CHAPTER 6

AGRICULTURE MARKETS OUTLOOK

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6. INTRODUCTION

For any country the production of biofuels from any agricultural feedstock can be a contentious issue with regards to the food versus fuel debate, but it is particularly sensitive for those countries that are already deemed food insecure. It is important for government officials to understand how biofuel demand for feedstock might impact the commodity supply-disposition[1] within their country over time. Agricultural markets are continuously reacting to changes in demand and supply and to comprehend what the plausible impact biofuels might have on commodity markets, it is important to have a picture or outlook of future supply and demand conditions that might materialize. Therefore, this chapter presents the agriculture market outlook for Tanzania over a ten-year period and an assessment of the market implications of biofuel production. This encompasses not only scenarios for Tanzanian biofuel production and blending mandates, but also plausible implications of changing world oil prices and policy risk from foreign countries' biofuel policies. The production of biofuels and blending or consumption mandates in many countries has created a stronger relationship between energy markets, mainly oil, and agricultural markets. The prices of agricultural feedstocks used to produce biofuels are now linked to movements in oil prices. Even in a country where there are no government policies intervening in biofuel markets, domestic biofuel production would remain vulnerable to the movement in world oil prices and the consequential impacts on world crop prices. Likewise, biofuel policies of other countries could possibly change, which could significantly alter the profitability of biofuel production and influence crop prices.

Currently, there are not many impartial, publicly available long-term projections for agricultural markets that are consistent across countries[2]. However, the Organisation of Economic Cooperation and Development and the Food and Agriculture Organization of the United Nations jointly produce an annual ten-year projection for national and global agricultural markets, called the OECD-FAO Agricultural Outlook. This Outlook provides projections for production, utilization (i.e. consumption in the form of food, feed,

1 Commodity supply-disposition refers to beginning stocks, production, imports, consumption, exports and ending stocks and the equilibrium condition that balances the market (i.e. beginning stocks + production + imports = consumption + exports + ending stocks).

2 Many countries produce forecasts for agricultural commodity markets, but these forecasts are from their perspective of the world and are not necessarily peer reviewed for consistency.

fuel or fibre), imports, exports, stocks and prices for the main agricultural commodities and biofuels of the countries influencing world agricultural markets[3]. The Outlook is an important foresighting tool that can highlight important challenges or opportunities in agricultural markets for some countries. It provides a picture of how agricultural markets could evolve over time with respect to a set of macroeconomic[4] conditions, trends and current agricultural policies employed in countries influencing world markets. The value of Outlook is not so much the precision of projected values in any one year, but the dynamics of how markets are expected to evolve over the next ten years. OECD-FAO use a partial equilibrium simulation model called AGLINK-COSIMO to produce the projections of national and global agricultural markets in the Outlook. The model along with the Outlook, which serves as a baseline, is used to conduct market and policy analyses to determine impacts on agricultural markets. The AGLINK-COSIMO model and Outlook provide comprehensive coverage of agricultural commodity markets by country or regions and their respective agricultural policies. This makes it an effective tool to analyse Tanzanian agricultural markets over the next ten years, as well as to conduct scenario analysis with respect to biofuels.

This document first discusses the rationale for analysing and reporting specific commodity markets in Tanzania. The following section then discusses in detail the assumptions and highlights of the baseline produced to analyse Tanzanian agricultural and biofuel markets. The following section sets forth the situation in Tanzania with respect to the possible development of biofuel production and the possible government biofuel blending mandate. This sets the context for the assumptions to be used for scenario analysis. Thereafter, the scenarios undertaken are explained along with the key results. Then considering the influence that foreign countries' biofuel prices have on biofuels and crop markets, the analysis: "Biofuel Support Policies: An Economic Assessment"[5] conducted by the OECD is highlighted to show the risk to Tanzanian agricultural markets presented by foreign policies. The final part of the report provides implications on effects of emerging biofuel developments and policies with respect to food security in Tanzania.

The analysis presented focuses on market projections for coarse grains (maize and sorghum), wheat, sugar, palm oil, rice, sugar cane, roots and tubers (cassava, yams and sweet potatoes) and biofuels. This list comprises both the main food security crops and the bioenergy feedstock, as previously discussed.

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3 For further information regarding commodity and country representation within the OECD-FAO Agricultural Outlook please see it online at www.oecd.org/publishing/corrigenda.

4 Macroeconomic assumptions for growth rates of GDP, inflation, interest rates, exchange rates, population and oil prices are derived from OECD, International Monetary Fund and World Bank estimates.

5 "Biofuel Support Policies: An Economic Assessment" – ISBN-97-89-26404922-2 © OECD 2008.

6.1 TANZANIA BASELINE

Following discussions with key stakeholders in Tanzania, the Outlook has been adjusted in order to reflect more up-to-date sugar cane production levels. This adjusted Outlook is here referred to as the Tanzanian baseline. The baseline represents the current status of agricultural markets in Tanzania in which there is no biofuel production. The scenarios set up in this chapter are assessed against this baseline.

Note that when discussing the baseline it is important to understand that the model assumes that Tanzanian agricultural markets are linked to world agricultural markets through both trade and prices. Domestic prices are determined from world prices and the trade status of the country as a net importer or exporter. The model uses a full price transmission elasticity with modifications for transition between trade positions[6]. Even though prices are important in explaining the behaviour of producers and consumers, it is more important to evaluate the growth paths of production and consumption with respect to price levels rather than any exact price forecast in a given year.

6.1.1 BASELINE ASSUMPTIONS

General Model Assumptions:

- Oil prices to remain at high levels, rising from USD90 in 2008 to USD104 per barrel in 2017.
- The projections run from 2008 to 2017.
- Robust economic growth in emerging economies and moderate growth for OECD countries.

Assumptions on macroeconomic, population and agricultural lands for the projection baseline scenario for Tanzania:

- Annual gross domestic product (GDP) growth is 6.8 percent on average over the Outlook period.
- Inflation for GDP and inflation for the consumer price index (CPI) differ. The average annual inflation rate for GDP is 7.9 percent and for CPI it is 8.1 percent.
- The domestic currency depreciates in nominal terms against the US dollar, at an average rate of 6.7 percent annually. The real exchange rate depreciates by 0.2 percent annually.
- Annual real expenditure (CPI deflated) growth rate is 2.9 percent on average over the Outlook period and food costs rise slower than income.
- Population increases at a 2.38 percent annual rate.
- Cultivated area expands at rate of 1.2 percent annually. On average 16.3 percent of total arable land is cultivated.

6 At the time of the analysis domestic commodity prices were not available. Due to this the model assumes the country is a small country price taker. This entails that domestic prices are determined through world price linkage equations that takes into account the exchange rate, tariffs, transport costs and net trade position. In the cases for which the country is a net exporter, domestic prices will equivalent to the world prices net of transport costs. On the other hand, when the country is a net importer, domestic prices are equivalent to the world prices plus applicable tariffs and transport costs.

6.1.2 HIGHLIGHTS FROM THE BASELINE

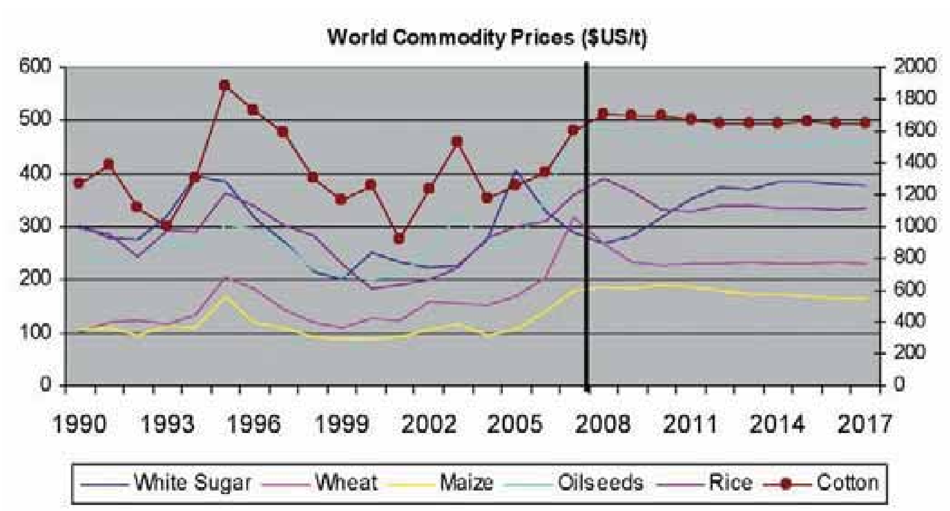
The purpose of the baseline is to show how Tanzanian agricultural markets could evolve over time in the absence of biofuel production or a biofuel mandate. In each key commodity market it is important to comprehend if Tanzania is capable of producing enough food to meet consumption and whether they are relying more on imports or producing surpluses that could lead to increased exports. Obviously this has implications for food security and trade balances, which impact the government balance of payments for Tanzania. The table at the end of the section shows the relative difference between 2007 and 2017 production, consumption and net trade projections and unless otherwise stated the results discussed below refer to differences between 2007 and 2017 and growth rates are computed annual averages[7].

6.1.2.1 WORLD OUTLOOK

The tightening of world supplies (droughts and low stocks) combined with increasing demand for crops, partly from biofuels, and investor speculation has created an upward swing in world agricultural commodity prices. The Outlook is projecting that prices over the next ten years will be on average higher than the previous years as new demand will outpace productivity gains. Crops that are used for biofuels, such as maize, sugar, vegetable oil, are projected to have relatively higher growth prospects than others; however, substitution and competition for cultivated land will have knock-on effects for other crops. Although prices are expected to decrease from recent strong upward swings the long-term average for most crop prices are projected to be at a new price plateau. Figure 6.1 shows the Outlook for world crop prices, but it is important to remember that in the Outlook price projections are based upon market fundamentals of demand and supply whereby markets eventually reach a long-term equilibrium. The Outlook assumes normality and does not project abnormalities, such as droughts or recessions, and it is important to look at trends and not absolute prices. Prices in the Outlook are annual prices and agricultural prices can fluctuate significantly over the course of a year.

7 Growth rates differ from year to year in the baseline but for purpose of discussion of results the annual average growth rate is used.

Figure 6.1
World commodity prices



**Cotton prices are on the right axis.*

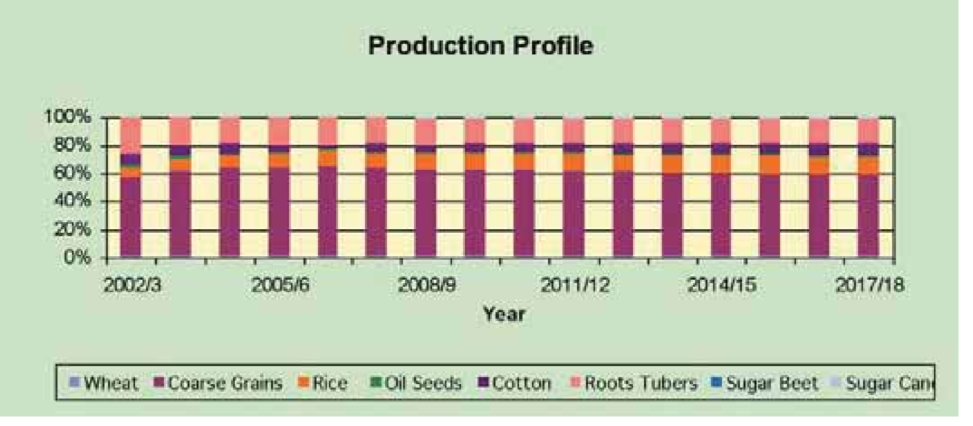
6.1.2.2 TANZANIA OUTLOOK

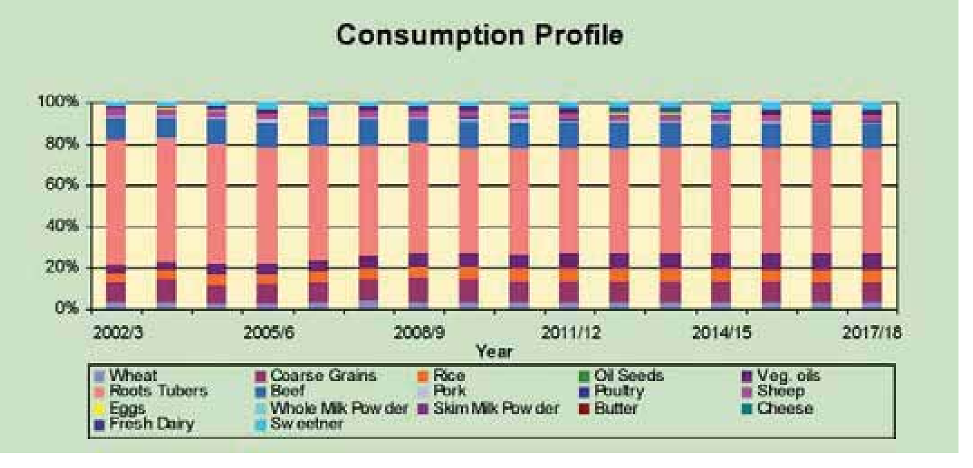
Coarse grains are the most important crops in Tanzania with an average area share of 60 percent (see Figure 6.2). Roots and tubers are the second most important crops with an average area of 18 percent. Rice is the third most important crop with an average area share 12 percent of the area. Relatively strong prices for rice, cotton and sugar over the Outlook encourage increasing shares of production for these crops, but they still have relatively low production shares compared to coarse grains.

Baseline projections on production and consumption trends are presented in Figure 6.2. The production trends indicate that overall sugar cane, wheat and oilseeds will continue to have a small share in the agricultural sector. On the other hand, coarse grain, rice and roots and tubers will be the most important agricultural crops in terms of production. With respect to trade, coarse grains are on average the dominant export commodity over the Outlook period, while wheat has the largest average net imports. With over half of total food expenditure on roots and tubers, it remains the largest commodity for food consumption over the baseline period. However, with income growth there is an increasing share of food expenditure on beef, dairy products and vegetable oils throughout the baseline, albeit these commodities start from a relatively small share of overall food expenditure.

Figure 6.2

Baseline projection production and consumption profile





As illustrated in Table 6.1 the outlook for commodities in Tanzania shows the following:

Coarse Grains

On the production side, the total coarse grains area[8] is assumed to increase 0.33 percent annually and yields increase 1.51 percent annually, which increases coarse grain production by 858 kt[9] from 2007 to 2017. This corresponds to production increasing at the rate of 1.84 percent annually. Better yields explained 80 percent of the improvement in production. For Tanzania, both maize and sorghum are aggregated in the AGLINK-COSIMO model in the coarse grains aggregate[10]. In Tanzania, production of maize is by far the largest coarse grain[11].

8 Area means cultivated or harvested area.

9 kt – thousand metric tons

10 The AGLINK-COSIMO coarse grains aggregate includes maize, sorghum, rye, oats and barley where applicable.

11 National Tanzanian statistics indicate that in 2004, 80 percent of coarse grains came from maize.

In Tanzania, coarse grains food expenditure represents on average 10 percent of their overall food expenditure and is the third largest share in their food budget. Total use or consumption is largely from food consumption with a relatively small share from feed. Total use increases by 1 384 kt over the projection period and is mainly driven by food use (increases by 979 kt).

Although the country is a net exporter of coarse grains from 2007 to 2017, consumption grows faster than production and consequently there is a decrease in net exports of 291 kt.

Roots and tubers

The roots and tubers aggregate includes cassava, yams, and sweet potatoes. In the case of Tanzania this group is mostly represented by cassava[12]. Roots and tubers are the second most important crop group in Tanzania with an average crop area share of 18 percent. The total area covered by roots and tubers increases by 105 000 hectares (ha), or 8.8 percent over the Outlook period. Yields increase marginally at a rate of 0.48 percent annually and reach 7.8 tons per ha by 2017. Throughout the projection period domestic supply fluctuates but overall production increases by 1 251 kt. Yields explained 34.7 percent of the increase in production.

People in Tanzania spend the largest share of their food budget on roots and tubers, an average budget share of 55 percent. Total consumption increases by 1 251 kt, where consumption is mainly driven from increased food use. Considering cassava production is largely subsistence farming, it is assumed that domestic demand will be met by domestic production, which implicitly assumes that roots and tubers are not imported or exported.

Rice

The area harvested for the production of rice increases at an annualized rate of 3.55 percent, whereas yields will remain at less than 1.30 tons per ha with an annual increase rate of 0.61 percent. The projection indicates overall production increases by 408 kt by 2017. Yields explained about 12.4 percent of the increases in production, and therefore, production growth is driven primarily by land expansion.

Total consumption is determined only by rice food consumption as no rice is used as feed and crushing (milling) rice is not considered in the baseline. Total domestic use is projected to increase by 399 kt. Due to higher production gains relative to consumption there is a slight decrease in rice imports of approximately 6 kt, however, Tanzania still needs to import 93 kt by 2017 to fulfil domestic use.

12 In the Agricultural Census 2002-2003 90 percent of the area harvested under roots and tubers in Tanzania was cassava.

Wheat

Harvested area for wheat is to remain relatively unchanged with area harvested reaching 74 000 ha in 2017. However, yields are expected to increase at a rate of 3.45 percent annually over the Outlook period and production increases by 36 kt. Intuitively, yields explained about 83.9 percent of the improvements in production.

Likewise with rice, wheat total consumption is only determined by food consumption, which is projected to grow at an annual rate of 4.13 percent. From 2007 to 2017, consumption of wheat increases by 217 kt. Consumption growth significantly outpaces increases in production and Tanzania becomes a larger importer of wheat over the baseline with an increase in net imports of 284 kt by 2017.

Sugar cane and Sugar

Historical data series were updated with information provided by the Sugar Board of Tanzania. Sugar cane area harvested is projected to increase at an annual rate of 4.84 percent. Yields are projected to go from 71 ton per ha in 2008 to 114 ton per ha in 2017. The projection indicates an overall production increment by 6 095 kt. Yields explained around 83.9 percent of the increase in production.

More than 75 percent of sugar cane goes into production of sugar with the remainder used for molasses production, for which some molasses is assumed to produce ethanol for non-fuel uses (potentially human consumption). There is no projected use of sugar cane for biofuels in the baseline.

The growth in sugar-cane production directly causes sugar production to increase by 348 kt. However, consumption of sugar in Tanzania is projected to increase annually at 4.48 percent, which represents an increase of 284 kt. With production growth outpacing consumption growth, Tanzania decreases its net imports by 55 kt by 2017.

Palm oil

Production of palm oil is assumed to grow from approximately 6 to 7 kt throughout the projection period. There is no trade information for Tanzania in this commodity. Palm oil and oilseeds' oil are estimated but are then aggregated into the vegetable oil market. Tanzania produces a relatively small amount of vegetable oil. The domestic supply of vegetable oil is projected to increase by 1 kt by 2017 and is directly from increased palm oil production.

Total consumption of vegetable oil is from food use and with strong income and population growth, consumption increases by 218 kt by 2017. With little increases in production Tanzania increases net imports by 214 kt for a total of net imports of 511 kt by 2017.

Jatropha

There is no jatropha production during the Outlook period.

Biofuel

The baseline projection assumes no production of biofuels from ethanol and biodiesel. However, it is assumed that there will be production of ethanol, but only for other uses such as human consumption.

TABLE 6.1

Main commodity highlights

Main commodity highlights of 2008 vs 2017 (kt, thousand tonnes)									
	2007	**2017**	**Change**	**%**		**2007**	**2017**	**Change**	**%**
Coarse Grains					**Root & Tubers**				
Production	4 283	5 141	858	20%	Production	8 879	10 130	1 251	14%
Consumption	4 008	5 044	1 037	26%	Consumption	8 887	10 130	1 243	14%
Net Trade*	365	74	-291		Net Trade	0	0	0	
Rice					**Wheat**				
Production	806	1 214	408	51%	Production	64	100	36	56%
Consumption	905	1 304	399	44%	Consumption	434	651	217	50%
Net Trade	-99	-93	6		Net Trade	-270	-554	-284	
Sugar					**Vegetable Oil**				
Production	286	634	348	122%	Production	15	16	1	9%
Consumption	516	800	284	55%	Consumption	310	528	218	70%
Net Trade	-223	-168	55		Net Trade	-297	-511	-214	

**Positive net trade implies a net exporter and negative implies net importer*

6.2 BIOFUEL PRODUCTION IN TANZANIA

6.2.1. ETHANOL FEEDSTOCK

The two feedstocks identified for ethanol production were sugar cane and cassava:

Sugar cane

The expansion of sugar-cane production for ethanol is assumed to come from a development of outgrower schemes, whereby both smallholders and commercial ethanol plantations will provide the feedstock for ethanol production. This expansion of sugar-cane area harvested for ethanol is assumed to reach 66 000 ha by 2017. The yields will gradually increase from 71 ton per ha to 114 ton per ha by 2017 as specified by the baseline. Sugar cane for ethanol production thus is estimated to be about 7.5 million tons by 2017. The conversion factor for sugar cane to ethanol used in the analysis was 69 litres per ton and is based on simulations carried out in Module 2. Molasses from sugar production is also used for ethanol production in the baseline, but this is assumed for non-biofuel markets and is held relatively constant throughout the scenarios as stakeholders indicated they were not planning to increase use of molasses for ethanol production.

Cassava

An expansion of cassava production for ethanol production is also analysed. It is assumed to come from a development of outgrower schemes, whereby cassava comes from smallholders and commercial plantations associated with the ethanol plants. The expansion from outgrowers as well as commercial will each be 50 000 ha by 2017. This will result in an additional 100 000 ha of new cassava area. The yields from smallholders are assumed to be 6 ton per ha from 2009 to 2011 and then increase to 9 ton per ha for the remainder of the projection period. The yields for outgrowers are assumed to be 17 ton per ha from 2009 to 2011 and then to be 20 ton per ha thereafter[13]. This will result in the production of additional 1 450 kt of cassava for ethanol production.

6.2.2 BIODIESEL FEEDSTOCK

The two feedstocks that are considered for biodiesel production include jatropha and palm oil.

Jatropha

The expansion of jatropha production is solely envisioned for its use in biodiesel production. The area devoted to jatropha is expected to reach 126 000 ha by 2017. The yield is assumed to gradually increase from 0 in 2008-09 to 2 tons per ha by 2010, then to 3 tons per ha by 2011 and to 4 tons per ha by 2012-2017. This corresponds to approximately 470 kt of jatropha oil by 2017.

Palm oil

Palm oil expansion is to take place both in small farmer and commercial sites, whereby yields for irrigated commercial sites are assumed to reach 27 tons per ha and rain fed smallholders' yields to reach 9 tons per ha by 2017. The total land expansion goes from a base of 2 000 ha in 2008 to 22 000 ha by 2017, which represents an increase of 20 000 ha. This corresponds to an increase of 414 kt of palm oil by 2017.

6.2.3 LAND EXPANSION DEVOTED TO BIOFUELS

Tanzania has the capacity to expand agricultural production through utilizing new land bases and increasing yield productivity, especially for biofuel feedstock. This along with its

13 Yields were defined from data on the Cassava Value Chain Report

preferential access to the EU market through the Everything-But-Arms (EBA) initiative, attracts potential investment for biofuel development. To this end, foreign investors have expressed interest in producing biofuels in Tanzania. This situation has led to investors and the Government of Tanzanian to explore what lands might be available to produce biofuel feedstock. With respect to land availability, information provided by the stakeholders form the basis for assumptions regarding land devoted to producing biofuel feedstock. This represents actual agricultural land expansion and is assumed to come from lands that are not currently utilized, therefore, this would represent an increase in area harvested compared to the baseline. The total land identified by for possible biofuel feedstock production is approximately 314 000 ha. The following section, 6.3 Scenario development, gives details on the assumptions on land by biofuel feedstock, yields and conversion factors for biofuels derived from the discussions with stakeholders.

6.2.4 THE GOVERNMENT BLENDING MANDATE FOR BIOFUELS IN TANZANIA

The Government of Tanzania does not have as yet an established policy on biofuels. To this end, the only clear action is that the Ministry of Energy (MOE) has been given the legislative authority to set up biofuel blending mandates. The MOE has only expressed a mandate range from 0 percent to as much as 20 percent. In Tanzania the main transport fuels are gasoline and diesel, with the latter representing the largest share. Ethanol and biodiesel would both be a part of a biofuels policy. In consultation with the country teams and national experts it has been proposed to analyse the impacts of a biofuels blending mandate of 10 percent for ethanol and 5 percent for biodiesel. The blending mandates are assumed to come into effect by 2011. Table 6.2 shows the amount of ethanol and biodiesel needed to meet the mandate between 2011 and 2017.

TABLE 6.2

Amount of biofuels required to meet the government blending mandates

Biofuel (Million Litres)	2011	2012	2013	2014	2015	2016	2017
Ethanol	37	39	41	43	45	47	49
Biodiesel	44	46	48	49	51	53	55

6.3 SCENARIO DEVELOPMENT

The scenarios were set up based on scale of production, a combination of domestic demand deriving from domestic biofuel mandates and land expansion due to international investors (see Table 6.3).

TABLE 6.3
The scenarios used in the analysis

Scenario Description	Features
Scenario 1: Biofuels mandate and no land expansion devoted to biofuels	- Biofuel Consumption Mandate of 10% ethanol and 5% diesel - Ethanol Production from 50% sugar cane and 50% cassava - Biodiesel Production from 80% vegetable oil and 20% jatropha - No land expansion except for jatropha
Scenario 2: Land expansion solely for biofuels and government blending mandate	- Biofuel Consumption Mandate of 10% ethanol and 5% diesel - Land expansion solely for biofuel feedstocks: - 66 000 ha sugar cane - 50 000 ha cassava - 126 000 ha jatropha - 20 000 ha palm oil
Scenario 3: As Scenario 2 above with lower oil prices	- Oil prices in 2008 are lined up to actual prices observed in 2008 at USD99 per barrel then reduced to USD68 per barrel in 2017 - Average decrease in oil prices approximately -35% (exception is 2008).

Further, considering that biofuels and crops are sensitive to changes in oil prices, sensitivity analysis to lower oil prices is also included in the analysis. The results from scenarios are then compared with the Tanzanian outlook, which serves as the baseline.

6.3.1 SCENARIO 1: BIOFUELS MANDATE AND NO LAND EXPANSION FOR BIOFUELS[14]

This scenario analyses the implementation the biofuels mandate of 10 percent ethanol and 5 percent diesel, whereby the production of biofuels to meet this mandate must come from feedstocks that are currently produced on the existing land base from the baseline. For ethanol it is assumed that 50 percent of the required amount will come from sugar cane and 50 percent from cassava. With respect to biodiesel, 80 percent will come from jatropha and 20 percent from palm oil. Considering that jatropha production is already being planted, as indicated from consultations with Tanzania, the scenario does allow expansion of land but only for jatropha. This scenario shows the possible impacts of a biofuels policy and its corresponding effects on the commodity supply-disposition of the major commodities and implications for food security if additional land expansion solely for biofuel feedstock is not realized.

14 The exception here is that jatropha was not in the baseline but will be a key feedstock for biofuels, so there is land expansion only for jatropha as it is strictly a biofuel feedstock and not a food crop.

6.3.2 SCENARIO 2: BIOFUELS MANDATE WITH LAND EXPANSION SOLELY FOR BIOFUELS

This scenario shows the impacts of both developing biofuels from land expansion and the implementation of government blending mandate on Tanzania's biofuel market. It shows how much biofuels would be produced, consumed and exported as a result of the land expansion and blending mandate.

6.3.3 SCENARIO 3: BIOFUELS MANDATE WITH LAND EXPANSION SOLELY FOR BIOFUELS AND LOWER OIL PRICES

Projection for oil prices used in the 2008-2017 Outlook was based on rather high prices. The Outlook assumed prices would go from USD90 per barrel in 2008 to as high as USD104. However, new published data from the OECD that takes into consideration the recent economic slow down, indicates that oil prices will be lower than previous projection. This projection ranges from USD99[15] per barrel in 2008 to USD68 per barrel in the final projection year. This scenario shows how lower oil prices could impact Tanzanian's agricultural markets. Scenario 3 is benchmarked or compared to Scenario 2 because the objective of this scenario was to evaluate how changing oil prices would impact both agricultural and biofuel markets. To observe these changes requires using Scenario 2 as the benchmark as it has the same level of prices, production, consumption and trade for Tanzanian agricultural markets as the Tanzanian baseline and the only difference between the baseline and Scenario 2 is the biofuels market.

6.4 DISCUSSION OF SCENARIO RESULTS

6.4.1 SCENARIO 1: BIOFUELS MANDATE AND NO LAND EXPANSION FOR BIOFUELS

The biofuels mandate requires approximately 49 million litres of ethanol by 2017, whereby 50 percent would be produced from sugar cane and 50 percent from cassava. With a conversion factor of 183 litres of ethanol per ton of cassava, implies that by 2017 over 132 kt of cassava is required for ethanol production. Likewise, with a conversion factor of 69 litres per ton of sugar cane, implies that by 2017 over 351 kt of sugar cane will be needed for ethanol production. In terms of how this impacts Tanzania's sugar market is that 351 kt less sugar cane is processed to be sugar and/or molasses, which corresponds into 25 kt less sugar produced. Considering that Tanzanian agricultural markets are assumed to be characterized by the small country price taker assumption (domestic prices are determined by world prices and net trade position) sugar prices remain basically unchanged in reference to the baseline; therefore, consumption of sugar remains the same also because prices do not change[16]. Ultimately, as consumption remains the same but production of sugar decreases with sugar

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15 The world price of oil for 2008 was USD99 per barrel and this actual market value was used in this scenario instead of the baseline projection of USD90 and it is thereafter from 2009-2017 that a lower oil price was used for the scenario.

16 The model result is that domestic prices do not change because there is no significant impact on net trade, which could impact prices for the country. However, increased demand in local markets where biofuel production takes place could lead to small price increases for some commodities in local markets, but overall these are likely to be small. If Tanzania markets are efficient then arbitrage will take place and the small country price taker assumption is valid.

cane being diverted to ethanol production, imports of sugar have to increase by 25 kt to meet domestic demand. This means that by 2017 net trade of sugar decreases from -168 kt to -193 kt, which corresponds to a 15 percent decrease. Tanzania could avoid this increase of imports of sugar if yields of sugar cane were to average 81.15 tons per ha with an increased acreage of 4.33[17] thousand ha by 2017. Although this only represents a 5.4 percent increase in acreage compared to the 2017 projection of 79.5 thousand ha, it represents a 20 percent increase if compared to the 2007 acreage of 21.7 thousand ha.

In terms of the market implications from ethanol production using cassava, the story is different because of the fact that roots and tubers are not a traded commodity and therefore, the ethanol demand for cassava will displace food use. To produce 24.3 million litres of ethanol 132 kt of cassava will be needed and this directly displaces 132 kt of food use of cassava, which represents only a reduction of 1.5 percent in 2017. Although the production of ethanol from cassava does displace some cassava that is normally consumed as food, it is relatively a small impact on the overall total consumption. However, it may be a small impact at the country level, but the impact could be very acute at a local level where the ethanol production takes place. It is quite possible that at this local level many people could be adversely impacted by incurring a significant reduction in food availability. A pertinent question will be whether the revenue earned from selling cassava to an ethanol plant will be sufficient to purchase other food crops to offset the reduction. Not only is it a question of sufficient revenue, but also the ownership of the cassava and distribution of the revenue. If it is subsistence farmers' selling their production to the ethanol plant then it is likely they will be able to purchase other foodstuffs to replace this production, otherwise why would they sell the cassava in the first place. However, if the cassava production is owned by landowners then it is uncertain whether farm workers who normally consume the cassava would be compensated sufficiently to purchase other foodstuffs. Again, if Tanzania wanted to avoid food displacement from ethanol production, if farmers could average yields of 7 tons per hectare then by 2017 there would only be a need of an additional 18.9 thousand ha of cassava. This represents only an increase of 1.5 percent in an area harvested for roots and tubers in 2017.

The government blending mandate of 10 percent for diesel would require 55 million litres of biodiesel by 2017, whereby it is assumed 80 percent would be from jatropha oil and 20 percent palm from palm oil. Regardless of which feedstock is used to produce biodiesel the conversion factor for vegetable oil to biodiesel is 1 175 litres of biodiesel per ton of vegetable oil. Considering the assumption that 80 percent of biodiesel will use jatropha as a feedstock then it implies that 44 million litres of biodiesel will be needed and consequently, this translates into approximately 80 kt of jatropha oil. To meet this production level Tanzania would need to average 3 tons of oil per hectare for yields and

17 The average yields required is applied only to the increased area harvested that is necessary to offset the increased demand for the commodity in question and this does not represent the average yield that is projected in the baseline.

would need 26.8 thousand hectares of jatropha. As indicated previously, the baseline assumed there was no production of jatropha, so this implies a significant increase of jatropha acreage and production.

The 20 percent assumption of biodiesel production from palm oil would require 11 million litres of biodiesel, which translates into approximately 9.4 kt of palm oil by 2017. This represents an increase in vegetable oil demand and given that production of vegetable oil remains unchanged as prices remain relatively unchanged, this causes imports of vegetable oil to increase by 9.4 kt and net trade decreases to a total of -520 kt. Considering that Tanzania already imports a considerable amount of vegetable oil the additional 9.4 kt is relatively insignificant as it only represents an increase of 1.8 percent over the baseline. However, relating this demand increase of 9.4 kt to domestic production implies that domestic production would have to increase by 58 percent compared to its baseline projection of 16 kt in 2017. To avoid increasing imports Tanzania would have to average yields of 10 tons per hectare and need an additional 0.94 thousand ha of palm oil production.

6.4.2 SCENARIO 2: BIOFUELS MANDATE WITH LAND EXPANSION SOLELY FOR BIOFUELS

The introduction of 314 000 hectares of additional land strictly devoted to biofuels production results in 1 495 million litres of biofuel being produced in Tanzania by 2017. Table 6.4 shows the planned area expansion by feedstock and Table 6.5 displays the amount of biofuel produced from each feedstock:

TABLE 6.4
Land expansion for biofuel feedstock

Land Expansion for Biofuel Feedstock, thousand hectares									
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sugarcane	3.0	8.0	13.0	18.0	**27.3**	36.7	46.0	56.0	66.0
Cassava	7.1	19.6	32.1	44.6	57.1	69.6	82.1	94.6	100.0
Jatropha	0.0	22.6	35.1	51.4	66.6	80.7	95.9	111.1	126.3
Palm oil	0.0	9.5	15.8	17.0	18.3	19.5	20.8	22.0	22.0
Total	10.1	59.8	96.0	131.0	**169.3**	206.6	244.8	283.7	314.3

For jatropha and palm oil acreage in the above table, the numbers represent actual harvested acreage. In the case of biodiesel production it does not start until 2010 because of the natural production cycle of both jatropha and palm oil where it takes several years before the crops can be efficiently used for cultivation.

TABLE 6.5
Tanzania biofuel production

Tanzania Biofuel Production, million litres									
	2009	2010	2011	2012	2013	2014	2015	2016	2017
Ethanol	46.8	99.2	160.8	252.5	364.6	486.9	593.2	709.8	800.2
Sugarcane	24.5	50.6	85.9	126.7	205.5	294.6	367.6	451.0	534.4
Cassava	22.3	48.6	75.0	125.9	159.1	192.3	225.5	258.8	265.8
Biodiesel	0.0	55.4	276.9	437.9	523.3	593.2	631.5	669.8	694.8
Jatropha	0.0	18.7	43.4	84.8	109.8	133.2	158.3	183.3	208.3
Palm oil	0.0	36.7	233.5	353.1	413.5	460.0	473.2	486.5	486.5
Biofuel	46.8	154.6	437.8	690.4	887.9	1 080.2	1 224.7	1 379.5	1 495.0

Initially, sugar cane and cassava produce practically the same amounts of biofuel, but larger increases in expected yields of sugar cane leads to a larger share of ethanol production from sugar cane (approximately 67 percent by 2017). For biodiesel, the yields for oil from palm production are substantially higher than jatropha and consequently, palm oil contributes to a larger share of biodiesel production (approximately 70 percent by 2017).

With land expansion there is obviously increased production of sugar cane, cassava (roots and tubers), jatropha and palm oil compared to the baseline. However, the assumption that the increased production is solely for biofuel production translates into increased demand exactly equaling increased supply and therefore, no impact on net trade for these crops. The commodity-supply disposition of Tanzania's agricultural commodity markets do not then exhibit any change from the baseline. But the biofuel markets obviously do exhibit impacts in production, consumption and net trade (see Annex for changes in supply and disposition of key commodity markets). Table 6.6 shows biofuels supply and disposition from 2009 to 2017.

TABLE 6.6
Tanzania Biofuels Supply-Disposition

Tanzania Biofuels Supply-Disposition, million litres									
Ethanol	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Production	66.5	119.1	180.5	271.0	383.0	505.4	611.8	728.5	818.9
Biofuel Use	31.3	31.5	68.5	70.7	72.9	75.0	77.2	79.4	81.6
Other Use	31.0	31.3	31.5	31.7	32.0	32.2	32.4	32.6	32.9
Net Trade	35.2	87.6	112.1	2 003	310.2	430.4	534.6	649.1	737.3
Ethanol									
Production	0.0	55.4	276.9	437.9	523.3	593.2	631.5	669.8	694.8
Biofuel Use	0.0	0.0	43.7	45.6	47.5	49.5	51.4	53.3	55.2
Net Trade	0.0	55.4	233.2	392.3	475.8	543.8	580.1	616.5	639.6

Ethanol production reaches 818 million litres by 2017 and the blending mandate translates into 81.6 million litres for biofuel use and other use remains fairly constant at approximately 32 million litres. Tanzanian ethanol production is much larger than domestic demand, which translates into 737 million litres of ethanol that are exported. The story is analogous for biodiesel where production reaches almost 695 million litres and the blending mandate only requires 55 million litres by 2017, which means approximately 640 million litres of biodiesel is surplus to the domestic market and is exported. Total biofuel exports for Tanzania in 2017 would be 1 376 million litres, which means that it would be a significant player in world biofuel markets. Probably the dominant destination export market for Tanzania would be the EU because of its preferential access through the EBA, but other African countries would be in similar positions and Tanzania would need to position itself as cost efficient producer to be competitive in world markets.

6.4.3 SCENARIO 3: BIOFUELS MANDATE WITH LAND EXPANSION SOLELY FOR BIOFUELS AND LOWER OIL PRICES

Implementing lower oil prices into the model shows how agricultural and biofuel markets are sensitive to changes in oil prices. Firstly, lower oil prices cause the demand for biofuels to decrease because of the substitution effect and it results in lower biofuel prices. This ultimately leads to lower biofuel profitability and a decrease in demand for biofuel feedstock such as maize, sugar, wheat, and vegetable oil, especially in countries that export and import into world markets such as Brazil, the European Union and the United States. These decreasing demand side impacts put downward pressure on world crop prices and reflect the new relationship between oil (energy) markets and agricultural markets. However, the traditional relationship of oil prices and supply side impacts still occur, whereby lower oil prices and related fertilizer prices[18] reduce crop costs of production. These reductions in costs cause an increase in crop production profitability and consequently, most world producers respond by increasing production. World supply increases and this also puts downward pressure on crop prices. Even though lower crop prices will negatively impact crop profitability, the relatively larger reduction in crop input costs from lower oil prices still results in overall increased crop profitability. Of course after the initial shock, it takes one to two years before the full impact is felt as crop production characterized by time lags, and likewise, lower prices also cause increased demand. The interactions of supply and demand interact simultaneously and determine a final equilibrium and in this case, this results in lower world commodity prices. Table 6.7 shows the decrease in world crop prices that are particular to Tanzania.

18 Fertilizer prices are highly correlated to energy prices, especially natural gas, and tend to move in tandem.

TABLE 6.7
Change in world commodity prices from lower oil prices

% Change in Commodity Prices from lower oil prices											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average
Oil	10.4	-33.3	-34.1	-34.6	-34.6	-34.6	-34.6	-34.6	-34.6	-34.7	-29.9
Maize	1.6	-3.4	-15.5	-19.1	-15.5	-12.7	-14.3	-16.8	-16.8	-15.6	-12.8
Wheat	1.1	-1.9	-11.2	-14.8	-11.0	-7.7	-9.2	-11.8	-11.9	-10.7	-8.9
Oilseeds	2.8	-7.0	-17.0	-18.9	-13.2	-12.8	-14.9	-15.2	-15.2	-15.3	-12.7
Rice	3.6	-9.8	-20.1	-18.6	-12.5	-11.7	-14.9	-16.7	-15.8	-14.6	-13.1
Veg Oil	2.6	-5.9	-12.3	-14.6	-13.5	-13.5	-14.5	-15.1	-15.6	-16.0	-13.4
Sugar	2.0	-8.1	-9.4	-10.3	-11.0	-10.4	-9.5	-9.3	-9.7	-10.2	-8.6

The linkage of Tanzanian to world agricultural commodity markets means that Tanzanian producers and consumers respond accordingly to these lower prices. Lower crop production costs increase production, while lower commodity prices increase consumption, the net effect depends on the relative elasticities of supply and demand for Tanzania. Tanzania has lower elasticity (supply response to prices) than developed countries probably because their producer's ability to expand production is more limited (i.e. production technology, access to fertilizer to increase yields, use of marginal land with mechanized agriculture, etc.). However, Tanzanian consumers are more sensitive[19] (more elastic) to changes in commodity prices than developed countries' consumers, and therefore, Tanzania might have a relatively larger demand response. The net effect on trade will depend on these relative elasticities of supply and demand. The following discussion of results reports the average percentage change from Scenario 3 compared to Scenario 2 from 2008-2017, but it is important to keep in context that it is a percentage of the initial absolute value. For this reason the absolute net impact on net trade for each main commodity is also presented to provide context. To observe the changes supply and disposition in commodity markets from year to year please see the Annex for further details.

Total Area Harvested

The lower oil prices and associated lower input costs cause Tanzania producers to expand and cultivate more land to capitalize on increased profitability. Total area harvested on average increases by 4.6 percent, which represents an increase of 321 000 hectares on average,

19 It has been well documented in the agricultural economic literature that developing countries crop supply elasticities are smaller and demand elasticities are higher than developed countries.

but by 2017 there is a 421 tha increase in area harvested compared to the baseline.

Coarse Grains

Initially, coarse grain production increases faster than consumption and Tanzania exports more coarse grains but by 2011 both food and feed consumption increase more and by 2017 Tanzania exports of coarse grains decrease compared to the Scenario 2. The average (2008-2017) increase in production was 3.4 percent, consumption 4.0 percent and net exports decreased by -23.2 percent or 26 kt.

Wheat

Tanzanian wheat production increases on average by 3.8 percent, consumption increased by 3.5 percent, which leads to net trade to decrease by -3.9 percent or in other words it is importing 17 kt more than Scenario 2. This is an example of where the production percentage increase is larger than the consumption percentage increase, but the absolute value of wheat production (2017 baseline value is 100 kt) is much smaller than the absolute value of consumption (2017 baseline value is 678 kt).

Rice

For Tanzania, rice production is relatively less sensitive to changes in oil-related input costs and production only increases on average by 2.1 percent. However, food consumption is sensitive to lower prices and consumption increases by 4.7 percent. The impact on net trade is a further decrease in net trade by 30 percent or imports increase on average by 29 kt.

Roots and Tubers

Considering that roots and tubers production is mostly for subsistence purposes and is assumed not to be a traded commodity, any increase in production would exactly be offset by the increase in consumption. Lower input costs causes roots and tubers' production to increase on average by 11.5 percent and consumption increases by the same amount. This 11.5 percent increase in production is up and above the amount of increased roots and tubers' production used for biofuels, as Scenario 2 already had this increased acreage. Total production reaches 13 338 kt by 2017.

Sugar

Lower sugar prices directly cause production of sugar to decrease by 0.7 percent, but consumption increases by on average by 1.4 percent and consequently, Tanzania net trade decreases by 7.6 percent or imports increase by 13.1 kt.

Vegetable Oil

Tanzanian vegetable oil production only decreases marginally on average by 0.05 percent because most palm oil production is relatively insensitive to changes in costs of production related lower oil prices. This is mostly due to the fact that palm tree production is perennial in nature. Also, another consideration in the vegetable oil market is that most of palm oil production is for food use, whereas all of the jatropha production is used for biofuels and oilseeds oil production is relatively small. All of these factors basically contribute to the result that vegetable production only decreases very slightly. However, lower vegetable oil prices do cause an average increase in consumption of 1.5 percent. The increase in consumption and slightly lower production causes net trade of vegetable oil to decrease by 2.5 percent or 11 kt.

Biofuel Markets

Table 6.8 shows how biofuel profitability is impacted by lower oil prices in Scenario 3. In terms of the biofuel markets, the assumption for Tanzania is that the land expansion is solely for producing biofuel feedstock for biofuel production, so there is no change in the production of biofuels. There is also no change in the consumption of biofuels considering that the consumption is determined by a government mandate. However, to understand how changes in oil prices impact biofuel profitability a comparison of ethanol sugar-cane profitability and biodiesel vegetable oil profitability are analysed for both the baseline and Scenario 3, which has lower oil prices. Profitability calculations for biofuels are determined by taking the biofuel wholesale price and subtracting net processing costs and capital costs for biofuel production. Net processing costs reflect the actual cost and processing of the biofuel feedstock (sugar cane or vegetable oil) into biofuel, but it also takes into account any by-product revenue[20] from the production process. At the time of developing the AGLINK-COSIMO model an actual production cost for biofuels did not exist in Tanzania and accessing this information had been difficult. The model bases the production cost for ethanol from the global LMC International Starch and Fermentation 2007 Report and used standard industry averages for biodiesel in terms of processing costs and conversion parameters. Biofuel prices for Tanzania are determined as other commodities in the model and are linked to world biofuel prices through a price transmission equation. The Brazilian export price for ethanol is used as the world reference price and adjusted for transport cost and the EU biodiesel price is used as the world reference price for biodiesel. An important characteristic to remember about biofuel prices is that in the absence of consumption mandates that biofuel prices are determined by their relative net energy equivalent in relations to gas and biodiesel and the relative price level of oil or fuel prices. For ethanol it has approximately 67 percent of the energy content compared to gasoline and biodiesel has approximately 89 percent energy content compared to diesel. It is important to understand that these are projections for biofuel profitability and estimates are contingent on the parameters used in the calculations. The parameters used in the model are constant over time, such as fixed levels of quantities of inputs to output relationships, and these relationships could change over time. It is quite possible that biofuel profitability could be different

20 For ethanol production where by-products are produced, such as dried distilled grains from grain ethanol production, these by-products can be sold into feed markets and are a revenue source for ethanol production. In the case for Tanzania there is no information on by-product markets for sugar cane or roots and tubers in ethanol production, so this value is 0. Likewise, biodiesel production from vegetable oil can produce glycerine as a by-product but there is no market information and this value is treated as 0 in the model.

in Tanzania under different assumptions on prices or production technology. However, generally the biofuel profitability indicators used in the model do provide a picture of profitability for countries linked to world commodity prices and technology currently employed in biofuel producing countries.

TABLE 6.8
Biofuel profitability

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Oil	**USS/barrel**									
Baseline	90.0	90.0	91.1	92.8	94.6	96.4	98.2	100.1	102.0	104.0
Scenario 3	99.3	60.0	60.0	60.7	61.9	63.1	64.3	65.5	66.7	67.9
Change	9.3	-30.0	-31.1	-32.1	-32.7	-33.3	-33.9	-34.6	-35.3	-36.1
Ethanol	**tsh**									
Baseline	31 117.4	31 656.2	10 261.8	-19 084	-6 304.1	-4 060.0	-5 312.4	-6 634.6	-6 458.1	-3 845.6
Scenario 3	35 678.9	-631.1	-5 444.3	-8 262.6	-12 445.2	-10 911.1	-11 891.2	-11 781.9	-11 152.4	-10 091.9
Change	4 561.5	-32 287.3	-15 706.1	-6 354.2	-6 141.1	-6 851.1	-6 578.9	-5 147.3	-4 694.3	-6 246.4
Biodiesel	**tsh**									
Baseline	-46 300.9	-42 787.5	-47 080.9	-55 831.9	-61 875.9	-67 243.2	-72 719.4	-78 291.3	-86 400.8	-94 639.9
Scenario 3	-44 102.9	-47 809.9	-55 103.9	-61 982.7	-68 867.3	-75 177.8	-80 372.3	-85 961.8	-93 993.6	-102 982.2
Change	2 198.3	-5 103.3	-7 933.0	-6 150.9	-6 991.4	-7 934.6	-7 652.8	-7 670.5	-7 592.8	-8 342.3

6.4.3.1 BIOFUEL ECONOMIC PROFITABILITY UNDER LOWER OIL PRICES[21]

In the context of the baseline it can be seen that ethanol is only profitable from 2008 to 2010 when oil prices were projected to be relatively high and when sugar-cane prices were relatively low. However, as demand for sugar/sugar cane (food and ethanol) increases relatively faster than oil prices, then ethanol profitability decreases throughout the rest of the projection and is actually negative from 2011 to 2017. The profitability situation even becomes worse in Scenario 3 with lower oil prices as negative margins first appear in 2009 where oil prices fall from USD90 to USD60 per barrel. Lower oil prices cause ethanol prices to decrease and although sugar-cane prices decrease also, it is not as much as ethanol prices, therefore, there is a further deterioration of ethanol profitability into further negative margins for Scenario 3. However, under the EBA Initiative there is the possibility that Tanzanian would have access to the lucrative EU biofuel market tariff free, which would mean the price linkage would be to the EU ethanol market. The EU ethanol market is protected by relatively high tariffs and the domestic ethanol price is much higher than the

21 It is only possible to present the implication of lower oil prices on the economic profitability of biofuels for the cases of ethanol from sugar cane and biodiesel from vegetable oil due to the structure of the AGLINK-COSIMO model.

Brazilian export price, thus this linkage would improve ethanol revenues and profitability. Another consideration would be ethanol profitability from using cassava. At the time there was not sufficient information on production costs and processing to develop equations in AGLINK-COSIMO for ethanol production from cassava. Preliminary results from Module 2 show that cassava could be more profitable than sugar cane.

Biodiesel production profitability that uses vegetable oil indicates the margins would be negative throughout the baseline and even become worse under Scenario 3 with lower oil prices[22]. This is not surprising considering that the vegetable oil price used in the model reflects a vegetable oil price that is used for food use. This price would be analogous to any vegetable oil that is produced from palm oil, maize or oilseeds such as soybean, canola, or sunflower. Vegetable oil has a relatively high price level compared to other agricultural commodities. It is because of the high cost of food-grade vegetable oil that has caused biodiesel refineries to search for cheaper sources of feedstock such as tallow (i.e. animal fat), algae and other varieties of oilseeds that produce lower quality vegetable oils. Jatropha production and processing costs were not available to include in the model at the time of the baseline. If oil produced from jatropha presents lower feedstock costs then biodiesel profitability could substantially increase. As in the case for ethanol where revenues increase through access to higher ethanol prices in the EU, biodiesel revenue would also increase if Tanzania is granted access to the EU biodiesel market.

6.5 GLOBAL BIOFUEL SUPPORT

As forementioned, existing global policies and any additional support for biofuels have important implications to biofuel and agricultural commodities worldwide. Full implementation of future policy developments such as the recently enacted US Energy Independence and Security Act (EISA)[23] or the proposed new EU Directive for Renewable Energy (DRE) among others can have a substantial implication in the production and use of both ethanol and biodiesel. As agricultural commodity prices escalated in 2008 and 2009 there was a considerable amount of accusations that biofuels were a significant factor for the escalation in prices. Many non-government organizations called on governments worldwide to re-think their biofuel policies and its implications on food security. Some governments responded to say that biofuel policies might have to be re-considered in terms of food security and environmental sustainability. This displays the policy risk around existing biofuel markets as without government support some biofuel production would be unprofitable and furthermore, regulations or policies regarding sustainability issues might govern some biofuel markets, which further represents another example of policy

22 The exception is for 2008 when a higher oil price was used to reflect the actual market price rather than the original projection from the baseline.

23 The Energy Independence and Security Act of 2007 established a 136 billion litres Renewable Fuel Standard (RFS) until 2022. While maize based ethanol constitutes the main biofuel in the coming decade and is to increase to 56.8 billion litres until 2015, other biofuels explicitly mentioned include cellulosic biofuels as well as biodiesel. The blending of biodiesel into fossil diesel is required starting with 1.9 billion litres by 2009 and to increase to at least 3.8 billion litres by 2012.

risk. To reflect this foreign policy risk for Tanzania the following discussion highlights analysis conducted by the OECD in the publication: "Biofuel Support Policies: An Economic Assessment", which analysed the impacts of various biofuel policies worldwide. Firstly, the analysis looks at the removal of existing biofuel policies, then, secondly looks at the implications of the new increments in biofuel policy reflected in the US's EISA and the EU's DRE.

6.5.1 REMOVAL OF EXISTING BIOFUEL POLICIES

A removal of the existing[24] biofuel support policies taken into account in this analysis would significantly reduce medium-term biofuel use in major biofuel consuming regions. This decreased world demand for biofuel feedstock would cause a reduction in world crop prices, which are consequently transmitted to Tanzania's domestic prices. The reduction in domestic prices induces changes to demand and supply, where demand increases and supply decreases and both negatively impact net trade. The relative size of the impact will depend on the relative demand and supply elasticities for each commodity. Table 6.9 shows the impact on world prices and the net impact on net trade for Tanzania's main food crops.

TABLE 6.9

Changes in world commodity prices from removing existing biofuel support policies

Elimination of World Biofuel Support Policies											
World Prices % Δ	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Average**
Maize	-2.2	-3.3	-4.2	-4.7	-5.2	-5.9	-6.2	-6.6	-7.1	-7.2	-5.3
Wheat	-0.8	-2.8	-4.1	-4.5	-4.6	-4.6	-4.9	-5.2	-5.1	-5.0	-4.2
Oilseeds	-2.8	-2.9	-2.1	-2.2	-2.7	-3.1	-3.4	-3.5	-3.4	-3.4	-2.9
Rice	-0.1	-0.4	-0.8	-0.8	-0.7	-0.7	-0.8	-0.8	-0.8	-0.8	-0.7
Veg. Oil	-9.1	-14.2	-14.9	-14.6	-15.1	-15.6	-15.8	-15.9	-15.8	-15.8	-14.7
Sugar	-1.2	-1.0	-0.2	0.8	1.8	2.1	2.1	1.9	1.5	1.0	0.9
Net Trade Δ	**Tanzania Net Trade (kt)**										
Coarse Grains	-34.7	-40.0	-60.0	-75.1	-89.1	-106.3	-115.8	-124.0	-98.4	-95.6	-83.9
Wheat	-4.7	-9.5	-3.9	-5.7	-9.0	-11.7	-15.0	-14.6	-14.0	-16.1	-10.4
Rice	-0.1	-0.9	-1.0	-1.7	-1.2	-1.2	-1.4	-1.1	-1.4	-1.9	-1.2
Veg. Oil	-6.3	-10.9	-12.3	-12.8	-14.0	-15.2	-16.2	-17.1	-17.8	-18.7	-14.1
Sugar	-2.4	-0.2	4.0	8.9	11.9	15.4	17.6	20.0	20.2	19.6	11.5
Cassava*	-0.2	11.2	18.5	22.0	24.6	27.5	31.8	35.4	37.2	31.0	23.9

**Represents change in production but this is offset by exactly same increase in consumption*

24 At the time of the OECD analysis the new EISA and EU directive were just announced so their new incremental impacts are compared in the second part of the analysis referring to first generation and second generation policies.

Vegetable oil prices have the largest percentage decrease from the elimination of biofuel support policies because it is the only biofuel feedstock used for biodiesel, whereas ethanol production uses several different feedstocks. Maize has the second largest decrease, and wheat follows closely behind. Rice has the smallest decrease because it is rarely used for ethanol production and most of the decrease is related to cross price effects. The reduction in prices causes production to decrease and demand to increase, thereby negatively impacting net trade and causing Tanzania to increase imports. For Tanzania, coarse grains incur the largest reduction in net trade and on average the country will have to import 83.9 kt more coarse grains to meet domestic demand and by 2015 Tanzania switches from a net exporter to a net importer. Likewise for wheat and vegetable oil, where net trade decreases further to be on average 10 kt and 14 kt lower respectively. Sugar prices actually increase because in Brazil more sugar cane is diverted to ethanol production because of eventual higher ethanol prices, which directly causes lower sugar production and eventually leads to slightly higher sugar prices. Roots and tubers production increases on average by 23.9 kt because it has a relatively higher return per hectare compared to the other Tanzanian crops due to the fact that the other major crops incur a higher reduction in prices compared to roots and tubers (i.e. cassava).

6.5.2 INTRODUCTION OF NEW POLICIES FOR FIRST GENERATION AND SECOND GENERATION BIOFUELS:

The new polices are the US's EISA and the EU's DRE, whereby there is an increase in the support for first generation biofuels (i.e. biofuel produced from sugar, coarse grains, wheat, vegetable oil, etc.), but also second generation biofuels (i.e. cellulosic). The impacts on the production of main food crops in Tanzania due to implementation of new programmes affecting the global supply and demand of biofuels are analysed. The introduction of new global policies supporting first and second generation biofuel production is evaluated against existing policies. New global policies that increase demand for first generation or traditional biofuel feedstock will cause an increase in world crop prices, but so will second generation biofuels. This occurs because demand for cellulosic feedstock will create further competition for arable land with traditional crops and causes a reduction in acreage planted for certain crops. The combined impact of increased world demand for first generation biofuel feedstock and increased land competition (reduces crop production) from second generation feedstock both contribute to an increase in world prices for crops. Table 6.10 shows the impact on world crop prices and the impact on net trade for the major food crops for Tanzania.

TABLE 6.10

Changes in world commodity prices from new biofuel support policies

Impact of New Incremental Biofuel Support Policies											
World Prices % Δ	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Average**
Maize	0.0	0.3	0.9	0.8	1.8	3.7	5.1	7.0	6.7	6.8	3.3
Wheat	0.0	0.2	0.4	0.5	0.7	1.4	2.2	2.9	2.9	2.9	1.4
Oilseeds	0.6	0.2	0.4	1.4	1.9	2.2	2.9	3.9	4.4	4.7	2.2
Rice	0.0	0.0	0.1	0.1	0.2	0.4	0.6	0.8	1.0	1.0	0.4
Veg. Oil	1.9	1.5	1.8	4.7	7.9	9.8	11.6	14.1	16.6	18.4	8.8
Sugar	0.3	0.1	0.3	0.6	1.0	1.2	1.4	1.7	1.9	2.1	1.0
Net Trade Δ	**Tanzania Net Trade (kt)**										
Coarse Grains	0.2	4.0	11.5	9.9	29.0	54.4	76.0	111.3	115.1	131.4	54.3
Wheat	0.0	0.9	0.9	0.2	2.2	4.5	4.9	5.7	4.8	7.2	3.1
Rice	0.0	0.1	0.1	0.3	0.6	0.9	1.3	1.2	1.5	1.5	0.8
Veg. Oil	1.2	1.0	1.3	3.6	6.3	8.2	10.0	12.5	15.2	17.5	7.7
Sugar	0.7	0.2	0.7	1.7	2.5	3.2	4.1	4.7	5.1	5.3	2.8
Cassava*	0.0	-0.8	-1.3	-3.8	-5.9	-10.2	-18.3	-27.3	-37.7	-41.2	-14.7

**Represents change in production but this is offset by exactly same increase in consumption*

The increase in world prices is transmitted to Tanzania's markets and producers react to these price changes. Relative price changes favour traditional biofuel feedstock such as coarse grains, wheat and rice, but will relatively disadvantage non-traditional biofuel feedstock such as roots and tubers because it is not used in the US or the EU for biofuels. Policies supporting ethanol production have positive impacts on Tanzania production of coarse grain because these global policies increase world prices for coarse grains, but will have negative impacts for Tanzanian consumers. Consumption decreases with these price increases and the net impact is that net trade increases on average by 131 kt by 2017. For Tanzania, by 2017 production increased by approximately 81 kt and consumption decreased by 50 kt. For most of Tanzanian agricultural commodities, the increase in world prices causes Tanzania to increase production and reduce consumption causing increases to net trade. The exception is for roots and tubers where price increases are minimal, so crop producers select to grow other crops that have incurred higher price increases. This corresponds to a reduction of 41 kt of roots and tubers' production by 2017, but this only represents a reduction of 0.4 percent of national production.

It is important that in the development of a biofuel sector in Tanzania stakeholders recognize that biofuel markets are subject to policy risk. Biofuel markets have been largely developed from government policies that help support the market. High oil prices will support the biofuel market but for the most part government policies are a significant factor explaining market growth. These policies are subject to change, in terms of consumption mandates, subsidies, and possible regulations governing environmental sustainability. The above analysis shows how crop markets are sensitive to these policy changes, and although world price changes might not seem to be large they do have impacts on consumption and production. For countries that are sensitive to changes in some staple food crops these changes can have implications for the poor and food security.

6.6 CONCLUSION

The development of biofuels offer both opportunities and challenges. It is important to understand the relationship between biofuels and agricultural markets and how this can change under different conditions. Agricultural and biofuels markets are continuously changing due to shocks such as weather, disease, oil price volatility, and sometimes even government policies. This module examines how Tanzania's agricultural markets are expected to evolve over the next several years in the absence of biofuels. Specifically, the analysis assesses the potential demand for commodities, given projected income and population growth, and the potential supply, given yield productivity and relative crop returns. Policy-makers can analyse these projections in order to determine the extent to which Tanzanian agricultural markets would be able to furnish a biofuel sector with feedstocks without impacting food security. The OECD-FAO Outlook indicates that prices for agricultural commodities are expected to be at a new price plateau when compared to historic averages. In Tanzania, coarse grain demand is expected to increase more than production, which ultimately causes lower exports. In wheat markets where production growth, at present, is fairly limited but demand growth is substantial, this could lead to a significant increase in imports. A similar situation can be expected for vegetable oil in which national demand outstrips supply and the shortfall has to be met through imports. By contrast, production growth in rice increases marginally faster than demand growth reducing net imports. Increases in sugar-cane production outweigh demand growth resulting in a significant reduction in sugar imports for Tanzania. Overall, the projections show that for some food crops Tanzania may have to rely on more imports to meet domestic demand in the absence of biofuel markets.

To understand the possible consequences of implementing a blending mandate for biofuels, a baseline model for Tanzania is set up and then the blending mandates were imposed into the model. The baseline provides a picture into the future given a set of macroeconomic and policy assumptions. It can be used to understand key relationships not only within agricultural markets, but also the linkages to biofuel markets. It should be noted that the results represent projections and not a definitive forecast. There are many factors that could cause markets to change such as adoption of new technology, climate change, trade agreements or economic shocks, which would change the outlook or picture for Tanzania.

The viability of a biofuel sector is very much linked to oil prices and international government biofuel policies. Both are subject to volatility. Lower oil prices would lead to an increase in world crop production, particularly in developed countries, and consequently this would lead to lower crop prices. The results exhibit the vulnerability of agriculture markets, especially biofuel feedstocks, to movements in oil prices. If Tanzania can use biofuel feedstocks with lower input costs or if it can successfully gain access to the EU market then biofuel production margins could be positive. With respect to foreign policy risk, the OECD analysis has shown the consequences if support policies, that is consumption mandates and production subsidies, are removed and how this would adversely impact biofuel markets and consequently, agricultural markets, particularly biofuel feedstocks. It is important to take into account this foreign policy risk if Tanzania is looking to produce biofuels to capitalize on export markets as these policies are subject to change and even sometimes foreign countries seek ways to protect their domestic markets.

In conclusion, this Module is used to show how Tanzania's agricultural markets are expected to evolve over the coming years in the absence of a biofuel market. Tanzania will have to contemplate future demands for agricultural commodities, whether it be food, fibre, or fuel and whether it has the productive capacity to meet all of these demands. Biofuels would represent a new source of demand for Tanzanian crops and could potentially offer a source of export earnings that contribute to balance of payments. However, the development of biofuels could create challenges for food security and imply increased imports, which would not only be economically inefficient but also socially undesirable. Moreover, these results are based on current productivity levels and resent a powerful argument for Tanzania to invest in improving agricultural productivity to avoid the potentially negative impacts of developing a biofuel sector. Under the current situation in Tanzania, biofuels pose risks. However, it is clear that any development of the sector ought to be accompanied by large-scale investments that can supply adequate quantities of feedstock for the industry to be viable without compromising food security.

APPENDIX 6 A

SUPPLY DISPOSITION OF THE MAJOR COMMODITIES FOR TANZANIA.

Coarse Grains											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	(thousand tonnes)										
Baseline	4 283	4 377	4 481	4 568	4 664	4 745	4 819	4 905	4 991	5 067	5 141
Scenario 1	4 283	4 377	4 481	4 568	4 664	4 745	4 819	4 905	4 991	5 067	5 141
Scenario 2	4 283	4 377	4 481	4 568	4 664	4 745	4 819	4 905	4 991	5 067	5 141
Scenario 3	4 283	4 309	4 765	4 823	4 821	4 859	4 967	5 096	5 185	5 240	5 310
Consumption	(thousand tonnes)										
Baseline	4 008	4 113	4 201	4 272	4 373	4 503	4 617	4 718	4 830	4 944	5 044
Scenario 1	4 008	4 113	4 201	4 272	4 373	4 503	4 617	4 718	4 830	4 944	5 044
Scenario 2	4 008	4 113	4 201	4 272	4 373	4 503	4 618	4 718	4 830	4 944	5 044
Scenario 3	4 008	4 088	4 264	4 485	4 644	4 724	4 793	4 915	5 077	5 206	5 291
Net Trade	(thousand tonnes)										
Baseline	365	136	143	324	314	207	181	189	140	88	74
Scenario 1	365	136	143	324	314	207	181	189	140	88	74
Scenario 2	365	136	143	324	314	207	181	188	140	88	74
Scenario 3	365	121	205	335	301	179	139	130	72	27	15
Price	(thousand tonnes)										
Baseline	204 004	230 634	231 948	243 881	266 028	283 996	302 444	329 165	358 549	386 131	416 841
Scenario 1	204 004	230 634	231 948	243 881	266 028	283 998	302 446	329 165	358 550	386 184	416 844
Scenario 2	204 004	230 634	231 946	243 874	266 010	283 954	302 391	329 111	358 467	386 009	416 700
Scenario 3	204 004	235 516	220 023	206 266	217 275	242 618	267 470	287 088	303 861	326 068	356 883

Wheat											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	(thousand tonnes)										
Baseline	64	94	95	93	93	94	95	96	97	98	100
Scenario 1	64	94	95	93	93	94	95	96	97	98	100
Scenario 2	64	94	95	93	93	94	95	96	97	98	100
Scenario 3	64	93	99	98	97	98	99	101	101	103	104
Consumption	(thousand tonnes)										
Baseline	434	455	483	504	520	541	563	587	609	630	651
Scenario 1	434	455	483	504	520	541	563	587	609	630	651
Scenario 2	434	455	483	504	520	541	563	587	609	630	651
Scenario 3	434	453	486	525	551	564	580	607	637	660	678
Net Trade	(thousand tonnes)										
Baseline	-270	-382	-369	-391	-424	-457	-470	-497	-518	-533	-554
Scenario 1	-270	-382	-369	-391	-424	-457	-470	-497	-518	-533	-554
Scenario 2	-270	-382	-369	-391	-424	-457	-471	-497	-518	-533	-554
Scenario 3	-270	-372	-407	-438	-423	-442	-487	-537	-547	-545	-571
Price	(thousand tonnes)										
Baseline	685 975	586 215	517 268	544 490	602 418	659 513	718 436	778 442	849 789	928 015	1 005 766
Scenario 1	685 975	586 215	517 268	544 490	602 420	659 519	718 444	778 446	849 791	928 018	1 005 771
Scenario 2	685 975	586 215	517 263	544 472	602 368	659 407	718 308	778 311	849 600	927 746	1 005 446
Scenario 3	685 975	592 908	507 283	483 542	513 357	587 151	662 954	706 351	749 712	817 765	898 196

Vegetable Oil											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	(thousand tonnes)										
Baseline	15	15	16	16	16	16	16	16	16	16	16
Scenario 1	15	15	16	16	16	16	16	16	16	16	16
Scenario 2	15	15	16	47	215	317	368	408	419	430	430
Scenario 3	15	15	16	47	215	316	368	407	419	430	430
Consumption	(thousand tonnes)										
Baseline	310	330	352	374	396	417	439	461	483	505	528
Scenario 1	310	330	352	374	404	425	447	470	492	514	537
Scenario 2	310	330	352	405	595	718	791	853	887	919	942
Scenario 3	310	328	356	414	606	729	803	866	901	935	959
Net Trade	(thousand tonnes)										
Baseline	-297	-314	-336	-358	-380	-401	-423	-445	-467	-489	-511
Scenario 1	-297	-314	-336	-358	-387	-409	-431	-453	-476	-498	-521
Scenario 2	-297	-314	-336	-358	-380	-401	-423	-445	-468	-489	-512
Scenario 3	-297	-313	-340	-367	-392	-413	-435	-459	-483	-505	-530
Price	(thousand tonnes)										
Baseline	1 775 266	1 762 007	1 832 587	2 011 075	2 199 396	2 423 358	2 648 150	2 890 446	3 161 052	3 455 180	3 742 354
Scenario 1	1 775 266	1 762 007	1 832 587	2 011 075	2 199 671	2 423 633	2 648 388	2 890 692	3 161 313	3 455 456	3 742 646
Scenario 2	1 775 266	1 762 007	1 832 587	2 009 988	2 195 146	2 417 264	2 641 357	2 881 750	3 151 208	3 444 475	3 731 080
Scenario 3	1 775 266	1 806 993	1 724 401	1 763 386	1 873 665	2 090 041	2 285 517	2 464 792	2 675 310	2 906 845	3 133 349

Sugar											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	(thousand tonnes)										
Baseline	286	323	328	335	398	458	524	587	601	620	634
Scenario 1	286	323	328	335	375	434	500	563	576	595	609
Scenario 2	286	323	328	335	398	458	524	587	601	620	634
Scenario 3	286	323	325	332	394	453	519	582	596	615	628
Consumption	(thousand tonnes)										
Baseline	516	545	581	608	628	652	681	708	737	767	800
Scenario 1	516	545	581	608	628	652	681	708	737	767	800
Scenario 2	516	545	581	608	628	652	681	708	737	767	800
Scenario 3	516	543	589	618	639	663	692	718	748	779	813
Net Trade	(thousand tonnes)										
Baseline	-223	-222	-251	-271	-231	-196	-161	-123	-138	-150	-168
Scenario 1	-223	-222	-251	-271	-254	-220	-185	-147	-163	-175	-193
Scenario 2	-223	-222	-251	-271	-231	-197	-161	-123	-139	-150	-168
Scenario 3	-223	-220	-264	-283	-244	-213	-177	-138	-154	-167	-167
Price	(thousand tonnes)										
Baseline	505 593	478 754	505 787	623 033	749 883	868 004	935 725	1 055 330	1 149 664	1 247 016	1 342 441
Scenario 1	505 593	478 754	505 787	623 033	750 259	868 416	936 123	1 055 714	1 150 050	1 247 394	1 342 817
Scenario 2	505 593	478 754	505 702	622 781	749 561	867 359	934 616	1 053 763	1 147 768	1 244740	1 340 008
Scenario 3	505 593	488 424	464 869	564 544	672 596	772 114	837 768	954 147	1 041 383	1 123 830	1 203 162

Rice											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	(thousand tonnes)										
Baseline	806	850	910	957	966	1 010	1 054	1 104	1 135	1 175	1 214
Scenario 1	806	850	910	957	966	1 010	1 054	1 104	1 135	1 175	1 214
Scenario 2	806	850	910	957	966	1 010	1 054	1 104	1 135	1 175	1 214
Scenario 3	806	850	957	985	972	1 019	1 078	1 135	1 163	1 202	1 249
Consumption	(thousand tonnes)										
Baseline	905	931	1 002	1 056	1 106	1 137	1 172	1 210	1 249	1 279	1 304
Scenario 1	905	931	1 002	1 056	1 106	1 137	1 172	1 210	1 249	1 279	1 304
Scenario 2	905	931	1 002	1 056	1 106	1 137	1 172	1 210	1 249	1 279	1 304
Scenario 3	905	921	1 038	1 135	1 183	1 188	1 222	1 274	1324	1 346	1 365
Net Trade	(thousand tonnes)										
Baseline	-99	-94	-122	-97	-121	-123	-123	-112	-113	-105	-93
Scenario 1	-99	-94	-122	-97	-121	-123	-123	-112	-113	-105	-93
Scenario 2	-99	-94	-122	-97	-121	-123	-123	-112	-113	-105	-93
Scenario 3	-99	-89	-150	-139	-168	-156	-159	-152	-158	-138	-122
Price	(thousand tonnes)										
Baseline	516 549	570 565	541 949	525 349	570 083	640 443	703 512	749 033	808 867	868 280	939 700
Scenario 1	516 549	570 565	541 949	525 349	570 087	640 449	703 515	749 033	808 871	868 288	939 708
Scenario 2	516 549	570 565	541 947	525 344	570068	640 401	703 443	748 970	808 793	868 169	939 549
Scenario 3	516 549	588 850	488 601	423 481	463 957	560 479	620 967	642 596	680 861	745 863	818 634

Roots & Tubers											
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Production	(thousand tonnes)										
Baseline	8 879	8 835	8 815	8 876	9 047	9 252	9 423	9 591	9 763	9 937	10 130
Scenario 1	8 879	8 835	8 815	8 876	9 047	9 252	9 423	9 591	9 763	9 937	10 130
Scenario 2	8 879	8 835	8 936	9 141	9 456	9 939	10 291	10 640	10 993	11 349	11 580
Scenario 3	8 879	8 694	9 385	10 004	10 683	11 403	11 835	12 209	12 613	13 044	13 338
Consumption	(thousand tonnes)										
Baseline	8 887	8 835	8 815	8 876	9 047	9 252	9 423	9 591	9 763	9 937	10 130
Scenario 1	8 887	8 835	8 815	8 876	9 047	9 252	9 423	9 591	9 763	9 937	10 130
Scenario 2	8 887	8 835	8 936	9 141	9 456	9 939	10 291	10 640	10 993	11 349	11 580
Scenario 3	8 887	8 694	9 385	10 004	10 683	11 403	11 835	12 209	12 613	13 044	13 338
Net Trade	(thousand tonnes)										
Baseline	-8	0	0	0	0	0	0	0	0	0	0
Scenario 1	-8	0	0	0	0	0	0	0	0	0	0
Scenario 2	-8	0	0	0	0	0	0	0	0	0	0
Scenario 3	-8	0	0	0	0	0	0	0	0	0	0
Price	(thousand tonnes)										
Baseline	448 638	464 351	475 273	525 070	580 082	640 861	708 005	782 186	864 139	954 679	1 054 323
Scenario 1	448 638	464 351	475 273	525 070	580 082	640 861	708 005	782 186	864 139	954 679	1 054 323
Scenario 2	448 638	464 351	475 273	525 070	580 082	640 861	708 005	782 186	864 139	954 679	1 054 323
Scenario 3	448 638	464 351	475 273	525 070	580 082	640 861	708 005	782 186	864 139	954 679	1 054 323

APPENDIX 6 B

TECHNICAL NOTE ON AGLINK-COSIMO

The AGLINK-COSIMO model is driven by elasticities, technical parameters and policy variables. All of the major agricultural sectors, including the biofuel sector, are connected and are integrated within the model so that all of the main characteristics of the crops and livestock sectors influence the final equilibrium. The AGLINK-COSIMO model and Outlook projections are reviewed by OECD member countries and FAO to ensure consistency and precision.

DATA SOURCES

The OECD-FAO Agricultural Outlook 2008-2017 serves as the foundation of the baseline to be used for the analysis. The Outlook relies on information from a large number of sources, including experts' judgment when necessary. Data for the model comes from information provided by national statistics sources and supplemented by external sources such as the United Nations and World Bank. This information is aimed at creating a first insight into possible market developments and at establishing the key assumptions to be used in the Outlook. In the case of developing countries agricultural data up to 2006 comes from FAOSTAT and data for 2007 is from databases managed by the Trade and Markets Division at FAO. Extension of the model to include the biofuel sector required technical data. These data came from LMC international . The technical data were used to generate a world commodity database for ethanol and biodiesel, along with country-specific baseline data on different feedstocks and their processing costs of production. An initial review of the OECD-FAO Agricultural Outlook with Tanzanian officials determined that projections for sugar-cane production were too low. Data was collected from the Tanzanian Sugar Board and projections were adjusted to reflect the higher level of sugar-cane production to form a new baseline.