance for agricultural FDIs – and the importance to secure benefits from FDIs to host countries.

This paper is structured so that chapters 2-5 present literature and studies related to agricultural FDIs in Africa. Literature review is relatively broad because agricultural FDIs in Africa contain unique features compared to FDIs in general. For example, the structure of economies and the level of property rights differ from what is common in most developed countries. Chapter 2 gives a background for the rising interest in farmland. Chapter 3 continues and discusses FDIs' effects on host countries and why the effects occur. The chapter focuses mainly on agricultural FDIs but touches also other types of FDIs. Chapter 4 focuses on land, agriculture and economies in Africa. Chapter 5 introduces property rights and their role in agricultural FDIs to more detail.

Chapter 6 focuses on a case study with CGE modeling: a so called 1-2-3-4 CGE model is constructed for Ghana and it presents a very simplified structure of Ghana's economy. The economy is assumed to have two factors of production (land and labor), three sectors and four commodities. The model is an extension from a better known 1-2-3 CGE model. In the model it is assumed that Ghana establishes a biofuel sector as a following from Ghana's policy goals. Biofuel sector requires FDIs and that builds the scene for modelling. Because CGE models can be solved with real numbers, real data is used for Ghana. Adjustments for data are required and assumptions are made for solving the model.

Chapter 7 connects and compares the 1-2-3-4 model results with Ghana's realized development in 2010-2013 and with oil sector establishment's impacts on Ghana. It also presents two other biofuel-related FDI studies in Ghana and in Tanzania. Finally, chapter 8 introduces policy recommendations and tools for African countries to secure that they benefit from FDIs.

2 Background

2.1 Rising global interest in agricultural land

For several years the global trend has been that interest in farmland is rising. Governments and international companies are trying to secure their food supply. There are many countries, especially in Africa, that have suitable land for agriculture available. This was recognized as a development problem already before the food price crisis in 2008. (Deininger & Byerlee, 2011.) After the food price crisis the interest towards agricultural land has been growing even greater.

Dettmer (2011) reminds us that world food markets have suffered two price spikes in four years and this have woken the rich countries to secure their food supplies. The same has been noticed by others as well: Joachim von Braun from IFPRI comments to Financial Times (2008)[1] that "the dominant force today is security of food supplies". As Dettmer (2011) puts it, the growing interest has a simple explanation: "strong demand and willing suppliers". The largest investors regarding Africa's arable land are capital-exporting countries trying to secure their food production and feed their people. How much of the worry is actually about feeding the people and how much about making money cannot be answered reliably. But based on the history and current situation of land deals the money definitely matters.

Various other reasons can also be identified behind land acquisitions and various groups on the demand side can be named. In addition to securing food production and raw materials supply, acquiring land for the production of biofuels is one of the reasons. Also, the shift of bulk commodities production to land-abundant developing countries increases the demand for land in Africa. Groups of investors on the demand side include governments trying to secure their food production, financial entities trying to find secure profits from land in the future (due to e.g. appreciation of land) and traditional agricultural operators trying to expand their operations. (Deininger & Byerlee, 2011.)

Population growth increases food demand directly. Even though people in rural areas tend to settle in areas suitable for agriculture, technological development, international trade and urbanization have mitigated the movement to these areas. Increasing income (especially in India and China) changes consumer preferences towards livestock products, fruits and vegetables, which in general require more land and water to produce than crops. And nowadays bioenergy belongs to the list of

[1] Blas and England (2008).

reasons behind increasing land demand. Meeting the increasing energy demand and the decreasing amount of non-renewable energy resources are the main drivers behind expanding production of biofuels.[2] For example, demand for energy is expected to increase by 35% by 2035 and biofuels' share of energy sources is expected to rise. (Nkonya et al. 2012.)[3]

Increase in biofuels is also forecasted by OECD-FAO (2008) which estimates that world biofuel (vegetable oil) demand will rise 49,5% by 2017 from its 2005 production level (96 million tonnes). This would amount to 143mt in 2017, and it would indicate a ca. 36% increase compared to 2007 level (105mt). Largest users of biofuels are predicted to be EU countries, United States, China, and India.

Table 1 below shows the expansion of cultivated area in different regions between 1961-1997 and 1997-2007. Measured by annual percentage change, growth has been fastest in Sub-Saharan Africa (2,63% annual average growth between 1997-2007) and in East Asia & Pacific (2,72% annual average growth between 1997-2007). And by looking at the right most column one can see that the land demand in 2009 was very strongly focused on Africa. It thus illustrates well the interest towards African farmland.

Table 1. Historical land expansion and recent land demand

Region	Cultivated area (millions of ha)			Annual change		Demand
	1961	1997	2007	1961-1997	1997-2007	2009
Sub-Saharan Africa	134,6	192,2	218,5	1,60 %	2,63 %	39,7
East Asia & Pacific	183,9	235,7	262,8	1,44 %	2,72 %	8,0
Eastern Europe & Central Asia	291,5	263,6	241,7	-0,77 %	-2,19 %	4,6
Latin America	102,6	160,9	168,0	1,62 %	0,71 %	3,2
Middle-East & North-Africa	77,9	91,3	89,0	0,37 %	-0,23 %	1,4
South Asia	197,9	212,9	213,5	0,41 %	0,06 %	0,7
North America	235,3	232,5	225,3	-0,08 %	-0,72 %	0,2
Western Europe	99,4	86,8	83,5	-0,35 %	-0,32 %	0,0
Oceania	34,0	42,8	46,7	0,25 %	0,38 %	0,0
World Total	**1 357,1**	**1 518,7**	**1 549,0**	**4,49 %**	**3,04 %**	**57,8**

Column "Demand" refers to intended or actual land acquisitions based on media reports during period October 2008 – August 2009.

Source: Arezki et al. (2011)

There are many different observations, results and claims about the true size of land sold or leased in Africa. Chaudhuri and Banerjee (2010) estimate that agricultural land acquired in Africa in 2007-

[2] Reducing GHG emissions is often mentioned as well, but so far the real impacts of biofuels on GHG emissions remain controversial (Nkonya et al. 2012).

[3] The above presented drivers behind interest in farmland are also among the main drivers of land use and land cover change (LUCC) addressed by Nkonya et al. (2012). LUCC refers to changes in Earth's surface caused by humans, and complete list of drivers behind LUCC includes also drivers for other types of land than just agricultural land.

2009 was up to 20 million hectares. Deininger and Byerlee (2011)[4] estimate that during period Octobed 2008 – August 2009 land deals would have covered an area of 39,7 million hectares in Africa (compared to 56,6 million hectares in the world which yields a share of 70 percent of the deals for Africa). Finally, Geary's (2012) estimation for the size of land acquired globally during the last decade is "an area eight times the size of UK" – which totals close up to 200 million hectares. Different and large numbers have also been seen in media but when it comes to that, it is argued that media reports tend to overestimate the amount of land covered by deals compared to research-based estimates. This could explain at least some of the variation in land size estimates.[5]

It is not the exact amount of land acquired that is central in this paper but rather how the deals affect welfare and development in host countries and for what purposes acquired land is used for. According to some estimates, the land usage of foreign investors has not been efficient because foreign investors have started cultivation processes only on a minority of the land acquired. For example, Deininger and Byerlee (2011) estimate that only 21 percent of deals have actually led to initiating cultivation. And according to their forecast, agricultural land used for cultivation in developing countries will increase by 6 million hectares every year until 2030 (and this is considered as a conservative forecast). Most of this increase would take place in Sub-Saharan Africa (SSA) which is in line with land demand statistics presented in Table 1.

Table 2. Sources of growth in agricultural production, realized 1961-2005 and forecast till 2050

Region	Arable land expansion		Cropping intensity increase		Yield increase	
	1961-2005	2005/07-2050	1961-2005	2005/07-2050	1961-2005	2005/07-2050
All developing countries	23 %	21 %	8 %	8 %	70 %	71 %
Sub-Saharan Africa	31 %	25 %	31 %	6 %	38 %	69 %
Near East/North Africa	17 %	-7 %	22 %	17 %	62 %	90 %
Latin America & Caribbean	40 %	30 %	7 %	18 %	53 %	52 %
South Asia	6 %	5 %	12 %	8 %	82 %	87 %
East Asia	28 %	2 %	-6 %	12 %	77 %	86 %
World	14 %	9 %	9 %	14 %	77 %	77 %
Developing countries, less than 40% of potentially arable land in use in 2005*	-	30 %	-	15 %	-	55 %
Developing countries, over 80% of potentially arable land in use in 2005**	-	2 %	-	9 %	-	89 %

* 42 countries; ** 19 countries

Source: Calculations based on Bruinsma (2009)

[4] According to Deininger and Byerlee (2011), their estimate of land deals is based on media reports that were posted on GRAIN web site (http://www.grain.org) during period 1 August 2008 – 31 August 2009.
[5] Cotula (2011) and Schoneveld (2011). For examples about differences in estimates, see pages 13-14 in Cotula (2011).

While Table 1 shows that growth of cultivated area has been fastest in SSA and in East Asia & Pacific, Table 2 above reveals an unfortunate fact concerning the growth of agriculture: yield increase has been clearly slower in Africa compared to other regions. The growth of African agricultural production has relied relatively more on land expansion and cropping intensity growth compared to rest of the world. This is a challenge for Africa but it is also one reason for why FDIs in agricultural land are needed.

Future prospects related to growth of food production and expansion of agricultural land are somewhat intimidating. UNFCCC Commission on Sustainable Agriculture and Climate Change (2011) claims that agricultural production has already exceeded its safe limits.[6] In other words, the maximum amount of food that can be produced to provide minimum amount of food required by current and growing population while having a minimum impact on climate, when current climate is given, is already exceeded. Taking into account that biofuel production is expected to rise during the next two decades and that some part of the expansion is achieved by switching food crops production to biofuel production, it seems reasonable to expect rising food prices in future.

2.2 Recent global food and agriculture trends and their implications

There was a rise in world food prices in 2007-2008 and the rise has been claimed to be different compared to previous ones. It was more severe and its impacts are forecasted to persist possibly over medium term. Another distinctive feature compared to previous crises is that the previous ones have been caused by weather phenomena or conflicts, but this time many other reasons have been suggested as causes of the crisis. In media such factors as population growth, food scarcity, global warming and steeply rising oil prices have been blamed for pushing the food prices up. (Smith & Edwards, 2008; Mittal, 2009.) Growing middle classes with their growing consumption patterns in India and China as well as production of biofuels (e.g. ethanol) have been suggested as causes as well (The New York Times, 2008; Mittal, 2009). Further, the occurrence of food price crisis can also be explained by other factors such as decline in growth of agricultural production and decline in countries' grain stocks, argued by e.g. Trostle (2008).[7]

According to Mittal (2009), an essential feature separating the recent food price crisis from the previous ones is speculation in financial markets. The logic behind this claim is that speculators' actions – although normally maybe stabilizing markets by buying when prices are low and selling

[6] Nkonya et al. (2012), originally in UNFCCC Climate Change Conference (2011).
[7] It is interesting to note Trostle's (2008) argument according to which decline in grain stocks can partly be a consequence of globalization, leading to liberalization of agricultural markets, and the rise of just-in-time inventory management (JIT).

when they are high – have actually made the grain markets more volatile. Mittal argues that emerging hedge funds and increasing participation of many other funds in agricultural commodity markets may have caused hyperinflation in food staples.

Some have argued that Africa's food production would have been high enough to feed the whole continent – prices just did not allow it (Kamara et al. 2009). As Mittal (2009), also Kamara et al. (2009) write that many African countries have not fully recovered from the rise of food prices in 2007 and 2008. However, they also indicate that if there is something positive in the crisis, it is the attention it has drawn to Africa's agriculture and bringing it out into development agenda

Global food and hunger situation was poor already before the rapid rise in food prices, but due to the 83% increase in prices between 2005 and 2008 the situation became even worse. According to FAO (2008a; 2008b), higher food prices drove 75 million people into hunger in 2007 and 40 million in 2008. According to Mittal (2009) and many others, the rising food prices have had the strongest impact on developing countries and their low-income people. One reason for this would be that low-income people have to spend a big share of their income to food. The share spent to food can account for 50-80% of total spending while in wealthier countries it accounts for only 10-20% share of income (UNCTAD, 2008). The situation in many countries worsened also because energy and commodity prices increased along with rising food prices. Kamara et al. (2009) argue that the consequences of price changes were even worsened in Africa because of its people's inability to save. Urban areas tend to suffer more from price changes than rural areas because they are net importers of food.

Rodrik (2010) admits that in developing countries it is urban areas that suffer from food price increases. However, he also argues that food price increases can actually benefit poor people in rural areas, if they are net sellers of food. And Swinnen (2010) reminds than before the food price crisis it was widely accepted that low food prices would be a curse to poor people and developing countries.

Yet, there have been many claims according to which high food prices caused developing countries to suffer more than rich countries. Not only were the low-income families spending a bigger share to food but also they suffered from a bigger price increase compared to wealthier countries: Kamara et al. (2009) note that food prices increased approximately 42% in developing countries in contrast to 19% increase wealthier ones. Salami et al. (2010) find that by 2010 food prices had already fallen below the 2008 level on the whole, but they still remained higher than the food prices before the spike. They also point out that it is possible to see a new and sharp rise again in the future.

Remaining high real food prices are identified by also FAO (2012): real prices have remained higher than normally for over ten consecutive years, and this is mentioned to be "the longest sustained cyclical rise in real prices experienced in the last 50 years".

But the real welfare and growth impacts of food price increase in developing countries may not be harmful as argued above. For example, Headey (2014) finds robust evidence that higher food prices reduce poverty in developing countries in the long-run (1-5 five years in the paper). Not only this, Headey finds that the "ultra poor" may benefit even more from food price increases than poor. And according Headey, wages in rural areas respond greatly to food prices, indicating that along with higher revenues to net sellers also the rural wage increase should increase welfare.

FDIs in agricultural land can have serious impacts in host countries' food security. If the food production is reduced due to foreign investors acquiring land, it can cause food prices to rise and damage at least some groups. And if a country's production shifts away from traditional food crops to cash cropping, it can push country's exchange rate upwards. Of course, appreciating exchange rate and increasing exports have their benefits as well, but those poor people who may not be able to enjoy them might suffer from food price increase.

General trend in the price increase 2007-2008 was a correlation between food and oil prices. When crude oil and natural gas prices started to fall after the halfway of 2008 also food prices started to decline. Despite these general trends, it should be remembered that there exist large differences and mixed trends between African countries. African countries often suffer from poor transportation infrastructure and factors such as market fragmentation and structural deficits, leading to disadvantages regarding agriculture and food markets. Therefore, African food markets do not always responds to shifts and trends in international markets. (Kamara et al. 2009.)

Deininger and Byerlee (2011) forecast that in future Africa will face extreme weather shocks as a consequence of climate change. This can lead to lower yields and depletion of countries food and grain stocks. Additionally, net importers of food may face difficulties, if fuel prices keep rising, and this can encourage more countries to set export restrictions. Output volatility can also increase as a result of more common and severe weather phenomena. If realized, these forecasts about macro-development of world weather conditions mean that small-scale agriculture will face even more risks in future.[8]

[8] Entrepreneurial risk and risk sharing are briefly discussed in section 4.5 Land tenure models.

While thinking about the effects of food prices rises, it can be useful to take a brief look at the term and concept of *Vicious circle of poverty*. If food price increase makes some of the world's poor people even worse of, it could implicate that breaking the vicious circle of poverty becomes even harder for these people. This forecast gains support when we take into account what Mittal (2009) and Kamara et al. (2009) write about the food price increase and food's share of total spending of poorer people: there are even less opportunities to break the circle and get out of poverty trap. The concept of *Big push* is also useful: food price increase may indicate that development countries and poor people fall even lower on the curve describing the *poverty trap*. Hence, even 'bigger push' would be needed to lift these people out from poverty.[9] However, if food price increases benefit agricultural areas and rural people, it might also provide welfare increases in many African countries.

Rising food prices can also be a sign of the *O-ring theory of low production*. This theory attempts to explain 'why poor countries are so poor' compared to the vicious circle concept, which concentrates more on the question 'why poor countries stay so poor'. The main blocks in this theory are skill-clustering, co-operation between different groups (such as firms) and matching of different tasks in production function. If some group works inefficiently or some task is carried out poorly, it reduces the value of all of them and the value for all. This can lead to nationwide clustering of skills (LDCs and DCs) and lead to low-level quality traps for some clusters (poor countries). (Kremer, 1993.) Because of the numerous problems in African agriculture, the O-ring theory can offer one explanation for why it is hard to develop and achieve growth in agricultural sector and why land-abundant countries have to rely on imported food. Furthermore, regarding agricultural FDIs it can imply that because some part of the economy is not working, the positive influence expected from FDIs cannot materialize.

Despite the problems associated with food price volatility and price increases, African Development Bank (ADB) sees some light in the dark. It forecasts that rising prices could increase the value of agricultural assets and this could stimulate investment into the sector. (Kamara et al. 2009.) Combining this opinion with FAO's (2012) viewpoint that agricultural investments are necessary to improve the living conditions in developing countries and the welfare of the poorest rural people, stimulating agricultural investment seems to be an important goal.

If we then consider the recent events between Ukraine and Russia and that the events can negatively affect grain markets, one might forecast that countries will increase their public grain reserves again.

[9] For Vicious circle of poverty, Big push and Poverty trap, see Basu (1997).

Ukraine is known as an exporter of grain, even though its agricultural potential is not even fully utilized due to lacking investment and technology,[10] and Russia is among the world's biggest exporters of wheat (Mittal, 2009). Ukraine's continuing problems as well as the crisis' damage to international relations and international trade can reduce supply in grain markets. Along with other factors it can lead to new food price increases in the future. And in case rising food prices leads to rising foreign investment activity in Africa's agricultural areas, it is important to secure that the locals can actually benefit from the investments.

3 Foreign direct investments

In foreign direct investment the investor acquires a lasting ownership in a company that is resided in another country than investor's home country. In a 'greenfield' type FDI a foreign company establishes new production facilities in a host country. (Sørensen & Whitta-Jacobsen, 2010.) Investors provide typically managerial know-how, new production technologies, access to financial markets and possibilities related to their stakeholders. FDI does not need to be a purchase of an already existing company but it can also be in an establishment of a subsidiary or a branch in host country. A limit of at least 10% ownership of the company resided in host country is usually applied to FDIs to separate them from portfolio investments.[11] Based on the above, agricultural FDIs can be defined as FDIs where the investment in host country includes acquiring land and the operations in host country could not be done without land as an input. In this paper agricultural FDIs also cover such investments where agricultural land is held as an asset and not used for production.

According to OECD-ILO (2008), the majority of all FDIs still take place between OECD countries. But similar to the trend of FDIs focusing on agricultural land, the share of non-OECD countries in all types of FDI inflows is growing. Outward FDIs of non-OECD countries are increasing as well. In 2012 the amount of FDI inflows to developing countries exceeded the inflows to developed countries for the first time. Total FDI inflows amounted to US$ 1 351 billion of which ca. 52% were to developing countries and ca. 42% to developed countries (remaining 6% were to transition economies). FDI outflows from developed countries were more than double the amount of outflows from developing countries. Africa's share of world FDI inflows remained approximately the same between 2012-2013, growing from 3,7% to 3,8%. The same applies to Africa's share of FDI inflows to developing countries: in 2012 Africa's share was 7,1% and in 2013 7,4%. Ghana's net

[10] Meagan Clark (2014).
[11] The 10% limit of ownership regarding foreign investment being a direct one is from OECD-ILO (2008).

FDI inflows increased 11,6% between 2009 and 2013, and reached US$ 3,23 billion in 2013. Ghana accounted for approximately 5,8% of Africa's FDI inflows in 2013.

Table 3. World FDI flows 2009-2013, US$ billions

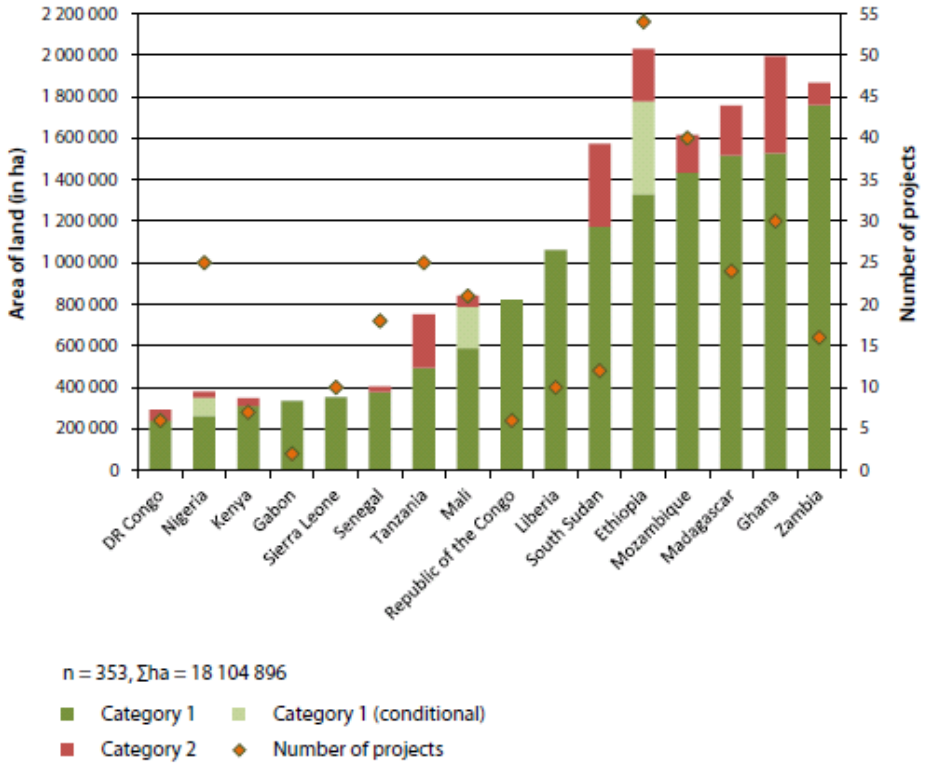
	Inflows					Outflows				
	2009	**2010**	**2011**	**2012**	**2013**	**2009**	**2010**	**2011**	**2012**	**2013**
World	1 198	1 409	1 652	1 351	1 461	1 175	1 505	1 678	1 391	1 411
Developed economies	606	696	735	561	576	858	1 030	1 183	909	857
Developing economies	519	637	735	703	759	269	413	422	426	454
Transition economies	72	75	96	87	126	49	62	73	55	99
Africa	60,2	44	48	50	56	5,6	9	5	14	12
Ghana										
Net FDIs	2,89	2,53	3,22	3,29	3,23	-	-	-	-	-
Portfolio investments	0,04	0,72	0,43	1,34	1,28	0,08	0,10	0,31	0,22	0,62

Source: Bank of Ghana (2014), UNCTAD (2012, 2013 & 2014)

3.1 Agricultural FDIs in Africa

Investment activity has been increasing Africa and nowadays it is African countries that receive the majority of land involving FDIs. Africa's share of all received agricultural land acquisitions could be as high as 70 percent according to some estimates. Table 4 shows the primary investment recipient countries in Africa measured by total land area acquired by investors.

Table 4. Primary investment recipient countries by total land area acquired in 08/2008-11/2011



Source: Table directly from Schoneveld (2011)

The above table shows data in Schoneveld's (2011) study and it includes projects from October 2008 to November 2011, divided into three categories based on their data accuracy. Category 1 projects are the most accurate and their data is gathered from the best verified sources, "conditional category 1" projects include data that could not be verified, and category 2 projects include all variable and doubtful data. Only projects that involved transfer of the ownership rights to farmland area larger than 2 000 hectares were included in the study and are shown in the table. Projects including small-scale farming were excluded from the study. (Schoneveld, 2011.)

Recipient side concentrated to seven countries (Liberia-Zambia in the table) that accounted for more than two-thirds of the land area acquired. The country of the model study in chapter 6, Ghana, received the second most investments. Majority of the investment projects involved foreign players on buyer side but there were also farmland acquisitions by domestic players. On the buyer side, the most common investor origin countries were India, Norway, the UK and the US. Two trends were identified: "Northern investors" such as European countries and the US have been targeting farmland for biofuel production, whereas "Southern investors" such as countries from South Asia and Middle East target farmland for food production. (ibid.)

Together all the projects (353) in the study covered an area of 18,1 millions of hectares. This estimate seems to be in line with other estimates.[12] 297 of the projects belong to category 1, so the majority of projects should have a relatively good accuracy. It is interesting to notice that countries with relatively small land area are among the key recipients: e.g. Ghana and Liberia belong to this type of countries. On the other hand, countries with abundant land reserves, such as the Democratic Republic of Congo, have not been as popular recipients of FDIs. (ibid.) Distribution of land area acquired is presented below in Table 5.

Table 5. Large-scale agricultural land acquisitions, hectares

Variable	Area
Total area acquired	18 104 896
Category 1 data (total)	15 094 911
Category 1 data (conditional)	734 718
Category 2 data	3 009 985
Mean	50 856
Median	18 512

Source: Schoneveld (2011)

[12] For example, Chaudhuri and Banerjee's (2010) estimate for the acquired land area in 2007-2009 is 20 million hectares.

3.2 Host country effects of FDIs

Foreign direct investments can have multiple effects on host countries, both beneficial and harmful. This subsection presents findings of FDI effects that are discussed in literature. The focus is not only on agricultural FDIs but also in general types of FDIs. It is usually assumed that FDIs can boost host countries' economies but observed results vary a lot.

3.2.1 Wages

Foreign firms' presence and investments can affect wages in host countries and the effect of FDIs on average wages seems to be positive: however, opinions and results on this matter are not unanimous. Wage-increasing impact of FDIs can occur due to higher wages paid by foreign-owned entities and wage spillovers. Wage increases can also arise through increased demand for labor (Chaudhuri and Banerjee, 2010). Adoption and use of new technologies can lead to skill upgrading of labor and that can increase the demand for high-skilled labor, which tend to increase average wages (Lipsey, 2002).

The impact on wages can be small, if higher wages are only paid to high-skilled workers (who are often hired from abroad and not from host countries). On average, foreign-owned firms tend to pay higher wages than local firms[13] and numerous reasons have been suggested to explain this: public relations, workers' preferences towards local firms, higher wages paid in order to reduce labor turnover and to attract better workers, and higher labor demand in the sector. At first look the underlying reason to explain higher wages may not seem crucial because higher wages benefit host countries in many ways. Yet, if the reason for higher wages is to attract more skilled local labor, it means that local firms might suffer from losing their more skilled and better workers and this could offset the positive effect of wage increases at economy level.

The above is exactly what OECD-ILO' (2008) report first says about higher wages: they might be paid only to get more skilled employees or to compensate employees for some reasons like working conditions. Nonetheless, the report continues and admits that there may also be other reasons behind higher wages paid by foreigners. Efficiency wages is one possible explanation and it means that higher wages would be paid to motivate employees (traditionally this means "not shirking"), to reduce employee turnover and risk, and to improve or maintain company image. This reasoning above is closer to what Lipsey (2002) and others argue and have found about wages.

[13] This applies both to developing countries and developed, higher-wage countries (Lipsey, 2002). The wage increase caused by FDI in agricultural land is found in Chaudhuri and Banerjee (2010).

Foreign-owned firms usually adapt to host countries' working conditions instead of applying those of their home countries. A lack of absorptive capacity in domestic firms may deter wage spillovers and crowding-out effect may drive local firms out of business. Findings about FDI wage spillovers suggest that wage spillovers may be stronger and more likely for skilled than low-skilled workers. Yet again, wage increases due to FDIs are more likely to realize in developing and emerging countries compared to developed economies. (OECD-ILO, 2008).

Studies concerning the wage-premium paid by foreign-owned firms tend to imply that wage premiums do exists. OECD-ILO' (2008) report lists some of the results. In a study about Mexico, Venezuela and the United States (Aitken et al. 1996) it was found that average wages paid by foreign-owned firms were 30% higher compared to domestic firms (when factors like capital intensity and skill mix were controlled). In a study about Indonesia, conducted by Lipsey and Sjöholm (2004), wages in foreign-owned firms were 12% higher for production workers and 20% higher for non-production workers. And in a study covering five African countries, conducted by Morrissey and Te Velde (2003), similar numbers were found but the increase in wages was found to be conditional on age, tenure and education. These results, however, are related to plant and factory workers and hence, they cannot be generalized to apply directly to FDIs in agricultural land. Still, they can offer one indication for what may happen to host country wages as a result of agricultural FDIs. And agricultural FDIs can also require factories to process raw materials further and to produce end-user products from agricultural inputs.

Regarding wage impacts, there is an interesting finding in Lipsey and Sjöholm (2002). Their study concentrates on Indonesian manufacturing firms and results indicate that wages tend to rise strongly as a result of FDI (acquirement of a domestic firm), whereas wages tend decrease after a takeover of a foreign-owned company by a domestic one. This might imply that FDIs can in some cases be more important for countries' welfare than domestic investments. One should keep in mind, though, that the evidence about wage effects is said to be anything but conclusive (Lipsey, 2002).

3.2.2 Job creation

Regarding job creation, different types of FDIs have different impacts. According to OECD-ILO (2008), the most jobs are usually created in greenfield-type FDIs and when the operations exercised by foreign-owned firms are labor-intensive. The need for jobs in agricultural sector is recognized and highlighted in Hanlon (2004): subsistence farming is inefficient and unable to provide profits, and therefore there is a need for jobs that actually provide earnings to locals. Hanlon, however, argues that big farms ("heavy investment strategies") are more about job creation and peasant

farming strategies are more about improving welfare of farmers. This opinion contradicts with that of OECD-ILO and with results found by Arndt et al. (2010) whose findings related to cash cropping and outgrower schemes indicate that contract farmers tend to use more labor than capital-intensive big farms.

According to Arndt et al. (2010), large plantations do not hire as much labor because they tend to have a higher land-labor ratio, whereas outgrower schemes use more labor and less capital per acre. Arndt et al. find also that productivity per acre tends to be lower when less capital per acre is used. However, opposing findings have been given by Basu (1997) and Ray (1998): higher labor per land, for instance in family farms, may compensate the lack of capital and thus the yield per acre can be higher in some cases. Labor-intensive outgrower schemes can also have better impacts in social terms due to higher labour demand and job creation.

Somewhat good example – but sadly, one of the few – of both job creation and wage increase is related to irrigation system 'Peuenos Libombos dam' in Mozambique. The irrigation system was used by locals that were supported by Italians. When Italians left Mozambique, the system collapsed and locals became indebted to the system. This led to a situation where many locals either had to lease or sell their lands. Selling was actually illegal, because owning land is not possible in Mozambique (Mozambicans can only register and title land through certain procedures rather than owning their lands). Eventually it occurred that most of those who leased their land ended up working for new cultivators (e.g. "urban dwellers to grow bananas") and earning as much as up to three times more than what they were earning when farming themselves. Yet, people who illegally sold their land were worse off than people who leased their lands. (Hanlon, 2004.) This can be seen as an example of locals entering into mutually beneficial transactions.

3.2.3 Productivity spillovers

Wage spillovers are not the only form of spillovers there exists. If a foreign-owned firm is more productive – as is usually expected due to technology and capital advantage – productivity spillovers may arise and they can spread through several mechanisms. Local firms may copy technologies and solutions, workers who previously worked at a foreign-owned company can transfer to domestic-owned companies and spread their knowledge, spillovers can occur through supply chain effects (e.g. because of standards and quality required by foreigners) and increasing competition may positively affect productivity. (OECD-ILO, 2008.) The greater the investment in learning and imitation by host country firms and the more competitive business environment, the faster the transfer of technology should be. Productivity spillovers tend to arise mainly inside the

industry where the foreign investor operates.[14] For Africa this could indicate that FDIs in agriculture should provide productivity spillovers exactly where they are needed.

Backward linkages are another way to achieve productivity spillovers. Partly similar to supply chain influences, backward linkages can provide benefits to local firms by increasing demand for better quality products and demand overall. Backward linkages may also be an important way for wage spillovers to spread between domestic- and foreign-owned firms, even though there is no robust evidence of productivity-driven wage spillovers. (OECD-ILO, 2008.) It may be difficult to find backward linkages related to agriculture since it is already a primary production sector. But if we think about FDIs in a form of cash cropping and biofuels, there may exist some. At least products and services provided to foreign-owned firms may increase demand. Moreover, if biofuels were further processed and refined in the host countries in Africa, the role of backward linkages could be higher.

Based on a study related to cash cropping and biofuels has been performed by Arndt et al. (2012), it seems that cash crops production can have positive spillover effects on economy when a question related to land used for production expansion is excluded. Similar results have been found in other studies related to cash crops, and an example of a spillover benefit has been increased adoption of fertilizers in producing food crops (Strasberg et al. 1999).

3.2.4 Growth impacts and other benefits

FDIs are commonly known as a source of external finance for developing countries (OECD-ILO, 2008). Liu (2008) treats this as closing developing countries' "savings gap". Closing the savings gap also means closing 'investment gap', emphasizing the need for investments in developing countries. Foreign actors' role is also present in chapter 6 where part of Ghana's investment is financed with foreign saving (current account deficit from Ghana's viewpoint).

Foreign direct investments can also have influences in host countries in forms of growth acceleration and introduction of new industries around the FDIs. In addition, FDIs may lead to higher quality goods and services provided by domestic firms which can increase the welfare of consumers (Lipsey and Sjöholm, 2004). For example, establishing a new biofuel industry in an African economy could be justified by the 'introduction of new industry' argument. But then a question of land use arises: if land is taken away from food production, establishing a new industry

[14] Liu (2008) reminds that spillovers are not a free meal for host countries: the degree of benefits to host countries depends on local firms' efforts in learning and investing.

may not automatically improve welfare of everyone, despite the possible wage and productivity effects and improved welfare of a country as a whole.

There is an illustrative comment about locals' expectations and wishes in Hanlon (2004): "We don't need investors to grow tomatoes for Maputo – our farmers already do that. What we need is investment in packing and processing." Although "packing and processing" is not exactly a new industry, it can be seen as operations that the local economy is not active in and as completion of local economy's resources or technologies. Intermediate sectors can create new income opportunities.

Growth increase is a common argument in favor of FDIs. Positive impacts on growth have been observed by e.g. Arndt et al. (2010) who find that biofuels production could increase economic growth by increasing growth rate of GDP by 0,2-0,4 percentage points. Sectoral linkages like spillovers are drivers behind assumed increasing growth rate. In addition to growth acceleration, expanding country's productive capacity affects directly to growth as well.[15] Expanding productive capacity refers here to taking new lands into usage and under cultivation, and the effects can be seen similar to what establishing new industries can provide. However, Arndt et al. warn that accelerating economic growth does not automatically transfer into more jobs and reduced poverty. Such pro-poor effects depend on the distribution of FDIs' welfare effects.

Lipsey (2002) argues that FDIs can affect growth by supplying technology and linkages to those parts of production networks that would otherwise be bottlenecks for industries and restrain growth. Lipsey's argument sees FDIs as a way to complete host country's resource bundle for efficient production and it is closely related to the above mentioned productive capacity and intermediate sectors. Another important, but at the same time discouraging, note in Lipsey is that among developing countries FDIs promote growth more likely in higher income countries. For countries being poorest of the poor, this finding is not encouraging. But if FDIs were to interact with the level of education, influences on growth could be stronger even in the poorest countries.[16]

Romer (1993) presents and defines two interesting concepts to promote economic growth: 'idea gaps' and 'object gaps'. Idea gap refers to a difference between country's level in ideas and knowledge compared to rest of the world. Romer argues that an easily applied policy could be to give foreign companies incentives to close the idea gap and make profit by doing so. A lot of

[15] Productive capacity refers to country's production possibility frontier (PPF), which describes countries different production possibilities arising from different input allocations.
[16] Lipsey (2002) makes a reference to results found originally by Borensztein, De Gregorio, and Lee (1995) in *How Does Foreign Direct Investment Affect Economic Growth*.

criticism has been aimed at incentives such as tax exemptions but notwithstanding, foreign investors bringing in new ideas can provide benefits by improving the economic environment and creating possibly new industries. Establishing a biofuel industry and starting cultivation in relatively barren lands can in best case be an example of closing the idea gap.

Object gaps have been recognized by others as well (but not necessary with the same term) and they refer to lagging physical objects and resources. 'Infrastructure gap' – the lack of roads and irrigation systems in Africa – is probably the most relevant part of object gaps for agricultural sector. Amanor (2012)[17] argues that in areas where smallholder agriculture suffers from low productivity due to poor availability of resources, large-scale mechanized agriculture could provide necessary investments and resources to utilize new areas of land.

Amanor's viewpoint is contrary to the findings favoring contract farming but the logic in Amanor's reasoning relates to infrastructure and labor conditions. In cases where the availability of labor and infrastructure are weak, large-scale mechanized farming strategies by foreign-owned companies may prove to be beneficial. Usually they need lower amount of labor due to capital abundance and they can have both the incentives and capital needed to build their own infrastructure. That can benefit a variety of groups and companies, such as local small-scale farmers. And furthermore, the improved infrastructure can act as an incentive for future development and investments to both locals and host country governments.

3.2.5 Risks and accusations related to FDIs

There are also downsides related to FDIs and in the context of this paper they are discussed mainly from host countries' perspective. Possibly the biggest risk and the risk that has gained most media attention is related to property rights and smallholders losing their land or getting into deals that provide them with only a marginal compensation.[18] While putting the blame entirely on foreign investors would be an easy answer, it is not the complete truth. Hanlon (2004) reminds that usually host countries' elite plays also a role. Elite may organize land concessions but at the same time it may lack money and motivation to start cultivation and bring in investments. This kind of behavior has occurred at least in Mozambique and it can increase speculative land transfers and decrease the land used for production.[19]

[17] Amanor (2012) refers to findings of Deininger and Byerlee (2011).
[18] For example, Deininger and Byerlee (2011) and Cotula (2011).
[19] Hanlon (2004, see p. 15) presents an illustrative comment from a Mozambican: "The problem is not foreigners stealing Mozambican land, it is the new Mozambican elite stealing land from peasants. In some places a serious foreign investor can only get land through a dodgy Mozambican."

Foreign firms are often seen as more efficient in their operations, due to knowledge and capital advantages. However, if the FDI is not a greenfield investment but rather an acquisition of a domestic firm, it may simply indicate that an efficient local firm is acquired. Thus, the efficiency would not be a result from foreign ownership. The appearance of foreign-owned companies may force local firms to less efficient production scales or sectors. Or they may drive locals out of business which can reduce the positive job creation effects or completely outweigh them. (Lipsey, 2002.) The process of driving locals out of business is called market-stealing hypothesis by Aitken and Harrison (1999).

If aggregate industry efficiency or agriculture productivity is measured and observed to be higher after the appearance of FDIs than before, one must consider whether it is due to spillovers (e.g. productivity and backward linkages) or just based on the higher efficiency of the foreign-owned firm. One should also notice that assuming productivity spillovers from FDIs requires assuming that foreign-owned firms are more efficient in the first place. Challenging the common expectation about higher productivity of foreign firms can be taken deeper by looking at labor productivity: in many studies foreign-owned firms have substantially higher labor productivity (due to e.g. capital-intensity) but the differences in total factor productivity (TFP) are considerably smaller. (Lipsey, 2002.)

It is true that a share of the higher productivity in foreign-owned firms comes from higher capital-intensity, but it does not directly imply that there would be no spillovers. For instance, Liu (2008) conducted a study about technology spillovers related to FDIs and found positive results. Liu's findings indicate that for technology spillovers to take place, a decrease in short-term productivity (at firm level) is required. Domestic firms must allocate a share of their resources and efforts to learning processes which decreases output at first. Learning pays off in the long-run as technology spillovers are reached. This can increase productivity and outweigh the temporary decline due to investment in learning.[20]

Another aspect related to risks of FDIs in Africa can be found in Amanor (2012). He discusses about two principal viewpoints in developing land governance and markets: some argue that developing functioning land markets that enable both selling and acquiring land is the best way to achieve equity, while others argue for protection policies. These protection policies underline social

[20] Liu (2008) focuses on Chinese manufacturing firms and thus, when generalizing of the results to cover also agriculture in Africa one must be careful. Yet, if we accept that managers have to use their efforts in learning and at least some amount of investments in learning the new technology is required, the results could be similar in agricultural sector.

safety nets and land's importance for rural livelihoods, and they emphasize that dwellers need to be protected against speculation and concentration of markets. Amanor argues that "land markets do not in themselves operate for the benefits of poor people or create transparency." Thus, the opening of land markets can lead to increasing number of land grabs, speculation and distress sales by the poor. All of this can create a process where poor people lose the lands they are using (often under customary rights) and where concentration of markets grows instead of facilitating easier participation for individuals and communities.

3.3 FDI issues with cash cropping and biofuels

Locals and host countries face risks also when FDIs are related to cash cropping. These risks are central in this paper because chapter 6 introduces a CGE model where FDIs are assumed to occur due to establishment of a biofuel sector in Ghana. Furthermore, cash cropping for biofuel production have been growing along with the growing interest in biofuels and interest in farmland in Africa. Three main political drivers have been identified behind the growth of biofuel production: policies to mitigate climate change, to improve energy security and to enhance development in rural areas through biofuel production (Brittaine & Lutaladio, 2010). This subsection introduces risks related to cash cropping only briefly because issues related to cash cropping and biofuels are discussed more in further sections.

Biofuel production and cash cropping in general can impose threats to other sectors in host countries: in practice this means especially traditional agriculture and food cropping in African countries. Land is of fixed amount and labor transferring to biofuel cultivation reduces labor available to food production. Closing the object gap and possible spillover effects can reduce this harmful impact. If FDIs target mainly unused or barren land, the amount of land allocated to food production will not be reduced as much. (Arndt et al. 2010.) This viewpoint, however, is not necessary realistic. Cotula (2011), for example, argues that investors have a tendency to target the most suitable and fertile lands.

The impacts on food production and food security are not straightforward. Von Braun and Kennedy (1994) point out that even though many studies have criticized cash crops in the past, there are other studies showing that the studies from which negative results have been generalized have been "conceptually flawed". For example, previous studies may not have taken all the variables into account.

An important question is related to characteristics of FDIs: what are the benefits and downsides related to outgrower schemes compared to large-scale plantations where land is leased or bought from locals? The risk of locals losing their land is higher when the land is leased in a long-term contract to foreign investors. African governments tend to favor outgrower schemes (on paper) because of their expected better job creation (Arndt et al. 2010).

Another aspect related to biofuels and cash cropping is their effect on exchange rate: if biofuel exports grow fast, it can lead to appreciation of domestic currency and real exchange rate. Increasing demand for domestic currency means that competitiveness of other exports than biofuels is reduced. For African countries this basically means that food exports are reduced due to appreciating real exchange rate. (Arndt et al. 2010.) Along with the increasing demand for labor this effect implies that even in case of FDIs targeting only unused land, host country's food production will face challenges and may decline to some extent.

In some countries biofuels are subsidized with policies like tax exemptions that can reduce government revenues. A much debated topic related to biofuels is also a question of how environmentally friendly biofuels really are. Promotion of biofuels has been justified by biofuels' positive contribution to abatement of GHG emissions, but not everybody agrees with it. One thing to consider is, for example, that biofuel production requires more energy than production of fossil fuels. Other questions related to environmentally friendliness include such topics as biofuels' emissions, irrigation and fertilizers needed for production. (Peters & Thielmann, 2008.)

Another negative aspect related to biofuels' impact on environment is introduced by Chakravorty et al. (2012) who argue that biofuels impacts on emissions and environment may not be beneficial: biofuels may increase carbon emissions (aggregate world emissions) indirectly by causing emission leakage due to lower oil prices and converting forests to farmland. Lower oil prices due to increasing supply of biofuels can launch a shift to increase oil use in countries that are not involved in biofuel production.

3.4 Limitations related to FDI studies

When one is looking at studies concluded in African countries it is often the case that data may not be reliable or it can be hard to get. Data is only rarely made publically available in most Sub-Saharan African countries. Data is also only rarely consolidated or maintained in one location, meaning that governments themselves may lack precise data as well. There can be multiple agencies gathering data but coordination between them can be poor. (Schoneveld, 2011.)

The mixed evidence of host country effects of FDIs may not be surprising given the problematic data availability and access, but the mixed evidence of real FDI effects on wages is a problem when trying to recognize the true effects of FDIs. Hence, the direct impacts of FDIs on wages, jobs, exchange rates and growth should be treated with caution. As Lipsey (2002) puts it, "only limited evidence in support of positive spillovers has been reported". It is argued that the diversity of results may be explained with differences between domestic firms and their absorptive capacities, industries, policy regimes, country capabilities and labor markets segmentation. (Lipsey, 2002; Lipsey & Sjöholm, 2004.) Positive findings exist but it is often underlined that the results cannot be taken for granted and transferred to apply automatically to other regions or countries.

4 Land, agriculture and economies in Africa

Typical farming model in Africa (especially in Sub-Saharan Africa, excluding South-Africa) is smallholder farming: small plots of land are cultivated by individuals and communities. When farming and ownership of the land are communal, it means that landownership, or the right to cultivate land, is based on kinship or belonging to a political group. Villages, families, lineages and other social networks play an important role in determining claims to land and resources. It is also said that land tenure in Africa is "characterized by flexibility, complexity and negotiability". (Shipton & Goheen, 1992.)

There is a common view according to which the growth in developing countries, and especially in Sub-Saharan Africa, needs to be based on productivity reform in the small-scale, subsistence farming.[21] So the remaining open question seems to relate in achieving the productivity reform. The importance of this question can be emphasized with World Bank's (2007) estimates according to which two-thirds of world's *agricultural value added* is created in developing countries, agriculture accounts for 29% of GDP on average in those countries, and agriculture employs 65% of the work force in developing countries.

Typical form of agriculture in Africa is small-scale farming: whether it is individuals, families or communities, farming usually happens at small-scale and (at least) close to subsistence level. Many of the small-scale farmers are women. There exist results when smallholder farming has proven to be more productive than larger-scale farming – when efficiency is measured as output per acre - but in many occasions smallholders face a lot of challenges and constraints: poor infrastructure, limited access to credit markets and capital, and highly volatile yields. In addition, government policies and

[21] For example, FAO (2012) and World Bank (2007).

politicians sometimes discriminate against local small-scale farmers. (FAO, 2012.) Despite the agricultural potential and abundant land resources of African countries, most of them are net importers in agricultural products (Schoneveld, 2010).

The above short description of Africa's agriculture makes it different compared to more capital-intensive agriculture in developed countries. Things that one could assume from legal infrastructure and markets in developed economies do not hold in many parts of Africa. Thus, to analyze agricultural FDIs one must also understand features of African agriculture. That is why this chapter introduces the main features related to land and agriculture that are relevant to agricultural FDIs.

Von Braun and Kennedy (1994) argue that subsistence production (to which smallholder agriculture often belongs) "is chosen by farmers because it is subjectively the best option, given all constraints". They continue by arguing that it is among the biggest prevailing misallocations of human and natural resources. Now, two decades after their paper, one can see that the observation still holds.

4.1 Features of African economies

African economies are still more or less suffering from the legacy of their historical policies and harmful, unstable conditions. SSA countries had policies discriminating against agriculture and those lasted till late 1980s. For instance, producer prices of agricultural products were kept low by controlled procurement prices and high export taxes, while overvalued exchange rates lowered real agricultural prices.[22] Public spending in agriculture as a share of national income was also very low in many countries, 4 percent and below that. Comparing it with the fact that most people in African countries are living in rural areas and getting their livelihood from agriculture, the public spending was very discouraging from locals' perspective. (Deininger & Byerlee, 2011.)

The same characteristics and problems of African countries were already recognized by World Commission on Environment and Development (WCED) in its report *Our Common Future* (1987) almost three decades ago. Already then it had been observed that farmers in developing countries were not sufficiently supported by adequate policies. Furthermore, WCED report points out that opposite policies in industrialized countries – subsidizing their own industries and protecting them from foreign competition – enabled them to create surplus output that was transferred to developing world. This surplus with its "concessional rates" undercut agriculture and policies in the recipient

[22] An example of controlled procurement prices is coffee production in Uganda: from late 1960s to early 1990s prices paid at each stage of the coffee production chain were fixed and pre-determined by national budget. This caused a situation where Ugandan coffee farmers earned "only one-fifth of the free on rail/truck price for their crop". (Masiga & Ruhweza, 2007.)

countries, that is, developing countries. And there is even more in the WCED report that is topical nowadays: pushing locals onto marginal land (less suitable for agriculture) and lacking incentive systems to encourage production were identified in 1987 as well.

Typical problems for African economies are poor market access and getting finance. Along with other factors these can make a country an unattractive place for investment and the result may be low wages and low yields. And the local small-scale farmers can face problems since market failures and deficiencies affect strongly at small-scale. (Venables, 2010.) This unattractiveness covers at least domestic investments but with FDIs the case may be more complicated: it has been claimed that foreign investors target African countries with poor infrastructure and weak rule of law to avoid fair market prices and genuine mutually beneficial transactions (Deininger & Byerlee, 2011). It thus seems that foreign investors can overcome the unattractiveness to some extent because they can seek their own benefits via means that are not possible for local small-scale farmers.

Venables (2010) highlights two points about African economies: (1) banking sector is highly concentrated and (2) grain merchants may have a monopsony in markets (such as raw cashews produced in Mozambique[23]). He argues that lack of many potential buyers of agricultural output deters investment. And as we can see by studying African tenure systems, highly concentrated banking sector (meaning also highly concentrated credit supply) makes investing even harder for locals. Yet, the high level of concentration may not hold for all the countries or every sector: Conning and Udry (2007) argue that the rural financial sector is not concentrated but rather fragmented and imperfect.

Eastwood et al. (2010) identify two groups demanding agricultural credit: big farms and small-scale farmers. Big farms usually borrow formally and from more institutional lenders, whereas small-scale farmers borrow informally from local lenders because of their inability to access formal credit markets. According to Conway (2011), 80% of the 33 million farms in Africa are small-scale farms, when small-scale is defined by having less than two hectares of farmland.

Collier and Venables (2009) write that in many African countries the ownership of natural assets is limited or concentrated to governments. They also argue that exploitation is usually undertaken by multinational companies rather than governments. However, even though exploitation may not

[23] McMillan et al. (2002) write that as a consequence of trade liberalization in cashew markets Mozambique transformed from exporting processed cashews to exporting raw cashews. World markets of processed cashew were considered competitive, whereas India was a monopsonistic buyer of raw cashews. The authors thus expected terms-of-trade losses and reduction of gains from liberalization for Mozambique.

occur through government actions, it can be African governments that allow the exploitation of locals indirectly: corruption and neglecting property rights to gain FDIs can be incentives. This is argued by e.g. Kachika (2010) who writes that "African regional and national governments are directly or indirectly behind the land grabbing".[24]

Africa has quite recently enjoyed some economic growth and this performance has been studied by e.g. Arbache and Page (2009) who try to find out whether some recent positive and growth-indicating signals from Africa really stand for longer-term growth or whether they are just some short-term fluctuations. Their findings show that investment share of GDP increased in resource-rich countries and trade openness increased during the both periods of the study, 1975-1994 and 1995-2005. However, as a whole the share of investment did not improve. Countries' policies, institutions and economic management improved during the last decade, supported by a small rise in Africa's Country Performance and Institutional Assessment score (World Bank's CPIA score) in 1997-2005. But some other measures than CPIA gave an opposite result.

Arbache and Page (2009) find no evidence to suggest that Africa's growth increase would be durable. They argue that it is rather because of increased demand of natural resources, moving towards region's existing production possibility frontier instead of pushing it forward, and by learning to avoid economic declines that has caused the recent growth increase in Africa. But contrary to Arbache and Page, Fosu (2012) argues that total factor productivity (TFP) would have been the main growth driver in Africa since the late 1990s. This could indicate that the growth increase in Africa is more durable than suggested by Arbache and Page.

Rodrik (2014) finds that economic fundamentals have improved in Africa. However, he also warns that the recent progress in Africa is more likely to provide just foundations for growth than to induce and sustain fast productivity growth. Because "traditional growth engines", such as structural change and industrialization, are not working at full pace, Rodrik forecasts "moderate and steady growth" with a 2% per capita growth as an upper limit. This estimate is conditional to changes in external environment. Interestingly, Rodrik also mentions that Africa may as well grow faster than at estimated 2% rate, and if that happens, it could be achieved with growth led by agriculture or services.

Two things can be pointed out from the above findings. First, it seems that the increased demand of natural resources, especially land, has not lead to major growth increases in Africa, but some improvements have occurred. This could be seen as evidence of FDIs not providing growth impacts

[24] See also p.24 for the role of host country elite that is argued by Hanlon (2004).

and economic benefits that were presented in the previous chapter. Second, Rodrik's viewpoint about fast growth led by agriculture means that securing the benefits from agricultural FDIs for host countries could be a way to support growth. And because forecasts suggest that the demand for natural resources and land in Africa will continue in future, the importance of how the host countries can benefits from the FDIs seems clear. This question is addressed more in chapter 8.

4.2 Land and its distinctiveness

Compared to rest of the world, Africa has a vast amount of abundant land and only few investors.[25] This situation is quite the opposite in other continents where land is scarce and there are many investors. One implication of this can be that the rent for land (e.g. Ricardian rent for land[26]) is lower in Africa, and this is actually visible throughout literature. Later in section 4.5 the rent and price for land are discussed more. It is important to notice that the very fact of lower sales and lease prices can impose African countries to selling or renting their land for nominal price for periods lasting more than one generation: land rental contracts in Africa can last for 20-50 years and even 100 year contracts are not impossible (Cotula, 2011).

Collier and Venables (2012) identify a dual challenge that African governments are facing when deciding on land policies and land deals: first, deals should provide benefits of commercialization to society and second, deals should trigger a transition process towards a similar situation that prevails elsewhere in the world. Fulfilling the latter purpose requires investments either from governments or FDIs from private actors. So far it is pretty clear that benefits of commercialization have not reached locals and societies.

There are governments and countries that already recognize an obligation towards future generations. This is connected to the greenhouse effect and widely discussed duty of every country to reduce GHG emissions to keep the Earth suitable for living. So far there are examples such as Norway and Kuwait that have created "future generation funds" where income from depletion of natural assets is paid to. (Collier & Venables, 2009.) Including agricultural and arable land into these funds or creating own funds for them could help African countries to recognize the value of their land.

[25] Whether the land really is unused or unoccupied, has been criticized and challenged by media and e.g. Hanlon (2004). For very contrary comments about land usage and land being vacant, see p. 5 in Hanlon (p. 607 in *Journal of Southern African Studies*, 30(3), 2004).

[26] See Ricardo (1817) for the rent of land: differences in quantity of land available and quality of land can cause rents for land in Africa to be lower than in most other parts of the world.

Uneven distribution of endowments in natural resources – including land and especially land suitable for cultivation – means that these resources are traded internationally. While Collier and Venables (2011) write about extraction technology and how it makes FDIs crucial to production, one could maybe replace 'extraction technology' by 'production technology' when discussing agriculture. However, a clear message is that FDIs carry a significant role in international trade of natural resources and that is why land should be valued and priced correctly by locals and their governments in Africa. This is not exactly the same thing as protection policies in Amanor (2012) but nonetheless it highlights the importance that land should have in Africa.

Collier and Venables (2011) recognize the distinctiveness of land by mentioning exhaustibility, price volatility and political economy, and these are often found in other literature as well. According to the authors, there exist major inefficiencies in the resource markets, but maybe more important is their following claim: many key policy variables are different than when looking at different types of trade, but properly coordinated policy corrections could offer gains for all. Put it in other words: ubiquitously beneficial solutions could be reached also in international trade related to land.

4.3 Agricultural investments

According to FAO (2012), farmers invest the most in agriculture in developing countries and hence, farmers and their investment decisions should be taken into account in strategies that strive for promoting agricultural investment. Agricultural investments are necessary for reducing world hunger and improving the living conditions in developing countries. If increasing agricultural investment positively affects growth and improves welfare of the poor, it could be possible to reach so called pro-poor growth.[27] Policies to increase agricultural investments – pro-poor policies in best case – may "protect the livelihood interests of the poor against the expansion of land markets" (Amanor, 2012). In addition, because this kind of approach sees that land has a central role regarding social roles and welfare provisioning, it can prevent markets (foreign investors and possibly host country governments) from undermining poor people's rights and livelihoods. These justifications provide background for favoring outgrower schemes over large-scale land acquisitions in FDIs – that would enable poor people's participation in the land markets and not drive them out of the markets by expropriations.

[27] *Pro-poor growth* can be defined in various ways but most common definitions are close to following conditions: (1) poor people must benefit disproportionately from growth (income growth rate of the poor must exceed the average growth rate) and/or (2) growth must reduce poverty (meaning actually that all growth which makes poor people better off would be pro-poor). (Page, 2005.)

Growth in agriculture has been found very effective in improving welfare of poor people: according to cross-country estimates of World Bank (2007), growth in agriculture is at least twice as effective as growth in other sectors than agriculture (for China the estimate is 3,5 times and for Latin America 2,7 times). Another finding is from Christiaensen et al. (2011) who argue that growth in agriculture can be 3,2 times as effective as non-agricultural sectors in reducing the headcount living below one US dollar a day in low-income but resource-rich countries. Yet, FAO (2012) finds a regrettable fact about governments' missing investment in agriculture in poor countries: farmers in poor countries tend to invest four times as much as their governments. Another negative aspect is related to decline in agriculture investments: Mittal (2009) argues that decline in agricultural investment activity is a long-term structural factor that actually played a role leading to food price crisis 2007-2008.

If we compare the above against the success stories in Vietnam and Thailand, where governments have supported smallholders with public investment to provide them access to technology (after first clarifying property rights) and reached positive influences, the lack of public investment in Africa appears to be even more regrettable. However, increasing public investment may not be beneficial in all cases. Fosu et al. (2014) point out that one should analyze the overall impact of public investment because increasing public investments draws resources away from other activities. Furthermore, financing the investments with e.g. taxes will have its adverse effects as well. The examples of Vietnam and Thailand show also that large-scale land acquisitions are not the only way to increase productivity in agriculture. (Deininger & Byerlee, 2011.)[28]

For this paper it is also important to note FAO's (2012) opinion about agricultural FDIs in developing countries. According to FAO, FDIs contribution to capital formation compared to mere change of ownership is not known. For example, the possible impacts of agricultural FDIs are not to be seen, if they are only about purchasing land for speculative reasons or leasing vast amount of land and leaving more than half of the land unused.

Even after agreeing with FAO's viewpoint and the central role of farmers and their rights in strategies aimed to improve investments, it would still be possible to argue that causality between agricultural productivity and tenure security is unclear. Investments can affect property rights of farmers and yet again improving property rights may affect investments. And there are also many

[28] Policies, solutions and successes in East Asia are often mentioned in discussions of agriculture and development in Africa. It is recognized that the solutions may not work as such in Africa because of the communality and insecurity of property rights. Also, the large-scale formalization of property rights may not help or it may be very difficult to carry out in Africa. Hence, the comparison with Vietnam and Thailand does not indicate that following their example would automatically be an easy way out for African countries.

third factors affecting productivity and investments other than just tenure security. (Udry, 2011.) Similarly, Bromley (2008) recognizes a two-way relationship: investments can many times be a way to promote and enhance property rights and moreover, insecure property rights can act both as a disincentive or incentive for investments.

The difficulty of forecasting FDIs' impacts on agriculture and productivity is approached from a different direction in Conley and Udry (2010): they highlight the importance of technology transformation and adapting it to local circumstances. Also, they write about process of social learning between actors and farmers. Understanding processes of adaptation and learning may not be easy and it makes forecasting the results of investments harder. If there is a lack of learning, individuals may act in an inefficient way compared to how they might act, if they utilized all new technology and information.[29] Even though the concept of social leaning is not exactly the same as what Liu (2008) argues about learning and investment to reach the spillover effects, it is closely linked to it: households' investments can mean investment in learning and that can be required for the benefits of FDIs to realize.

Social learning may actually interconnect with a theory of growth presented by Sutton (2002) in a different context. Sutton argues that the basic process of growth driven by accumulation of capital and "an ever-increasing capital-labour ratio" may not be the real driver of growth. According to Sutton, the primary driver of growth would be "gradual build-up in firms' capabilities" which would raise real wages in the economy. The reason why Sutton's finding can be linked to social learning is related to information neighborhoods. Small-scale farmers could be seen as firms building up their capabilities rather than just trying to increase their productivity and profits by increasing capital. Information shared between farmers could mean improving capability for all and increasing productivity (increasing yield) could be comparable to rising real wages of Sutton's. Still, Sutton also recognizes the roles of capital and increasing the capital-labor ratio. With regard to FDIs and foreign investors, there is no reason why the knowledge (capability) build-up should happen only among domestic actors. Foreign investors' role could be more important and their impact larger, if both their knowledge and access to capital was utilized. This could be achieved with joint-ventures, contract farming for example.

[29] Conley and Udry (2010) present a definition of *information neighborhoods*: they questioned individuals by asking, for instance, if they ever go and ask help from neighbors. This was done to find empirical results about information availability (information diffusion could describe it better). The authors find it plausible that high profits earned among farmers' information neighbors affect positively their input level decisions (production methods).

Goldstein and Udry (2008) show that insecure land tenure reduces investments in land fertility in Ghana. One's lack of political power causes a situation where insecure property rights decreases incentives to invest, because profits from investment could accrue to someone else. This results share similarities with disincentive to invest related sharecropping:[30] the difference is that in sharecropping the lower incentives of a small-scale farmer to invest are based on a contract and risk-sharing, instead of disincentive caused by insecure property rights.

The lack of foreign capital in Africa is discussed in Udry and Anagol (2006). An interesting finding in their paper is that Ghana suffers from lack of capital, even though the return to capital is high in cases where investments to new technologies are made. Taking into account that rich countries enjoy a higher output per worker due to higher capital per worker, and that there are diminishing returns to scale of capital, one could fairly argue that capital should flow from rich to poor countries. However, due to financial market imperfections the flow is reversed and does not reach poor countries. Udry and Anagol approximate the rate of return on capital by using Ghana's pineapple sector as an example and they find that rate of return varies from 30% to 50% when plots are cultivated with traditional technology. With newer technologies the rate of return is even higher.

It is common to see arguments according to which investments are decreased or held back by the market imperfections in Africa, but based on findings of Udry and Anagol, one could fairly recommend FDIs in African agriculture.[31] The high rates of return imply also that locals entering into contract farming with foreign investors should have potential to produce high yields. Further, large-scale land leases by foreigners should have potential to provide good returns on investments and offer wage jobs to locals as well.

There are differences between investment patterns of individuals and governments. According to FAO (2012), farmers invest directly in farm equipment, machinery and buildings, whereas governments tend to invest in infrastructure like roads and large-scale irrigation systems. In addition, governments concentrate on institutions such as legal and market environment to enhance the climate for private investments (local and foreign). According to FAO, three main reasons for

[30] See section 4.5 Land tenure models.
[31] However, one should keep in mind Udry and Anagol (2006) was written before the food price crisis (2007-2008) and before interest in Africa's land really started to grow.

public investment in agriculture in Africa are economic growth and poverty reduction, food and nutrition security, and environmental sustainability.[32]

Despite governments' investment patterns that seem promising at first glance, the investments from governments are not what they should be in Africa. An interesting and possible explanation for the missing investment from governments and people with power (e.g. landlords) is offered by Basu (1997): based on *Lewis model* (dual economy) and Lewis's writings, Basu argues that capitalists may have an incentive not to invest. Assuming that they recognize the "turning point" in Lewis model and that they understand the potential of subsistence sector (rural sector) as a nearly unlimited source providing cheap labor, it is in their interest to deter investment to keep wages low. Recognizing that corruption is a serious problems in Africa, Basu's reasoning could explain why the institutions and infrastructure are not fully functional in Africa and why the public investment in agriculture has not been at sufficient level.[33]

4.4 Institutions

Institutions are nowadays discussed a lot in development economics and African agriculture makes no exception. Rodrik (2008) writes that the focus in policy reforms in developing countries has moved into institutions. According to him, this follows from recognizing that markets will not work when set of rules is unpredictable and illegitimate. Some desirable goals of institutions are to provide secure property rights, rule of law to enable enforcing contracts, attractive investment environment and macroeconomic stability. These goals can be achieved in many ways so there are no strict or universal policy suggestions or restrictions.

Related to importance of institutions, Bromley (2008) introduces a term *institutional isolation*. He argues that being isolated from market places, actors and information exposes small-scale farmers to higher transaction costs and hence puts them into a disadvantageous position. Foreign investments could be a medicine to the isolation as well. Large-scale investors could have resources to build their own infrastructure that could benefit all local stakeholders: for example, roads, technology and market access could be enhanced or created.

[32] Related to land rights and FDIs, Hanlon (2004) writes that "land debate is actually a proxy about rural development". This contributes to economic growth and poverty reduction and hence, when we are discussing foreign agricultural investments, at the same time we are also talking about growth and poverty reduction.

[33] Basu (1997). Lewis's dual economy model is introduced in Lewis (1954). The general idea is to analyze an economy which is divided in two sectors, rural and urban. In urban and more industrialized sector there are higher wages but also a risk for being unemployed. In contrast, in rural sector the wages are low but there is no risk for unemployment. When it comes to capitalists' interest in keeping rural wages low by freezing investment, the matter is not straightforward: the argument can be questioned e.g. by looking at individual capitalist's decisions and investment.

Rodrik (2008) identifies institution areas that can be used to analyze country's functioning and attractiveness from investors' viewpoint. For instance, weak contract enforcement and country's legal system (rule of law) are usually seen as imposing significant costs on doing business. However, as a contrary example, Vietnam's economy and its business sector have been very successful for years and the legal system may be even worse than in many parts of Africa.[34] And Deininger and Byerlee (2011) find that countries with abundant land or weak land governance attract foreign investors. This is contrary to what Rodrik argues and also harmful from locals' perspective. It also differs from Vietnam example since the attractiveness originates from foreign investors' possibilities to conclude dubious deals in host countries.

4.5 Land tenure models

Land tenure models are typically divided into two types: fixed-rent contracts and sharecropping (share tenancy) contracts. These are very basic models and they can be extended in many ways. For example, provision of credit by landlord and cost sharing between tenant and landlord can be included in models. Fixed-wage contract is not a pure land tenure model but it is closely tied to them. In such owner-operator system landowner bears all the risk while employees are paid fixed wages. Hence, it is the opposite for fixed-rent tenancy. In addition, land tenure types such as family farms can be defined. (Basu, 1997.)

The main differences between fixed-rent contracts and sharecropping are incentives and risk. By cutting corners, in fixed-rent tenancy the tenant bears all the risk but in turn enjoys all the profits of investments. Hence, both the incentives to invest and the risk of failure or default are carried by tenant. The rent must be paid to landlord no matter how successful cultivation is. In sharecropping the rent is paid by outputs, so a share of the yield is paid to landlord and the rest belongs to tenant. This means that if the yield is low, also the landlord suffers, and that is why the system implies risk sharing. For tenants this type of arrangement is beneficial in situations where low yield occurs independently of tenant's efforts: a low yield can result for example from bad weather conditions. However, tenant's incentives to invest are now lower because a share of all the (increasing) profits that might occur from investment belongs to landlord.

Due to its risk and profit-sharing nature, sharecropping tenancy can be seen as risk-aversive contract from tenant's point of view (like fixed-rent contract from landlord's viewpoint). It can also

[34]In Vietnam, instead of trust in legal system companies have to rely on relational contracting, relationships based on trust and renegotiations. Also, payments have to be made immediately. These features are similar to Africa. (Rodrik, 2008).

be seen as giving a rise to a phenomena called *Marshallian inefficiency*. This inefficiency occurs because the tenant does not have an incentive to invest and work as much as he or she would in a fixed-rent contract. However, Marshallian inefficiency can be challenged by taking into account risk-sharing: a risk aversive tenant may be willing to pay a premium for insurance and removal of risk. (Basu, 1997; Ray, 1998.)

In reality there exist much more complicated and sophisticated contracts between tenants and landlords. Landlords can for instance provide also credit to tenants and they may contribute to farming by providing technology and inputs. Due to credit markets characteristics in Africa, it is often hard for tenants to get credit. Hence, landlords have usually power in negotiations (related to monopoly power) and the credit can actually be used by landlord to capture a larger share of tenant's surplus.[35]

Regarding providing credit to tenants and small-scale farmers, there exists an interesting feature that could be linked to de Soto's (2000) undercapitalization and financially invisible resources: if credit markets function imperfectly – or perhaps if there is a lack of them – farmers may face a situation where they need to sell or lease part of their land. In those situations it is likely that buyers are either wealthier landlords or foreign investors. Either way, it follows that land would be transferred from poor to rich people. Some may call it a perverse situation because one could easily assume that (small plots of) land would be leased from rich owners to poor people (Ray, 1998). These implications could possibly be extended to cover situations where financial and capital markets work to some extent but because of unofficial and unregistered ownership some people are prevented from accessing those.[36]

There is mixed evidence and results related to joint effects of different land tenure models, investment and productivity. Udry (2011) argues that this is due to subtle interactions between tenure rules and incentives to invest. Udry also points out that there is a positive side in Africa's tenure systems: it leads to almost total absence of "a rural landless class" and provides insurance when it is needed.[37] This viewpoint is not a new idea since it is directly related to Lewis's Dual economy and the features of rural sector in it (Basu, 1997). However, even though this bundle of different tenure systems may provide insurance, small-scale agriculture often means poverty and

[35] Mathematical optimization and planning of these contracts is given by e.g. Bazu (1997).
[36] The limited access to credit markets would leave out e.g. people that cannot use their capital (land) as a collateral (de Soto, 2000).
[37] Udry (2011) is also to indicate that along with the beneficial impact on risk mitigation, the system of insecure property rights means severe costs in terms of production choices. This is analyzed more in Goldstein and Udry (2008).

provides income just for the subsistence. And in cases where locals have forfeited their land because of FDIs and government actions the absence of rural landless class does not hold.

Goldstein and Udry (2008) argue that in smallholder agriculture individual's production decisions are shaped by e.g. opportunity cost of capital and beliefs about the probability to be able to continue cultivation after a fallow period. This sounds reasonable but their first point may need some closer investigation. For example, at least Basu (1997) argues that the decision made by small-scale farmers may not always be rational. Sometimes a small amount of irrationality can help everybody to be better off – prisoner's dilemma is an example of it. By acting "irrationally" and following the basic human or cultural behaviour – trusting another player or a member of society – the total penalty is minimized and the welfare of the prisoners maximized. In short-term one's welfare may be maximized by acting against "normal cultural" ways but if everybody tries to maximize their own welfare like that, then everyone is worse off in long-term (prisoner's dilemma result where both prisoners defect). Although, it can also be that because of differing social norms between countries and cultures we do not always understand the logic or opportunity cost behind decisions.

4.6 Linking land tenure models to FDIs: Contract farming

Contract farming is one form of tenure and it is also known as outgrower schemes. Contract farming is a business relationship or agreement that binds producer and buyer together. Buyer (foreign investor in this case) can provide technology and other inputs to a small-scale farmer that commits to sell the whole yield or part of it to buyer at a possibly predetermined price. For this paper it is important to introduce especially findings from a study carried out by Benfica (2006).[38] Benfica's study concentrates on contract farming of cash crops (cotton and tobacco) in Mozambique. Contract farming is chosen by the poor small-scale farmers because of the prevailing circumstances: poor people face cash constraints, poor access to inputs and credit and they have to meet buyers' requirements for quality and volume. Because of this farmers enter into contracts with foreigners and commit to sell (all of) their output to buyers. Mozambican government regulates and controls this system by granting the rights to investors to buy the whole output from contract farmers. In return for the right, investors must provide farmers with inputs like credit.

[38] Benfica's (2006) study focuses first on nature of contract farming (for cotton and tobacco) and then on factors that determine farmers' participation in contract farming schemes and profitability of it. Thereafter the study introduces an economy-wide CGE model with SAM to evaluate income and poverty effects of cash cropping more thoroughly. The study uses data gathered in a two-round survey from households in Zambezi Valley, Mozambique (other data sources are used as well).

Benfica argues that contract farming with regard to tobacco production exist because producing tobacco imposes requirements for production structure. Production requires a large amount of labor which would mean large supervision costs for companies (investors), if they ought to produce tobacco with hired labor in owner-operator systems. Firms would also have to pay a minimum wage to labor, which should presumably be higher than what contract farmers are paying. There arise problems like asymmetric information and contract farmers being likely to lose some of their bargaining power because of specializing in tobacco production and being tied to one buyer.

Benfica finds that the likelihood of becoming a contract farmer is different with regard to tobacco and cotton. For example, land amount does not affect entering into tobacco contract farming but it does affect when cotton is analyzed. In both cases other options for livelihood, such as wage jobs, decrease the likelihood for entering into contracts. Size of the land possessed influences profits of contract farmers only at higher amounts of land owned, after a certain threshold level is reached (both cases). The main result is that household income level is increased by contract farming compared to those who do not enter contract farming deals, but only at "highest land holding" levels. Education does not seem to affect profitability of contract farming. (ibid.)

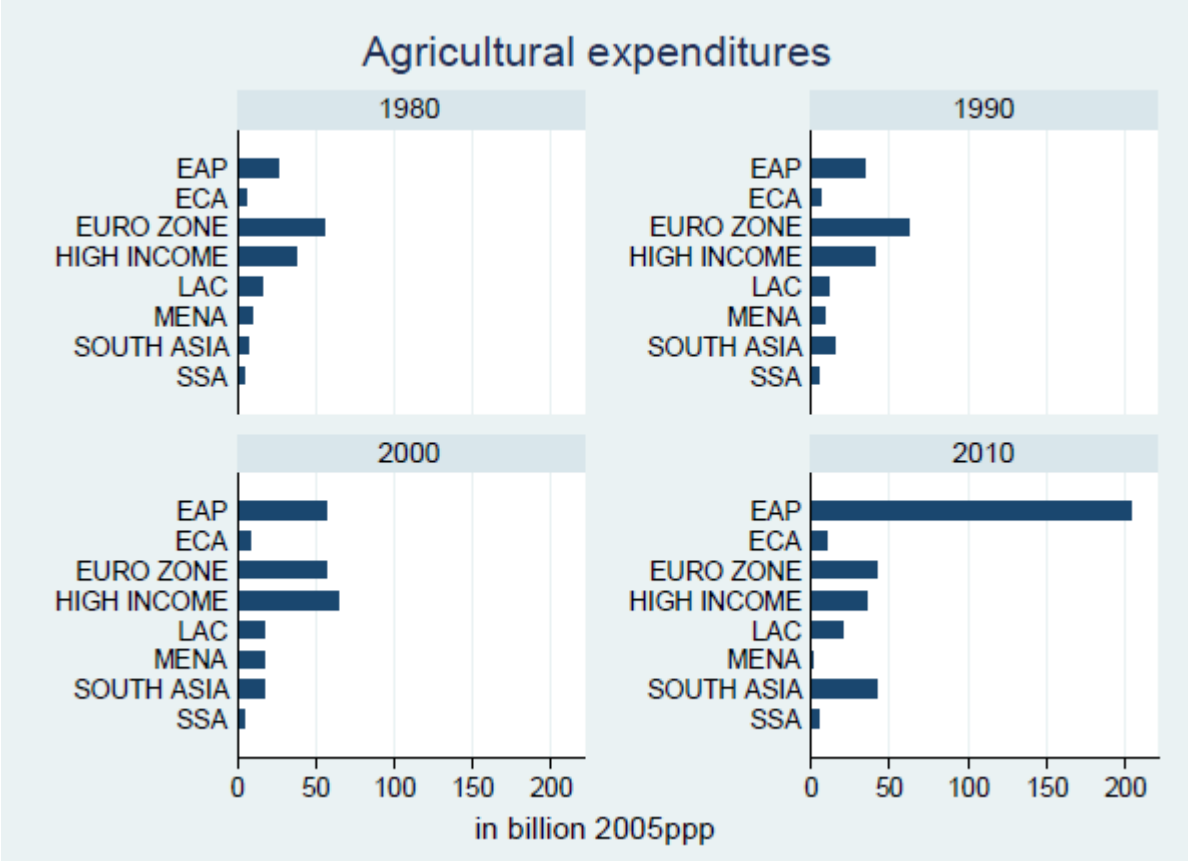
CGE Model results found by Benfica indicate the following: cash crop production expansion leads to income growth and poverty reduction, both for non-growers and growers, but the effects for non-growers are smaller. Benfica, however, does not discuss where the expansion would draw its land from (whether it would be from unused land or land already used for food crops production). This question is relevant in chapter 6 where a 1-2-3-4 CGE model is built for Ghana and analysis is provided regarding cash cropping in a form of biofuels. There are different scenarios regarding the question of where the new land comes.

4.7 Challenges in African agriculture

The challenges in Africa's agriculture are widely recognized. Among them are good governance, incentives to invest, public goods and geographically scattered production. In addition, agriculture is strongly affected by drought, pests and diseases. The result of these factors is that agriculture can be risky business and good rural infrastructure would be needed. (FAO, 2012.) As remarked by FAO, public investment could reduce risks and increase the attractiveness of private investments. Looking at IFPRI's figure below reveals the unfortunate situation in Africa: government expenditure on agriculture is very low in Sub-Saharan Africa as well as Middle East and North

Africa (as regions in the figure) compared to other regions in the world. This may not stand directly for example of *rural-urban bias*, but it can be a sign of it.[39]

Table 6. Government expenditure on agriculture, by regions, constant 2005ppp billions



EAP = East Asia and Pacific, ECA = Europe and Central Asia, MENA = Middle East and North Africa, SSA = Sub-Saharan Africa

Source: Table directly from IFPRI's SPEED (2013)

To support the existence of rural-urban bias and to further emphasize the ongoing situation in Africa, it can be mentioned that African countries have not been successful in following the *Maputo Declaration on Agriculture and Food Security in Africa*.[40] This declaration was signed in 2003 and according to FAO (2012), only ca. 25% of African countries had been able to meet the target share of government expenditure (10% of GDP in agriculture) in 2007-2008. In addition, Africa's Agricultural Orientation Index (AOI) results are among the lowest. AOI is calculated by dividing agriculture's share of total government spending by agriculture's share of GDP.

[39] Rural-urban bias refers to recognizing that rural areas need a great amount of investment, announcing that investments will be made and actually acting as opposite and leaving rural areas with a little amount of focus.

[40] In this declaration countries agreed on two targets: (1) to increase agricultural productivity by 6 % and (2) to allocate at least 10% of national GDP to agriculture and rural development within five years.

Low productivity dominates African agriculture. One could maybe fairly think that it is caused by small-scale agriculture but the situation is not that simple. Factor endowments can be an underlying reason and this is argued by Collier and Venables (2012). A high land-capital ratio[41] exists in most parts of Africa and it can cause marginal product of land to be low. Related to factor endowments FAO (2012) notes two important measures for describing agriculture's functioning: capital stock per worker and agricultural output per worker.[42] This viewpoint extends the term capital beyond just land. According to FAO, it is typically low-income countries that fit into a group "low capital per worker – low output per worker".

However, it is recognized that output per acre can also be high in small farms and this often claimed to be due to overuse of labor. In these cases the marginal product of land is higher.[43] And the results found by Ray (1998) indicate that FAO's claim does not tell everything about efficiency: even though output per worker can be low, output per acre can be high (due to e.g. above mentioned overuse of labor).[44]

Basu (1997) gives two possible explanations for the observations about inverse relation between farm size and productivity: traditional explanation is the above mentioned and so-called labor-based explanation and the other is "fertility-explanation" (studied also by e.g. Bardhan, 1973[45]). In the latter it is higher fertility of land that causes farms to be smaller: landlords want to ensure more labor per acre and thus they have incentives to lease only smaller pieces of land. This situation may occur when tenants do not have options for livelihood, if they quit, and if land's high fertility enables reasonable livelihood from a smaller land plot.

Another reason behind Africa's inefficiency in agriculture is property rights. Goldstein and Udry (2008) analyze fallow periods to prove and explain this: fallow periods between similar farms vary both within households and across plots held by an individual, whereas in an efficient and competitive allocation the fallow periods between similar plots would be the same. The logic is that fallow period lengths between different actors should converge towards the most optimal period

[41] Also a high land-labor ratio (Deininger & Byerlee, 2011).
[42] At country level the total agricultural capital stock of a country matters, but per capita numbers may be more important for small-scale farmers than country-level numbers.
[43] Udry and Anagol (2006) argue and prove that the rate of return is actually high in pineapple production in Ghana but they focus mainly on cultivation with either new technologies or traditional and well-established technologies. It is in almost total absence of capital and technologies – in smallholder agriculture – where low productivity may dominate.
[44] Also Basu (1997).
[45] Bardhan (1973) studies the inverse relationship between farm size and productivity with Indian farms. He finds that larger size leads to "managerial diseconomies of scale" related labor supervision costs, and that family farms pay labor input prices below market prices (lower prices compared to large-scale farms). Further, Bardhan argues that the inverse relation is more likely to occur due to "inverse correlation between size and other inputs" than due to diseconomies of scale.

length due to learning. But because of weak and informal property rights fallow periods are kept shorter than the optimal to hold on to the right to land.

Economies of scale (arising from e.g. specialization) should not be forgotten but there is evidence that larger farm size does not automatically imply efficiency (Eastwood et al. 2010). Moreover, Nkonya et al. (2004) find that smaller farms can have a higher total factor productivity (TFP) and not just higher productivity of land.[46]

Even though smaller farm size can in some cases provide better results than large farms, small farm size is not seen ideal by everyone. An interesting point in Collier and Venables (2012) is that small average farm size can be a sign of a severe market failure. If the efficient or optimal size of farms is increasing (for instance, due to better technology) and yet the actual average size of farms in Africa decreases, this has to be a result of malfunctioning agricultural markets. The malfunctioning appears to be widely recognized and reasons behind it are e.g. poor infrastructure and customary property rights. I would like to point out that this argument relies on the assumption of technological development and without a doubt also Africa enjoys some of the development. But because there are areas where levels of technology and capital are low but labor is abundant, the efficient farm size may not automatically increase.

Another problem of African agriculture identified by many is that utilizing economies of scale and adoption of new and better techniques are often difficult. Additionally, high-yield variables that give bigger yields require substantial use of both irrigation and fertilizers. Yet again, these require capital and infrastructure and we have already seen that Africa's small-scale farmers lack those. (Kamara et al. 2009.) This is one reason for why foreign investments are needed in Africa. FDIs can utilize unused land and with FDIs the amount of capital in agriculture can be increased and infrastructure enhanced. Hence, FDIs can help to remove land constraints that hinder countries' economic growth. (Chaudhuri & Banerjee, 2010.)

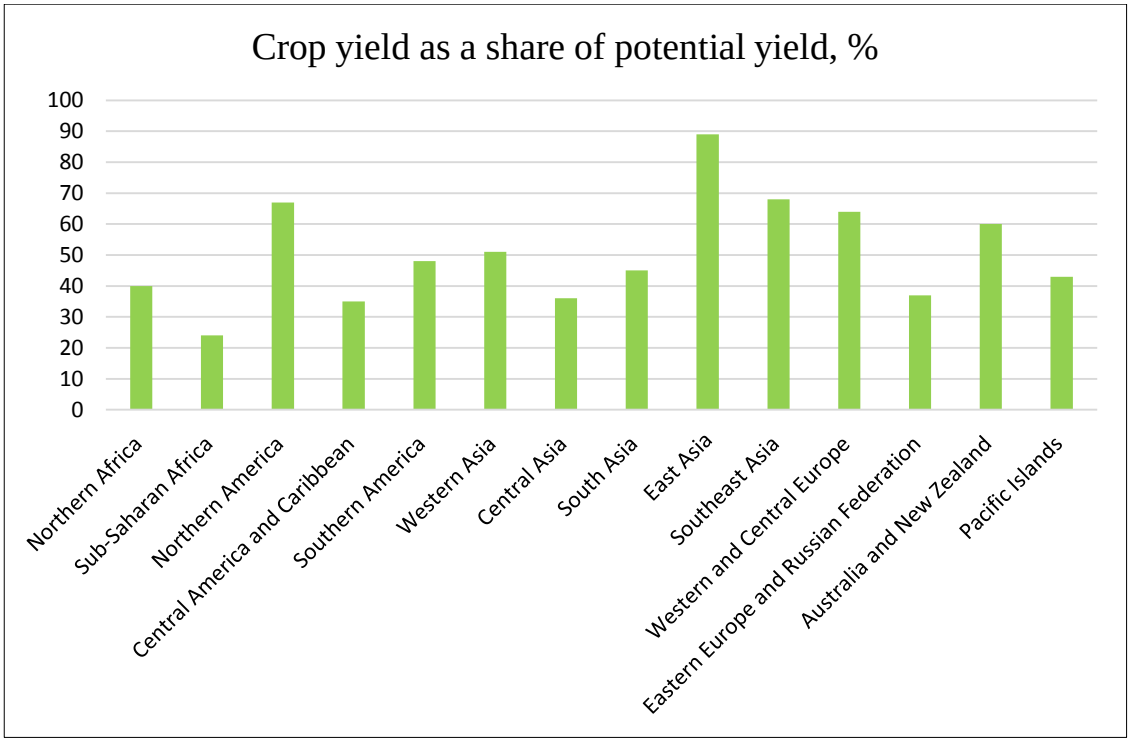
Knowing that the term unused land is problematic and not widely accepted – land may or may not be unused no matter what parties of land deals claim – a more convenient term could be *underutilized land*. It captures the idea that land could be used more efficiently and does not claim that nobody is using it in any meaningful way. One should remember, though, that despite the attention given to unused land, foreign investors often target the most suitable land for agriculture and investments (for example, Cotula, 2011).

[46] The study of Nkonya et al. (2004) focuses on land management and poverty reduction in Uganda.

Bromley's (2008) institutional isolation (introduced in section 4.4.) exposes African agriculture to challenges in many areas: wherever rural farms and villages are isolated and far from urban areas or out of the reach of transportation network, small-scale producers are suffering from asymmetric transaction costs. Costs related to buying necessary inputs and selling outputs are naturally higher. Along with the direct transaction costs there arise also higher costs of acquiring information which creates a problem of asymmetric information. Remembering that asymmetric information is one of the main causes of market failures in economics, asymmetric information may partly explain why Africa's agricultural markets are not in efficient equilibrium and transactions are not always mutually beneficial.

The challenges in agriculture lead to situation where Africa has the biggest productivity gap in agriculture. According to FAO (2011), agricultural yield in Africa is less than 25% of its potential, highlighting that productivity improvements are much needed.

Table 7. Productivity gaps in agriculture, 2005



Source: FAO (2011)

5 Property rights and land deals in Africa

Large-scale agricultural FDIs have gained a lot of attention in media latterly, but they actually represent a minor share of total investment in agriculture. (FAO, 2012) Nevertheless, it is recognized by FAO that the impacts of FDIs can be major and severe in situations where there

occur events like expropriating land from locals and driving them out of business and livelihood. On the other hand, Collier and Venables (2012) remind that although it is important to respect locals and their rights, one should also remember not to exaggerate them. They justify this opinion by pointing out that "where huge areas of land are very lightly exploited […] and the user does not have the right to sell the land, by creating and enabling leases the government adds considerable value". This reasoning sounds reliable but it faces the doubt related to unused land.[47] And when governments have concluded sales or leases, parts of those lands have still been left unused by the foreign investors (Cotula, 2011).[48]

Taking into account that land acquired by foreign investors may have been left unused – and land being unused is at the same time used as a justification for selling or leasing land to foreigners – may first sound odd. If investors are interested in buying or leasing land, whether it is to produce food or cash crops and whether to export outputs or sell them locally, why not start cultivation? One possible explanation is offered in Pindyck and Rubinfeld (2009): when a resource is exhaustible, cost of using or producing it is greater than just its extraction cost. This is because there is also an opportunity cost of using the resource. The opportunity cost arises because using the resource makes it unavailable for using in the future and due to decreasing amount of resources left the opportunity cost increases (also called user cost of production) over time.

Now this reasoning does not apply directly in selling or leasing land. But if we consider agricultural land available for selling or leasing as an exhaustible resource from a country's perspective – and clearly, the more land is sold or leased to foreigners for cultivation the less land there is available for selling or leasing in the future – its rising opportunity cost should increase its value over time. Treating agricultural land as an exhaustible resource can also be justified by taking into account land erosion and degradation caused by agriculture.

If exhaustibility of land is accepted, it means that investors may invest in land hoping to enjoy its higher sales value in future.[49] The exhaustibility is not the only reason behind the appreciation of land value: opportunity cost of land can also rise due to development of agricultural markets, productivity increases and infrastructure development. The appreciation of land has been recognized as a reason behind land purchases already decades ago by e.g. Atwood (1990) who

[47] For more discussion about problems concerning unused land see p. 36 in Amanor (2012).
[48] Land having been left unused by foreign investors has also been found by, for example, Collier and Venables (2012) and Deininger and Byerlee (2011).
[49] Pindyck and Rubinfeld (2009) analyze the user cost of production regarding exhaustible resources and competitive markets. One can well argue that agricultural land markets are not competitive in Africa, but the reasoning can still offer one explanation for why land is possibly bought for speculative reasons.

argues that potential purchasers might see land as an appreciating asset rather than as a production factor. This can have adverse effects on host countries, if it leads to poorer land use or reduced production due to holding land idle.

Collier and Venables (2012) discuss the option value of land and how it is lost when long-term sales or leases occur. Option value of land in this case means an option value of future productivity that cannot be negative due to its characteristics. Currently the productivity of land is low in Africa, but if it increases and the land lease contract is of long-term with a very low price, all the gains from productivity increases accrue to foreign investors, not to locals (although, if locals would be employed by foreign investors and average wages increased, then locals would see some part of the productivity gains accruing to them). Productivity of land and its option value are affected by many factors but just a simple rise in global agricultural output prices can increase the option value. The current, low option value of land in Africa can be explained by lack of technical knowledge, poor infrastructure, deficiencies in governance and asymmetrical information about what works in agriculture.

Von Braun from IFPRI comments to Financial Times (2008)[50] that importers (of food) have become nervous and they are seeking to get a grip on countries with potential for agriculture exports. It is the word *potential* that catches attention here: it connects this opinion with the above of Pindyck and Rubinfeld's (2009) by suggesting that investors may not acquire land to start cultivating it immediately: land can be rather acquired because of its potential for agriculture in future. And if the African agriculture becomes more profitable and more competitive in future, the cultivation could start or the land could be sold for its value - which would possibly be closer to the sum of its discounted future profits than what the prices are at the moment.

Chaudhuri and Banerjee (2010) add their own contribution to the discussion about effects of FDIs in agricultural land. They construct a three-sector general equilibrium model for unemployment in a developing country and they show that "an inflow of foreign capital in agriculture is unambiguously welfare-improving." Their results show that FDIs should raise the aggregate unskilled wage, aggregate skilled employment and aggregate skilled wage, while lowering domestic rental income on land. As the end result national welfare improves despite some lowering effects of FDIs, because the positive impacts outweigh the negative.

To take it as given that FDIs in agriculture would be unambiguously welfare-improving can be too simplistic and questionable. There are, for example, observations according to which there have

[50] Blas and England (2008).

been large exports of food from countries which at the same time have been dependent on foreign food aid (Arezki et al. 2011; Cotula, 2011). The situation gets even more dubious when considering that large-scale land acquisitions are sometimes justified by claiming that allowing FDIs will improve food security.

Deininger and Byerlee (2011) find that land deals in 2011 covered as much as 40 million hectares in Africa, which is close to 2 percent of Africa's total acreage. Median size of acquisitions was 40 000 hectares, more than 25% of the deals covered at least 200 000 hectares and only 25% of the deals involved less than 10 000 hectares. If these numbers are compared with the prevailing form of agriculture in Africa – small-scale farming – that uses less than two hectares of land and that is practiced by 80% of the farms in Africa,[51] it means that deals typically cover more than thousand times the area used by a typical local small-scale farmer. Typical duration of land leases has been 20-100 years. To put these numbers together, we can see that land leases tend to last more than one generation. This means that even though the ownership is not sold or transferred, the possibility to use land can be lost for decades.

Rental income from land has been nominal in many cases. For example, yearly income has been around $6-$12 per hectare in Mali and around $2-$10 in Ethiopia. A zero annual rent for land has also occurred in some cases. In addition to rental income, a country and at least its government could benefit from tax income but in many cases there are tax exemptions and investment allowances given to foreign investors and the real tax income can be marginal. (Collier & Venables, 2012.)

5.1 Property rights

Property rights in Africa are often informal, insecure and communal. World Bank (2003, xxi) estimates that only 2-10% of land is held under formal tenure in Africa. Even though the prevailing insecure property rights often lead to a question of formalizing rights, this question may not be the most appropriate in Africa. That is because their idea of rights can differ substantially from that of ours ("Western concept"). Secure property rights and their central role in increasing investments are also highlighted continuously but there is evidence which suggests that secure land rights is not always the key player in increasing domestic investments (Place & Hazell, 1993). Instead, the opposite has happened and informal rights together with weak rule of law have attracted foreign investors and enabled land-grabbing.

[51] Conway (2011).

In some African countries property rights are constrained already because of state ownership: land can only be owned by state and it cannot be sold or mortgaged. Communities and individuals are only allowed to occupy their land, title it and then use and develop it. This type of system actually distributes property rights to communities which then become decision makers in tenure arrangements. For instance, private ownership of land is prohibited in Ethiopia where government only allows long-term land leases. (Cotula, 2011; Hanlon, 2004.)

Private ownership of land is prohibited also in Mozambique (Hanlon, 2004). Interestingly, Mozambican law gives a relatively broad definition of communities.[52] Defining communities is important because of the Mozambican system concerning FDIs and investors' compulsory negotiations with communities. The Mozambican system is presented briefly in section 5.3.1 due to its interesting aspects related to transactions between investors, locals and government.

Formalization of property rights does not provide an automatic improvement in agriculture and thus, secure property rights should not be the only goal. Despite the questions concerning formalization of property rights, it is recognized that insecure property rights can have an adverse effects on investment and agriculture. Insecure property rights decrease the amount of investments below the optimum because farmers may lose the lands, if investments pay off. Additionally, the inability to use land as collateral is often mentioned as a disadvantage of insecure property rights. For locals it means more expensive credit or more difficult access to credit. (Udry, 2009.)

But the real value of land as collateral and the impacts of it are not straightforward. Even though secure tenure rights and well-defined ownership facilitate sales and leases, these deals may not always benefit poor. Instead, poor small-scale farmers may suffer from crisis such as crop failures and economic shocks which can force them so sell or lease their land at distress prices. (World Bank, 2003.)

Udry (2011) argues that those individuals that are not insiders in networks of local political power – small-scale farmers and landowners – are most likely to lose their land through expropriation. This observation is not unexpected, since corruption and malfunctioning political systems often prevail in African countries. Yet, we should also understand that security is not crucial just for locals but also for investors. Hanlon (2004) reminds that "while the renter is to make investments […], he or she must have a long enough secure rental tenure to make a profit on those investments".

[52] Community is "a group of families and individuals living in a defined area, smaller than a locality, that wants to safeguard its common interests by protecting its living area, farming areas whether cultivated or fallow, forests, sites of socio-cultural importance, pasture, water sources and areas of expansion". (Hanlon, 2004.)

However, sometimes the countries attracting the most FDIs have the weakest tenure security and rule of law. Based on this, Hanlon's opinion with regard to foreign investors can be questioned. But at the same time it is clear that investors must be convinced at least to some extent about the security of their investments to attract them. This may give a rise to corruption and cases where foreign investors "buy the security" from host countries but the money paid is not going to locals.

Property rights and political power are related to fallow periods. Because there is uncertainty related to small-scale farmers' ability to restart their cultivation process after optimal fallow period – which would be longer than the current average – the fallow periods are often shorter than optimal, leading to inefficient production choices between periods. (Udry, 2009.) In their study Goldstein and Udry (2008) find that political power determines to large extent which groups can have more optimal fallow periods and thus higher yields.

De Soto (2000) writes about *dead capital* or *invisible capital* which refer to unofficial and informal ownership of different assets, such as land, buildings and machines. He argues that informal ownership leads to a situation where "most people's resources are commercially and financially invisible" in developing countries and the amount of these resources – dead capital – can be unexpectedly vast.[53] An implication follows from this: the often mentioned undercapitalization of development countries may not hold. Instead, it can be constrained economies and access to capital that make economies to underutilize their resources.

One group of people (maybe better expressed as culture or livelihood) that often suffers from land titling and FDIs, and that is often left outside the discussions, is pastoralists. Due to their habits and livelihood characteristics, they often lack property rights and ownership to the land that they are using. (Amanor, 2012; Deininger & Byerlee, 2011.) This paper does not focus on pastoralists more than this, but one should keep in mind that the welfare loss arising from damage of FDIs to culture and livelihood is most likely very large for this group.

5.2 Formalizing property rights and registration

While it is broadly recognized that insecure property rights cause many problems and hinder development and economic growth, formalizing rights is not an automatic solution. Without uncorrupted governmental and legal system the possibility of positive results from formalization is

[53] To express the amount by numbers, de Soto (2000) uses Haiti as an example: he argues that the value of untitled rural and urban real estate holdings in Haiti totals to around $5.2 billion. If true, this amount would be four times the total assets of all legally operating companies and nine times the value of government-owned assets in Haiti. In addition, according to de Soto's estimations at that time, "the total value of the real estate held but not legally owned by the poor of the Third World and former communist nations" could have been at least $9.3 trillion.

lower. One should remember that a promise from government to formalize property rights (to tackle the problems caused by insecurity and informality) is not a guarantee that the government will always respect those formalized rights. If it happens that rights are formalized but nothing actually changes, no acceleration of economic development will occur. Bromley (2008) puts it as: "the failed legal (and political) environment that produces institutional isolation is the very same failed legal (and political) environment that will most certainly mean that formalization of tenure will fail to do the necessary work."

Bromley (2008) argues that formalizing tenure and property rights is not an automatic solution for developing countries. The correlation between formalization and beneficial economic outcomes is neither clear nor necessarily strong, if it even exists. This argument of Bromley is similar to those of others (e.g. de Soto, 2000) and it questions the functioning of "Western concepts" in other parts of the world. Even though property rights were to be formalized and secure, it might not be possible to obtain credit from the banking sector. In this situation the value of land as collateral would still not materialize in developing countries.

There are countries in Africa that share similarities with Mozambican system of formalization and 'land mapping'. Ethiopia has implemented a decentralized land registration and certification system in some regions. This system relies partly on some traditional methods and written descriptions, and it enables smallholders to title land individually or to apply for rights as a group. In Uganda customary rights are fully comparable to private property rights. Rights to land can be gained through long-term occupancy (user rights). (Amanor, 2012.)

Alden Wily (2006) argues that unused lands should be treated as property of communities. This could offer one way out of the tragedy or dispute of unused land but it does not help avoiding another problem: quarrels between different groups (communities, villages) over rights and boundaries of their lands. Registration of customary rights tends to lead in a process where parties are just seeking to advance one's own interests at the cost of others. At the center of this problem there is difficulty to determine prior ownership, development and use of land which are all used when deciding on formal rights. (Amanor, 2012.)

The above mentioned challenges share some similarities with tragedy of commons. Forests and fisheries, for example, are typical examples regarding overuse of common resources: the lack of property rights leads to overfishing in waters that belong to no one. Just as waters offer livelihood to some communities and cultures, agricultural land offers livelihood to others. Naturally, the overuse is different when agricultural FDIs are concerned: overuse could described as acquiring the land for

a nominal price in circumstances where nobody regulates the markets properly. This is where land rights can be linked to Oström's (2008) argument related common-pool resources and sustainable development: "[…] policies also have to fit with the local culture and institutional environments of those who depend on ecosystems for their livelihood." In other words, formalization of property rights and land registration programs should be tailored to country and small-scale farming specific conditions.

5.3 Transferring land ownership or the right to use land

In Africa the most common way of transferring the ownership of land or the right to use it is through inheritance. Market mechanisms for firms to buy or lease land do not exist in all areas. When investors wish to acquire land the procedure usually involves host country government and local smallholders. The ownership of land can be very restricted or even denied: acquiring land in such conditions is anything but simple. And in some countries direct transactions between locals and investors are prohibited: this is the case in countries such as Ethiopia, Sudan, Tanzania and Zambia. (Deininger & Byerlee, 2011.)

Limited possibilities to enter into transactions can lead to expropriations by host country governments. For example, land can be considered as state property which can and has to be "taken back" before selling or leasing it to investors. Expropriation and government intervention can on paper protect local landowners and owners of communal rights against investors by guaranteeing a fair price and compensation. It can also help to prevent conflicts between locals and investors related to ownership of land by making the deal official. Based on empirical evidence, it should be noted that even if this kind of approach can have positive effects, they hardly materialize in reality.

It should thus not come as a surprise to anyone that the 'taking back' procedure faces a lot of critique. One thing to consider is that because owning the land can be prohibited and even though the compensation would actually be a fair one, people losing their land may not be able to obtain new land from somewhere else. (Deininger & Byerlee, 2011.) Another thing is that compensation may only be paid for "loss of visible improvements, not for loss of land" (Cotula, 2011).[54] Already this on its own means that compensation will not be fair or enough to restore the livelihood somewhere else, but in addition it is usual that losses for resources like water and forests are not compensated at all.

[54] Justification for the taking back procedure seems weak: land is claimed to have originally been owned by the state and hence the state would only be taking back what belonged to it.

The ownership can also be transferred or obtained by belonging to or getting an access to a political group or into a community. Aryeetey and Udry (2010) mention also a membership in a corporate group, but in a broader view they use a term "extended families" to describe different groups through which people can obtain a right to land.

From investors' viewpoint there is a variety of systems for how to acquire land in Africa. In Democratic Republic of the Congo (DRC) there is rule according to which all foreign investors acquiring land have to team up with a Congolese citizen who needs to own at least 51% of the company stock. (Nkonya et al. 2012.) This system has its concerns, downsides and loopholes but at the same time it is an idea that could help secure that benefits from investments in agriculture would stay in the host country. Next, three systems are introduced into more detail.

5.3.1 Mozambican system

In Mozambique communities can "delimit and register their land" – a right given them by the law – and potential investors are required to negotiate with communities (Hanlon, 2004). At first glance this seems like a promising solution, but at the time when Hanlon's article was published, in 2004, there had been no negotiations between communities and locals. Still, the system could have potential because it would allow FDIs and possibly joint ventures between locals and foreign investors while at the same time providing communities with compensation and a possibility to decide on what deals to accept.

Mozambican system can be divided into two different phases. The first one concerns communities and individuals titling land and gaining right to use it and the second concerns entering into transactions with investors. For the first phase, Hanlon (2004) identifies three possibilities: Mozambicans have (1) a right to land that they have occupied traditionally (permanent right), (2) "a right to land which they have occupied 'in good faith' for at least ten years" (permanent right) and they can get (3) a permission from government to use land for 50 years (temporary, can be renewed after 50 years). The last of the ways is also possible for foreign investors. A right to land arising by the first two ways can be registered formally. Registration process includes e.g. map sketching and delimiting and once the registration (titling) is completed, it is then up to communities to manage their land and decide on land tenure arrangements.

Title or permission to land can only be issued to investors by government, if the land is free and does not have occupants. First, there is a two year provisional authorization during which an investor must present a development plan. If the plan is accepted, investor may then gain a title to land (for example, for 50 years as mentioned above). Land can also be transferred as part of the deal

when the deal includes selling buildings and other infrastructure, but also then government permission is required. The last way to transfer ownership to land is when a company is sold and the farmland owned (or titled) by the company is transferred. (ibid.)

The Mozambican system could be used in Africa more widely, but some issues would need to be solved. First, negotiations between communities and companies may be very short, communities may not be very well informed of the real implications of the suggested transaction and some members of the communities may be restricted from participating. Second, there arises the question of land being unused and free. Third, if land is not titled or registered, there may come up several communities that claim a right to the land based on their occupancy. Finally, the promised development and project plans of investors have not been successful in fulfilling their promises and the results of negotiations are often strange, unequal and unexplained (ibid.).

5.3.2 Public auctions in Peru

Peru's public auction mechanism is an interesting example of transferring ownership of land. First, the government regularizes land rights and investigates possible claims for land that ought to be respected. This should reveal which and what kind of rights can be transferred. Second, the government launches an auction and its rules are published in public for at least 90 days. Third, participants' (bidders) competency to fulfill their possible future obligations is confirmed by requiring them to post a bond worth at least 60 percent of the minimum bid plus their intended amount of investment. Finally, the winning investor must deposit the land payment and a letter of credit covering the intended investment with the government. (Deininger & Byerlee.)

Peru has also a procedure for divesting public land, if an investor shows interest towards it. Government requires a proposal of business plan and if it is found viable, the proposal is published in public for 90 days. This allows other potential investors to show their interest and match the proposal with their own ones. If at least two investors show interest, the public auction is launched, but otherwise the first investor can launch the project. (ibid.)

The above mechanisms could be used also in Africa, but just like the Mozambican system there are some limitations and challenges that would have to be solved. Peru's model requires defining and recognizing land rights at least to some extent. And in Africa, this would mean some level of formalization which, yet again, has been criticized for not necessary improving welfare and increasing investment. If the government is corrupted or not focusing on the welfare of the country – but rather on the welfare of a few – public auction may not respect customary or communal rights and the identification of possible claims may not be reliable. The mechanism will not work, if the

government cannot convince investors that both the result of the auction and their accepted investment plan are respected. And corruption of the government would threaten the mechanism, even though the business plans would be published in public.

5.3.3 Ghana's land tenure system and land banks

Ghana's land governance is described as "a complex mix of constitutional and legislative sources" which leads to different tenure systems and overlapping claims and imposes risks on investments. Land tenure systems such as "customary law, statutory law, constitutional provisions, judicial decisions and religious law" can be named. Ghana has also a land registration system but the implementation has not reached very far yet. Ghana's National Land Policy is carried out by The Land Administration Project (LAP) and its administrators, "Customary Land Secreteriats". (IS Academy, 2012.)

There are two common land tenure systems, customary tenure and public land tenure. Approximately 80% of the land in Ghana is under customary land tenure systems that are guaranteed by the government and supervised and managed by the customary land secreteriats. Communities and can have several types of rights to their land. These include allodial title, freehold, sharecropping and leaseholds. Allodial title and freehold title are closest to the prevailing rights elsewhere in the world and owning the land, whereas sharecropping and leaseholding are actually contracts for using the land. Allodial title gives the strongest customary rights to its holder. (IS Academy, 2012.)

The most common right in rural areas of Ghana is allodial title: under this type of right land is vested in communities and managed by customary chiefs. Completely individual rights are very rare in rural areas. Chiefs are also usually the heads of dispute settlements. It is difficult to determine whether chiefs actually have the right to enter into transactions involving land (even without consulting the community): this is a current and growing problem with the land acquisitions, and not only in Ghana but also in other countries in Africa. (Hughes et al. 2011.)

Allodial rights are in questions also, when Goldstein and Udry (2008) talk about "individuals' extended matrilineage" as the primary source of farm land. Chiefs' management decisions on land allocation to individuals rely eventually on political influence and perceived need.

Most of the estimated 80% of land under customary tenure is vital for locals and their livelihoods. Yet, Ghana Investment Promotion Centre (GIPC) advertises that Ghana has 8,3 million hectares of uncultivated arable land. (Hughes et al. 2011.) This estimate for size of uncultivated area seems to

equal to "land under permanent meadows and pasture" which totals 8,3 million hectares in 2010 and 2011 according to FAOSTAT (2014). How much of this land is actually unused is not sure but at least pasture land is used by livestock growing farmers. It thus seems that GIPC seeks to attract investors by advertising also land that is under some kind of rights.[55]

Ghana's customary rights are often hold by customary authorities. While state land is governed and leased by the government, private land under customary rights constitute the majority of land acquisitions and the deals are often managed by customary chiefs. (Hughes et al. 2011.) Cotula et al. (2009) writes that all the land deals have to be approved by the party having rights over the land, and that there are requirements also for fair compensation and possibilities for reviewing the deal. So far this has not been the reality of the deals. Typical land leases for foreign investors have a 50-year lease period and annual compensation is fully negotiable with authorities (Schoneveld, 2011).

Ghana's land bank system is an example that could be examined further to see, if it can be used in other parts of Africa as well. The land bank system is a concept of Aryeetey and Udry (2010) and it would require a land titling and registration system to function. Land banks would then act to "depersonalize land transactions and separate the rights of owners and users". To put it simply, land banks would take land deposits from landowners and lease those out to commercial farmers (domestic and foreign). Considering the form of business of these banks, they could be e.g. limited liability companies with locals, communities, officials and government as their shareholders.

Aryeetey and Udry (2010) argue that the most important task of land banks would be to facilitate large-scale land acquisitions. This could be achieved through better knowledge and efficiency of allocation. I see the concept of land banks as a potential way to improve the functioning of land markets in Africa. Still, the requirement of land titling and registration system can impose questions on the concept. Also, to really make individuals, communities and countries better off, the ownership of land banks should be shared between all these groups. This could guarantee that the interests of smallholders and government would coincide and be represented in land banks' decisions.

Besides land banks, Ghana has another system that sounds promising, namely rent-sharing. With regard to this system the purpose is to allocate and share the rental income from land leases. Ghana is not the only country using such a system: at least Sierra Leone has used a similar system with a share of 50% allocated to landowners, 20% to local government, 10% to national government and 20% to administration. (Cotula et al. 2009.) Without knowing how this system works in reality, it

[55] See Table 11 in chapter 6 for Ghana's land statistics and biofuel land requirements.

can only be said that this could be one way to avoid principal-agent problem and confirm that land leases would provide revenues to smallholders as well.

5.4 Contracts of land transactions

This section presents characteristics of land-involving contracts in Africa. Issues are mainly based on findings and observations in Cotula (2011), where he analyses 12 contracts and their legal aspects. Due to limited access to documentation (although it may be seen wide compared to other studies), Cotula warns that his results and arguments need to be treated carefully. Nevertheless, given the circumstances Cotula's study offers a relatively good picture about land-involving contracts in Africa.

To some extent the difficulty to obtain reliable information about land deals in Africa is because the contracts are seldom public. Lease contracts are often made for decades and foreign investors may receive priorities over some resources, e.g. water. It is undeniably discriminating from locals' perspective and even though foreign investors may promise to provide new jobs and better infrastructure, they are not very likely to emerge (based on observed results in past). Some positive examples have been found with regard to consultation with locals, but there are many problems as well. (ibid.)

As contracts define the terms of FDIs, they have a central role in determining the distribution of risks, costs and benefits.[56] Most relevant questions regarding contracts concern the authority to decide and sign contracts (who has it on the host country selling or leasing side), what kind of a process needs to be gone through prior to signing, what terms are included in contracts (e.g. duration of a lease) and what are the responsibilities of parties. Land contracts in Africa tend to be negotiated behind closed doors, local smallholders can only rarely participate in negotiations, contracts are not publicly available and they are usually unspecific and short in terms of length of the document. The legal environment where contracts are made is often weak. (ibid.)[57]

Some contracts include negotiations with locals but still, it is usually the government who makes decisions. And while a contract may be acceptable and well-defined, it does not guarantee good outcomes from the transaction to all sides. This calls for legal empowerment of smallholders and better rule of law. Rights should be more secure but the legal environment must also support

[56] There are many forms of land deals and deals may involve many separate contracts: these may focus on, for instance, taxation, shareholding, technical assistance and supply chains (Cotula, 2011).
[57] Compared to problematic transactions that are not disclosed in public, Liberia is an example of better practices: deals have to be confirmed by parliament and they are available online. (Cotula, 2011.)

respecting them: the relationship between contract and outcomes is of two-way. An ill-defined contract can provide locals with benefits like job creation and spillovers, but the mechanisms to hold investors to account – in case of future conflicts – would be weak. (ibid.)

Table 8 shows the land area covered by contracts in Cotula's study compared to different estimates about the land transferred during the period 2004-2009. World Bank's estimates are the largest among the studies in general but the different estimates are not completely comparable. According to Cotula et al. (2009), the studies differ from each other with respect to what kind of deals are included and what counts as a deal. For instance, Cotula et al. (2009) include only projects bigger than 1 000 hectares, World Bank includes renegotiations of already existing concessions in some cases and Görgen et al. estimates "land demanded", not only deals that would have materialized.[58]

Table 8. Land areas covered by deals in Cotula's (2011) study (Jan 2004 - Mar 2009), hectares

Source / Country	World Bank (2010)	Görgen et al. (2009)	Cotula et al. (2009)	Office du Niger (2009)	Schoneveld et al. (2010)
Ethiopia	1 190 000		602 760		
Ghana			452 000		1 075 000
Liberia	1 602 000				
Madagascar		1 720 300	803 414		
Mali		159 505	162 850	242 577	
Mozambique	2 670 000				
Sudan	3 965 000				

Source: Cotula et al. (2009) and Cotula (2011)

Deals involve often more than two parties. A common example would be a deal involving at least foreign investors, a local community and host country government. Very large land acquisitions tend to conflict with locals' rights and lands, especially when investors target "higher-value" agricultural lands. Another problematic aspect concerns information and negotiations: duration of the negotiations might be very short compared to size and duration (if a lease contract) of deals. It leads to questioning of how well individuals and communities are actually informed about the terms and consequences of contracts. (ibid.) Furthermore, it gives a rise to asymmetric information problem and differences in negotiation power.

Most contracts studied by Cotula involve annual rents, but not all of them. Although the rent is not the only benefit or compensation for smallholders and host country governments, it is important to remember that the occurrence of other potential benefits is not very likely – based on the

[58] Cotula's (2011) estimate concerning Ghana is substantially lower than what Schoneveld (2011) estimates: according to the latter, the amount of land acquired for just biofuel production in Ghana could have been 1,33 million hectares. However, Schoneveld's time period in question is not the same as Cotula's.

observations so far. And furthermore, transactions below market price may encourage foreign investors to search for and enter into land acquisitions for speculative reasons. Even if there has been annual rent per hectare, it has been quite nominal: USD 2 in Ethiopia and USD 5 in Liberia, for instance. (ibid.)

The importance of including annual rents in contracts can be justified by considering rent as a compensation method for a moment. Annual rent is a direct method that does not require supervision or control (from governments or communities) beyond collecting the rent, it is typically independent of profitability of projects and investments and it is also independent of even initiating the project that land was acquired for. Rents seem to be even more important when evidence and problems related to international taxation are considered. Collecting taxes would only be possible after the investment started to create profits. Host countries often grant tax exemptions to foreign investors and even if they do not, collecting tax may be hard because there are many ways for driving farm's (companies) taxable income towards zero: especially because there appears to be no clauses related to transfer pricing or financial accounts in contracts according to Cotula (2011).

Cotula (2011) finds that almost all contracts include terms related to government's right of seizure conditional to public interest. In return, government would be obliged to compensate for the seizure. As was written earlier, there is a strong need for increasing government investment in agriculture in Africa. From that perspective government's actions to protect public interest and improve infrastructure in rural areas would be desired. Sadly, Cotula finds that the right of seizure clause is rather used to validate private investments by saying that private investment is in public interests. Cotula continues by arguing that "one might expect them to be able to buy out local people on a negotiated rather than a compulsory basis". This is to say that if the deal actually is in both public and local interest, and if it really is a mutually beneficial transaction, it should occur without compulsory actions.

As a contrary to the weaknesses of taxation as a host country compensation method, Deininger and Byerlee (2011) introduce some advantages of taxation. Whenever taxes would account for a great deal of host country's benefits, it would be in government's intentions to choose and accept FDIs that have actual potential to make profits and thus provide benefits. But at the same time, the tax breaks offered to investors may prevent countries from enjoying tax revenues. This holds, for instance, with Ghana, which is the discussed in the next case study section: its "far-reaching tax breaks imply that even profitable companies will pay almost no taxes".

There are so called stabilization clauses included in contracts to protect investors. They are meant to prevent hostile or arbitrary host country actions that could cause damage to investors. These clauses are justifiable, because investors would otherwise be too vulnerable after completing the investment to some extent. Investments in infrastructure and in physical capital (like machinery) would be under the threat of host country's policy changes or decisions after completion. The potential disadvantage of these clauses is that host country loses its ability to take action if foreign investors are damaging local livelihoods and not keeping their promises (which are rarely properly defined in contracts). (Cotula, 2011.)

5.5 Pricing of land

This subsection introduces briefly the basics that locals and governments should take into account when setting a price for their land (whether it is a lease or a sale). Investors' demand curve is such that the lower the rent, the higher the demand. One possibility for governments is to choose a rent equaling opportunity cost (profits from land in its alternative use), which could be very low or even zero. An investor would then choose to rent land until productivity equals its opportunity cost. However, a deal structured like this could leave all the profits to investors and to avoid this governments could set a transaction tax or lease tax to extract some of the profits. If it is not possible to set a high enough tax, then the rent could be higher to leave the country better off. (Collier & Venables, 2012.)

But rents are typically pushed low in negotiations. Levels of rent and taxes are formulated in negotiations and in these negotiations investors have a lot of bargaining power – "land-abundant, investor-scarce" regime guarantees it. Thus, raising the rent may not be easily done. (ibid.)

For locals it can be hard, if not impossible, to negotiate beneficial deals with investors: this is due to asymmetric information, government legislation and restricted ownership. But land banks in Ghana are an interesting example for how local smallholders could benefit more from the deals. Land banks could help in pricing by providing knowledge and an advanced and reliable pricing mechanism.

The right price of land can be approached from many directions. In case of a sales contract, the value could be the net present value of future income. In case of a lease contract, the annual lease price could be the annual net return to land after other factors' contributions have been taken into account. (Deininger & Byerlee, 2011.) These guidelines follow the common ways of pricing as they apply also to pricing of financial products and forecasting the net present value of e.g. projects and

financial leases. Considering a local farmer with a small endowment of capital and technology, and a foreign investor with larger capital and technology endowments (and a better access to financial markets), there should exist a potential for a mutually beneficial deal that both sides could enter into. The price of land could be between the net present value of land under the usage of local farmer and under the usage of capital-intensive foreign investor. An important aspect regarding pricing could also be the option value of land. The possibility of productivity increase should be taken into account – and simply put, it would mean higher rents.

Just a simple comparison between the above pricing principles and the realized prices reveals that investors buying or renting the land are capturing bigger share of welfare in the deals. For example, in Cotula's (2011) report the annual rent per hectare ranges from US$ 2 (Ethiopia) to US$ 13.80 (Cameroon). Because it is hard to gain reliable data – or sometimes any data at all – about African countries and land deals, it can simply be assumed that Cotula's numbers represent fairly well the range of annual rental in Africa (although the lower limit might be US$ 0 rather than US$ 2). Comparing African prices with US annual rental prices shows the gap in pricing: average cropland rental price in US was US$ 102 per acre in 2010, making it 10 200 dollars per hectare. Average rental price for pasture land was substantially lower, US$ 11 per acre, giving a 1 100 dollars per hectare rent.[59] There are of course differences in quality of soil and availability of infrastructure and irrigation, which are not taken into account, but these numbers illustrate just how nominal the rental price for land can be in Africa.

Also, Knight Frank (2011) writes about Ukraine's land leases for 5-10 years with a lease price of US$ 150 per hectare and implicates that it is greatly undervalued. Ukraine has been suffering from political and economic instability already in past and the crisis in 2014 has only worsened things, but nevertheless the undervaluation is easy to believe just by comparing the prices with the US ones. Even though Knight Frank argues that the rent for land in Ukraine is undervalued, one can see that it is substantially higher than in Africa.

Table 9 below may further explain the nominal rental prices in Africa by it showing that many African countries have a low average value for farmland: and of the countries included Ghana has the lowest value.[60] The reliability and accuracy of these numbers should be treated with cautious. What is somewhat surprising in the values is that Russia and Ukraine have very low values. Taking into account that Ukraine's farmland is among the most fertile in the world, it seems that land value

[59] United States average rental prices are from USDA (2010).
[60] Data for Table 9 is from Savills (2012) but Savills has gathered its data from various data sources.

does not describe very well the actual farming potential but is rather determined by other business and political attributes. Also, one should remember that Ukraine's agriculture suffers from lacking investment and technology.

Table 9. Farmland values in US$ per ha (cropland)

Africa		Other selected countries	
Country	**Value**	**Country**	**Value**
Botswana	1200	Argentina	6508
Ghana	100	Australia*(1)	1606
Mauritius	35000	Brazil	5245
Mozambique	800	Canada	3661
Namibia	1100	France	6919
Swaziland	1100	Germany	15173
South Africa	2989	Russia	1140
Tanzania	1900	Ukraine	1152
Uganda *(2)	1000	United Kingdom	22264
Zambia	800	United States	7487

*(1) Average of New South Wales and Western Australia

*(2) The Economist (2012), 'latest price 2011'

Source: Savills (2012) and The Economist (2012)

6 FDIs and biofuels: 1-2-3-4 CGE Model for Ghana

In this chapter I first discuss cash cropping and biofuels and how they can be related to FDIs in agricultural land. Then I build a simple computable general equilibrium (CGE) model for Ghana in the following subsections. The CGE model takes a "1-2-3-4" form that stands for one country, two factors, three sectors and four commodities. The model is an extension to a better-known and simpler "1-2-3" CGE Model: compared to the 1-2-3 CGE model, the 1-2-3-4 version in this study includes government, factors of production (land and labor), one new sector producing biofuels and one new commodity, biofuels. Intermediate products are excluded from the model.

The model derives many of its characteristics from 1-2-2-3 model of Robinson and Thierfelder (1996), 1-2-3 CGE model with government and investment of Devarajan et al. (1997) and 1-2-3 Model with factor markets and intermediate inputs of Devarajan et al. (1990).[61] The model is used to analyse impacts of biofuel sector establishment on Ghana's economy and computability allows solving the model with real numbers. Hence, national account data for Ghana is needed.

[61] Chapter *Simple General Equilibrium Modeling* by Devarajan et al. is presented in Francois and Reinert (1997) and it is derived from previous papers: Devarajan et al. (1990) and Go and Sinko (1993). According to Robinson and Thierfelder (1996), 1-2-3 model was first introduced by de Melo and Robinson (1989) and it contains similarities with Jones (1965).

Government, investment and savings are included in the model and that allows for analysing impacts of shocks on economy-wide scale, even though the economy is in a very simplified form. A social accounting matrix (SAM) is built for Ghana for the base year 2010. This enables to check that calibration of the model variables to their base year values has been correctly and that the national account data is balanced properly.

The following model uses some of the results of other studies, such as CGE model studies, and what we have learned so far. Results regarding FDIs are used to justify some assumptions that are necessary for making the model simpler. Additionally, some assumptions are required because there is no data or no reliable way to determine them.

6.1 Biofuels and cash copping in the model

Renewable sources of energy and biofuels are becoming more and more popular and they challenge common ways to produce energy and fossil fuels. They are also already taken into account in legislation: in European Union's directive on the promotion of the use of energy from renewable sources (RES directive) target share of renewable energy sit set to 20% of total energy use in 2020 and in transportation there is a minimum share of 10% set for biofuels. According to the RES directive, imported biofuels have to meet the same sustainability criteria as biofuels produced in EU. (Kretschmer & Peterson, 2009; European Commission, 2007.) RES directive means that biofuels are in global interests and that gives an opportunity for African economies to develop their agricultural sector with the help of FDIs. This can create a development path where production technology and production methods of biofuels in Africa would convergence towards rest of the world, to meet EU's requirements regarding quality of biofuels and production.

In US more than 40% of grain is nowadays used for biofuel production to produce substitutes for fossil fuels. Approximately 10% of fuels comes from corn in US and that share is expected to increase to at least three times higher in future. And it is not only European Union and US that have interest towards biofuels: also China and India are the striving for increasing biofuel production. (Chakravorty et al. 2012.) This underlines further the possible significance of biofuels for Africa in future.

Similar to EU, Ghana has also published goals for its biofuel usage and it is one of the main reasons why Ghana was chosen to be the country of the case study model in this paper. *The Draft Policy on Bioenergy in Ghana* in 2010 provides guidelines for future bioenergy policies: 10% of the fuel consumption of transportation should be met with biofuels by 2020 and 20% of the consumption by

2030. In addition, 10% of electricity consumed in Ghana should be produced by renewable fuels (Hughes et al. 2011). Considering that transportation sector uses approximately 30% of energy worldwide,[62] Ghana's targets seem interesting from world's perspective as well: calculations give an approximation for how much of land might have to be allocated for biofuels production to substitute a share of fossil fuels with biofuels in transportation.

In general there are two types of biofuels, bioethanol and biodiesel. Bioethanol is produced from starch crops such as sugar cane and corn, whereas biodiesel is produced from oil crops such as rapeseed and jatropha. (Peters & Thielmann, 2008.) Biofuels are also often divided into first generation and second generation fuels: first generation biofuels require more land while second generation biofuels are less land-intensive and utilize newer technologies. (Chakravorty et al. 2012.)

In this study I choose to concentrate on jatropha and sugar cane, and to calculate land required by biodiesel and bioethanol production using these two crops. The study will not go deep into analyzing different crops or biofuel production characteristics, but choosing jatropha for biodiesel production can be justified due to following reasons:

(1) Jathropha is suitable for cultivation in poor lands and in a savannah climate (sandy soil, hay and shrublands) and thus, it may not directly impose a threat to forests by requiring cutting them down (Kaminski, 2011).

    Jatropha is suitable for cultivation in tropical and subtropical regions (Ghana belongs to tropical region) and it is not sensitive to day length. Furthermore, jatropha is not sensitive to drought and animals do not eat it when grazing. If jatropha is used for biodiesel production, the process produces also by-products that can be used as fertilizers, livestock feed or as biogas feedstock. Jatropha can also be used for heating and providing light. (Brittaine & Lutaladio, 2010.)

(2) Majority of foreign companies in the biofuel industry of Ghana has been using jatropha as their primary cash crop (13 of total 17 foreign companies) and that makes jatropha a natural choice. These companies had acquired 1,075 million hectares of agricultural land by 2009. (Schoneveld et al. 2010.)

(3) One of the leading biofuel companies in the world, Neste Oil, advertises on its website that its *NEXBTL* renewable biodiesel can be used in all modern diesel engines without blending it with fossil diesel, although *NEXBTL* is suitable for blending as well (Neste Oil). Notwithstanding whether Ghana's diesel engine are mainly of the modern type or not, the

[62] Brittaine and Lutaladio (2010).

feature of using biodiesel without blending could become important in future. And jatropha could become an important feedstock for modern biodiesel production.

After choosing jatropha as cash crop for biodiesel production, it is then convenient to use sugar cane as feedstock for bioethanol because Arndt et al. (2008) provide calculations for both of the crops' cultivation characteristics. Arndt et al. (2008) study focuses on Mozambique and I simply assume similar conditions in Ghana and use their results about production characteristics for Ghana.

Despite the potential and benefits of jatropha, it cannot be concluded that jatropha production would be profitable more often than not. Observed jatropha yields have not been high enough to be profitable, and to make the production profitable might require genetic modification or improvement in production practices. Also, taking advantage of by-products resulting from jatropha oil production should be paid more attention to make the production profitable for farmers. (Brittaine & Lutaladio, 2010.)

Production costs are typically found to be higher for biofuels than for fossil fuels. (Peters & Thielmann, 2008). There is also a lot of variability in production costs because the cost structure is determined by variables such as wages, land fertility, type of feedstock used, processing technology, transportation costs and the farming type chosen (Arndt et al. 2010). Other caveats for biofuels were already introduced in section 3.3 and the issues are related to irrigation and fertilizers usage, tax exemptions and land availability. On the other hand, biofuel production gains support from policy makers and some see biofuels as the only feasible option to substitute fossil fuels with (Peters & Thielmann, 2008).

6.2 Building the 1-2-3-4 CGE model for Ghana

Ghana's biofuel policy goals offer a fair starting point for building a CGE model to describe effects of FDIs: the policy is assumed to trigger a need to attract FDIs in Ghana. Technology and capital required for these investments are assumed to be available only to foreign investors meaning that it is not possible for Ghanaians to produce biofuel by using solely domestic resources. In some of the scenarios it is assumed that biofuels would be produced on small-scale farms and by contract farming: foreign investors would provide some capital and technology to Ghanaian outgrower farmers but no land would be sold or leased. Even though Ghana's policy goals aim to use biofuels in domestic transportation sector, in the 1-2-3-4 model it is assumed that the whole biofuel production is exported. Ghana's policy goals are thus used for estimating biofuel sector's land

requirement but their real goal regarding substituting a share of fossil fuels is not implemented in the model.

Biofuel production does not exist in the base year of the model, it will be established and that causes a shock in Ghana's economy. The model is eventually solved by finding a new equilibrium after the biofuel sector is fully established. The establishment of the biofuel sector in Ghana requires the same factors of production as other sectors, land and labor. It is assumed that biofuel sector uses much debated unused land to some extent and to some extent the land is leased or taken from locals and from its current usage. This means that the amount of unused land that is brought into the model varies and that other sectors will lose some of their current inputs in some scenarios.

The 1-2-3-4 model is constructed by using year 2010 as base year due to data availability. Even though targets in Ghana's biofuel policy are set for year 2020, in the model I apply Ghana's 10% targets to year 2010. The meaning is to study what meeting the targets would have require and how it would affect, assuming that the targets could be met in just one year. The 1-2-3-4 model does not include forecasting of Ghana's fuel and electricity consumption in 2020.

Computability in CGE models means that they can be solved by plotting in real numbers and calibrating the model. The 1-2-3-4 is a relatively simple model and hence, I use Microsoft Excel's optimization tools to solve it (solver). Extending the model to cover more sectors, goods and intermediate goods would give a more realistic viewpoint to effects in economy, but such larger models usually require a vast amount of data and commercial models.

6.2.1 Land required to meet Ghana's 10% policy targets

Estimates for the amount of land required take into account that agricultural land acquired by foreigners may be left unused. This is based on empirical evidence. My assumption is that 80% of the foreign-leased land will be used for production of biodiesel crops. It is fairly optimistic since the share of farmland left unused has in reality been substantially higher than 20%. The actual, realized implementation rate of approved land deals has actually been vice versa.[63]

The 80% assumption means that the amount of land leased or bought from locals plus the unused land taken under cultivation will not be fully utilized. The reasoning behind my relatively positive assumption with regard to land use is based on policy suggestions presented in chapter 8, where I suggest that by setting a minimum share of acquired land that has to be taken into efficient use by

[63] As was mentioned earlier, according to Deininger and Byerlee (2011), farming has started in only ca. 20% of the deals announced. Not all the deals are announced, so this number should be treated with caution.

some deadline Ghana could ensure that land is not bought just for speculative reasons. This kind of provision in contracts could also mean that only realistic projects and investment plans – with proper and realistic profit making expectations – would be launched by foreign investors.

The amount of land needed for biofuels is approximated by using data of Ghana's transportation fuel consumption, biofuel crops' production requirements from Arndt et al. (2008) and substitution rate between biofuels and fossil fuels from Peters and Thielmann (2008). Ghana's electricity and fuel consumption numbers are collected from World Bank's WDI database. Jatropha plant's breakdown to different parts and their energy contents is needed for the electricity production and it is presented in Appendix 1. Optional way would be to calculate biofuel sector's value at market prices and then assume that biofuels would require land in proportion to its GDP share: this is shown briefly as well.

Calculations for land requirement are presented in Table 10 below. Scenario 1 shows land requirement when the possibility to utilize non-oil part of jatropha (ca. 80% of original fruit mass) after oil extraction is excluded. Scenario 2 allows fully utilizing the non-oil part of jatropha and thus, the land requirement is smaller in it. For simplicity, I assume that Ghana's renewable target share of electricity would be produced solely from jatropha in both scenarios, even though in reality there would multiple possibilities for what source of renewable energy to use (Ghana's policy draft does not require using biofuels). Currently, Ghana does not produce electricity from renewable sources other than hydroelectric (World Bank, WDI 2014). Below it is also assumed that biofuel production and processing would not increase the electricity consumption of Ghana. Appendix 2 shows calculations for jatropha in electricity production (with a 10 MWh power plant).

Table 10. Land requirement to meet biofuels production target (10%)

1. Scenario: Electricity production cannot utilize non-oil jatropha part after oil extraction		
Electricity	**Value**	**Measure**
Ghana's electricity consumption 2010	7 256 000	MWh
10% target share of electricity	725 600	MWh
Required jatropha fruit	231 236	t
Land jatropha yield	3,0	t/ha
Land required (1)	**77 079**	**ha**
Biodiesel		
10% target share of diesel fuels	114 259 046	lt
10% target	114	m*lt
Jatropha biodiesel yield	120,0	lt/t
Jatropha required	952 159	t
Land jatropha yield	3,0	t/ha
Land required (2)	**317 386**	**ha**
Bioethanol		
10% target share of gasoline fuels	115 622 677	lt
10% target	116	m*lt

Sugar cane bioethanol yield	50,0	lt/t
Sugar cane required	2 312 454	t
Land sugar cane yield	15,0	t/ha
Land required (3)	**154 164**	**ha**
Land required, total (1+2+3)	548 629	ha
Land required, total (1+2+3) with assumed 80% initiation rate of cultivation	**685 786**	**ha**
Land required, total in square km	6 858	km2
2. Scenario: Electricity production can fully utilize non-oil jatropha part after oil extraction		
Electricity	**Value**	**Measure**
Required non-oil jatropha	185 128	t
Jatropha required by biodiesel production	952 159	t
Non-oil jatropha produced by biodiesel	762 298	t
Non-oil jatropha required after using by-product of biodiesel	0,0	t
Land required by electricity (1)	**0,0**	**ha**
Biodiesel		
10% target share of diesel fuels	114 259 046	lt
10% target	114	m*lt
Jatropha biodiesel yield	120,0	lt/t
Jatropha required	952 159	t
Land jatropha yield	3,0	t/ha
Land required (2)	**317 386**	**ha**
Bioethanol		
10% target share of gasoline fuels	115 622 677	lt
10% target	116	m*lt
Sugar cane bioethanol yield	50,0	m*lt
Sugar cane required	2 312 454	t
Land sugar cane yield	15,0	t/ha
Land required (3)	**154 164**	**ha**
Land required, total (1+2+3)	471 550	ha
Land required, total (1+2+3) with assumed 80% initiation rate of cultivation	**589 437**	**ha**
Land required, total in square km	5 894	km2

Source: Calculations based on Arndt et al. (2008), Brittaine & Lutaladio (2010), Jingura et al. (2010), Mkoma & Mabiki (2011), Peters & Thielmann (2008), Woodbank Communications Ltd (2014) and World Bank (WDI 2014)

In the first scenario electricity production with power plants cannot utilize non-oil part of jatropha seed and therefore land requirement is a little higher: 685 786 hectares which equals to 6 858 km^2. In the second scenario electricity production can utilize the whole amount of 'non-oil, after oil extraction' part of jatropha fruit. This part accounts for ca. 80% of jatropha's mass and 60% of its energy,[64] and in calculations all the demand for jatropha in electricity production can be met with non-oil parts resulting from biodiesel production. Hence, the land requirement in the scenario 2 is lower: 589 437 hectares equaling to 5 894 km^2. These numbers include the adjustment for 80% initiation rate of cultivation on FDIs.

Scenario 2 describes also the land needed to meet only transportation sector biofuel targets: because no additional production is needed given the utilization of non-oil jatropha, calculations solely for

[64] Brittaine and Lutaladio (2010) and Jingura et al. (2010). See Appendix 1.

transportation biofuel requirements would be identical. Scenario 2 with its lower land requirement seems to be more appropriate for the purpose of my study: it is unrealistic to think that Ghana's electricity production would meet its renewable energy share with only biofuels. And in addition, biofuel sector cannot be established in one year – it means that results of my model (presented later) are exaggerated because it assumes that biofuel sector could be launched in one and that it would be immediately fully operational. Naturally, a greater land requirement would impose a greater shock in Ghana's economy, but the choice between scenarios should not play a key role in functioning of the model.

When the amount of land needed for biofuels production (given Ghana's policy draft targets) is compared to Ghana's recent situation concerning available land, establishing the biofuel production seems possible. According to Aquastat (2014) and FAOSTAT (2014), Ghana had at most 8,2 million hectares of agricultural land free for cultivation in 2011. Yet, this could be an overly optimistic estimation because part of it is used as pasture land and possibly for other purposes as well.

Ghana's land area is 22,754 million hectares (World Bank, WDI 2014), so at most ca. 36% of the country area would have been free for cultivation. The total cultivable area (agricultural land) sums up to ca. 69% of the country area. Land required in Scenario 2 (Scenario 1) would then be ca. 2,6% (3%) of total country area, 3,7% (4,3%) of total cultivable area, 7,8% (9%) of currently cultivated area and 7,2% (8,4%) of the area free for cultivation. These shares are shown below in Table 11:

Table 11. Ghana's land stock and biofuel land requirements, 1000*ha (2011)

Country area	22 754	100 %
Agricultural land	15 800	69,44 %
Land under permanent meadows and pasture	8 300	36,48 %
Arable land and permanent crops	7 500	32,96 %
Arable land	4 700	20,66 %
Currently cultivated area	7 600	33,40 %
Area free for cultivation/agriculture	8 200	36,04 %

Land required for biofuels	**Scenario 1**	**Scenario 2**
Land required, 1000*ha	685,79	589,44
a) Share of country area	3,01 %	2,59 %
b) Share of agricultural land	4,34 %	3,73 %
c) Share of currently cultivated area	9,02 %	7,76 %
d) Share of arable land	14,59 %	12,54 %
e) Share of area free for cultivation	8,36 %	7,19 %

Source: Aquastat (2014) and FAOSTAT (2014)

Once the calculation for biofuel sector's land requirement is concluded, the next step is to choose the most appropriate measure describing the amount of new land that is brought into as a factor of production between base year and current year. The most appropriate choices for the 1-2-3-4 model are *b) Share of agricultural land* and *c) Share of currently cultivated area*, but neither of them is correct. When land requirement is measured as a share of agricultural land, *b),* it understates the proportional land area that is needed. This is because not all of the agricultural land serve as a factor of production in Ghana (by assumption and according to Table 11, there is unused agricultural land in Ghana). And when the measure is share of currently cultivated area, *c),* it probably overstates the amount of land required. This is because there is land used for production that is not included in this account: this would be land used for pasture and possibly unofficial cultivation.[65]

Based on the above, I choose to use a value in between Scenario 2's *b)* and *c)* for the model: 5,0%. It is a crude approximation of the land required, but the choice should not reduce the usability of the model. This is because other assumptions have to be made and used as well. Furthermore, 1-2-3-4 is a very simplified illustration of an economy and an assumption already by itself.

If the GDP share of biofuel sector would be used to approximate the land needed for biofuels, the result would be substantially lower compared to the above results with biofuel production characteristics: only ca. 0,85% share of GDP would be achieved by producing biofuels. The share of GDP produced by biofuels would be even lower, 0,54%, if only the biofuels sold at world price would be included in the calculations. If these numbers were used to estimate the land required in the model, the estimate would be 0,85% or 0,54% and thus, clearly smaller compared to the previous 5% estimate of land required. However, if the value 0,85% would be seen as share of all the production factors required (to produce 0,85% of GDP) rather than just the share of land required, then the estimate might be more adequate. Biofuels' value at world market price and electricity production value are presented in Table 12 below.

Table 12. Biofuel production value at world price

Biofuel type	Measure	2009	2010	2011	2012	2013
Bioethanol world price	USD/100lt	44,78	60,52	86,61	64,27	61,87
Biodiesel world price	USD/100lt	82,60	95,57	132,47	116,89	112,59
Bioethanol required	million lt		115,62			
Biodiesel required	million lt		114,26			
Ghana GDP at market prices, 2010	USD billion		33,15			
Biofuel sector value at market prices, 2010	USD billion		0,18			

[65] World Bank's (WDI 2014) description for arable land: "[…] land defined by the FAO as land under temporary crops (…), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded." Briefly described, agricultural land then refers to "[…] the share of land area that is arable, under permanent crops, and under permanent pastures."

Transportation biofuels' share of GDP	**%**	**0,54 %**

Ghana's electricity		**2010**
ECG energy sales	GWh	4 972
ECG sales revenue	GHc million	1 006
Price (sales revenue/energy sales)	GHc'm/GWh	0,20
ECG Average end-user tariff	GHc/kWh	0,20
Biofuel electricity production, 10% target	MWh	725 600
Biofuel electricity production value	GHc billion	0,15
Biofuel electricity production value	USD billion	0,10
Biofuels + electricity, sector total value	USD billion	0,28
Biofuels' total sector share of GDP	**%**	**0,85 %**

Source: GSS (2014a), ECG (2011) and OECD and FAO (2014)

6.2.2 Model description

The 1-2-3-4 CGE model includes one country, two factors, three sectors and four commodities. Government and factors of production are included in the model but intermediate products are left out. The 1-2-3-4 model focuses on Ghana and the base year values are calculated for year 2010. In comparison to Robinson and Thierfelder (1996), the two production factors in this paper are labor and land instead of more traditional choices labor and capital. The model is described and solved by using equations in their level forms instead of logarithmic derivatives that are used by Robinson and Thierfelder. Level form equations are also used in Devarajan et al. (1990) and in Devarajan et al. (1997).

As an extension to the most basic 1-2-3 model, the 1-2-3-4 CGE model is still a minimalistic model. This offers simplicity that is advantageous to some extent. For example, the model would allow for analysis of trade and fiscal policy tools (such as import tariffs and export subsidies) and external price shocks. By switching between world import and export prices it would be possible to analyze country's terms of trade and trade balance impacts. CGE models like the 1-2-3-4 can be solved in many ways, including for example numerical and graphical solving. CGE models like 1-2-3 model use similar equations and behave in a similar way as more complex multi-sector models. (Devarajan et al. 1990.)

At base year (starting point) Ghana's economy is assumed to have only two productive sectors, domestic and export. Domestic sector produces good *D* that is sold and consumed only domestically. Export sector produces good *E* which is exported and not sold or consumed in Ghana's domestic market. The third good is imported good *M* which is not produced in Ghana. *M* is an imperfect substitute to *D*. Biofuel sector does not exist in base year: it is inserted in the model and it acts somewhat like an external shock. After inserting biofuel good *QB* there are three sectors and four

commodities in the new equilibrium. Biofuel sector uses the same inputs as domestic and export sectors, but according to assumptions, it uses implicitly foreign technology and knowledge as well.

Total demand in the economy is given by CES-utility function *QS* that gives demands for *D* and *M*. Only *D* and *M* are consumed in Ghana. The function is also called "Armington function" referring to the imperfect substitutability of import and domestic goods.[66] It can also be called "aggregate absorption" describing the total amount of goods the economy absorbs. The absorption can be seen as supply of a so called composite good (Devarajan et al. 1997). There is imperfect substitutability between *D* and *M* and it has a form of constant elasticity of substitution (CES) that is denoted by σ_Q.[67]

$$QS = F\left(M, D, \sigma_Q\right) = SC(\alpha_Q\, M^{\rho_Q} + \left(1 - \alpha_Q\right)D^{\rho_Q})^{\frac{1}{\rho_Q}} \quad (1)$$

$$\sigma_Q = \frac{1}{1-\rho_Q} \quad (2)$$

In the model I use a value 2 for the substitution elasticity for CES function, following thus Devarajan et al. (1990). However, a value below one for the elasticity could be justified as well because developing countries may well have an elasticity below 1. This gives room for the "standard policy advice" to depreciate real exchange rate when an adverse terms of trade shock occurs. When elasticity is below one, a so called *income effect* dominates: production will shift towards exported goods because of consumers' lower real income. If the elasticity is above one, a *substitution effect* dominates, meaning that consumers' shift towards consuming more domestic goods. In the model the substitution elasticity is assumed to be fixed. Nominal exchange rate is chosen to be a *numeraire* having a value 1.[68] This is because only relative prices matter in the model. (Devarajan et al. 1990.) If substitution elasticity would have a value below 1 in the model, it would mean that imports and domestic good *D* production would be more rigid. This would appear in model results as larger changes in traditional exports *E*.

[66] Armington function was originally introduced in Armington (1969): *A Theory of Demand for Products Distinguished by Place of Production*.

[67] CES functions have different forms and they can be applied to utility and production functions. Constant elasticity of substitution means that a percentage change in marginal rate of technical substitution induces a constant percentage change in factor proportions (land and labor in the 1-2-3-4 model). With export sector production function as an example, CES can be written as: $\sigma = \frac{d\ ln(K_E/L_E)}{d\ln\left(MRTS_{K,L}\right)} = -\frac{\frac{d\,(K_E/L_E)}{K_E/L_E}}{\frac{d\left(\frac{dE}{dK_E}/\frac{dE}{dL_E}\right)}{\frac{dE}{dK_E}/\frac{dE}{dL_E}}}$.

[68] Actual nominal exchange rate between USD and GHc (Ghana's cedi) was 1,43 in 2010 (World Bank, 2014).

The ratio between consumption of imports and domestic goods is determined next. The function is found by taking first-order conditions with respect to imports and domestic good from a profit maximizing function, which in this case would be a function $P^Q*QS - (P^M*M+P^D*D)$. This yields a demand function for *M*: [69]

$$M = D\left(\left(\frac{P^D}{P^M}\right) * \left(\frac{\alpha_Q}{1-\alpha_Q}\right)\right)^{\sigma_Q} \quad (3)$$

Imperfect substitutability between domestic goods *D* and import goods *D* means that the 1-2-3-4 model is different from standard neoclassical trade models with all goods traded and all tradables being perfect substitutes with domestic goods. The choice of imperfect substitutability originates from empirical results of standard models that are not in line with the reality: they assume that domestic prices are completely set by world prices, leading to "extreme specialization in production and unrealistic swings in domestic relative prices in response to changes". This assumption or phenomena is also called as *the law of one price*. As a contrary to the law of one price, empirical evidence shows that changes in import and export world prices are only partially shifted into domestic prices. With imperfect substitutability, there still exist a link between domestic and world prices, but the link is weaker. (Devarajan et al. 1990.) The 1-2-3-4 model fits with empirical results because there are no pure non-tradables, i.e. goods with no imports or exports.

In the traditional 1-2-3 model there is also so called constant elasticity of transformation function, (CET function) that gives the production possibility frontier of an economy. CET is defined between export good *E* and domestic good *D*, and together with CES it indicates that trade shares are not easy to shift in export or import markets. The CET function, however, is not needed in the 1-2-3-4 model because sectoral production functions determine economy's total production possibility frontier. Sectoral production functions in the base year are also CES functions producing their output by using inputs land, *K*, and labor, *L*:

$$E = F * (\alpha_E * {K_E}^{\rho} + (1 - \alpha_E) * {L_E}^{\rho})^{1/\rho} \quad (4)$$

$$D = G * (\alpha_D * {K_D}^{\rho} + (1 - \alpha_D) * {L_D}^{\rho})^{1/\rho} \quad (5)$$

F and *G* represent sectoral efficiency parameters whereas α_E and α_D represent sectoral distribution (share) parameters. Export sector is assumed to be more land-intensive (and capital-intensive) than

[69] Lofgren et al. (2002, p. 29-30).

domestic sector and thus, $\alpha_E > \alpha_D$. Both sectors are assumed to have the same elasticity of substitution: $\sigma(E) = \sigma(D) = \sigma$. Exponent parameter, ρ, is derived from elasticity of substitution as:

$$\rho_E = \frac{\sigma_E - 1}{\sigma_E} = \frac{\sigma_D - 1}{\sigma_D} = \rho_D = \rho \quad (6)$$

As with Armington elasticity σ_Q, it follows from (6) that:

$$\sigma = \frac{1}{1-\rho} \quad (7)$$

Biofuel sector is denoted by *QB* and it also a CES production function. It is assumed that biofuel sector has the same constant elasticity of substitution, σ, as export and domestic sectors. Production function parameters for the three sectors are derived in section 6.2.6.

$$QB = H * (\alpha_B * {K_B}^{\rho} + (1 - \alpha_B) * {L_B}^{\rho})^{1/\rho} \quad (8)$$

The assumption that all sectors have the same substitution elasticity in all scenarios can be too simplistic. One could easily assume that it is not the same to substitute land and labor in sectors that differ in terms of input factor intensities. And when it comes to biofuels, the production structure differs between scenarios: this means that different elasticities could be justified for land- and capital-intensive large-scale biofuel production and labor-intensive outgrower scheme production.

The model is solved by finding an equilibrium which is assumed to be partially competitive. It requires that two conditions are met. First, factor markets clearing requires that the sum of inputs used by sectors equal to total factor endowments in economy, *KT* for land and *LT* for labor. Total factor endowments are exogenous and partially fixed. The reason for factor stocks being only partially fixed is that along with the biofuel sector establishment more land is taken under production. Thus, the land stock increases by an exogenous amount between base year and current year (new equilibrium). Factor market clearing implies that Ghana's economy is assumed to have full employment.

$$K_E + K_D + K_B = KT$$

$$L_E + L_D + L_B = LT \quad (9)$$

Second, in competitive equilibrium unit costs have to equal market prices. This is denoted below, where W_K represents return to land in export and domestic sectors, W_L represents wages in all sectors and W_{KB} represents return to land in biofuel sector:

$$K_E * W_K + L_E * W_L = P^E$$

$$K_D * W_K + L_D * W_L = P^D$$

$$K_B * W_{KB} + L_B * W_L = P^B \quad (10)$$

This is where the 1-2-3-4 model differs from previous adaptations of 1-2-3 models with factors of production. Compared to Devarajan et al. (1990) and Robinson and Thierfelder (1996), I allow return to land be different in biofuel sector but the wages have to be at the same level. This originates from the feature that biofuel sector production function parameters are calibrated to their values depending on the scenario and biofuel sector's use of land, K_B, is determined by the scenario. When biofuel sector is established and implemented into the economy, the sector uses labor so that all the sectors adjust to have the same wage, W_L. Domestic prices of goods are denoted by P^E, P^D and P^B and they all have values of one in base year (P^B has value of one in the base year for calibration purposes).

Trade balance of goods and services is denoted by equation (11), where Φ is a variable describing ratio of Ghana's spending on imports to its earnings from exports. Φ is an endogenous variable and it is useful for describing change in Ghana's trade balance of goods and services between base year and current year. However, the model could also be solved without it.

$$PWM * M * \Phi = PWE * E + PWB * QB \quad (11)$$

When Φ = 1, country's export earnings equal to its import expenditures. An increase in Φ means improvement in trade balance.

6.2.3 Shares in the model

Factor *i* share of income in sector *j* is defined as:

$$\theta_{KE} = \frac{\frac{dE}{dK} * K_E}{E}; \ \theta_{LE} = \frac{\frac{dE}{dL} * L_E}{E}$$

$$\theta_{KD} = \frac{\frac{dD}{dK} * K_D}{D}; \ \theta_{LD} = \frac{\frac{dD}{dL} * L_D}{D}$$

$$\theta_{KB} = \frac{\frac{dQB}{dK} * K_B}{QB}; \ \theta_{LB} = \frac{\frac{dQB}{dL} * L_B}{QB} \quad (12)$$

Factor shares, θ_{ij} describe factor *i*'s share of sector *j*'s production value that can be traced back to the factor in that sector. Because domestic and export sector have different production

characteristics – export sector being land-abundant and domestic sector labor-abundant – the value share of land is higher in export sector than in domestic. It indicates that:

$$\theta_{KE} > \theta_{KD} \tag{13}$$

Due to equilibrium conditions, it must be that:

$$\sum_i \theta_{ij} = 1 \tag{14}$$

Depending on the applicable scenarios, value shares of land and labor in biofuel sector are either similar to export or domestic sector. Value shares are determined by the assumption of the biofuel production structure which can be carried out either by large-scale farms or by labor-intensive outgrower schemes.

6.2.4 Unit costs and wages

Unit cost functions can be derived from the production functions (4), (5) and (8):[70]

$$c_E(w_K, w_L) = \frac{1}{F} * (\alpha_E{}^{\sigma} * w_K{}^{1-\sigma} + (1-\alpha_E)^{\sigma} * w_L{}^{1-\sigma})^{\frac{1}{1-\sigma}}$$

$$c_D(w_K, w_L) = \frac{1}{G} * (\alpha_D{}^{\sigma} * w_K{}^{1-\sigma} + (1-\alpha_D)^{\sigma} * w_L{}^{1-\sigma})^{\frac{1}{1-\sigma}}$$

$$c_B(w_{KB}, w_L) = \frac{1}{H} * (\alpha_B{}^{\sigma} * w_{KB}{}^{1-\sigma} + (1-\alpha_B)^{\sigma} * w_L{}^{1-\sigma})^{\frac{1}{1-\sigma}} \tag{15}$$

All the three sectors have the same elasticity of substitution in unit cost functions: *1/σ*. Because unit prices have to equal unit costs, all unit costs equal to one and thus:

$$c_E = P^E;\ c_D = P^D;\ c_B = P^B \tag{16}$$

Now W_K, W_L and W_{KB} are defined as marginal products of land and labor. In the base year W_K, W_L and W_{KB} have values of one. Marginal products are derived by taking partial derivatives of (4), (5) and (8) with respect to land and labor:

$$w_K = \frac{dE}{dK} = \frac{dD}{dK}\ ;\ w_L = \frac{dE}{dL} = \frac{dD}{dL} = \frac{dQB}{dL}; w_{KB} = \frac{dQB}{dK} \tag{17}$$

$$\frac{dE}{dK} = \alpha_E\ K_E{}^{\rho-1}\ F\ (\alpha_E\ K_E{}^{\rho} + (1-\alpha_E)\ L_E{}^{\rho})^{\frac{1-\rho}{\rho}}$$

$$\frac{dD}{dK} = \ \alpha_D\ K_D{}^{\rho-1}\ G\ (\alpha_D\ K_D{}^{\rho} + (1-\alpha_D)\ L_D{}^{\rho})^{\frac{1-\rho}{\rho}}$$

[70] For detailed derivation of these equations, see Rutherford (2002).

$$\frac{dQB}{dK} = \alpha_B K_B{}^{\rho-1} H (\alpha_B K_B{}^{\rho} + (1-\alpha_B) L_B{}^{\rho})^{\frac{1-\rho}{\rho}}$$

$$\frac{dE}{dL} = (1-\alpha_E) L_E{}^{\rho-1} F (\alpha_E K_E{}^{\rho} + (1-\alpha_E) L_E{}^{\rho})^{\frac{1-\rho}{\rho}}$$

$$\frac{dD}{dL} = (1-\alpha_D) L_D{}^{\rho-1} G (\alpha_D K_D{}^{\rho} + (1-\alpha_D) L_D{}^{\rho})^{\frac{1-\rho}{\rho}}$$

$$\frac{dB}{dL} = (1-\alpha_B) L_B{}^{\rho-1} H (\alpha_B K_B{}^{\rho} + (1-\alpha_B) L_B{}^{\rho})^{\frac{1-\rho}{\rho}} \quad (18)$$

And further, because in equilibrium unit costs have to equal unit prices, prices can be written based on (15) as:

$$P^E = \frac{1}{F} (\alpha_E{}^{\sigma} w_K{}^{1-\sigma} + (1-\alpha_E)^{\sigma} w_L{}^{1-\sigma})^{\frac{1}{1-\sigma}} = c_E(w_K, w_L)$$

$$P^D = \frac{1}{G} (\alpha_D{}^{\sigma} w_K{}^{1-\sigma} + (1-\alpha_D)^{\sigma} w_L{}^{1-\sigma})^{\frac{1}{1-\sigma}} = c_D(w_K, w_L)$$

$$P^B = \frac{1}{H} (\alpha_B{}^{\sigma} w_{KB}{}^{1-\sigma} + (1-\alpha_B)^{\sigma} w_L{}^{1-\sigma})^{\frac{1}{1-\sigma}} = c_B(w_{KB}, w_L) \quad (19)$$

One should note that unit cost and wage equations (10), (15-19) indicate perfectly competitive factor markets in the model. This is not in line with the previous chapters that discuss African agriculture and FDIs. For example, wages paid to employees might not represent their marginal productivity in reality. Additionally, wages could be different between sectors and biofuel sector wage could be assumed to be higher than in other sectors, if one assumes that foreign investors producing biofuels would pay higher wages (based on the potential reasons presented in chapter 3). The assumption of wage difference could be included in the model, for example, by adding a new variable (wage for biofuel sector) and writing that $W_{LB} = x * W_L$, where x would be above 1.

In reality, unit prices of different commodities may not represent real unit costs, which means that equation (16) may not reflect reality. This can arise from e.g. government control and fixed prices in African economies. In addition, biofuel production could be subsidized in Ghana, especially because in the model biofuel production is established due to policy goals.[71] Equation (16) might not hold also because of foreign investors would require making profits with biofuels and they could be able to negotiate deals that would leave host country's employees little to say. Of course, the same could happen due to government corruption.

[71] For example, according to Deininger and Byerlee (2011), Ghana has tax breaks that can allow profitable companies to pay almost zero taxes.

Difference between model assumptions and empirical evidence means that there are limitations to models' results in section 6.3. Considering the evidence, the 1-2-3-4 model probably gives too positive results from households' point of view. Also, even though factor market clearing (9) is a reasonable condition, in reality the land leased or purchased by foreign investors have not been used for production to full extent. Thus, biofuel production (8) could actually use less land than what factor market clearing condition (and land requirement estimated in 6.2.1) suggests.

6.2.5 Inserting government and investment into 1-2-3-4 model

In this section government and investment are inserted into 1-2-3-4 model. It requires determining taxes, savings and investments, transfers and subsidies between sectors, and deriving their equations. This extension to basic 1-2-3 model requires three steps: first a national account data is built for Ghana. The national account data presented in Table 13 shows the accounts in billions of US dollars and as shares of total value added output. Second, exogenous and endogenous variables are calibrated to their base year 2010 values following calibration in Devarajan et al. (1990, and 1997). Equations in the model are similar to those used for base year calibration and hence, model equations are derived along with the calibration. Finally, a social accounting matrix (SAM) is constructed for Ghana with the calibrated variables. To construct the SAM, I use instructions from Breisinger et al. (2010). The SAM allows for checking that the national account data and the variables are balanced.

National account data in Table 13 is in adjusted form to make it suitable for the model and therefore the numbers in it do not completely match the sources where the data was gathered from. There are also differences between the estimates of main sources of national account data, Bank of Ghana (*annual publication 2013* and *quarterly bulletins*) and GSS (2014b). Appendix 3 shows Ghana's national account data presented in GHc (Ghana cedi) and it explains the adjustments made in more detail. The specific points *(1)-*(12) are related to data adjustments and Ghana's taxation system. Capital income tax is 15% according to Ghana Revenue Authority (GRA), but information about the capital tax revenues to government is unavailable. *Statistical discrepancy* is driven to zero for calibration and balancing purposes, even though discrepancy is non-zero in the sources of data. Exchange rate between USD and GHc, was 1,43 in 2010 (World Bank, 2014).

Table 13. Ghana National Account Data 2010, US$ billions

Currenry: US$	**Billions**	**Output=1**		**Billions**	**Output = 1**
National accounts			**Fiscal account**		
Output (value added)	30,341	1,000	*Total Revenue*	6,161	0,203
Wages *(1)	15,171	0,500	Non-tax revenue *(9)	1,613	0,053
			O/W grants *(9)	0,755	0,025
GDP at market prices *(2)	33,149	1,093	*Current expenditure*	6,102	0,201
Private consumption	25,077	0,826	Goods & Services *(10)	3,374	0,111
Public consumption *(3)	3,374	0,111	Interest payments	1,007	0,033
Investment *(3)	9,255	0,305	Transfers & Subsidies	1,722	0,057
Exports *(4)	9,437	0,311	Capital expenditure	2,216	0,073
Imports *(4)	13,995	0,461	*Fiscal balance*	-2,157	-0,071
Statistical discrepancy	0,000	0,000	**Balance of payments**		
Tax revenue			Trade balance, goods & services *(11)	-4,557	-0,150
Sales & Excise tax *(5)	1,608	0,053	Net profits and dividends	-0,343	-0,011
Import tariffs *(6)	1,133	0,037	Interest payments	-0,192	-0,006
Export duties	0,066	0,002	Net private transfers	2,123	0,070
Personal income tax *(7)	1,741	0,057	Net official transfers *(12)	0,755	0,025
Capital income tax *(8)	0,0	0,0	*Current account balance*	-2,214	-0,073
Total Tax Revenue	4,549	0,150			
			External debt	6,321	0,208
Exchange rate 2010, US$/GHc	**1,43**		Debt service payments	0,322	0,011

Sources: Bank of Ghana (2011b-e), Bank of Ghana (2014), GRA (2014a-b), GSS (2014b) and World Bank (2014)

External debt and service payments are shown in the national account data (Table 13) but they are not used for calibration. They are touched very briefly in chapter 7 when Ghana's actual development is analysed. One can see that external debt service payments accounted for ca. 33% of total interest payments in 2010 and the amount of external debt amounted to ca. 21% of Ghana's value added GDP.

Ghana's national account data is used to calibrate model variables to their base year values. The model has 31 endogenous variables and 18 exogenous variables that are listed below in Table 14.

Table 14. List of variables

Endogenous variables		***Exogenous variables***	
E	Exports	*PWM*	World import price
M	Imports	*PWE*	World export price
DS	Supply of domestic good	*TM*	Import tariff rate
DD	Demand for domestic good	*TE*	Export duty rate
QS	Composite supply (Absorption)	*TS*	Indirect tax rate
QD	Composite demand	*TY*	Direct tax rate
PE	Domestic price of export good	*TR*	Government transfers
PM	Domestic price of import good	*FT*	Foreign transfers to government
PD	Producer price of domestic good	*RE*	Foreign remittances to private sector
PT	Sales price of composite good	*SY*	Private savings rate
PQ	Price of composite good	*G*	Government consumption
R	Exchange rate (Numeraire)	*B*	Current account balance (foreign saving)
T	Tax revenue	*KT*	Total land supply
SG	Government savings	*LT*	Total labor supply
Y	Total private income	*KN*	Amount of new land used as factor input

C	Private consumption	*K%*	Share of *KB* acquired from other sectors
S	Aggregate savings	*PWB*	World biofuel price
Z	Aggregate real investment	*KBR*	Biofuel land requirement
WK	Return to land		
WL	Wage in all sectors		
KE	Land used to produce Exports		
LE	Labor used to produce Exports		
KD	Land used to produce Domestics		
LD	Labor used to produce Domestics		
Walras	Walras' law		
WKB	Return to land in Biofuels		
KB	Land used to produce Biofuels		
LB	Labor used to produce Biofuels		
PB	Domestic price of biofuels		
QB	Biofuel production		
Φ	Trade balance		

There are three exogenous world prices and six endogenous domestic prices in the model. Nominal exchange rate is held as numeraire and hence, government's policy instruments in the model would be tax instruments. Indirect tax (sales tax) *TS* is applied to sales in Ghana, import tariff rate *TM* is collected from imports and export duty rate *TE* is levied on exported goods. There is no specific export duty rate for biofuels and biofuel exports are assumed to be subject to the same export duty rate. This, however, could be easily changed in the model, if, for example, biofuels would be assumed to be exempted from export duties. Government also collects direct taxes from households in form of direct tax rate *TY*. There are thee savings variables constructing together the aggregate savings *S* that needs to equal to total aggregate real investment *Z*: these are private savings rate *SY*, government savings *SG* and current account balance *B* which describes foreign savings in the model. As is shown in the calibration of exogenous variables in Table 15, current account balance consists of a residual that is found by deducting exports from imports and adjusting it with grants and remittances received from abroad (Devarajan et al. 1997). *Walras* is an endogenous variable that describes Walras' law and balance between investment and savings. Satisfying Walras' law means that there are no leakages in the model and that total savings equal to total investment.

Exogenous variables are calibrated using Ghana's national account data. World prices of imports and exports are calibrated to their base year values and it is assumed that they remain constant. This results from a small-country assumption, according to which Ghana's economy has no impact on world prices. The 1-2-3-4 model could also be used to analyze impacts of world price changes as well as other exogenous shocks on the economy: such analysis has been done with previous 1-2-3 CGE model adaptations. All the variables are calculated as relative to value added output, where the value added output has value of one.

Table 15. Calibration of exogenous variables

		Definition	Calibration of exogenous variables to base year	Base
1	PWM	World import price	PWM = PM0/R0/(1+TM0)	0,925
2	PWE	World export price	PWE = PE0*(1+TE0)/R0	1,007
3	TM	Import tariff rate	TM = (Import tariffs)/Imports	0,081
4	TE	Export duty rate	TE = Export duties/Exports	0,007
5	TS	Indirect tax rate	TS = (Sales & Excise tax)/(QS0*PQ0)	0,045
6	TY	Direct tax rate	TY = (Sum of payroll, personal income and capital tax)/Y0	0,052
7	TR	Government transfers	TR = (Interest payments + Transfers & Subsidies)-(Non-tax revenue - Foreign grants)	0,062
8	FT	Foreign transfers to government	FT = (Net official transfers)/R0	0,025
9	RE	Foreign remittances to private sector	RE = (Sum of net profits & dividends, interest payments, net private transfers)/R0	0,052
10	SY	Private savings rate	SY = (Y0 -(CN0*PT0)-TY*YO)/YO	0,207
11	G	Government consumption	G = Public consumption/(PT0)	0,106
12	B	Current account balance	B = ((PWM0*M0) - (PWE0*E0) - FT0 - RE0)/R0	0,073
13	KT	Total land supply	KT = 0,5 + KN	0,500
14	LT	Total labor supply	LT = 0,5	0,500
15	KN	New land used as factor input	K(N) = (1-K%)*KBR0*0,5	0,000
16	K%	Share of KB acquired from other sectors	Depends on scenario and assumptions, K%0 = 0	0,0
17	PWB	World biofuel price	PWB = PWE = PB0*(1+TE0)/R0	1,007
18	KBR	Biofuel land requirement	KBR0 = 0 (current = 0,05*KT0)	0,000

There are some exogenous variables regarding biofuel sector that could be dropped from the model. For instance, *KBR* and *K%* would not be necessary because these variables could be determined in other ways as well. The purpose of including these variables in the model lies in using them in the scenarios to change the assumptions about biofuel sector and its requirements.

Table 16 below shows how endogenous variables are calibrated to their base year values. As exogenous variables, also endogenous variable values are relative values to value added output. All real flow values are presented as real flows without indirect taxes (*QS*, *QD*, *M*, *E*, *D* and *QB*).

Table 16. Calibration of endogenous variables

		Definition	Calibration of endogenous variables to base year	Base
1	E	Exports	E0 = (Exports-TE0)/PE0	0,309
2	M	Imports	M0 = (Imports+TM0)/PM0	0,499
3	DS	Supply of domestic good	DS0 = 1-E0	0,691
4	DD	Demand for domestic good	DD0 = DS0	0,691
5	QS	Composite supply (Absorption)	QS0 = M0 + DD0	1,190
6	QD	Composite demand	QD0 = QS0	1,190
7	PE	Domestic price of export good	PE0 = 1	1,000
8	PM	Domestic price of import good	PM0 = 1	1,000
9	PD	Producer price of domestic good	PD0 = 1	1,000
10	PT	Sales price of composite good	PT0 = PQ0*(1+TS0)	1,045
11	PQ	Price of composite good	PQ0 = 1	1,000

12	R	Exchange rate (Numeraire)	R0 = 1	1,000
13	T	Tax revenue	T0 = (TM0*PWM0*M0*R0) + (TE0*R0*(PE0*E0+PB0*QB0)) + (TS0*PQ0*QD0)+(TY0*Y0)	0,150
14	SG	Government savings	SG0 = T0 - G0*PT0 - TR0*PQ0 + FT0*R0	0,002
15	Y	Total private income	Y0 = (WK0*(KE0+KD0))) + (WL0*(LE0+LD0+LB0)) + (TR0*PQ0) + (RE0*R0) + (WKB0*KB0)	1,114
16	C	Private consumption	C0 = Private consumption/PT0	0,791
17	S	Aggregate savings	S0 = SY0*Y0 + R0*B0 + SG0	0,305
18	Z	Aggregate real investment	Z0 = Investment/PT0	0,292
19	WK	Return to land	WK0 = MPKE0 = MPKD0 = 1	1,000
20	WL	Wage in all sectors	WL0 = MPLE0 = MPLD0 = 1	1,000
21	KE	Land used to produce Exports	KE0 = 0,184	0,184
22	LE	Labor used to produce Exports	LE0 = E0-KE0	0,125
23	KD	Land used to produce Domestics	KD0 = 0,316	0,316
24	LD	Labor used to produce Domestics	LD0 = DS0-KD0	0,375
25	Walras	Walras' law	Walras = Z0*PT0 - S0	0,000
26	KB	Return to land in Biofuels	KB0 = KBR0*0,5	0,000
27	LB	Land used to produce Biofuels	LB0 = QB0-KB0	0,000
28	WKB	Labor used to produce Biofuels	WKB0 = 0	0,000
29	PB	Domestic price of biofuels	PB0 = 0	0,000
30	QB	Biofuel production	QB0 = 0	0,000
31	Φ	Trade balance	ϕ0 = (PWE0*E0+PWB0*QB0)/(PWM0*M0)	0,674

From the table it can be seen that all the biofuel sector values are zero in the base year. Calibration of the biofuel sector production parameters is done similarly to export and domestic sector parameters but due to CES production function characteristics, functions with elasticity of 0,1 are not acceptable when input factors are zero. Hence, the base year is actually treated as there would not be any biofuels. Another option would be to write biofuel sector equations so that their share of production factors land and labor would approach zero. For example, values of $1*10^{-7}$ could be used in Excel so that biofuel sector would have no material impact in the model at base.

Government tax revenue denoted by *T* is the sum of direct and indirect taxes levied in the economy. Taxes are presented in Ghana's national account data (Table 13) based on which the exogenous tax variables are being built. Tax revenues equation is written as follows:

$$T = (TM * PWM * M * R) + (TS * PQ * QD) + (TY * Y) + (TE * PE * E * R) + (TE * PB * QB * R) \quad (20)$$

The above tax equation is the sum of import tariffs, indirect sales taxes, direct income taxes, export duties of traditional exports and export duties of biofuels. The applicable tax rates are denoted by import tariff rate *TM*, indirect tax rate *TS*, direct tax rate *TY*, and export duty rate *TE* for both traditional sector and biofuels. Based on Ghana's national account data for base year 2010, export duties were collected from exported goods in 2010. However, the amount of export duties collected

decreased to almost zero in 2011 and then in 2012 and 2013 export duties rose again to approximately same level as in 2010 (Bank of Ghana, *Quarterly bulletins* 2011-2013). And as is shown in Table 15, even in 2010, the export duty rate has been only 0,7%. This is to say that export duties are relatively minor source of revenue for Ghana's government. And taking account that in developing countries exports can be subsidized rather than taxed, assuming export duty rate for biofuels could be challenged. However, as the export duty rate is very small, having zero export duty rate for biofuels would not have any larger impacts in model results.

Next, the equation for total income of private sector (households) *Y* is defined. This equation sums up the incomes from factor inputs and all the transfers and remittances private sector receives from government and abroad.

$$Y = WK * (K_E + K_D) + WKB * K_B + WL * (L_E + L_D + L_B) + TR * PQ + RE * R \quad (21)$$

As was discussed earlier, all the sectors are assumed and required to have the same wage, *WL*, but biofuel sector has a different return to land, *WKB*, compared to the other two sectors. *TR* denotes government transfers to private sector and *RE* denotes foreign remittances to private sector.

Total saving in the economy consists of private saving (22), public saving (23) and foreign saving (24). Private saving is assumed to be a fixed proportion, *SY*, of households' total income *Y*. Public saving *SG* is an endogenous variable representing the difference between government revenues and total spending. Foreign saving describes Ghana's current account deficit and it is exogenous, calibrated from the national account data. Private saving is written as:

$$Private\ saving = SY * Y \quad (22)$$

Public saving *SG* is an endogenous variable representing the difference between government revenues and total spending. Government revenues consist of tax revenues *T* and foreign transfers to government (such as grants) *TR*. Total public spending consists of public consumption *G* plus transfers to private sector *TR*. *PT* denotes the market sales price of composite good which is a good describing the overall consumption in the economy.

$$SG = T - G * PT - TR * PQ + FT * R \quad (23)$$

Foreign saving *B* (*B0* as base year value) describes the current account deficit of Ghana and it is calibrated as an exogenous variable by deducting Ghana's export earnings and foreign transfers from import expenditure. In the model current values (new equilibrium values) must fulfill equation (24):

$$B0 = B = PWM * M - PWE * E - PWB * QB - FT - RE \quad (24)$$

With equations (22), (23) and (24) total savings *S* can now be written as:

$$S = SY * Y + B * R + SG \quad (25)$$

After writing the equations for total income (21) and private saving (22), and by using direct tax rate *TY* from (20), private consumption *C* can be written as their remainder. The target function in the model has the following form:

$$C = Y * (1 - SY - TY)/PT \quad (26)$$

Before presenting final model equations, additional equilibrium conditions need to be derived. First, domestic goods market must clear and thus, demand and supply of domestic good *D* must equal to each other in equilibrium:

$$DD - DS = 0 \quad (27)$$

Supply and demand for the composite good (formed by *D* and *M*) must also equal to each other in equilibrium:

$$QD - QS = 0 \quad (28)$$

Demand for composite good is given by private consumption, public consumption and investment. When *Z* denotes the amount of total investment in the economy, *QD* is written as:

$$QD = C + G + Z \quad (29)$$

Government budget must be in balanced so that government revenues equal to expenditures. For the budget balance we can write:

$$T - G * PT - TR * PQ + FT * R - SG = 0 \quad (30)$$

Last, the model must be in balance with respect to total savings and total investment. They need to equal to each other to ensure that there are no leakages in the model. This is also called *Walras' law* and the equation is written so that *Walras* is an endogenous variable that should maintain its value of zero in the new equilibrium.

$$Z * PT - S = Walras \quad (31)$$

The 1-2-3-4 model has now 31 endogenous variables, 18 exogenous variables and 31 equations. As it was already mentioned before, some of the variables and equations could be dropped and Walras' law would still be satisfied. Such is the case with e.g. trade balance *Φ*. Finally, Table 17 below presents all the model equations that are used to solve a new equilibrium after the biofuel establishment. The equilibrium is found by maximizing *Private consumption, C*. Maximizing private consumption would not be the only option to solve the model because other variables could be used for that as well. *C* is used here because it describes private consumption and in this context it is important because we are interested in biofuels' effects on Ghana's consumers. Social accounting matrix for Ghana is presented and discussed in the next section with model assumptions.

Table 17. 1-2-3-4 CGE model equations

Real flows	**16.** $R = 1$
1. $QS = F(M, D, \sigma_Q)$	***Equilibrium conditions***
2. $QD = C + G + Z$	**17.** $DD - DS = 0$
3. $M = D\left(\left(\frac{P^D}{P^M}\right) * \left(\frac{\alpha_Q}{1-\alpha_Q}\right)\right)^{\sigma_Q}$	**18.** $QD - QS = 0$
4. $E = F * (\alpha_E * {K_E}^{\rho} + (1 - \alpha_E) * {L_E}^{\rho})^{1/\rho}$	**19.** $PWM * M - PWE * E - PWB * QB - FT - RE - B = 0$
5. $D = G * (\alpha_D * {K_D}^{\rho} + (1 - \alpha_D) * {L_D}^{\rho})^{1/\rho}$	**20.** $T - G * P^T - TR * P^Q + FT * R - SG = 0$
6. $QB = H * (\alpha_B * {K_B}^{\rho} + (1 - \alpha_B) * {L_B}^{\rho})^{1/\rho}$	**21.** $Z * PT - S = Walras$
Nominal flows	**22.** $KE + KD + KB - KT = 0$
7. $T = (TM * PWM * R * M) + (TS * PQ * QD) + (TY * Y) + (TE * PE * E * R) + (TE * PB * QB * R) * P^T$	**23.** $LE + LD + LB - LT = 0$
8. $Y = WK * (KE + KD) + WL * (LE + LD + LB) + WKB * KB + TR * PQ + RE * R$	**24.** $KB - BKR = 0$
9. $S = SY * Y + R * B + SG$	**25.** $PWM * M * \Phi = PWE * E + PWB * QB$
10. $C = Y * (1 - TY - SY)/PT$	***Wages***
Prices	**26.** $WK = MPKE * P^E$
11. $P^M = PWM * R * (1 + TM)$	**27.** $WK = MPKD * P^D$
12. $P^E = PWE * R/(1 + TE)$	**28.** $WL = MPLE * P^E$
13. $PB = PWB * R/(1 + TE)$	**29.** $WL = MPLD * P^D$

14. $P^T = P^Q * (1 + TS)$

15. $P^Q = (P^M * M + P^D * DD)/QS$

30. $WL = MPLB * P^B$

31. $WKB = MPKB * P^B$

There are 6 real flow equations (1-6) describing good flows in the economy. Equations 7-10 describe income flows (nominal flows) and equations 11-16 determine the prices. Equilibrium conditions are given by equations 17-25 and wages by equations 26-31. However, wages could also belong to nominal flows: here they have just been separated into their own section.

6.2.6 Sectoral production functions and wages in the model

Before the solving the model and presenting the results of different scenarios, wages need to be discussed and function parameters need to be derived. This subsection introduces production function characteristics and calibration of their parameters. Ghana's social account matrix for 2010 is also prepared to ensure that model accounts are balanced. Intermediate products are not included in the model and that is why they are left out from SAM as well.

SAMs are balanced matrixes summarizing all the transfers and transactions between different accounts in an economy during a given period (Kretschmer & Peterson, 2009). Row and column sums must equal to each other in SAMs for an economy to be balanced without any leakages. Rows describe accounts' revenues from other accounts and columns show accounts' expenditure and how the expenditure is allocated between different accounts. Thus, SAMs contain a feature called double-entry accounting because revenues must equal to expenditure for every account (Breisinger et al. 2010, p. 1). This is one benefit from SAMs because it allows to check whether the calibration of variables is correct: one needs to be able to reproduce the values of national account data into SAM with the calibrated variables.

Table 18 below presents Ghana's SAM for 2010, constructed from the calibrated variables that in turn have their basis in the national account data presented earlier. SAM shows that all the accounts are balanced, implying thus that there are no leakages or mistakes in the calibration of base year.

Table 18. Social accounting matrix for Ghana, 2010, US$ billions

	Activities	Commodities	Factors	Households	Government	Savings and investment	Rest of world	Total
Activities		30,341						30,341
Commodities				25,077	3,374	9,255	9,437	47,143
Factors	30,341							30,341
Households			30,341		1,871		1,588	33,800
Government		2,808		1,741			0,755	5,304
Savings and investment				6,982	0,059		2,214	9,255
Rest of world		13,995						13,995
Total	30,341	47,143	30,341	33,800	5,304	9,255	13,995	

Account "Activities" in the SAM refers to entities producing goods and services and "Commodities" refers to goods and services produced (Breisinger et al. 2010). Activity account is measured in value added numbers while Commodities is measured in market prices, i.e. including indirect taxes.

As biofuels are not included in the base year in the 1-2-3-4 model, they are not included in the above SAM either. This relates to an issue in a broader context, recognized by Kretschmer and Peterson (2009): they argue that incorporating biofuels in CGE model is problematic because bioenergy is not a production sector that would be included in the base year SAM. It means that biofuels cannot be calibrated as other sectors. On the other hand, biofuels are not "a pure future technology" but instead they use existing production and trade patterns.

Data availability for Ghana makes it different to achieve reliable estimates about labor's share of *factor income* which is denoted by cell (Factors, Activities) in the SAM. This notation refers to cell ("*row"*, "*column"*) and it means row account's income from the column account. Regarding labor's factor income, it simply refers to wages. One estimation for wages in Ghana is presented below in Table 19 and it indicates that wages would amount to ca. 63% of the factor income in Ghana. This estimate is calculated with 2011 average wages and it should be treated with caution regarding its accuracy. Hence, I choose to use a rather crude assumption that land and labor both account for 50% of factor income in 2010 in the 1-2-3-4 model.[72] This assumption leads to the following values of total stocks for land and labor: $K(T0) = 0{,}5$ and $L(T0) = 0{,}5$ when total (value added) output is 1.

[72] See wages in Table 13.

Table 19. Wages in Ghana, 2011 values

Private sector average wage (GHc)	412,80
Public sector average wage (GHc)	688,21
Private/public	59,98 %
Public sector wage bill, % of GDP	6,88 %
Public sector employees of total work force	6,30 %
Total wages of GDP	63,08 %

Source: Ghanaweb (2013) and GSS (2012)

When land and labor endowments and production function parameters are correct and functioning, conditions and equations (4), (5), (8), (9), (10), (15), (16), (17), (18) and (19 must hold. After estimating labor used by both sectors the total land stock can then be divided between sectors (as residuals). Table 20 shows calculations for an estimate of labor usage in export sector in the model. This is done by dividing Ghana's economy into three sectors (only for these calculations, as these are not sectors in the 1-2-3-4 model), Agriculture, Industry and Services. Sectoral labor usage, GDP share and export share are used to estimate exports' share of labor in each sector.

In the table there are 2 different columns for GDP representing GDP estimates for sectors from different sources. Labor endowments in sectors have been calculated using data in GSS (2012). There are two different possibilities for labor intensities (labor share divided by GDP share) and they give rise to two different estimates for the share of labor used by export sector. The calculations use World Bank's estimate for Ghana's exports, 29,5%, instead of 30,9% that is used in the 1-2-3-4 model. Export shares in each sector have been calculated by using FAOSTAT (2014), World Bank (WDI 2014) and Bank of Ghana (2014).

Table 20. Estimating labor endowment in Ghana's export sector, 2010

Sector	**Labor (L)**	**L share**	**GDP (1)**	**GDP (2)**	**Export share in sector (1)**	**Export share in sector (2)**
Agriculture	4 345 723	41,47 %	0,298	0,370	0,314	0,253
Industry	1 613 599	15,40 %	0,191	0,148	0,813	1,048
Services	4 520 163	43,13 %	0,511	0,482	0,090	0,095
Total	10 479 485	1	1	1	0,295	0,324
Sector	**Share of Exports**	**Labor intensity (1)**	**Labor intensity (2)**	**L in exports (1)**	**L in exports (2)**	
Agriculture	0,317	1,394	1,121	0,130	0,105	
Industry	0,527	0,806	1,039	0,125	0,161	
Services	0,156	0,844	0,895	0,039	0,041	
Total	1			**0,294**	**0,307**	
(1) Ghana Statistical Service, GSS						
(2) World Bank						
Exports of goods and services, share of GDP (World Bank)			**0,295**			

Sources: Bank of Ghana (2014), FAOSTAT (2014), GSS (2012), GSS (2014a) and World Bank (WDI 2014)

Two notices can be made about the estimates. First, based on the calculations the estimate for labor share used by export sector in Ghana would be 0,294 or 0,307. Given that exports account for 29,5% according to World Bank (WDI 2014), 31,4% of GDP according to GSS (2014a), and 31,1% as

adjusted for the calibration, it could imply that export sector and domestic sector are close to each other when it comes to factor usages. Exports could even be labor-intensive in total according to World Bank numbers.

Second, numbers and estimates in the table cannot tell how the labor really is allocated inside sectors: dividing labor directly on a basis of exports' share of sector's GDP is the simplest way, but probably not the correct way. One might easily assume that exporting companies are less labor-intensive than non-exporting peer companies in the same sector. This assumption is why I have included *assumption 3)* as a third estimate for labor endowment in export sector: *3)* assumes that labor endowment is 25% of labor endowment in export sector and 75% in domestic sector. These endowments lead to values *LE=0,125* and *LD=0,375*. Table 21 below shows land and labor endowments, factor shares and value shares in the two sectors resulting from both estimates and the additional assumption. Land endowments are calculated as 'residuals': $K_j = Y_j - L_j$, where j denotes sector and Y_j denotes sector's share of GDP. Assumption *3)* is used in the 1-2-3-4 model to make export sector land-intensive and to achieve larger differences between the two sectors in the model.

Table 21. Factor endowments, factor shares and values shares by sector

	Estimate		
Endowments	***1***	***2***	***3: assumption***
Labor, L			
Exports, E	0,147	0,154	0,125
Domestic, D	0,353	0,346	0,375
Land, K			
Exports, E	0,162	0,155	0,184
Domestic, D	0,338	0,345	0,316
Factor shares	***1***	***2***	***3: assumption***
Labor, L			
Exports, E	0,294	0,307	0,250
Domestic, D	0,706	0,693	0,750
Land, K			
Exports, E	0,324	0,310	0,368
Domestic, D	0,676	0,690	0,632
Value shares	***1***	***2***	***3: assumption***
Labor, L			
Exports, E	0,476	0,498	0,405
Domestic, D	0,511	0,501	0,543
Land, K			
Exports, E	0,524	0,502	0,595
Domestic, D	0,489	0,499	0,457

Sectoral production function parameters are calibrated by using GAMS instructions from

Rutherford (2002) and meeting the conditions (4), (5), (8), (9), (10), (15), (16), (17) and (18). Distribution parameters are calibrated as:

$$\alpha_E = \frac{w_K * K_E^{\frac{1}{\sigma}}}{w_K * K_E^{\frac{1}{\sigma}} + w_L * L_E^{\frac{1}{\sigma}}};\ \alpha_D = \frac{w_K * K_D^{\frac{1}{\sigma}}}{w_K * K_D^{\frac{1}{\sigma}} + w_L * L_D^{\frac{1}{\sigma}}};\ \alpha_B = \frac{w_{KB} * K_B^{\frac{1}{\sigma}}}{w_{KB} * K_B^{\frac{1}{\sigma}} + w_L * L_B^{\frac{1}{\sigma}}} \quad (32)$$

And land endowments could be written as:

$$K_E = \left(\frac{E}{F}\right)\left(\frac{\alpha_E * F * C_E(w_K, w_L)}{w_K}\right)^{\sigma};\ K_D = \left(\frac{D}{G}\right)\left(\frac{\alpha_D * G * C_D(w_K, w_L)}{w_K}\right)^{\sigma};\ K_B = \left(\frac{QB}{H}\right)\left(\frac{\alpha_B * H * C_B(w_{KB}, w_L)}{w_{KB}}\right)^{\sigma} \quad (33)$$

For the calibration, following values are used for endowments and wages: *KE=0,184*, *KD=0,316*, *LE=0,125*, *LD=0,375*, *WK=1*, *WL=1* and *WKB=1*. Calibration of the biofuel sector parameters is similar to other sectors, but the calibration varies between scenarios. This is due to different assumptions about land and labor parameters between scenarios and it results in different parameter values. When distribution parameters are known, sector efficiency parameters can then be directly derived from the production functions as:

$$F = E * (\alpha_E\ {K_E}^{\rho} + (1 - \alpha_E)\ {L_E}^{\rho})^{\frac{-1}{\rho}}$$

$$G = D * (\alpha_D\ {K_D}^{\rho} + (1 - \alpha_D)\ {L_D}^{\rho})^{\frac{-1}{\rho}} \quad (34)$$

Parameters for domestic and export sectors are shown in Table 22 below. Parameters for biofuel sector are given with each scenario, because they need to be calibrated according to applicable production assumptions.

Table 22. Production function parameters, export and domestic sector

Distribution parameters	
α_E	0,954
α_D	0,134
Efficiency parameters	
F	1,976
G	1,925

6.2.7 Total supply function parameters

Total supply function (1) was presented earlier and it is written as:

$$Q_S = F(M, D, \sigma_Q) = (\alpha_Q\ M^{\rho_Q} + (1 - \alpha_Q) D^{\rho_Q})^{\frac{1}{\rho_Q}}$$

Calibration of CES supply function parameters is similar to that of sectoral production functions. Exponent parameter was defined in (2) and import substitution distribution parameter is calibrated as:

$$\alpha_Q = \frac{P^M * M^{\left(\frac{1}{\sigma_Q}\right)}}{P^M * M^{\left(\frac{1}{\sigma_Q}\right)} + P^D * DS^{\left(\frac{1}{\sigma_Q}\right)}} \quad (35)$$

Import substitution scale coefficient is derived from (1) similar to (35):

$$SC = Q_S(\alpha_Q \, M^{\rho_Q} + (1 - \alpha_Q) D^{\rho_Q})^{\frac{-1}{\rho_Q}} \quad (36)$$

Import substitution elasticity, σ_Q, is assumed to be 2, following Devarajan et al. (1990). According to equation (2), import substitution value of 2 leads to exponent parameter with value of -0,5. Total supply function parameters are shown in Table 23 below.

Table 23. Total supply function parameters

Import substitution distribution parameter	α_Q	0,459
Import substitution scale coefficient	SC	1,987
Import substitution elasticity	σ_Q	2
Import substitution exponent parameter	ρ_Q	-0,5

6.3 Solving the model: results and interpretation

6.3.1 Scenarios and results

The 1-2-3-4 CGE model is solved in 4 scenarios that differ from each other by the amount of new land that is taken under the cultivation and also by the structure of biofuel production. Land allocated to produce biofuels comes either from unused land – referring to land free for cultivation according to Aquastat (2014) and FAOSTAT (2014) – or from land that is already used for production in existing sectors. The amount of land needed for biofuels production was calculated in section 6.2.1 and the amount is held fixed in all scenarios. In scenarios 1 and 3 all the land needed for biofuels comes from unused land, which means that the other sectors will not suffer from losing the land, and in scenarios 2 and 4 half of the land needed comes from unused land and half from already used land. The positive resource (land) shock is thus stronger in scenarios 1 and 3.

Total amount of labor in Ghana's economy is held fixed in all scenarios. In scenarios 1 and 2 the production of biofuels is assumed to be carried out by large-scale farms. In other words, the established biofuel sector is land-abundant, it requires lesser labor due and uses better technology

and more capital. In scenarios 3 and 4 the production is assumed to be carried out by small-scale farms that can enter into contract farming deals. This means that biofuel production is labor-intensive in scenarios 3-4. Production requires less technology and capital, and more labor per hectare.

Table 24 provides a description of the model scenarios regarding biofuel sector's production structure, land assumption and shock in factor markets. Table 25 presents the model results for all four scenarios. It shows changes of endogenous variables both in absolute and in percentage terms. Biofuel sector's production function parameters are also shown for each scenario. Analysis of the results is done so that scenarios 1 and 2 are compared to 3 and 4. This choice is natural and it is based on the different biofuel production structures of the scenario pairs, and on the assumptions of new land that are similar in scenarios 1 and 3 (100% unused land), and in 2 and 4 (50% unused land).

Table 24. Scenario descriptions

	Scenario 1.	Scenario 2.	Scenario 3.	Scenario 4.
Biofuel sector production structure	- Biofuels are produced by land-intensive large-scale farms. This implies that value share of land is higher than value share of labor in biofuel sector. Production structure is similar to traditional exports.	- Biofuels are produced by land-intensive large-scale farms. This implies that value share of land is higher than value share of labor in biofuel sector. Production structure is similar to traditional exports.	- Biofuels are produced by labor-intensive outgrower schemes and small-scale farms. This implies that value share of labor is higher than value share of land in biofuel sector. Production structure is similar to traditional domestics.	- Biofuels are produced by labor-intensive outgrower schemes and small-scale farms. This implies that value share of labor is higher than value share of land in biofuel sector. Production structure is similar to traditional domestics.
Assumptions regarding land	- 100% of the land required by biofuels (5% of original land stock) comes from unused land stock. This indicates a larger positive resource shock than in scenarios 2 and 4.	- 50% of the land required by biofuels (5% of original land stock) comes from unused land stock. This indicates a smaller positive resource shock than in scenarios 1 and 3.	- 100% of the land required by biofuels (5% of original land stock) comes from unused land stock. This indicates a larger positive resource shock than in scenarios 2 and 4.	- 50% of the land required by biofuels (5% of original land stock) comes from unused land stock. This indicates a smaller positive resource shock than in scenarios 1 and 3.
Shock in factor markets	- Biofuel sector does not capture land from traditional sectors, all reallocation of original land stock happens between export and domestic sectors and land markets adjust. A share of labor transfers from traditional sectors to biofuel sector and labor markets need to adjust.	- Biofuel sector captures land from traditional sectors, so reallocation of original land stock happens between all three sectors in new equilibrium and land markets adjust. A share of labor transfers from traditional sectors to biofuel sector and labor markets need to adjust.	- Biofuel sector does not capture land from traditional sectors, all reallocation of original land stock happens between export and domestic sectors and land markets adjust. A share of labor transfers from traditional sectors to biofuel sector and labor markets need to adjust.	- Biofuel sector captures land from traditional sectors, so reallocation of original land stock happens between all three sectors in new equilibrium and land markets adjust. A share of labor transfers from traditional sectors to biofuel sector and labor markets need to adjust.
Biofuel distribution parameter (αB)	0,979	0,979	0,154	0,154
Biofuel productivity parameter (H)	1,776	1,776	1,937	1,937

Table 25. 1-2-3-4 model results

			Scenario 1.			Scenario 2.			Scenario 3.			Scenario 4.		
		Base: 2010	Current	Change	Change (%)	Current	Change	Change (%)	Current	Change	Change (%)	Current	Change	Change (%)
E	Traditional Exports	0,309	0,303	-0,005	-1,76 %	0,285	-0,024	-7,64 %	0,307	-0,002	-0,70 %	0,289	-0,020	-6,45 %
M	Imports	0,499	0,538	0,039	7,85 %	0,518	0,020	3,95 %	0,553	0,054	10,90 %	0,535	0,036	7,22 %
DS	Supply of domestic good	0,691	0,679	-0,012	-1,79 %	0,685	-0,006	-0,86 %	0,662	-0,029	-4,15 %	0,669	-0,022	-3,23 %
DD	Demand for domestic good	0,691	0,679	-0,012	-1,79 %	0,685	-0,006	-0,86 %	0,662	-0,029	-4,15 %	0,669	-0,022	-3,23 %
QS	Absorption	1,190	1,216	0,026	2,19 %	1,203	0,014	1,14 %	1,214	0,024	2,03 %	1,203	0,013	1,08 %
QD	Demand for composite good	1,190	1,216	0,026	2,19 %	1,203	0,014	1,14 %	1,214	0,024	2,03 %	1,203	0,013	1,08 %
PE	Domestic price of export good	1,000	1,000	0,000	0,00 %	1,000	0,000	0,00 %	1,000	0,000	0,00 %	1,000	0,000	0,00 %
PM	Domestic price of import good	1,000	1,000	0,000	0,00 %	1,000	0,000	0,00 %	1,000	0,000	0,00 %	1,000	0,000	0,00 %
PD	Producer price of domestic good	1,000	1,048	0,048	4,79 %	1,024	0,024	2,40 %	1,076	0,076	7,57 %	1,053	0,053	5,26 %
PT	Sales price of composite good	1,045	1,073	0,029	2,73 %	1,059	0,014	1,38 %	1,089	0,044	4,26 %	1,076	0,031	2,99 %
PQ	Price of composite good	1,000	1,027	0,027	2,73 %	1,014	0,014	1,38 %	1,043	0,043	4,26 %	1,030	0,030	2,99 %
R	Exchange rate (Numeraire)	1,000	1,000	0,000	0,00 %	1,000	0,000	0,00 %	1,000	0,000	0,00 %	1,000	0,000	0,00 %
T	Tax revenue	0,150	0,159	0,009	5,87 %	0,154	0,004	2,98 %	0,162	0,012	7,75 %	0,157	0,008	5,05 %
SG	Government savings	0,002	0,006	0,004	209,28 %	0,004	0,002	106,54 %	0,006	0,004	218,04 %	0,004	0,002	122,69 %
Y	Total income	1,114	1,172	0,058	5,18 %	1,143	0,029	2,64 %	1,188	0,074	6,65 %	1,162	0,048	4,29 %
C	Private consumption	0,791	0,810	0,019	2,39 %	0,801	0,010	1,24 %	0,809	0,018	2,29 %	0,801	0,010	1,26 %
S	Aggregate savings	0,305	0,321	0,016	5,25 %	0,313	0,008	2,67 %	0,325	0,020	6,41 %	0,317	0,012	4,02 %
Z	Aggregate real investment	0,292	0,299	0,007	2,45 %	0,296	0,004	1,28 %	0,298	0,006	2,06 %	0,295	0,003	1,00 %
WK	Return to land	1,000	0,861	-0,139	-13,93 %	0,930	-0,070	-7,01 %	0,781	-0,219	-21,87 %	0,847	-0,153	-15,28 %
WL	Wage in all sectors	1,000	1,208	0,208	20,84 %	1,104	0,104	10,40 %	1,330	0,330	33,03 %	1,229	0,229	22,91 %
KE	Land used to produce Exports	0,184	0,183	-0,001	-0,28 %	0,171	-0,013	-6,97 %	0,187	0,003	1,78 %	0,175	-0,009	-4,89 %
LE	Labor used to produce Exports	0,125	0,120	-0,005	-3,60 %	0,114	-0,011	-8,55 %	0,121	-0,004	-3,50 %	0,115	-0,010	-8,36 %
KD	Land used to produce Domestics	0,316	0,317	0,001	0,16 %	0,316	0,000	0,10 %	0,313	-0,003	-1,03 %	0,313	-0,004	-1,11 %
LD	Labor used to produce Domestics	0,375	0,363	-0,012	-3,18 %	0,369	-0,006	-1,61 %	0,352	-0,023	-6,16 %	0,357	-0,018	-4,72 %
Walras	Walras' law	0,000	0,000	0,000	-	0,000	0,000	-	0,000	0,000	-	0,000	0,000	-
KB	Land used to produce Biofuels	0,000	0,025	0,025	-	0,025	0,025	-	0,025	0,025	-	0,025	0,025	-
LB	Labor used to produce Biofuels	0,000	0,016	0,016	-	0,017	0,017	-	0,027	0,027	-	0,028	0,028	-
WKB	Return to land in Biofuels	0,000	0,861	0,861	-	0,930	0,930	-	0,622	0,622	-	0,735	0,735	-
PB	Domestic price of biofuels	0,000	1,000	0,000	-	1,000	0,000	-	1,000	0,000	-	1,000	0,000	-
QB	Biofuel production	0,000	0,041	0,041	-	0,042	0,042	-	0,052	0,052	-	0,053	0,053	-
ϕ	Trade balance	0,674	0,698	0,024	3,51 %	0,687	0,012	1,84 %	0,706	0,032	4,75 %	0,696	0,022	3,25 %
αB	Biofuel distribution parameter	0	0,979			0,979			0,154			0,154		
H	Biofuel productivity parameter	0	1,776			1,776			1,937			1,937		

6.3.2 General interpretation of results

Ghana and consumers are better off in all scenarios 1-4. This is a natural result because Ghana's production possibility frontier expands due to increasing land stock between base year and current year. In scenarios 1 and 3 increases in private consumption and in total income are strongest. This is also an expected result because in these scenarios it is assumed that all the land for biofuels comes from unused land and hence, the increase in land stock is also greater than in scenarios 2 and 4, where 50% of the land required by biofuels is taken from existing sectors. It results from the larger resource shock and as such it is not surprising and does not offer that much of value about the impacts of biofuel sector establishment. Looking at the values of *QS* (CES utility function) reveals the same thing as private consumption values: welfare increase is strongest in scenarios 1 and 3 due to larger resource shock, and scenarios 1-2 yield mildly better welfare (utility) impacts than 3-4.

Growth rates of total income *Y* and private consumption *C* are different from each other in a way that private consumption grows by a lower rate (half or less than half compared to total income) in all scenarios. In scenarios 3 and 4 the gap between growth rates is bigger than in scenarios 1 and 2 where biofuel production is land abundant. It is interesting because in scenarios 3 and 4 the absolute growth in total income is higher compared to 1 and 2 while at the same time the growth in private consumption is smaller in absolute terms. This effect can be partly explained by changes in price of composite good *PQ* and sales price of composite good *PT*. They rise more in scenarios 3 and 4, leading to smaller growth in private consumption that is measured as real consumption.

Factor returns react also more in scenarios 3 and 4 compared to 1 and 2. In all scenarios wages increase in Ghana's economy while return to land decreases, but in scenarios 3 and 4 both effects are stronger. The reason lies in the biofuel sector's production structure: as the biofuel production is labor abundant and still requires as much as land in scenarios 1 and 2, it results in more production factors being drawn away from existing sectors. This could be interpreted as tightening competition in labor markets resulting in increasing negotiation power of employees.

Results regarding Ghana's trade balance are similar in all scenarios when it comes to direction of movement. Traditional exports decrease more in the first two scenarios compared to the latter two, and production of the domestic good (demand as well) suffers a larger decrease in scenarios 3 and 4 compared to 1 and 2. Different movement magnitudes can be explained by the production assumptions of biofuel sector: in scenarios 1 and 2 production is land-intensive and requires less labor and therefore it affects more to land-intensive export sector. And vice versa, in scenarios 3

and 4 biofuel production is labor-intensive and it affects more labor-intensive domestic sector. Imports increase in all scenarios but the increase is stronger in scenarios 3 and 4.

Overall the demand for composite good is slightly higher in scenarios 1 and 2 compared to 3 and 4, but in scenarios 3 and 4 total exports (biofuels included) increase more. This leads to higher appreciation in real exchange rate in scenarios 3 and 4 compared to 1 and 2, and it can also be seen in the increases of domestic price of composite good and producers' price of domestic good. Domestic price of imported good and domestic price of exported good are fixed due to model composition (world prices and tariffs remain the constant) and therefore they remain the same.

From the Table 25 (results) one can see that *Walras* variable stays in zero in all the scenarios. It confirms that Walras' law is satisfied and that there are no leakages in the model.

By looking at the growth in private consumption that the 1-2-3-4 model maximizes, scenarios 1 and 2 seem to be preferable compared to 3 and 4. But the difference is very small and before telling which form of FDIs to prefer – large-scale farms or outgrower schemes – one should look at other impacts as well. Aggregate real investment increases more in scenarios 1 and 2 whereas aggregate savings, government tax revenue and government savings increase more in scenarios 3 and 4. The difference between impacts on real investment and total savings is explained by the higher sales price in scenarios 3 and 4. Thus, real investment activity in Ghana increases more in scenarios 1 and 2.

6.3.3 Resources: land and labor

The effect of new biofuel sector in other sectors can be seen in their changes of input use. In scenarios 1 and 3 the effect of biofuel sector covers mainly labor, because no land is acquired from domestic or export sector. In terms of land usage, traditional export suffers a greater loss of its land in scenarios 1 and 2 compared to 3 and 4 (in fact, K_E increases slightly in scenario 3 and K_D increases slightly in 1 and 2). This is partly due to the similarity of biofuel and traditional export sector. Because they are both land-intensive in scenarios 1 and 2, the impact on land use is strongest in traditional exports. However, this effect arises also partly due to model composition and the partial substitutability between domestic and import goods.

In scenarios 3 and 4 biofuel sector is composed of outgrower schemes and smaller farms that are labor-intensive. The domestic sector is thus affected slightly more than in the first two scenarios and it actually happens in scenario 3 that land used in export sector grows slightly by the amount that

domestic sector decreases. But in scenario 4 it is traditional export sector that suffers a greater loss of land input compared to domestic sector.

Changes in labor endowments in the domestic and traditional export sector follow the changes in land endowments. The strongest impacts in percentage terms can be seen in export sector in all scenarios except 3. In addition, the decrease of labor demand in domestic and export sector in total is greater in the last two scenarios. This is because biofuel sector is assumed to be labor-intensive in those.

One can see that the wage increase in this model results from increasing labor demand rather than from higher wages paid by foreigners. This result is in line with literature and empirical results that were discussed in subsection 3.2.1. And with the 1-2-3-4 model assumptions that are used here, higher wages paid by foreign investors are not possible because of the assumed same wage for all sectors.

The decrease in return to land occurs because of the positive land resource shock: it increases the amount of total land stock (production) in Ghana and leads to depreciation in land's value. This is visible in land's value share that decreases in all scenarios: as there is more land available but the amount of labor is fixed, marginal product of labor increases and marginal product of land decreases. One could also consider this as a positive supply shock that decreases prices. Due to higher decrease in return to land in scenarios 3 and 4, the drop in land's value share is also higher in those scenarios. As land's value share decreases in all scenarios, labor's value share increases. Value shares of land and labor are shown in Table 26 below.

Table 26. Value shares of land and labor by sectors

			Scenario 1.			**Scenario 2.**		
		Base: 2010	Current	Change	Change (%)	Current	Change	Change (%)
θKE	Exports value share of land	0,595	0,520	-0,075	-12,63 %	0,558	-0,038	-6,33 %
θLE	Exports value share of labor	0,405	0,480	0,075	18,58 %	0,442	0,038	9,32 %
θKD	Domestics value share of land	0,457	0,383	-0,074	-16,23 %	0,419	-0,038	-8,31 %
θLD	Domestics value share of labor	0,543	0,617	0,074	13,69 %	0,581	0,038	7,01 %
θKB	Biofuels value share of land	-	0,520	-	-	0,558	-	-
θLB	Biofuels value share of labor	-	0,480	-	-	0,442	-	-
			Scenario 3.			**Scenario 4.**		
		Base: 2010	Current	Change	Change (%)	Current	Change	Change (%)
θKE	Exports value share of land	0,595	0,477	-0,119	-19,91 %	0,513	-0,083	-13,87 %
θLE	Exports value share of labor	0,405	0,523	0,119	29,29 %	0,487	0,083	20,40 %
θKD	Domestics value share of land	0,457	0,343	-0,114	-25,00 %	0,376	-0,081	-17,75 %
θLD	Domestics value share of labor	0,543	0,657	0,114	21,08 %	0,624	0,081	14,97 %
θKB	Biofuels value share of land	-	0,299	-	-	0,347	-	-
θLB	Biofuels value share of labor	-	0,701	-	-	0,653	-	-

It is important to consider what the difference between impacts on factor returns indicates for developing countries. Remembering that outgrower schemes have been commonly preferred to large-scale farms and outgrower schemes tend to provide more favorable results for local farmers (section 3.2 earlier), scenarios 3 and 4 seem to provide similar results when looking at wages. However, less beneficial private consumption reaction to biofuel establishment shock in scenarios 3 and 4 indicates that the impact of outgrower schemes may not be that much more beneficial in terms of welfare improvement compared to large-scale farms.

Yet, outgrower schemes may still be more favorable to locals in reality, when we consider Ghana's ownership structure regarding agricultural land. Most of the land in Ghana is under informal ownership and as we have learned, this creates problems in agricultural land acquisitions. Based on empirical evidence, it could be assumed that locals would lose some of their land without a proper consideration in case of large-scale FDIs. In the model it would mean that a share of factor income *WK* and *WKB* would be lost from private consumers' perspective in scenarios 1 and 2. At the same time outgrower schemes imply that return to land in biofuel sector would still belong to locals in scenarios 3 and 4 by assumption. This might change the balance in favor of scenarios 3 and 4 despite the fact that return to land decreases more in these scenarios.

However, contract farming partnerships with foreign investors include typically assistance to locals. The assistance can be for example, capital, technological know-how, market access and other services. So even though small-scale farmers would be left with the return to land in scenarios 3 and 4, there should be payments to foreign investors to compensate for their contribution. This would reduce the revenues received by households and hence, by looking only at wages and return to land it is hard to say what the utmost impact on locals' welfare is. More accurate results about the real impacts on households in the context of 1-2-3-4 would require more accurate estimates about wage effects, employment terms and contract farming conditions. Then it could be possible to adjust the 1-2-3-4 model to better reflect reality. Now the model rather shows aggregate impacts on economy without including the problems and effects of land grabs and questionable transactions with locals.

6.3.4 Trade and exchange rate

Trade balance variable shows that Ghana's trade balance improves in all scenarios which is another expected result due to positive results shock. The improvement is higher in the latter two scenarios. Because world prices for all tradable goods are fixed in the model, the improvement in trade balance results directly from changes in export and import volumes. Trade balance variable also indicates an improvement in Ghana's *terms of trade* ratio that describes total value of exports

compared to total value of imports. While nominal exchange rate remains the same as *R=1*, because of being numeraire, the improvement in country's trade balance can be seen as "relieving foreign exchange constraints".[73] Because current account balance is fixed, the model does not allow turning the current account balance to positive due to trade effects.

Table 27 shows a breakdown of impacts on exports in the model. Total exports increase in all scenarios, as expected, and traditional exports decrease in all. It is interesting to note that even though biofuel production is higher in scenarios 3 and 4, traditional exports decrease less in those compared to 1 and 2. This originates from the labor-intensive production structure in scenarios 3 and 4, and it could also imply that favoring outgrower schemes as form of FDIs can be reasonable.

Table 27. Export impacts

			Scenario 1.			**Scenario 2.**		
		Base: 2010	Current	Change	Change (%)	Current	Change	Change (%)
E	Traditional Exports	0,309	0,303	-0,005	-1,76 %	0,285	-0,024	-7,64 %
QB	Biofuel production	0,000	0,041	0,041	-	0,042	0,042	-
	Total exports	**0,309**	**0,345**	**0,036**	**11,63 %**	**0,327**	**0,018**	**5,86 %**
			Scenario 3.			**Scenario 4.**		
		Base: 2010	Current	Change	Change (%)	Current	Change	Change (%)
E	Traditional Exports	0,309	0,307	-0,002	-0,70 %	0,289	-0,020	-6,45 %
QB	Biofuel production	0,000	0,052	0,052	-	0,053	0,053	-
	Total exports	**0,309**	**0,359**	**0,050**	**16,17 %**	**0,342**	**0,033**	**10,70 %**

The impact of biofuel sector's composition (land- or labor-intensive) can also be seen in the increases of imports and domestic prices. Imports increase and domestic good production decrease more in 3 and 4 compared to 1 and 2. However, domestic prices of composite good and domestic good (producer price) increase more in scenarios 3 and 4, induced by the wage increase due to higher labor demand. This leads to appreciating real exchange rate, although the result is different from the traditional 1-2-3 CGE model, where appreciation of real exchange rate is usually connected to increased demand for both imported and domestic good.

Improvement in Ghana's terms of trade can also be seen by looking at *Paasche's* and *Laspeyres*' indexes described in Reinsdorf (2010). *Paasche price index* describes relative price change between periods, here between base year and current year. When *'0'* denotes base year value, Paasche price index is written as:

$$PDP = \frac{P^D * D}{P^{D0} * D}$$

[73] Arndt et al. (2010).

Laspeyres volume index for GDP between base year and current year, where GDP equals to domestic absorption adjusted with balance of trade (exports minus imports), is given by:

$$V(GDP)^{Laspeyres} = \frac{P^{D0}*D+P^{E0}*E+P^{B0}*QB-P^{M0}*M}{P^{D0}*D0+P^{E0}*E0+P^{B0}*QB0-P^{M0}*M0}$$

Laspeyres volume index for GDI (gross domestic income) is written as:

$$V(GDI)^{Laspeyres} = \frac{(P^{D0}*D+P^{E0}*E+P^{B0}*QB-P^{M0}*M)/PDP}{P^{D0}*D0+P^{E0}*E0+P^{B0}*QB0-P^{M0}*M0}$$

Dividing volume index for GDI by volume index for GDP yields *trading gains index*. From Table 28 below one can see the same result that is given by balance of trade coefficient: trading gains index has a higher value in scenarios 3 and 4 compared to 1 and 2, implying that labor-intensive biofuel production establishment yields more favorable terms of trade results.

Table 28. Laspeyres and Paasche indexes

		Scenario 1.	Scenario 2.	Scenario 3.	Scenario 4.
PDP	Paasche price index	1,048	1,024	1,076	1,053
V(GDP)	Laspeyres volume index of GDP	0,969	0,985	0,934	0,950
V(GDI)	Laspeyres volume index for GDI	0,987	0,994	0,961	0,969
	Trading gains index = V(GDI)/V(GDP)	1,018	1,009	1,029	1,020

Source: Index equations from Reinsdorf (2010)

Finally, Table 29 provides 1-2-3-4 model results in a summary table. Main results of the model are categorized in six groups and the table presents differences in the volumes of changes in selected variables between scenario groups “1-2” and “3-4”, without quantifying.

Table 29. 1-2-3-4 model results summary

	Scenario 1.	Scenario 2.	Scenario 3.	Scenario 4.
Description	- Biofuels land-intensive, 100% of land from unused land stock.	- Biofuels land-intensive, 50% land from unused land stock.	- Biofuels labor-intensive, 100% land from unused land stock.	- Biofuels labor-intensive, 50% land from unused land stock.
Welfare	- Private consumption increases slightly (+), total income increases (-) and welfare increases in terms of QS (+).	- Private consumption increases slightly (+), total income increases (-) and welfare increases in terms of QS (+).	- Private consumption increases slightly (-), total income increases (+) and welfare increases in terms of QS (-).	- Private consumption increases slightly (-), total income increases (+) and welfare increases in terms of QS (-).
Factor markets	- Wage increases (-), return to land decreases in traditional sectors and biofuel sector (-). Value share of land decreases (-) in traditional sectors and value share of labor increases (-).	- Wage increases (-), return to land decreases in traditional sectors and biofuel sector (-). Value share of land decreases (-) in traditional sectors and value share of labor increases (-).	- Wage increases (+), return to land decreases in traditional sectors and biofuel sector (+). Value share of land decreases (+) in traditional sectors and value share of labor increases (+).	- Wage increases (+), return to land decreases in traditional sectors and biofuel sector (+). Value share of land decreases (+) in traditional sectors and value share of labor increases (+).
Trade	- Total exports increase (-), traditional exports decrease (+) and imports increase (-). Trade balance improves (-).	- Total exports increase (-), traditional exports decrease plenty (+) and imports increase (-). Trade balance improves (-).	- Total exports increase (+), traditional exports decrease (-) and imports increase (+). Trade balance improves (+).	- Total exports increase (+), traditional exports decrease plenty (-) and imports increase (+). Trade balance improves (+).
Prices	- Sales price of composite good and producers' price of domestic good increase (-), real exchange rate appreciates (-).	- Sales price of composite good and producers' price of domestic good increase (-), real exchange rate appreciates (-).	- Sales price of composite good and producers' price of domestic good increase (+), real exchange rate appreciates (+).	- Sales price of composite good and producers' price of domestic good increase (+), real exchange rate appreciates (+).
Savings and investment	- Both savings and investment increase (-) but savings increase more. Savings increase occurs mainly due to increase in private savings, foreign saving fixed.	- Both savings and investment increase (-) but savings increase more. Savings increase occurs mainly due to increase in private savings, foreign saving fixed.	- Both savings and investment increase (+) but savings increase more. Savings increase occurs mainly due to increase in private savings, foreign saving fixed.	- Both savings and investment increase (+) but savings increase more. Savings increase occurs mainly due to increase in private savings, foreign saving fixed.
Government	- Government savings increase (-) and government tax revenue increase (-).	- Government savings increase (-) and government tax revenue increase (-).	- Government savings increase (+) and government tax revenue increase (+).	- Government savings increase (+) and government tax revenue increase (+).

Analysis between scenario pairs "1 -2" and "3-4" is provided:
"(+)" denotes larger relative change compared to other pair
"(-)" denotes smaller relative change compared to other pair

6.4 Modeling issues related to biofuels

Kretschmer and Peterson (2009) argue that studying biofuels with CGE models should take two dimensions into account: first, international perspective and policies supporting biofuels should be taken into account, and second, when analysing biofuels one should concentrate on economy-wide effects rather than impacts on only agriculture and food production. The first dimension is only partly included in the 1-2-3-4 model for Ghana, since there is no specific quota (which would mean *QB* being fixed in the model) and biofuels are subject to export duties. However, *KB* is fixed in all scenarios and that brings the model closer to having quotas in it.

It would be possible to incorporate both of these aspects (quotas and having no export duty on biofuels), but having a quota would bring up other problems. If both *QB* and *KB* were fixed in the model, it would mean that wages could not adjust in the economy. This is because in calibration of the production function parameters all wages are set to equal one, and because the competitive equilibrium is assumed regarding wages, they would have to remain the same. Changing biofuel sector's wage assumption and allowing it biofuel sector's wage to be higher by some percentage would not solve this problem because it would be already incorporated in the biofuel sector's parameter calibration. Removing export duties, though, would not be a problem in the model. It would only require rewriting of particular equations to get rid of the duty on biofuels.

Challenges concerning biofuels in CGE modelling arise with calibration because biofuels are not included in base years of SAMs and CGE models. Biofuels could be analysed with either partial equilibrium (PE) or general equilibrium (GE) models such as CGE models. They both have their ups and downs, PE models allowing for more detailed representation of specific issues and GE models allowing for economy-wide effects. (Kretschmer & Peterson, 2009.) The possibility of having impacts on Ghana's economy at economy-wide level (even though Ghana's economy is very simplified) is the reason why CGE modelling was chosen for use this paper. That enables to look at the impacts of FDIs in a broader perspective.

There are also modelling issues such as modelling direct and indirect land use change, and taking into account environmental impacts. In addition, biofuel trade structure can impose problems to models because there may not exist bilateral trade flows for biofuels. Furthermore, by-products of biofuels should also be incorporated in the models in some way. (Kretschmer & Peterson, 2009.) Regarding the last two issues, the 1-2-3-4 model in this paper contains ways to overcome the issues to some extent. All biofuels are exported – despite Ghana's policy targets which actually aim to

switch biofuels with gasoline and diesel fuels domestically – and this could be seen as illustrating trade structure where biofuels are produced outside EU and then imported there. And also, by-products of jatropha used for biofuel production were briefly touched by looking at how to utilize the non-oil part in electricity production. Thus, one could think that by-products are included in the model through the land requirement.

There are also issues that are specifically related to the 1-2-3-4 model composition and solving it. Due to (partially) competitive equilibrium assumptions wages in all sectors have to be the same and the model does not allow foreign investors paying higher wages. As mentioned in section 6.2, this could be overcome by inserting a coefficient for the biofuel sector to denote the wage premium paid by foreigners. However, for such an approach to be reasonable, one should have reliable data of the expected wage premium. Also, the demand for labor in large-scale farms should be estimated closely.

Further, return to land in biofuel sector (*WKB*) does not reflect reality very well, because households receive all the income from the land even after the biofuel sector is established. It means that the return on investments to foreign investors is left outside the analysis. This would not be a problem, if the sales or lease price of land, or other compensation, would have been fair in the FDI deals. To incorporate the empirical evidence into 1-2-3-4 could be done, for example, by reducing the return to land in biofuel sector by some amount. But again, this would require detailed information about the real compensation prices and methods in land deals. In addition, the decrease in return to land may not describe reality very well. It would be more likely that due to agricultural FDIs the demand for land should increase and push return to land higher (and land rental prices as well). The adaptation of 1-2-3-4 model in this paper describes “optimal” FDI impacts rather than the reality in light of empirical evidence.

Finally, the 1-2-3-4 model scenarios in this study do not focus on the common ways to use 1-2-3 CGE models. World prices are kept fixed and government does not use its policy tools (taxes). It would be perfectly possible to study these shocks with 1-2-3-4 as well, but results would be likely to follow the results from previous 1-2-3 CGE model adaptations.

7 Comparing 1-2-3-4 model results with other studies and Ghana's actual development in 2010-2013

This chapter compares results from the 1-2-3-4 CGE model in Ghana to other studies and Ghana's actual development during period 2010-2013. Ghana's realized development is a good baseline because of the discovery of *Jubilee oil field* in 2007: the discovery expanded energy sector and production substantially and provided a positive resource shock.

7.1 Ghana's development 2010-2013 and oil production rise

Jubilee field was discovered in Ghana in 2007 and oil production started in the field in 2010. In 2009, prior to Jubilee field, the daily oil production in Ghana was 7 000 barrels per day. In 2010 production started and it rose to 8 500 barrels per day, then rapidly climbed up to roughly 78 000 bbl/day in 2011 and further to 99 000 bbl/day in 2013 (US EIA, 2014). The annual amounts of oil production are shown in Table 30 below. Proved (but expected to rise due to latter discoveries) crude oil reserves in Jubilee field are 660 million barrels, and at 2013's annual production rate of 24,4 million barrels the field's reserves would enable roughly 27 years of production.

Table 30. Ghana oil and fuel sector indicators 2009-2013, millions of bbl

	2009	2010	2011	2012	2013
Oil consumption (US EIA)	21,49	23,63	23,73	23,34	24,30
Oil production (US EIA)	2,51	3,09	28,39	29,06	36,20
Fuel exports (WDI) *1	3,96	0,33	66,48	44,74	-
Fuel exports (WDI) *2	4,00	0,33	64,34	42,92	-
Oil exports (BOG) *1	0,00	0,00	26,71	28,34	37,33
Oil exports (BOG) *2	0,00	0,00	25,86	27,19	36,70
Fuel Imports (WDI) *1	3,97	1,35	1,35	4,29	-
Fuel imports (WDI) *2	4,01	1,37	1,31	4,12	-
Oil imports (BOG) *1	24,11	28,29	30,43	31,72	34,11
Oil imports (BOG) *2	24,39	28,87	29,46	30,43	33,54
Road fuel consumption (WDI) *3	11,38	11,61	-	-	-

*1) Calculations based on average annual crude oil price from World Bank (GEM)
*2) Calculations based on annual average OPEC Basket Price
*3) Diesel fuel and gasoline fuel in total

Source: Bank of Ghana (2014), OPEC (2014), US EIA (2014) and World Bank (GEM and WDI 2014),

In the above table there are some things that need to be considered. Bank of Ghana (BOG) notes the oil exports for the first time in its annual report 2011.[74] Before that, only oil imports were recognized. However, according to U.S. Energy Information Administration, Ghana has been producing crude oil around 2,5 million bbl/year already before the discovery of Jubilee field. And

[74] Bank of Ghana annual report 2010 does not note oil exports (Bank of Ghana, 2011a).

World Bank WDI data indicates also that Ghana has been exporting fuels prior to Jubilee field discovery: but in this case 'fuel' has a broader meaning since it comprises all the commodities mentioned in United Nations SITC 3, not just oil.[75]

Based on the oil and fuel sector data, it is clear that a large share of the oil produced in Jubilee field is exported. After 2010, oil consumption has remained relatively stable while oil exports have increased drastically and at the same time oil imports have more or less maintained at the same level. This indicates that oil production has affected Ghana's economy by increasing exports rather than reducing oil imports.

Oil production establishment has positively affected Ghana's economy, although not all the promises about development and prosperity have been met. Job creation of the Jubilee field has been quite small: Hicks (2014) writes that in 2012 the field employed only about 300 people of which 86% were locals. The most direct contribution to Ghana's economy is likely the payments by oil companies made under the *Petroleum Revenue Management Act*: the act allocates a share of the oil money to government and strengthens its budget. 30% of receipts can be saved for future and 70% goes ministry of finance (ibid.).

7.1.1 Ghana's balance of payments development 2010-2013

Appendices 4 and 5 show development in balance of payments 2010-2013 and Ghana's national account development 2010-2013. Between 2010 and 2013 Ghana's oil exports grew from zero to ca. US$ 3,89 billion meanwhile total exports grew 72,76%, from 7,96 to 13,75 billion. Oil exports accounted for around 19% of total exports (goods and services) in 2011, 18% in 2012 and 24% in 2013. This indicates that after the Jubilee field production was launched, oil exports quickly increased total exports and provided a relatively large share of export income. It also means that oil exports accounted for 67% of all the growth in Ghana's exports during the period 2010-2013.

Oil imports also increased during the period but compared to exports the increase was modest in monetary terms: from 2,23 billion in 2010 to 3,55 billion in 2013 (58,79% growth). Total imports grew more than total exports in monetary terms (from US$ 10,92 billion to 17,60 billion) but less in percentage terms, 61,14 %. The growth in both exports and imports fits well in the CGE framework: finding the Jubilee field can be seen as a "resource boom" resulting in increase in export earnings (Devarajan et al. 1997). This should induce an increase in domestic prices and lead to growth in

[75] United Nations Standard International Trade Classification (SITC) 3 includes the following commodities: Mineral fuels, lubricants and related materials: coal, coke, briquettes, petroleum, petroleum products and related materials, gas (natural and manufactured) and electric current. (United Nations Statistics Division, 2014.)

both domestic good (non-tradable) production and imports. Appreciation in real exchange rate should also follow, but this cannot be seen from the balance of payments development.

In reality, Ghana's economy is of course more complex than the very simplistic 1-2-3-4 CGE framework, but one can see similarities in Ghana's development with model's outcomes. The rise in exports and imports is similar to the results found in all scenarios of the 1-2-3-4 model in the previous chapter.

Altogether the current account deficit was growing each year in 2010-2013. According to balance of payment development in Bank of Ghana (2014), current account deficit worsened between 2010 and 2013 by increasing from US$ -2,77 billion to -5,70 billion, yielding the a 105,95% deficit increase. This means that oil sector launch and fast growth in oil exports were not enough to turn Ghana's current account positive.

7.1.2 Ghana's national account development 2010-2013

According to GSS (2014b), gross domestic product increased 48,86% in total between 2010 and 2013 which yields a two-digit average annual growth rate, 14,18%. At the same time national value added output increased even more, totaling to 53,70% increase during the period. When growth rates of private and public consumption are compared, there is an interesting difference between them: public consumption more than doubled during the period by growing 140,04% from US$ 3,33 billion to 8,00 billion. Private consumption instead enjoyed only a moderate growth of 13,15% in total, growing from 25,08 billion to 28,37 billion. However, external debt increased even more than public consumption, ca. 5 billion (79,44%) during the period, indicating that public expenditure growth was financed with debt.

Table 31 shows that the influence of oil receipts in government revenues has been quite small. Government direct revenues from oil have been only 1-3% of total government revenues in 2011-2013 which confirms that only a small share of government revenues growth can be traced back to oil receipts. Hence, the difference between public and private consumption growth rates arises rather because of overall increase in government revenues and worsened fiscal balance: during the period government total revenues and grants increased by 59,55% totaling US$ 9,83 billion in 2013, whereas current expenditure increased by 125,58% totaling 13,765 billion in 2013. Fiscal balance deficit grew 191,19% during the period and it amounted to 6,16 billion in 2013.

Table 31. Government revenues from oil 2011-2013, billions

	2011	2012	2013
Company taxes on oil, GHc	0,000	0,000	0,364
Royalties from oil (other direct taxes), GHc	0,184	0,270	0,267
Contribution to government revenue, GHc	0,184	0,270	0,632
Company taxes on oil, US$	0,000	0,000	0,187
Royalties from oil (other direct taxes), US$	0,122	0,150	0,137
Contribution to government revenue, US$	0,122	0,150	0,324
Share of total government revenue & grants	**1,43 %**	**1,64 %**	**3,30 %**

Source: Bank of Ghana (2011b-e, 2012b-e, 2013a-d)

Comparing Ghana's national account development during the period 2010-2013 with the 1-2-3-4 model results shows that there are similarities. There is a relatively strong growth in both in GDP and government revenues whereas private consumption instead enjoys only a moderate growth compared to them. Ghana's realized public consumption cannot be compared because in the 1-2-3-4 model it was exogenous and held fixed between base and current year. Government tax revenue increase slightly more in percentage terms compared to GDP in the 1-2-3-4 model, and the same happened with Ghana in 2010-2013. Another similarity is that investment growth is slightly lower than GDP growth in both the study results and the realized development: investments increased 39,94% between 2010 and 2013.

One should note that there are differences between Ghana Statistical Service's (GSS) estimates and Bank of Ghana's (BOG) estimates regarding export and import values in balance of payments in period 2010-2013: after 2010 GSS gives larger estimates for exports of goods and services with both World Bank and BOG annual exchange rates (GHC/USD). Using BOG exchange rate yields a smaller difference but it still remains. Residual of the difference could be explained by BOG's choice to present export estimates in f.o.b (free on board) numbers in balance of payments.

Nevertheless, Ghana's national account development in Appendix 4 shows that exports have increased at higher rate than imports: according to Bank of Ghana, exports have grown 71,72% in total, from US$ 9,44 billion in 2010 to 16,21 billion in 2013, whereas imports have grown 60,76% in total, from 14,00 billion to 22,50 billion during the same period. By using GSS numbers, oil exports would have accounted for around 16% of total exports in 2011, 14,9% in 2012 and 19,1% in 2013. These numbers are slightly lower than the ones presented above, due to different export estimates, but they indicate the same role of oil exports behind growth in Ghana's total exports. If GSS estimates would be used for exports growth and then compared to oil sector's impact on growth, almost 40% of the growth in total exports during the period 2010-2013 could be explained

by oil sector establishment. This, even though it is notably smaller than the above estimate of 67%, is a significant contribution to Ghana's export growth.

Finally, there are two things to address while analyzing oil sector's impact on Ghana. We can first compare the value of oil production to Ghana's gross domestic product. From Table 32 below it can be seen that oil production had captured ca. 8% share of the GDP by 2013, starting from around 0,75% in 2010. In the 1-2-3-4 model biofuel sector accounts for ca. 4-5,2% of value added GDP which means that the size of the contribution of biofuel sector in the model is somewhat of the same size as oil sector's contribution to Ghana's economy in 2010-2013.

The other thing to look at is private consumption: this account is very important because the 1-2-3-4 CGE model in the previous chapter is solved by maximizing private consumption and it is an important factor while describing welfare of households. From the national account development (Appendix 4) one can see that of all the bricks of GDP it is private consumption that has increased the least in both absolute and percentage terms. Private consumption growth rate during the period, 13,15%, falls not just behind public consumption but also behind total government revenue (*Total Revenue & Grants* in Appendix 4) that increased by 59,56% during the period 2010-2013. In addition, Table 33 shows that GDP per capita increased 39,53% during the period. This indicates that Ghana's gross domestic production growth has been higher than population growth: annual population growth rate varied between 2,2% and 2,4% in 2010-2012 (World Bank, WDI 2014).

Table 32. GDP and oil production development 2010-2013, US$ billions

	2010	2011	2012	2013	2010-2013
GDP at market prices	32,197	39,613	41,644	47,929	48,86 %
Oil production *1	0,244	2,953	3,052	3,768	1 443 %
Oil production *2	0,239	3,051	3,181	3,833	1 502 %
Oil sector share of GDP *1	0,76 %	7,45 %	7,33 %	7,86 %	
Oil sector share of GDP *2	0,74 %	7,70 %	7,64 %	8,00 %	

*1) Calculations based on average annual crude oil price from World Bank (GEM)
*2) Calculations based on annual average OPEC Basket Price

Source: GSS (2014b), OPEC Basket Price (2014) and World Bank (GEM)

Table 33. GDP per capita development 2010-2013

	2010	2011	2012	2013	2010-2013
GDP per capita, current US$	1 326,07	1 594,03	1 645,52	1 850,20	39,53 %
Annual growth	20,93 %	20,21 %	3,23 %	12,44 %	

Source: World Bank (WDI 2014)

It seems that Ghana has benefitted from Jubilee field and the oil sector's establishment but the impact on people's welfare has been fairly modest. Analysis of the period 2010-2013 shows that

private consumption has been growing only moderately on average. Also, both current account deficit and fiscal account deficit worsened during the period. This indicates that even though the oil sector might have increased the GDP growth rate and exports in Ghana, it may not have increased households' welfare that much. In addition, Ghana's GDP and public consumption growth may not be sustainable because government debt has been increasing.

Finally, Table 34 below shows an approximation of Ghana's welfare development between 2010 and 2013. According to *QS* values, welfare decreased during the period 2010-2013. The estimate is found by calculating value added demands for domestic and imported goods and services as share of value added output, and plotting the values into *QS* Armington function from the 1-2-3-4 model. Because *QS* is a CES utility function, it gives a rough approximation of Ghana's welfare development, but without recognizing distribution of income. However, Ghana's national account development already revealed that private consumption has grown at slower rate compared to public consumption and investments. Taking into account all of this, it is no wonder why Hicks (2014) uses a headline "Ghana struggling to translate oil money into development gains".

Table 34. Ghana's welfare development by Armington function

	2010	2011	2012	2013
Total demand, GHc	52,462	64,434	75,049	93,517
Total demand, USD	36,686	42,672	41,694	47,958
Imports of goods and services, GHc	21,134	29,727	39,773	44,338
Imports of goods and services, USD	14,779	19,687	22,096	22,738
GDP at basis prices, GHc	43,388	55,852	72,587	90,935
GDP at purchaser prices, GHc	46,042	59,816	74,959	93,461
Market price coefficient*	1,061	1,071	1,033	1,028
Consumption of domestics**	0,680	0,580	0,471	0,526
Consumption of imports**	0,459	0,497	0,531	0,474
QS Welfare approximation* **	**1,139**	**1,075**	**0,989**	**0,998**
Exchange rate USD/GHc	1,430	1,510	1,800	1,950

* GDP at purchaser prices / GDP at basis prices
** Value added consumption as a share of value added GDP (basis prices)
*** By utilizing QS equation and its parameters from the 1-2-3-4 model

Source: GSS (2014a-b) and World Bank (WDI 2014)

However, the above is not to say results from the 1-2-3-4 model would be of no use. The 1-2-3-4 model simplifies Ghana's economy and the focus is on agricultural sector and FDIs' impact on it. The overall development in economy is naturally more complex. Oil sector jump start is only one factor influencing Ghana and oil sector's impacts on Ghana's development in 2010-2013 are not the same what development in agricultural sector could have, because agricultural sector is much larger in Ghana.

7.2 FDIs and biofuels in Ghana: Case BioFuel Africa

Although the 1-2-3-4 CGE model for Ghana in the previous chapter derives its basis from draft *Bioenergy policy for Ghana* (Energy Commission, 2010), the establishment of biofuel sector is more than an assumption. Ghana has received many foreign direct investments in agricultural land that have goals in producing biofuels. By 2011, there were 23 (confirmed) projects related to agricultural land acquirements in Ghana, covering an area of 1,33 million hectares in total (Schoneveld, 2011). Foreign companies such as ScanFuel AS[76] and BioFuel Africa Ltd have operated in Ghana (Boamah, 2011). These investors along with many others (mainly foreign biofuel companies) have faced a lot of negative media attention and fears for locals' livelihoods. With regard to media attention and debate on biofuels' and FDIs' impacts, Ghana makes no exception to the on-going debate between "win-win" and "populist" discourses (Boamah, 2011).

BioFuel Africa Ltd can be used as an example. In the beginning of its operations, 2009, locals were hopeful, willing to lease idle land to the company and hoping for it generate new jobs in the area. (ibid.) These sound exactly like the common justifications behind agricultural FDIs and their impacts discussed in section 3.2. Based on a study by an NGO (*Rural Consult Ltd*), BioFuel Africa's operations provided a win-win situation where benefits outweighed the downsides. On the other hand, these results were opposed by writings that blamed the company for taking advantage of (e.g.) communal land ownership. (ibid.) The opposing argument is quite common in literature as well, referring to the risk of locals being exploited and losing their lands without compensation.

Boamah (2011) finds that due to BioFuel Africa's jatropha operations food security improved through job creation, and "petty trading activities" and food production increased. Food security improvement is an example of a possible welfare effect of biofuel related FDIs recognized e.g. by Ewing and Msangi (2009): this effect is quite controversial to more common view where food security is threatened by cash cropping, but it draws from broader working possibilities and higher revenue streams for locals.

At first BioFuel Africa's operations helped to improve economic welfare and security of locals in areas where it operated. But along with negative publicity the company suffered from financing and weather problems. This all led to lay-offs and cutting the operations, of which the result was that many employees had to return their older jobs and less-paid farming. (Boamah, 2011.) This means

[76] ScanFuel AS has changed its name to ScanFarm AS. The company acquired 303 750 ha of land in Ghana and started to cultivate jatropha and produce biofuels in 2008. Jatropha cultivation was ceased and turned into maize and soya cultivation in 2010 due to disappointing jatropha yields. In 2010, the company cultivated and area of only 1500 ha. (Schoneveld, 2011.)

that even though the foreign investor was actually providing benefits and welfare to locals and carrying out the operations the FDI was made for, the business eventually failed. The case is thus different from those FDI experiences (see chapter 3) where land has been acquired for speculative reasons or held idle. This example reveals a problem that foreign investors may not be able to carry out its intended plans, no matter the original intentions. For example, if land would be acquired from existing sectors to biofuel sector and then the investors would fail to use it (or if they would hold it idle) potential gains would not realize in the 1-2-3-4 model either.

An issue regarding FDIs related to biofuels is that their results and real impacts on economies and locals are yet to be seen. There are of course examples to study but many times investors have not started cultivation or they have only started operating on a minor scale compared to the land area acquired. For example, only 10 000 hectares of the acquired 1,075 million hectares by foreign companies in biofuel industry were under cultivation in Ghana by 2010 (Schoneveld et al. 2010). Based on this, it seems that host countries seeking growth and development effects should focus on contracts with investors to avoid long periods during which locals cannot use the land and no jobs are created. This also indicates that the assumptions in the 1-2-3-4 model are not realistic regarding land acquired from other sectors and from unused land stock: market clearing condition for land is not a problem but the model could be more realistic if, for example, a 50% share of the land acquired for biofuel production would not be utilized for production at all.

Still, from the BioFuel example's initial phase we can see that there lies potential in agricultural FDIs and cash cropping, but there are also risks that can completely destroy the potential welfare effects to locals. This is also visible in the next case with Tanzania and *Bioshape*.

7.3 FDIs and biofuels in Tanzania: Case Bioshape

Ghana's development and investments in biofuel sector can be compared to *Bioshape* case in Tanzania that is analyzed in Sulle and Nelson (2013). The case offers valuable insight because it shows the potential of biofuels and cash cropping and also discusses the reasons why the investments failed and what went wrong. According to the authors, Bioshape case is just one of the large-scale biofuels projects and investment that occurred in Tanzania during its "biofuel boom in 2005-2008".

Bioshape Tanzania Ltd. belongs to a Dutch holding company, Bioshape Holding BV. The company initiated its project in Tanzania in 2006 and eventually acquired 34 000 ha of land in 2008 to produce biofuels from jatropha. The company cooperated with Tanzania Investment Centre (TIC)

and Kilwa District where investments took place. The process of acquiring the land is unclear to some extent but it did not follow all the regulations such as Land Act and Village Act.[77] For example, Bioshape gained a formal approval from village and district members but those members did not necessarily understand all impacts of the deal: such would be a transfer from 'village land' to 'general land' which caused communities to lose their customary rights and restrained them from claiming back the land in future. (ibid.)

Valuation process of the acquired land and the decision making process concerning proper compensation to locals was not clear either, but it appears that it did not represent the true opportunity costs or compensate the loss of lands.[78] The total price paid by Bioshape was US$ 676 000 and it was based on a valuation price of $12 per acre. 50% of the price was distributed to the four villages leasing their land (although in these "leases" the villages lost future right to their lands) and 50% was kept by the District Council, causing objections and debate on whether the distribution was appropriate or not. As part of the deal the company promised also to carry out projects like construction and social services in the area. (ibid.)

The price of $12 per acre yields a price $1 200 per hectare. Compared to prices Table 9, it is lower than the average farm land price in Tanzania, $1 900 (Savills, 2012), but still closer to being appropriate compared to usual prices in deals found by Cotula (2011).

7.3.1 Launching operations and economic boost in the area

Bioshape's presence and its operations boosted Kilwa District's economy by increasing demand of both skilled and unskilled workers, and the area draw employees also from outside the area. Company offered attractive benefit packages and high salaries. The increase in employment occurring directly from Bioshape's job creation was quite modest, around 800 workers altogether (according to one estimate), but Bioshape's operations created jobs also indirectly. Housing rents rose sharply which lead to increased activity in building new houses: people wanted to offer housing and office space to the company. Demand for food and services increased, the area attracted visitors and researchers because of Bioshape's operations, and restaurants and guest houses were built. In addition to these, some of the company's promised development projects were carried out. (Sulle & Nelson, 2013.)

Three things should be noticed from above. First, the case could imply materialization of the FDI effect where higher salaries are paid by foreign-owned firms. Second, increase in wages shares

[77] For village land and general land, see p. 4 in Sulle and Nelson (2013).
[78] See p. 15 in Sulle and Nelson (2013) for more precise valuation estimates and their basis.

similarities with the result suggested by the 1-2-3-4 model in chapter 6, although in the model the wage increase occurs only due to higher labor demand. And third, Bioshape case is a good example of relatively broad boost in an area's economy and business activities that could be achieved by FDIs and biofuel establishment in Africa.

7.3.2 Bioshape's bankruptcy and post-investment collapse in the area

Bioshape run its operations in Kilwa for only around one year and by 2009 operations were shut down due to Bioshape's bankruptcy. Four main reasons have been identified behind the failure of the company. First, water and soil conditions were harder and more fluctuating than Bioshape might have prepared for (even though jatropha should be suitable for harsh conditions, dry period turned out to be too rough) and irrigation system was apparently insufficient. Second, Bioshape suffered from negative media attention both in Tanzania and in Netherlands, making it difficult for the company to convince investors and stakeholders. Third, Bioshape faced financing problems because of the global financial crisis and because one of its main shareholders withdrew from the project. Finally, the company's business model was highly risky, requiring vast front-heavy investments and focusing on a newly found and promising, but not very well-known jatropha crop. (Sulle & Nelson, 2013.)

The collapse resulted in losing the benefits that Bioshape had directly and indirectly created ("boom-and-bust"). The sectors and participants who enjoyed the boom were also covered by the downside caused by bust and much of the damage took place in Kilwa area. Villages that had leased their lands to Bioshape were possibly suffering the most. Their unskilled people lost jobs and faced hard times finding new ones compared to more skilled laborers. The company's property was left to rust in the areas where the company had operated and many promised development projects never had time to start. And because village land and was transformed into general land when the deal was made, it prevented villages from redeeming their customary lands back. It seems, though, that the land transfer from village to general did not follow the correct legal process and therefore the villages may have a possibility to regain their lands. (ibid.)

Land tenure models and risk sharing were introduced earlier in section 4.5: sharecropping reduces tenant's risk compared to fixed rent contracts and for landlord it is vice versa. Now would a landlord enter voluntarily into a contract where he or she might both lose land and be left without rental fees or compensation, if the investment or farming of the tenant failed? Obviously, such a deal would not be made. This underlines one major problem related to Tanzania's Bioshape case: "communities not only lose their future expected benefits, but also their land" (ibid.). This problem

concerns the whole Africa in a broader sense. When land is sold or leased, communities or smallholders first face a risk of entering into transactions they do not fully understand or a risk of expropriation of their lands. And second, even if the deal and promised compensation would be fair, locals may still end up losing, if the investment fails or never really starts and locals cannot regain the land for their own purposes.

8 Policy tools and recommendations

In this chapter I present main policy tools and recommendations to enhance agriculture in Africa and to benefit the most from foreign direct investment received. Results of the 1-2-3-4 CGE model are as well as other results discussed earlier are taken into account in the discussion. Tools and recommendations are conditional to host countries' governments and their goals, and it is assumed that governments would have the power of "benevolent dictators", that is, they would have power to introduce reforms and policies and they would be targeting growth and welfare increase in their economies.

8.1 Public investment

One medicine to enhance agriculture in Africa lies in public investment and it is tied to FDIs. Schmidhuber and Bruinsma (2011) estimate that increasing public investments in agriculture by ca. US$ 50 billion a year would be needed to make the world free of hunger by 2025. Although the number is for the whole world, it gives a picture that more public investments are needed. A breakdown of the investments is made into five broad areas: areas needing the investment would be (1) rural infrastructure and market access, (2) developing and conserving natural resources, (3) research, development and extension, (4) rural institutions and (5) expenditures for safety nets.

However, FAO (2012) recognizes that by just increasing the amount of public investment in agriculture the results regarding growth and food security will not be enough. Hence, FAO highlights that the focus should be in ensuring that adequate agricultural investments occur. This is where African countries can turn to foreign investors, since foreign investors can provide capital and technology required for more efficient agriculture. The word "adequate" requires not only amount being sufficient but investments being adequate in terms of their quality as well. Land grabbing investments that do not really enhance locals' welfare or possibilities cannot be included in this scope.

The main point in public investment should be to support all types of infrastructure related to agriculture. This would enable building institutions that would attract the right type of foreign investors and enable FDI inflows and form a link between public investment and effects of FDIs. An interesting example to finance public investment can be borrowed from Collier and Venables (2009): the national funds for depletion of natural resources could be applied to agriculture. For instance, if all land deals made with foreign investors included a compensation paid to national fund, the fund could then be used for the good of the area where the FDI occurs.

8.2 Investment climate and infrastructure

The importance and status of property rights in Africa were discussed in chapter 5. Some argue that they are vital for locals but it is also recognized that improving property rights is not an all-inclusive solution, if legal infrastructure and institutions will not be improved as well. From a policy perspective the property rights are important, at least when their meaning is analyzed from the perspective of option value of land. Von Braun et al. (1989) recognize that land value may rise rapidly, when investments in agricultural land increase and when export crop production expands. This effect follows from the increased demand and competition when land is of a fixed amount in an economy. Without rights to their lands, small-scale landowners could loss the profits from increased land value, when the much needed investments in agriculture occurred.

One can see that the 1-2-3-4 model in chapter for Ghana does not capture the effect of rising land value along with FDI inflows. In fact, the land value can be interpreted to go down because value share of land decreases in all scenarios (marginal product of land decreases). This happens because the model assumes that additional land is brought into production from Ghana's unused or underutilized land stock while the amount labor remains fixed.

If increased public investment in agricultural sector will not be enough to support and promote agriculture in Africa, and private sector does not have the financial resources needed for investments, foreign players are needed. This creates the demand for agricultural FDIs and host countries are responsible for creating the climate, the proper circumstances for FDIs to flow in. For building the adequate climate, World Bank's (2004) policy suggestions are useful: 1) ensuring stability and security, including verifying land and other property rights, 2) improving regulation and taxation, 3) providing functioning infrastructure and financial market institutions and 4) improving labor markets and creating flexible and fair labor regulation.

The four focus areas are based on its viewpoint that "investment climate is central to growth and poverty reduction" (Wolrd Bank, 2004). A definition for a good investment climate is, according to World Bank, such that it "encourages firms to invest by removing unjustified costs, risks and barriers to competition". This definition applies very well to the main issues regarding FDIs in agricultural land in Africa, because foreign investors need a fair playground, but small-scale farmers need it just as well. For example, we have already learned that in case there is a risk for a farmer to lose his or her land when left fallow, the fallow periods are forced to be below the optimal level. And also, if there are barriers for foreign investors to enter into land deals with locals, much needed foreign capital may not flow into African countries. Based on this, it seems that institutions, business and legal infrastructure, and property rights should be essential focus areas for countries seeking to attract the right type of foreign investors.

Yet, empirical evidence shows that investors require functional business climate but at the same time it is also weak land governance and tenure security that attract investors (Arezki et al. 2011). Naturally, a country seeking for FDIs that would positively contribute their economies should not worry about this. Now FAO (2012) finds that the elements of good governance needed for overall investments are exactly the same elements that agriculture needs.[79] However, taking into account history of FDIs and remembering where the term land grabbing has originated from, it is no surprise that World Bank (2007) puts it as: "In many countries, land administration is one of the most corrupt public services." If the corruption cannot be overcome and if the legal infrastructure in Africa cannot be improved, the welfare improvements from FDIs are not likely to materialize from smallholders' perspective.

By having well-functioning *land rental markets* (World Bank, 2007) or *land banks* (Aryeetey & Udry, 2010), countries could ensure that land is transferred to those parties who can use it most efficiently. To meet the criteria of mutually beneficial transactions the participation of these markets or banks need to be voluntary and the systems require respect of property rights. World Bank (2007) discusses this as ensuring access to land in form of rentals or sales. Furthermore, World Bank recognizes land sales markets also as way to strengthen land's role as collateral – although land as collateral is a controversial topic and although credit markets are lacking in many parts of Africa, being able to use land as collateral should enable smallholders and communities to receive credit easier. And being able to receive credits easier (more possibilities where to lend from and better

[79] FAO (2012) shows a correlation between Worldwide Governance Indicator for Rule of Law and agricultural capital stock per worker. Even though correlation does not automatically imply dependence between variables, FAO argues that the relationship suggest that agriculture needs the same good governance as other sectors.

terms) might allow locals to negotiate better deals with foreign investors. Locals would have more opportunities and that should provide them with more negotiation power.

With respect to this, Miller et al. (2010) write about agricultural investment funds for developing countries being developed fast. These funds target small and medium size agricultural enterprises and smallholders. If land banks can be seen as developing common markets for land, investment funds for agriculture could be seen as providing a new type common source of finance for land investments.

Bringing in FDIs and investors could also have a positive impact regarding infrastructure and market access which could enhance the overall business infrastructure in a particular area and not only for the contract farmers. Because governments may not have resources needed to build infrastructure and provide public investments in agriculture, large-scale and mechanized farms can be one way to address the problem. Even though large-scale FDIs can be favored with this respect, it does not exclude having also outgrower schemes. Also, the example of Bioshape in section 7.3 shows that along with the presence of FDIs, development of infrastructure can be done by locals as well (new houses were built and new business arose around the FDI thus revitalizing business environment).

8.3 Capital, technology and spillovers

Turning to foreign investors can help to close or narrow the "potential-actual yield gap" in agriculture (Nkonya et al. 2012). This refers to the same idea that was discussed already earlier with names like *idea gap* and *object gap* and this is recognized by many in literature. In policy, the balance should be found between providing foreign investors an incentive to close the gap and make profits by doing so, and at the same secure that locals benefit from technology, capital and market access provided by foreign investors. To achieve spillover benefits host countries must allow foreign investors' presence.

FDIs can act as a source of financing and that way they can help African countries to close their savings gap (OECD-ILO, 2008; Liu, 2008). This applies both to large-scale FDIs and contract farming. While part of this role of investors can be to provide credit, another is to provide technology and know-how. Taking into account the potential of big farms and large-scale FDIs, host countries should not target only FDIs as outgrower schemes, even though their direct job creation may be stronger. This is argued by e.g. Arndt et al. (2010). When it comes to biofuels,

Arndt et al. also point out that reliance on solely outgrower schemes providing the feedstock crop may not be reliable enough from investors' point of view.

World Bank (2007) argues that productivity in food staples is the key behind development. This goes well in line with the findings of FDI impacts on host countries in chapter 3. Technology and productivity spillovers as well as closing the capital gap can be ways to enhance the productivity in staple crops. Thus, cash crops should not be seen only as a threat to food production but also as an opportunity to raise food sector's productivity due to technology spillovers. And based on Udry and Anagol (2006) return to capital and technology can be high in Africa – this should provide a proper incentive to investors to bring in capital flows to Africa.

A balance between outgrower schemes and large-scale FDIs seems ideal appropriate from host countries' point of view. A potential way to secure that both types of FDIs occur might be to require a certain amount or share of FDIs to be carried out as outgrower schemes. Denying large-scale farms might make a country unattractive for investors.

8.4 Joint ventures and more inclusive business relationships

Based on examples of FDI impacts in previous chapter it seems that the positive host country impacts are tied with investors' success in the long-run, and with also the quality of property rights and governance. This leads to demand for more inclusive business models and FDIs that actually involve locals, argued by e.g. FAO (2012). If locals lose their access to resources and livelihoods, FDIs will not provide the growth boost in agriculture that many African countries are trying to achieve. In case of a plain land purchase and in the light of recent studies it seems very unlikely for the acquisition to yield positive host country impacts, if the land has been used by small-scale farmers or for some other purpose by communities (ibid.).

Many others write about the same thing as FAO: for example, joint ventures and outgrower schemes are examples that can share the same goal as more inclusive business models. Involving locals more, building relationships based on cooperation and having deeper partnerships should be strived for. This comes down to basics of economics and could be seen as both parties of the deal utilizing their comparative advantages – the comparative advantage of local communities or smallholders would be the land they are holding and labor they can provide, whereas foreign investor would have a comparative advantage in the amount of capital and technological know-how. With trade between these parties both should be better off than without it.

Von Braun et al. (1989) argue that joint operations and development is needed in rural areas to achieve welfare effects for poor. This is related to diversification into cash crops and gains from specialization. Arndt et al. (2010) also highlight the importance of "mixed investment strategy" where contract farming should not be forgotten because it can engage small-scale farmers in production and tends to create more jobs.

An interesting addition to why host countries should provide an appropriate infrastructure and environment for outgrower schemes can be seen in Basu (1997) and Ray (1998). They argue that because there is shortage of capital (and if public investment and FDIs cannot completely help it), labor-intensive outgrower schemes can compensate the lack of capital and that way small-scale farms can improve their yield per acre. Related to compensating capital shortage with labor, Carletto et al. (2009) point out that "resource-poor smallholders can have a comparative advantage in cash crops ("NTX")[80] production through substantial cost savings as labor-intensive production processes can absorb abundant family labor at below market price".

Strasberg et al. (2002) discuss joint venture companies (JVCs) from domestic perspective but there is no reason why JVCs with foreign investors could not provide the same benefits. Of course, given Africa's weak rule of law and property rights, beneficial JVCs require government administration. African countries should also study, if JVCs could be combined with land banks: locals and communities could register and signal that they would be willing to enter into JVCs with foreign investors regarding some part of their land. Strasberg et al. (2002) also recommend that both locals and organizations (civil society organizations or government) should concentrate on building mutually beneficial and more meaningful relationships with investors.

An interesting option to look at could also be joint ventures directly with governments: taking into account investor's preferences and targets, governments could help in planning the investment and securing that land leases do not harm the areas but rather boost their economic environment. That might also help to overcome the possible food production decreases because governments could take their food policies into account.

African FDI recipient countries could also investigate a rule applied in Democratic Republic of Congo. DRC has a rule according to which foreign investors are required to team up with a local citizen in order to be allowed to acquire agricultural land. In DRC's system local must own a minimum of 51% of the company in question. (Nkonya et al. 2012.) Similar systems could be

[80] NTX refers to non-traditional agricultural export, i.e. exported cash crops.

potential and bring locals' and investors' goals and needs closer to each other and provide protection for locals in land deals.

8.5 Cash crops

Adoption of non-traditional export crops is one way stimulate agricultural sector and create employment directly on farms and indirectly via forward and backward linkages (von Braun et al. 1989). Biofuel feedstock crops such as sugar cane and jatropha are natural solutions in the context of this paper. Even though food security issues can easily arise because of shifting production towards exported non-food crops, blaming cash crops from harming food security should not be taken for granted. For example, von Braun et al. (1989) find that higher level of adoption in exported cash crop production results in higher food crop yields (maize), even when input factors are controlled. The authors also argue that export crops and subsistence crops are closer to complementary than competitive. Additionally, Strasberg et al. (1999) as well as Ewing and Msangi (2009) have found that cash crops and food production share synergies with each other. Spillover effects can arise e.g. through fertilizer use and improved delivery channels. Cash crops can also increase households' income.

Because harming host countries' food production can reduce the welfare of locals, balance between food production and cash cropping needs to be found. Similar to balance between FDIs' composition structure mentioned earlier, host countries should prepare plans and rules regarding food production. FDIs' destructive impacts on countries' food production could be reduced by requiring foreign investors to invest some share in food production as well, but in turn this could reduce attractiveness because investors targeting cash crops may not be willing to enter into food production. To solve this, host countries could think about imposing sort of bundling conditions on land deals: investors could be required to provide e.g. credits or technological assistance to local small-scale food croppers and that way contribute to food production.

Switching to exported cash crops imposes small-scale farmers also to exchange rate risks and risks of price collapses and breakdowns of marketing institutions (von Braun et al. 1989). Medicine for this could be contract farming because contracts with foreign investors would provide farmers with an agreed price and thus the price risk could be mitigated. Naturally, in turn the possible upside would be reduced as well.

But adoption of exported cash crops, or cash crops in general, can also be a way for locals to diversify their risk and thus, it could also be seen as a form of risk aversion. This is mentioned by

e.g. von Braun (2009) and by looking back at land tenure models in section 4.5 one can see that this would mean just a different aspect of risk aversion in land tenure models: instead of making an absolute choice between fixed-wage, fixed rent and sharecropping contracts, smallholders could create a bundle of these. Communities and families could allocate a share of their land to cash crops or to investors and continue traditional food production with the rest of the land. However, such arrangements would require more than informal property rights to work.

Cash crop production has been found to require more capital and better technology than food crops in some cases, and in some cases the production can be labor-intensive. First, this underlines foreign investors' role as providing finance and capital to help the transfer to towards cash crops production. And second, if the production can be efficient as labor-intensive, it means that cash crops can provide benefits in host countries even without capital from investors.

If we consider the 1-2-3-4 model in chapter 6 and stick to the assumption that there really is underutilized land that is not vital for food production in Ghana, then according to von Braun et al. (1989), "no obvious technical reason exists why farmers should not expand their export vegetable area, as suitable land remains in reserve". This seems to hold in the light of the 1-2-3-4 model results because households were better off in the model after the biofuel sector establishment – it would be comparable to expansion of the export vegetables. Further, notwithstanding the negative examples where food have been exported away from countries suffering from hunger, export bans and trade restrictions undermine potential gains from trade that African countries would certainly need (von Braun, 2009). What this means is that as long as food production is not pushed down, underutilized resources in African countries should be considered as assets that could help countries to increase their exports in cash crops sector. It also means that there should be room for agricultural FDIs in Africa without harming the food production, as long as the investments are made under proper recognition of locals' rights, also when the rights are informal.

8.6 Contract design

Collier and Venables (2012) argue that capturing benefits from FDIs in agricultural land should be done by setting low rents and complementing them with other instruments such as taxes. This could provide governments and locals with a share of possible abnormal profits made by investors. But there also contrary arguments supporting fair lease and sales prices of land because relying on taxation causes its own problems and thus, I would recommend host countries being careful with lowering lease prices and relying only on taxes.

Another important thing would be to take into account the option value of land: if land value increases, part of the gains (capital gain from increased land value) should be captured by the host country. Capital gains tax, possibly specially targeted for land purposes could be a solution. An interesting concept could a "development region" – these regions could have different sizes and governments could use targeted policy measures inside regions. This could be taken into account in the contracts with investors by requiring specific actions from the investors in the region. Or government could guide the money it receives from the acquisition to the development region in question. (ibid.)

Collier and Venables (2012) discuss also issues that are important for investors: R&D activities may need to be carried out and this can be a significant initial investment costs. It favors leasing right to land to large-scale farms having the resources and will to carry out the necessary R&D activities and possible infrastructure development. However, institutions and business climate must enable enough security to investors to benefit from their R&D efforts (e.g. rights to discovery and patents). If there is a risk of not benefitting from the efforts, the option value of land may stay too low, thus leading to unattractiveness from pioneers' perspective. A solution could be to allow the first mover to acquire more land or lease rights than he will use. This would allow the investor to enjoy the profits, if land value rises due to his actions. (ibid.)

But the above presented is problematic because speculative land demand means that land would be acquired from locals and then held idle. This would also mean that in case the first mover is successful with R&D, land value would rise but locals would not benefit from it. Thus, host countries should be selective when accepting FDIs and leasing or selling their land, even though R&D is needed. Countries should also avoid competing in attracting FDIs to avoid a race to the bottom, where foreign investors can select the longest contracts with most nominal fees.

An interesting policy tool that could be studied and tried is given by Benfica (2006): he argues that Mozambigue could levy export tax on raw tobacco to encourage further processing in the country. This could be useful in a broader perspective because specifically targeted export taxes might encourage further processing and thus, create new industries and new jobs. For example, biofuels' production in factories can become important for African countries, if biofuel feedstock cultivation continues growing in Africa. Another option would be to include clauses in the contracts to require further processing in host countries. But investors would likely try to avoid clauses that limit their choices of operations.

Based on Cotula's (2011) findings presented in sections 5.4 and 5.5, contracts with foreign investors need more attention and they need to be done correctly. Host countries should ensure that appropriate conditions and clauses are included in the contracts. Also, property rights must be respected, contracts should support locals' participation and food security have to be secured. With respect to contract design, it is important to note that a proper contract design can only help host countries and smallholders, if the property rights and land tenure are secure.

Further, based on Cotula's (2011) findings, it is evident that sales and lease prices of agricultural land are many times nominal in Africa. Host countries should focus on the compensation in the deals and provide support to smallholders and communities in negotiations. Even though some countries have set rules for negotiations processes, they have not solved the compensation issue. Thus, host countries should study a possibility where foreign investors would need to obtain permissions for their deals from both the landholders and government. Naturally, there is a risk of corruption and it can prevent the system from working.

In chapter 6 it was assumed that 80% of the acquired land would eventually be used for biofuels production. Host countries should consider how they could include clauses such as "initiation milestones" in the contracts and how the land could be returned to locals, if investors would not initiate their projects according the agreed schedule. This could be a way to avoid majority of speculative agricultural FDIs. Contracts could also be designed to include job creation clauses. For example, investors could be liable to providing jobs to the locals in the area where the investment occurs and who are leasing or selling their lands.

8.7 International cooperation

Without international cooperation and some level of organized governance, it can be hard to avoid race to bottom and reach positive host country effects of FDIs. Interesting example of a policy tool could be found from *Payments for ecosystem services* (PES): these programs focus originally on supporting environmentally friendly initiatives by paying land owners or users to give up and avoid destructive practices. (Nkonya et al. 2012).[81] If PES directive can be expanded or transformed to cover e.g. joint ventures and outgrower schemes between locals and foreign investors, it could be one way to regulate FDIs.

[81] PES is by no means a trouble-free program, and there is a problem concerning poorest people and communities: too low compensation for locals for their commitment to PES and not being able to improve their welfare and getting out of the poverty trap (Nkonya et al. 2012).

One could also consider a program where foreign investors and their activities were obligated to fulfil PES requirements before agricultural land acquisitions and leases were allowed. Naturally, this kind of system would require a vast amount of international cooperation, coordination and a consensus between the parties involved to be effective. PES could also be transformed, or a "PES-type program" could be created, to cover food production and cash cropping. For instance, food production in host countries by foreigner investors could be supported. And further, if a foreign investor needs to build infrastructure for production and the infrastructure would benefit also locals, such development projects should be included in the scope of "PES-type programs". Host countries have also responsibility here, for they can invent and tailor programs that are suitable for their purposes and their main development areas.

International organizations have published their guidelines but without getting countries and investors committed to those, they will not change the big picture. For example, FAO, IFAD, UNCTAD and World Bank (2010) have together published *Principles for Responsible Agricultural Investment that Respects Rights, Livelihoods and Resources* (PRAI). PRAI includes seven principles that are 1) Land and resource rights (recognition and respect for existing ones), 2) Investments not allowed to jeopardize food security, 3) Transparency, monitoring and accountability, 4) Consultation and participation (parties who will be affected, recording and enforcement of consultations), 5) Economic viability and responsible agro-enterprise investing, 6) Social sustainability, and 7) Environmental sustainability.

There are also other initiatives and guidelines such as *PFIA* but they are likely to affect agricultural FDIs' outcomes only, if there is a critical mass standing behind the rules.[82] Chakrabarti and da Silva (2012) remind that international organizations can help in coordination and other assistance and thus, their support is needed. In addition, they highlight that international organizations can also help in providing small-scale farmers finance. It would provide locals with another source of finance and better access to markets. Finally, Chakrabarti and da Silva remind that host country governments need to participate as well: creating an adequate policy framework would enable agricultural investments from all actors. This would, however, require improvements in legal systems in many countries.

[82] For PFIA, Policy Framework for Investment in Agriculture, see OECD (2013).

8.8 Comprehensive and strategic approach

Based on the literature related to agricultural FDIs, different policy tools and guidelines like PFIA and PRAI, it seems that there is no single action or tool that could alone ensure possible results to host countries from agricultural FDIs. The tools presented in this chapter tend to rely on conditions to be met, and many times the conditions rely on overcoming corruption and respecting locals' rights. In addition, the recommendations presented in this chapter are overlapping to some extent. Thus, effects of policy tools are more or less dependent on each other. For African countries receiving and attracting agricultural FDIs this might be the one most essential thing to notice: multiple actions and a comprehensive approach are required to make the single policy tools work. A large formalizations of property rights might be needed but it would have to be accompanied by investments in infrastructure and institutions.

Host countries should also prepare strategies for how to secure benefits from FDIs without harming locals and communities while at the same time providing incentives for foreign investors. The tools and recommendations presented here provide a starting point, but African countries should tailor them for their own conditions. An important step in preparing the strategy would be to identify what the country needs and where to find the land for investors. For example, food production can be vital and there should be a strategy to secure enough of food production, and possibly also technological assistance to traditional food crops. Allocating agricultural land available for investors may be impossible to do without violating someone's or some group's rights and thus, the area and the people affected by investments need to be compensated.

9 Conclusions

Interest in agricultural land in Africa has grown in recent years and nowadays Africa is the main recipient of world's agricultural FDIs. Main drivers behind growing interest have been securing food and raw material production, and biofuels production as an emerging trend. Empirical evidence and results from the 1-2-3-4 model show that there is potential in agricultural FDIs to have positive influences in host countries' economies and local people. But the potential seems to be conditional to large extent: it seems to require right circumstances and benevolent goals from both investors and host countries' governments.

Property rights and infrastructure are weak in many rural areas in Africa and it has provided foreign investors with a playground where they have been able to acquire land for a nominal compensation and not to keep their development promises. Government actions and corruption have many times a

role behind smallholders losing their land through expropriations. Negotiations with foreigners have been problematic and locals have entered into contracts that they may not really understand and that have been unfavorable for them. Countries' legislation may prevent locals acting on their own benefit and even though foreign investors have not acted in accordance with contracts and their plans, locals may not have been able to claim their lands back.

Positive effects of FDIs have been found as well. There are examples where FDIs have improved welfare and yielded some of their potential benefits. There have occurred such benefits as job creation (direct and indirect), wage increases, technology and productivity spillovers, income increases and business environment revitalizing. However, the examples studied in chapter 7 eventually met a downturn and the initial positive impacts occurred only for a short period of time.

Findings from the 1-2-3-4 model study for Ghana indicate that benefits for host countries could be achieved with a right structuring. However, the findings are conditional to the model assumptions which are more optimistic than what the reality of agricultural FDIs has been. All scenarios of the 1-2-3-4 model indicate that FDIs along with the biofuel sector establishment would be welfare improving in Ghana. It is an expected result because in all scenarios there is a positive resource shock, new land taken from the underutilized land stock. Imports and total exports increase in all scenarios, and results of the model indicate that there are differences in host country impacts between large-scale FDIs and FDIs carried out by outgrower schemes. Welfare impacts between land-intensive large-scale FDIs and labor-intensive outgrower schemes are close to each other, but wage increase is higher with outgrower schemes. The 1-2-3-4 does not yield any unexpected results that would be strongly against other studies or trade theory.

Results in the 1-2-3-4 model share similarities with Ghana's realized development in 2010-2013, when it is broken down in national accounts and analyzed. Ghana's actual development provides a good baseline because of Jubilee oil field discovery in Ghana in 2007: oil production started in 2010 and Ghana's exports increased, as happens in the 1-2-3-4 with biofuel exports. Analyzing impacts of oil production on Ghana's economy shows that it contributed strongly to exports growth and provided revenues to government. However, the analysis reveals that oil sector's impact on households' welfare was not major and that the jump start of oil production was not enough to turn Ghana's current account balance and trade balance positive. Of course, oil sector is only one shock and one factor that affected Ghana's development during the period. Thus, is not easy to extract oil sector's real impact on Ghana, and comparison of the real development with the 1-2-3-4 model findings must be treated with caution.

Cash cropping and biofuels, investment in infrastructure, contract design and enhancing property rights are all tools for African countries to benefit from FDIs. But the impacts of FDIs can be complex and many times functioning of tools and actions require other actions to support them. Hence, it seems that no single tool can alone secure mutually beneficial FDIs. This indicates that a larger formalization and a lot of investments in institutions and infrastructure are needed. African countries can attract FDIs without the proper actions in future as well, but they will not induce pro-poor growth or welfare increase in host countries, if the current situation prevails.

Land is a natural resource and many African countries have abundant stocks of agricultural land. By leasing or selling their land at nominal prices for decades host countries are also selling the option value of their land at the same time. And if the interest and FDIs in agricultural land continue rising, the option value of land should also increase along the way. Host countries should be careful when deciding on what deals to accept, if it is government and officials that negotiate the deals. Host countries should also prepare comprehensive strategies for how to secure benefits from FDIs without violating property rights and harming livelihoods. The tools and recommendations presented in this paper can provide a starting point, but African countries need tailor them for their own conditions.

Further research

Based on forecasts, the interest towards African farmland will not cease in future. Thus, the trend of acquiring agricultural land for food and biofuel production can be assumed to continue and the topic of agricultural FDIs to remain timely. When more case studies of biofuel-related investments in Africa are published, there will be more information available to study their impacts on host countries. Also, if more accurate data comes available about the real conditions in contracts, it can help to better understand different micro-level effects and compensation structures in agricultural FDIs. With more accurate data and more information one could try build a more detailed and sophisticated CGE model drawing from the basic 1-2-3 model. The 1-2-3-4 model can also be enhanced by dividing the economy into more sectors, but enhancing the broadening the model will also make it more complex. With better and more accurate information it would be possible to match the 1-2-3-4 CGE model better with reality.

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Appendixes

Appendix 1. Jatropha fruit contents breakdown

	Share of weight	Gross calorific value	Measure
Fruit	**1**		
Shell	37,50 %	11,1	MJ/kg
Seed	62,50 %	20,85	MJ/kg
Seed	**0,625**	**20,85**	**MJ/kg**
Husk share of seed	42,00 %	16	MJ/kg
Kernels share of seed	58,00 %		
Kernels	**0,363**		
Oil share of kernels	0,55 %	37,832	MJ/kg
Seed cake/press cake share of kernels	0,45 %	18-25,1	MJ/kg
Jatropha oil extracted from fruit			
Oil share of total fruit	19,94 %		
Jatropha oil energy value		37,83	MJ/kg
Jatropha oil energy value		37,83	GJ/t
Oil part energy content in fruits		7,04	GJ/t
Non-oil part of jatropha			
Shell share of total fruit	37,50 %		
Shell energy value		11,10	GJ/t
Husk share of total fruit	26,25 %		
Husk energy value		16,00	GJ/t
Seed cake/press cake share of total fruit	16,31 %		
Seed cake/press cake energy value		18	GJ/t
Total non-oil part share of of total fruit	80,06 %		
Total (weighted) non-oil part energy value		14,11	GJ/t

Source: Brittaine and Lutaladio (2010), Jingura et al. (2010), Mkoma & Mabiki (2011) and World Bank (WDI 2014)

Appendix 2. Jatropha required for electricity production (with 10 MW power plant)

Jatropha fruit gross energetic value: oil and non-oil parts	**Value**	**Measure**
a) Oil part (extracted) share of fruit weight	19,94 %	%
b) Non-oil part (after extraction) share of fruit weight	80,06 %	%
a) Jatropha crude oil energy value	37,83	GJ/t
b) Weighted non-oil part (after extraction) energy value	14,11	GJ/t
Total weighted fruit energy value	18,84	GJ/t
a) Jatropha crude oil share of fruit energy	40,04 %	
b) Weighted non-oil part (after extraction) share of fruit energy	59,96 %	
Biofuel requirements for power plants: 10 MegaWatt power plant	**Value**	**Measure**
Power plant delivers per year	87,60	MWh
Efficiency: 35%	0,35	
Required 'non-efficient' (MWh)	250,29	MWh
Required gigajoules (ratio: 1 MWh = 3,6 Gj)	901,03	Gj
Required non-oil jatropha for 10MW pover plant:	63,86	t
Required non-oil jatropha	63857,26	kg
Non-oil jathropha 'Efficient' t/MWh	0,26	t/MWH
Ghana electricity consumption in 2010	**Value**	**Measure**
Electricity consumed, MWh	7256000,00	MWh
10% target share	725600,00	MWh
Required non-oil jatropha	**185127,75**	**t**
Required jatropha as whole	231236,26	t

Source: Woodbank Communications Ltd (2014) and World Bank (WDI 2014)

Appendix 3. Ghana National Account Data 2010, Ghc billions

Currency: GHC	**Billions**	**Output=1**		**Billions**	**Output = 1**
National accounts			**Fiscal account**		
Output (value added)	43,388	1,000	*Total Revenue*	8,811	0,203
Wages *(1)	21,694	0,500	Non-tax revenue *(9)	2,306	0,053
			O/W grants *(9)	1,080	0,025
GDP at market prices *(2)	47,403	1,093	*Current expenditure*	8,726	0,201
Private consumption	35,860	0,826	Goods & Services *(10)	4,825	0,111
Public consumption *(3)	4,825	0,111	Interest payments	1,439	0,033
Investment *(3)	13,235	0,305	Transfers & Subsidies	2,462	0,057
Exports *(4)	13,495	0,311	Capital expenditure	3,169	0,073
Imports *(4)	20,012	0,461	*Fiscal balance*	-3,084	-0,071
Statistical discrepancy	0,000	0,000	**Balance of payments**		
Tax revenue			Trade balance, goods & services *(11)	-6,517	-0,150
Sales & Excise tax *(5)	2,299	0,053	Net profits and dividends	-0,490	-0,011
Import tariffs *(6)	1,621	0,037	Interest payments	-0,275	-0,006
Export duties	0,095	0,002	Net private transfers	3,035	0,070
Personal income tax *(7)	2,490	0,057	Net official transfers *(12)	1,080	0,025
Capital income tax *(8)	0,0	0,0	Current account balance	-3,166	-0,073
Total Tax Revenue	6,504	0,150			
			External debt	9,039	0,208
Exchange rate 2010, US$/GHc	**1,43**		Debt service payments	0,460	0,011

Sources: GRA (2014a-b), GSS (2014b), Bank of Ghana Quarterly Bulletins (2011b-e), Bank of Ghana Annual Report 2013 (2014) and World Bank (2014) for exchange rate

*(1) Wages are adjusted to be 50% of value added output. See Table 19 where the approximation for Ghana's wage share of value added output is 63,08%.

*(2) GDP at market prices is adjusted so that the difference between value added output and GDP at market prices represents the total amount of indirect taxes, ca. 4,015 billion GHc. In Ghana Statistical Service (2014) GDP at market prices has a value of 46,042 billion and there is recognized a 1,143 billion statistical discrepancy.

*(3): Public consumption and Investment (total) are adjusted to drive statistical discrepancy to zero (with three digits the discrepancy is zero in US$ billions) after making the adjustment GDP at market prices. These two accounts were adjusted to balance Ghana's SAM for 2010 and because there is variability in Public consumption's estimates between different sources: Bank of Ghana Quarterly bulletins (2011b-e) and GSS (2014b). Also, BOG's quarterly bulletins do not give a direct number for Public consumption, so if one would use the value of "Goods and services" from government's current expenditure breakdown, the value would most likely be too low. If "Personal emoluments" paid by government are included in the Public consumption account, BOG's estimate would be 4,144 billion compared to GSS' estimate of 4,768 billion. Public consumption was increased by 0,681 billion from its BOG estimate (personal emoluments included) and Investment was increased by 1,401 billion from GSS (2014) estimate of 11,834 billion.

*(4): Exports and imports values are collected from BOG Annual report 2013 instead of using GSS (2014b) values. There are differences between these sources and the decision to use BOG's values is based on using the same numbers in the 'Balance of payments' breakdown.

*(5): Sales & Excise tax account includes value added tax (VAT), VATS NHIL, CST and Airport Tax. Both domestic and external VAT are included. VATS NHIL is National Health Insurance Levy (NHIL) that is levied on all goods and services unless they are otherwise exempted, and it is collected by a registered Ghanaian business like value added tax (GRA). CST means Communications Service Tax that is levied on charges for the use communications services. These taxes belong to indirect taxes and the data is collected from BOG quarterly bulletins (2011b-e).

*(6): Import tariffs account includes traditional import tariffs, NHIL CEPS and import exemptions. NHIL CEPS stands for the share of NHIL levied on imports and it is collected by CEPS: The Customs, Excise and Preventive Service. Import exemptions (import excise) are levied as an additional taxes on some selected commodities and they are also included in this account. (GRA.) Data is collected from BOG quarterly bulletins (2011b-e).

*(7): Personal income tax has been adjusted so that it includes personal income tax for hired and self-employed personnel, NHIL SSNIT, taxes on companies, other direct taxes and non-tax revenue as well. SSNIT stands for Social Security and National Insurance Trust: 2,5% of each person's contribution to SSNIT is allocated to Ghana's National Health Insurance Scheme (NHIS) and SSNIT payments form a share of total NHIL (GRA, 2014a).

Taxes on companies are included because there is no distinction between households and companies in the CGE model. According to GRA, corporate income tax rate is 25% on companies' annual profits. Other direct taxes include NFSL that stands for National Fiscal Stabilization Levy, NRL (arrears) that stands for National Reconstruction Levy, and royalties from oil. Non-tax revenue is includes lodgement and retention. Data for the personal income tax account is collected from BOG quarterly bulletins (2011b-e).

*(8): According to Ghana Revenue Agency, capital income tax rate in Ghana is 15%. However, such authorities as GRA, Bank of Ghana or Ghana Statistical Service give no information about the share of personal income tax composed by capital income tax. Payroll tax is not mentioned separately in BOG's quarterly bulletins and thus, it is not considered separately but assumed to be included in the personal income tax.

*(9): Non-tax revenue consists of domestic lodgement and retention revenue, and foreign grants (BOG quarterly bulletins, 2011b-e).

*(10): Goods & Services account is adjusted to match the 'Public consumption' account of GDP at market prices. Hence, it differs from the estimate constructed from BOG's quarterly bulletins (2011b-e).

*(11): Trade balance represents the difference between Exports and Imports and the data is from BOG Annual report 2013 (2014).

*(12): Net official transfers value is collected from BOG quarterly bulletins (2011b-e) and the estimate differs from BOG Annual report 2013 value. This seems to be because quarterly bulletins contains numbers in more detail and thus, the grants in the constructed national account data have a broader meaning compared to Annual report's value.

Appendix 4. Balance of payments development in Ghana, 2010-2013

Ghana's Balance of payments development 2009-2013, US$ billion					%-change
	2010	2011	2012	2013	2010-2013
A) Balance on Current account: 1+4+5	**-2,770**	**-3,541**	**-4,921**	**-5,704**	**-105,95 %**
(1) Trade balance: 2+3	**-2,962**	**-3,052**	**-4,220**	**-3,848**	**-29,92 %**
(2) Exports f.o.b	**7,960**	**12,785**	**13,543**	**13,752**	72,76 %
Cocoa beans	1,594	2,028	2,193	1,612	1,11 %
Cocoa products	0,625	0,843	0,636	0,655	4,80 %
Gold	3,804	4,920	5,643	4,966	30,56 %
Oil exports	**0,000**	**2,779**	**2,976**	**3,885**	-
Timber and timber products	0,190	0,166	0,121	0,166	-12,51 %
Other exports	1,748	2,050	1,973	2,468	41,23 %
(3) Imports f.o.b	**-10,922**	**-15,838**	**-17,763**	**-17,600**	**61,14 %**
Non-oil	-8,686	-12,672	-14,433	-14,050	61,75 %
Oil imports	-2,236	-3,165	-3,331	-3,550	58,79 %
(4) Balance on Services and income (net)	**-2,130**	**-3,086**	**-3,105**	**-3,795**	**-78,17 %**
Services (net)	-1,595	-1,856	-0,975	-2,444	53,21 %
Inflows	1,477	1,810	3,259	2,454	66,11 %
Outflows	-3,072	-3,666	-4,235	-4,898	59,41 %
Investment income (net)	-0,535	-1,230	-2,130	-1,351	152,60 %
Inflows	0,053	0,055	0,055	0,285	437,60 %
Outflows	-0,588	-1,286	-2,185	-1,636	178,28 %
Of which: interest payments	-0,192	-0,224	-0,271	-0,417	116,70 %
of which: bonds	-0,103	-0,118	-0,098	-0,218	112,16 %
(5) Balance on Current transfers	**2,322**	**2,597**	**2,405**	**1,939**	**-16,49 %**
Private transfers	2,123	2,369	2,148	1,859	-12,41 %
Official transfers	0,200	0,229	0,258	0,080	-59,79 %
B) Capital and Financial account	**4,290**	**4,479**	**3,651**	**4,892**	**14,06 %**
Capital account (net)	**0,338**	**0,445**	**0,283**	**0,020**	**-94,19 %**
Financial account (net)	**3,952**	**4,034**	**3,368**	**4,873**	**23,30 %**
Official financing (Medium & Long-term loans)	0,880	0,650	0,982	0,888	1,00 %
Inflows	1,058	0,889	1,342	1,205	13,89 %
Outflows	-0,178	-0,239	-0,360	-0,316	77,55 %
Government oil investment (net)	0,000	0,000	-0,024	-0,381	-
Private capital	2,034	2,863	2,983	2,919	43,52 %
Of which: Foreign direct investment (net)	2,527	3,222	3,293	3,226	27,65 %
Short-term capital (net)	0,418	0,404	-1,695	0,787	88,35 %
Non-monetary (net)	0,311	0,771	-0,958	0,075	-75,84 %
Monetary (net)	0,107	-0,367	-0,738	0,712	567,39 %
Portfolio investment (net)	0,621	0,118	1,122	0,659	6,19 %
Inflows	0,723	0,428	1,338	1,276	76,51 %
Outflows	-0,103	-0,311	-0,216	-0,617	502,24 %
C) Errors and Omissions	**-0,057**	**-0,392**	**0,058**	**-0,354**	**-**
D) Overall balance	**1,463**	**0,547**	**-1,211**	**-1,166**	**-179,71 %**
Changes in Net internatioal reserves (-,increase)	-1,463	-0,547	1,211	1,166	-
Exchange rate USD-GHc, (World Bank)	1,430	1,510	1,800	1,950	-36,36 %
Exchange rate USD-GHc, (BOG)	1,474	1,551	1,880	2,200	-49,27 %

Source: Bank of Ghana (2011a, 2012a, 2013a & 2014)

Appendix 5. Ghana national account development 2010-2013

	Current US$ billions				Annual %-change			Period	%
	2010	2011	2012	2013	2011	2012	2013	2010-2013	2010-2013
Output (value-added, at basic prices)	**30,341**	**36,988**	**40,326**	**46,633**	**21,91 %**	**9,02 %**	**15,64 %**	**16,292**	**53,70 %**
Wages	-	-	-	-	-	-	-	-	-
GDP at market prices	32,197	39,613	41,644	47,929	23,03 %	5,13 %	15,09 %	15,731	48,86 %
Private consumption	25,077	24,342	19,238	28,374	-2,93 %	-20,97 %	47,49 %	3,297	13,15 %
Public consumption	3,334	6,593	8,740	8,003	97,74 %	32,56 %	-8,43 %	4,669	140,04 %
Investment	8,275	11,737	13,716	11,581	41,83 %	16,87 %	-15,57 %	3,305	39,94 %
Exports	9,437	14,596	16,802	16,206	54,66 %	15,12 %	-3,55 %	6,769	71,72 %
Imports	13,995	19,504	21,998	22,498	39,37 %	12,79 %	2,27 %	8,504	60,76 %
Statistical discrepancy	0,068	-0,848	2,008	2,412	-	-	-	-	-
Tax revenue									
Sales & Excise tax (VAT & VATS NHIL included)	1,608	2,220	2,165	2,315	38,08 %	-2,50 %	6,93 %	0,707	43,95 %
Import tariffs (NHIL CEPS included)	1,133	1,610	1,679	1,784	42,06 %	4,28 %	6,23 %	0,650	57,38 %
Export duties	0,066	0,003	0,057	0,051	-95,00 %	1631,47 %	-10,55 %	-0,015	-22,56 %
Personal income tax (NHIL SSNIT included)	1,741	2,693	3,146	3,269	54,66 %	16,83 %	3,92 %	1,528	87,78 %
Payroll tax	-	-	-	-	-	-	-	-	-
Capital income tax	-	-	-	-	-	-	-	-	-
Total Tax Revenue	4,549	6,526	7,047	7,419	43,48 %	7,98 %	5,28 %	2,870	63,10 %
Fiscal account								0,000	
Total Revenue & Grants	6,161	8,511	9,276	9,831	38,13 %	8,99 %	5,97 %	3,669	59,55 %
Non-tax	0,857	1,207	1,585	2,187	40,72 %	31,36 %	38,01 %	1,330	155,10 %
Grants	0,755	0,778	0,645	0,224	3,01 %	-17,16 %	-65,18 %	-0,531	-70,29 %
Current expenditure	6,062	9,319	12,919	13,765	53,71 %	38,64 %	6,55 %	7,703	127,06 %
Goods & Services	3,334	6,593	8,740	8,003	97,74 %	32,56 %	-8,43 %	4,669	140,04 %
Interest payments	1,007	1,067	1,353	2,255	6,01 %	26,84 %	66,61 %	1,248	124,02 %
Transfers & Subsidies	1,722	1,659	2,826	3,507	-3,67 %	70,36 %	24,11 %	1,785	103,68 %
Other non-interest expenditure	-	-	-	-	-	-	-	-	-
Capital expenditure	2,216	2,434	2,762	2,230	9,84 %	13,48 %	-19,27 %	0,014	0,62 %
Fiscal balance	-2,117	-3,241	-6,404	-6,164	53,12 %	97,58 %	-3,75 %	-4,047	191,19 %
Balance of payments								0,000	
Trade balance, Goods	-4,557	-4,909	-5,196	-6,292	7,71 %	5,86 %	21,10 %	-1,735	-38,07 %
Net profits and dividends	-0,343	-1,007	-1,859	-0,935	193,64 %	84,71 %	-49,72 %	-0,592	-172,72 %
Interest payments	-0,192	-0,224	-0,271	-0,417	16,29 %	21,12 %	53,86 %	-0,224	-116,70 %
Net private transfers	2,123	2,369	2,148	1,859	11,59 %	-9,34 %	-13,42 %	-0,264	-12,41 %
Net official transfers	0,200	0,229	0,258	0,080	14,52 %	12,72 %	-68,85 %	-0,119	-59,79 %
Current account balance	-2,770	-3,541	-4,921	-5,704	27,85 %	38,96 %	15,92 %	-2,934	105,94 %
External debt	6,321	7,590	8,836	11,342	20,07 %	16,42 %	28,37 %	5,021	79,44 %
External debt service payments	0,322	0,426	0,524	0,634	32,42 %	22,84 %	20,99 %	0,312	96,80 %
Exchange rate USD-GHc, (World Bank)	1,430	1,510	1,800	1,950	5,59 %	19,21 %	8,33 %	0,520	-36,36 %
Exchange rate USD-GHc (BOG)	1,474	1,551	1,880	2,200	5,20 %	21,25 %	17,02 %	0,726	-49,27 %

Source: Bank of Ghana (2011b-e, 2012b-e, 2013a-d & 2014), GSS (2014b) and World Bank (2014)