Feed – Food – Fuel: A perspective for Africa

Franziska Junker

Verena Wolf

Martin Banse

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1 Introduction

Food, feed and fuel are increasingly seen as competitive uses of restricted resources. Concerns about increasing feed and fuel use at the cost of food use continue to be raised. But how much of each crop is in fact used for food, feed and fuel, globally and in African countries? And what is to be expected in the future? The answer to this question is not trivial.

Increasing purchasing power is expected to increase consumption of animal products and hence feed use. Biofuel policies encourage the use of crops for energy purposes. Increasing population will increase the overall need for food. A priori it is unclear which of the three factors will dominate.

Our paper shows how we combine different available data sources into one framework allowing the global analyses of feed, food and fuel use in a straightforward manner. It explains how we expanded the GTAP 8 database by corn and soybeans. Based on this, we elaborate a projection up to 2025. We draw a consistent picture of the importance of feed, food, and fuel use of major cereals and oilseeds today and in the future. To sharpen the analysis, we vary our policy assumption in the area of biofuel consumption and production. Against the background of global developments, we focus our analysis on the outlook for African countries, e.g. Kenya and Ethiopia.

2 Methodology

2.1 The MAGNET model

Our analysis is based on the MAGNET model (Modular Applied General Equilibrium Tool, see Woltjer, Bezlepkina et al. (2011)). MAGNET is a general equilibrium model based on the GTAP framework and was developed by LEI/WUR (Wageningen University Research Center). Enhancements include the representation of the Common Agricultural Policy (CAP) of the EU, the introduction of a land supply function, substitutability between different types of land and the representation of the biofuel sector (bioethanol and biodiesel) including the by-products oilcakes and Distiller Dried Grains with Solubles (DDGS). Due to data constraints, non-food feedstock for biofuels could not be captured.

2.2 Newcomers to the database: Corn and soybeans

We expanded the database by two additional products – corn and soybeans. We created the new sectors and commodities by splitting them off their original sectors. In the case of soybeans, the original sector is oilseeds (´OSD´ in GTAP notation), for corn it is cereal grains other than wheat (´GRO´ in GTAP notation).

Using production, consumption, import and export shares derived from various sources, we create the new sectors and commodities. Production and consumption shares were computed based on FAO data (FAO n.d.). Trade shares are based on the BACI dataset as described in Gaulier and Zignago (2010).

Using different shares results in a SAM (Social Accounting Matrix) in which the column total does not equal the total of the respective row. A number of corrections are made to smooth the imbalances and to ensure that standard economic accounting rules hold.

2.3 Feed, Food, Fuel – disentangling consumption data

In applied agricultural modelling, researchers are often faced with the problem of reporting results only in monetary values when using CGE models. The non-scientific community prefers working with quantities and hence there is a need to connect the obtained results from a CGE to quantities measured in metric tons. In this study we are especially interested in the consumption of primary agricultural products for different purposes. We collected data on food, feed, fuel and other uses of these primary agricultural products. We built a database consisting of the primary agricultural products consumed as food, feed, fuel or other in each GTAP region. This database is then *ex post* updated with calculated quantity changes from the simulations in MAGNET. As a result, we can tell for example how much wheat is consumed as food in metric tons or how the share of fuel consumption in total consumption changes over time.

The main sources of data for the split of total consumption measured in metric tons into its components food, feed and other are the commodity balances provided by (FAO n.d.). Further data sources for fuel use are the OECD (OECD-FAO 2013), FAPRI (FAPRI 2012) and the AGMEMOD database (AGMEMOD n.d.) because the FAO does not state feedstock for biofuel use explicitly.

The domestic supply quantity[1] reported in the FAO commodity balances equals total consumption. As stated in FAO (2001) domestic supply quantity should equal the sum of the items "Feed", "Food", "Processed"[2], "Waste", "Seed" and "Other Util"[3] of the FAO commodity balances. However, probably due to reporting errors, this is not true for all countries. Hence, we adjust the data with the following formula:

$$use(x) = \frac{use(x)}{\sum use(x_i)} * totalUse,$$

with $use(x)$ representing the different consumption types in FAOSTAT ("feed", "food", "processed", "waste", "seed" and "other util") and $totalUse$ equals the domestic supply quantity given by FAOSTAT.

The FAO reports primary agricultural products and in some cases processed products. If processed products are reported, the consumption type of the primary product is mainly "Processed". The primary agricultural product in "Processed" is used to produce the processed products. The processed products are categorized with the same consumption types. We draw conclusions from this information to express the use of the primary agricultural product more precisely by applying the following formula:

$$use(x) = use(j, x) + use(j, processed) * \frac{\sum_k use(y)_k}{\sum_k totalUse_k}$$

with x equals "feed", "food", "processed", "waste", "seed" and "other util", y equals x plus "Processed" and j equals the primary product and k equals the processed products. This formula expresses the consumption types on a primary agricultural product basis. Primary agricultural

[1] Domestic supply quantity = Production + Imports – Exports + Changes in Stocks (FAO, 2001).

[2] It is assumed that the item „Processed" as reported in the FAOSTAT database is equivalent to „Food Manufacture" as described in FAO (2001).

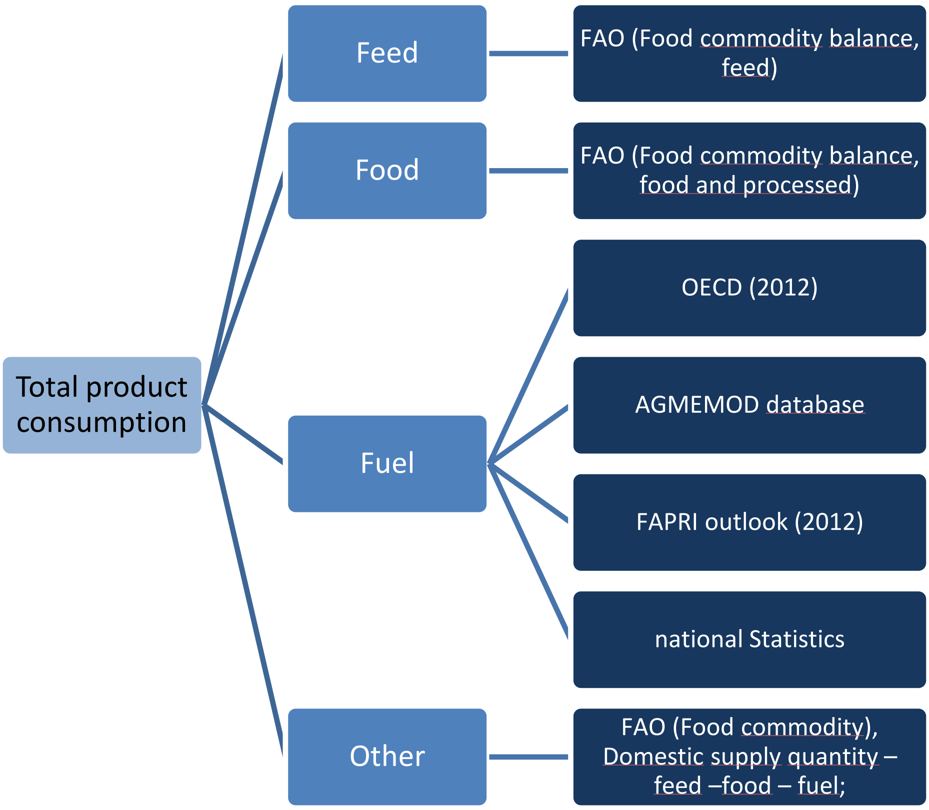
[3] It is assumed that the item „other util" as reported in the FAOSTAT database is equivalent to „other Uses" as described in FAO (2001).

products which are not used for biofuel production are assigned to the various consumption types by using solely FAO data, i.e. in our model these are vegetable and fruits, rice and other crops.

Crops which are used for biofuel production need some adjustment because the FAO does not explicitly state the use of feedstocks for biofuel production. We assume that biofuel production is included in the variable “other util” and use data from other sources to better quantify it. The OECD and FAPRI provide biofuel use data for major world players. However, the EU-27 is only represented as an aggregate. Consequently, data for individual EU countries had to be found from other sources, in this case the AGMEMOD database. Generally, feedstocks for biofuel use are only accounted for if data is available on a country basis. This was not always the case and may lead to a slight underestimation of biofuel use.

Figure 1 shows the general split of a primary agricultural product into “food”, “feed”, “fuel” and “other”. “Other”, on the bottom of the graph, is the rest of the domestic supply quantity after feed, food and fuel is subtracted. In general, it represents “waste”, “seed”, and “other util” minus biofuel production. In the case that “other” results in a negative number, it is set to 0 and the remaining is subtracted from “food”, which includes the FAO data for “food” and “processed”. This can be the case in some countries with biofuel production due to the use of different databases. We justify this because of the fact that some countries might report feedstocks used for biofuel production in “processed” instead of reporting them in “other util”.

Figure 1 General split of the consumption of a product and its data sources



This approach is valid for wheat, coarse grains and Corn. For corn, only limited data is available from FAPRI and no further data is used for corn. Furthermore, dried distillers’ grains with soluble (ddgs) are not considered in the analysis as used for feed but are included in the data for biofuel use. Beside these general steps, some adjustments for certain products have to be made because of the available data.

In the FAO database, sugar cane and beet consumption falls mainly into the category "processed". Sugar cane and beet is processed into raw sugar, non-centrifugal sugar, sweeteners and molasses (FAO 2001). These products are then consumed as food, feed and others. The processed product "sugar, raw equivalent" equals the sum of raw sugar, non-centrifugal sugar and sweeteners (FAO n.d.). The following equation approximates the consumption of sugar cane and beet based on the consumption of its processed products:

$$use(x) = use(cane, x) + use(cane, processed) * \frac{\sum_k use(y)_k}{\sum_k totalUse_k}$$

with y equals "Feed", "Food", "Processed", "Waste", "Seed" and "Other util", x equals y without "Processed" and k equals " "sugar, raw equivalent" and "molasses". The underlying assumptions here are that sugarcane and beet are used similarly to produce "sugar, raw equivalent" and "molasses" and that domestic and imported sugar cane and beet are processed similarly. Additionally, data concerning sugar beet used for ethanol production is not available at a country basis by AGMEMOD. The OECD reports sugar beet used for ethanol production for the EU27 but this data is not further used so that there is no use of sugar beet in biofuel production for the European Union.

Most of the oilseeds in the FAO database are reported as used in "processed". Hence a similar approach as in sugar cane and beet is applied here with the processed products being all sorts of vegetable oil and oil cakes. The data sources for fuel use report vegetable oil or soybean oil used for biofuel production and not oilseeds or soybeans (FAPRI 2012, OECD-FAO 2013). To approximate the oilseeds needed, we assume the following formula:

$$\frac{vegetable\ oil(i)\ for\ fuel\ use}{total\ vegetable\ oil(i) + total\ oil\ cake(i)} = \frac{oilseeds(i)\ used\ for\ fuel\ use}{total\ oilseeds(i)}$$

with i being a specific oilseed, i.e. in our case we have the sectors soybeans and other oilseeds. Here we have to keep in mind that the same oilseed is producing both products, i.e. y tons of oilseed produce x tons of vegetable oil and z tons of oil cake, with $x + z = y - l$ where l is equal to losses due to processing. Hence, this share can only be used for calculating purposes but there cannot be drawn any conclusion on e.g. how much land is needed to produce biofuels from oilseeds just by looking on the calculated number of oilseeds used for biofuel production.

This database on primary agricultural products assigned to their final consumption types is used ex post in our model simulation and updated with information from the CGE model MAGNET.

The sectors in our MAGNET version can be attributed to the different consumption types. Table 1 shows this attribution. The table is read as follows. Each crop product which goes into the respective MAGNET sector is consumed as food, feed, fuel or other[4]. For example, all primary agricultural

[4] Note that theoretically all crops can go into all sectors. Practically, crops go only in a few sectors. For example, only sugar beet and sugar cane go into the sector „sugar". Hence, wheat into "sugar" consumed as food is zero.

products which are used as input in the sectors “cattle”, ”oap”, ”rmk”, “cmt”, “omt”, “dairy”, “feed” and “fsh” are consumed as feed. The consumption of one primary agricultural product as feed is than updated by a weighted average of the quantity changes of that primary agricultural product into these sectors over time. Primary agricultural products which are directly consumed by households or the government are attributed to food use. The crops oilseeds and soybeans are an exception. They are crushed to vegetable oils and oilcakes in the sector “cvol” before they are consumed. Hence, oilseed and soybean consumption are updated with the input of “cvol” into the other sectors.

Table 1 Attribution of MAGNET sectors to the four consumption categories

MAGNET sectors	Consumption category
Wheat	other
Cereal grains nec.	other
Oilseeds nec.	other
Sugar beet and cane	other
Vegetables, fruits, nuts	other
Rest Crops: Plant based fibres and Crops nec.	other
Bovine cattle, sheep and goats, horses, wool, silk worm cocons	feed
Animal products nec	feed
Raw milk	feed
Bovine meat products	feed
Meat products nec	feed
Dairy Products	feed
Sugar, molasses	food
Crude vegetable oil	food/fuel/feed
Oilcake	feed
Vegetable oil	food
Processed Food: Beverages and tobacco, food products nec.	food
Animal feed	feed
Oil	other
Petroleum, coal products	other
Biodiesel	fuel
Biogasoline	fuel
Distiller Dried Grains with Solubles	feed
Gas	other
Coal	other
Electricity	other
Chemical, rubber, plastic products	other
Other Industries	other
Services	other
Paddy rice	other
Processed rice	food
Forestry	other
Fish	feed
Corn	other
Soybeans	other

3 Scenario analysis

3.1 Projecting into the future – scenario construction

The MAGNET database represents a snap-shot of the economy in 2007. In order to make a projection into the future, assumptions on the development of key macroeconomic variables and technical coefficients need to be made. We calibrate our model to assumptions on the expected development of the gross domestic product (GDP), population and factor supply (see Woltjer, Bezlepkina et al. (2011) and Hertel, Anderson et al. (2000)). The sources of projections as well as the assumption made for the development of the supply of factors are shown in Table 2.

Table 2 Baseline assumptions

Variable	Source
GDP	Derived from USDA (2012)
Population	Derived from USDA (2012)
Capital stock	Same growth rate as for GDP
Labour force (skilled and unskilled)	Same growth rate as for population
Natural resources	25 % of growth of the capital stock

Source: MAGNET modeling system

Information on the evolution of GDP and population growth are derived from USDA (2012) [5]. It is further presumed that the capital stock in each country grows proportionally with the GDP, which is in line with historic observations (Henrichsmeyer, Ganz et al. 1993).

The availability of labour, both skilled and unskilled, is assumed to grow proportionally with total population. Natural resource availability is assumed to grow with 25 per cent of the growth of the capital stock. This is to be interpreted as an increase in the rate of extraction of natural resources that comes with growing GDP and capital stock. The rate of 25 per cent is an ad-hoc assumption that was tested and validated in various applications. The exogenous, not price responsive component of land productivity is also part of our baseline assumptions. It was taken from MNP (2006) and Bruinsma (2003).

Broadly in line with Gehlhar, Hertel et al. (1994) and Anderson, Dimaranan et al. (1997), calibration to these exogenous assumptions yields a parameter for technical change, that is distributed over sectors and inputs with fixed proportions (Woltjer, Bezlepkina et al. 2011).

Policy instruments represented in the model include taxes, tariffs, quotas and blending mandates. We assume that both the milk quota as well as the sugar quota in EU will expire in 2015 and 2017, respectively. In order to isolate the effect of biofuel policies on the distribution between feed, food and fuel use, we run two scenarios: One with biofuel mandates in several major economies and one without biofuel mandates.

In the scenario including biofuel mandates, we assume a continuation of the European biofuel policies as defined in the directive 2009/28/EC (European Parliament and Council 2009). In contrast to the target of ten per cent biofuels in the transport sector as defined in the legislation, a share of

[5] The USDA publishes its projection in absolute monetary values, from which then percentage growth rates are computed.

7.6 per cent is implemented in this study. This corresponds to the share that is projected to be achieved from first generation biofuels by the OECD (OECD-FAO 2013). We further assume that the biofuel blending targets of the United States (US) as described by OECD-FAO (2012) are realized. We decided not to implement the blending mandate for Brazil, because the actual blending rate exceeds the minimum policy requirement and due to the model specification a mandatory biofuel share also acts as maximum ceiling. For 2010 and earlier, biofuel shares are calculated based on data from the International Energy Agency (2013). The resulting blending shares are shown in Table 3.

Table 3 Shares in biofuel in total petrol used for transportation

	2007	2010	2013	2015	2020	2025
USA	2.7%	4.8%	4.8%	5.4%	7.1%	7.4%
EU 28	2.5%	4.5%	5.5%	6.1%	7.6%	7.6%

Sources: , OECD-FAO (2013), International Energy Agency (2013), European Parliament and Council (2009)

In the scenario without biofuel mandates, there are no exogenous biofuel shares. Biofuels are produced if they prove competitive under current market conditions.

3.2 Regional and commodity aggregation

We distinguish 27 regions and 36 commodities.

The sectorial aggregation was made in a way that allows a maximum of insight into the competition between feed, food and fuel use. That is, corn, wheat and other cereals as well as soybeans and other oilseeds are represented individually. The same is true for oilcakes and DDGS, which are used as feed in the livestock sector. The livestock sector distinguishes between cattle and other animal products as well as the related meat, raw milk and dairy products. The sectorial aggregation is presented in annex Table 4.

The regional breakdown was chosen to cover the major economies on the African continent individually. According to USDA data, especially South Africa and Nigeria, but also Kenya, Ethiopia, Tanzania and Senegal range high in terms of economic power among the African countries that are represented individually in the GTAP database (USDA 2012). Detailed information on the regional breakdown can be found in annex Table 5.

4 Results and discussion

Our analysis shows that worldwide, food use is the dominating use of agricultural production. Globally, food use accounted for a share of roughly 60% of total use in 2013. Feed use accounts for 20%, and fuel use for 6%.

In Africa, food use is even more dominant (70%). Our enlarged database sheds light on the importance of food use for corn in certain regions: In Kenya, where corn is the most important cereal in human consumption, about 90 % of corn is used for human consumption. Fuel use of corn plays virtually no role in Africa. This stands in sharp contrast to countries like the US, where only some 10% of corn consumption can be attributed to food purposes. The remaining quantities are almost equally distributed between fuel and feed use.

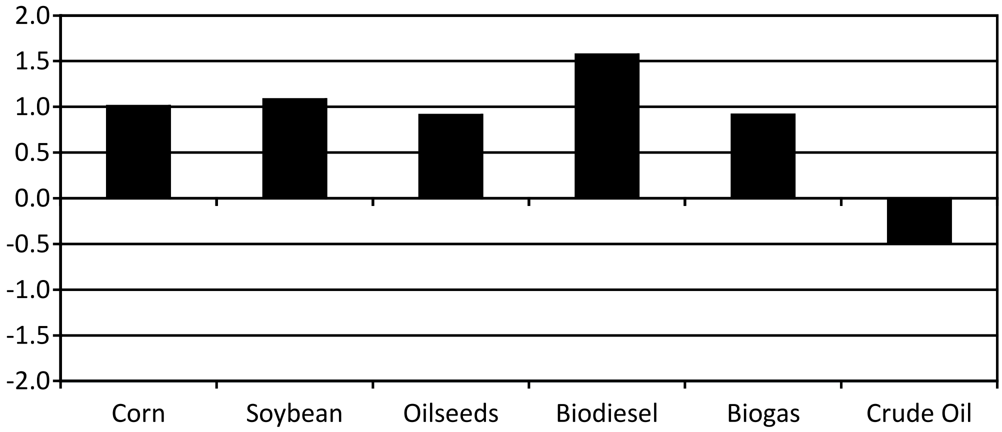
For Africa, though overall consumption increases by almost one quarter over our baseline period, there is little change in the distribution across the different consumption categories.

Our results show that biofuel policies have an effect on worldwide agricultural production. However, their effect on African market is limited.

The paper presents results of our analysis in a broader scope. It covers several African countries (e.g. Ethiopia, Tanzania, and Nigeria) and crops (e.g. rice, coarse grains, sugar crops and oilseeds).

With the implementation of biofuel policies global prices of agricultural products tend to increase especially the case for those products which are directly used as biofuel crops. Figure 3 presents the changes in real agricultural prices relative to the reference scenario. Under the biofuel scenario world prices increase relative to the reference scenario only at a moderate rate. Amongst the crops used for biofuel production the real price of oilseeds shows an increase by around 1% above the level under the reference scenario.

Figure 2 Change in real world prices, in percent, 2025 relative to Baseline scenario



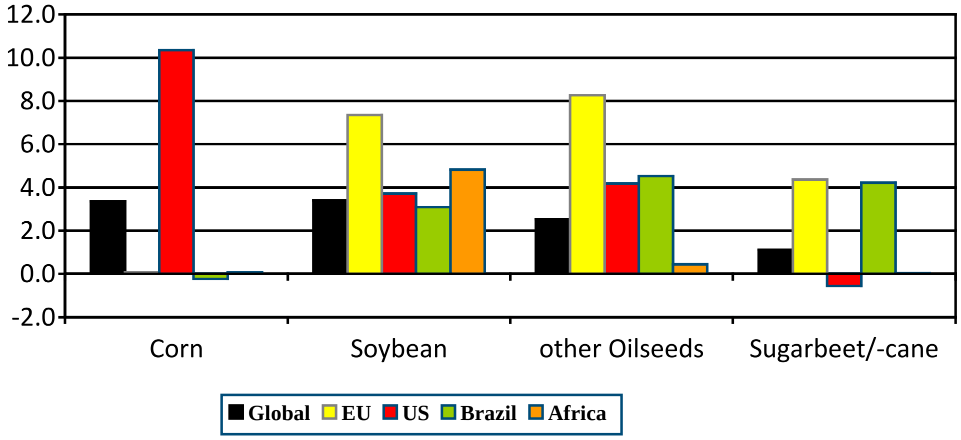
Source: Own calculations based on MAGNET.

These results show that at global level biofuel policies show a stronger effect on the oilseed markets than cereal markets. This can be explained by the shares of biofuel-use in oilseed market which is around 12% and the biofuel-use in the cereal markets which is less than 5% at global level. Due to the lower consumption of fossil fuels crude oil demand declines relative to the reference scenario and consequently crude oil price declines also a little bit due to the introduction of biofuel policies in the EU and the US.

How do these policies in the EU and the US affect agricultural markets in Africa? Are the consumption and the demand side affected in these regions by biofuel policies in the area of industrialized countries? Do biofuel policies provide market opportunities to African (export-oriented) farmers and do the strong increase in agricultural demand for biodiesel and bioethanol jeopardize food security in food-importing countries?

The following graphs show the impact of EU and U.S. biofuel policies on production, demand and (net-) trade of agri-food products for countries/regions in Africa.

Figure 3 Change in agricultural production for selected regions, in percent, 2025 relative to Baseline scenario



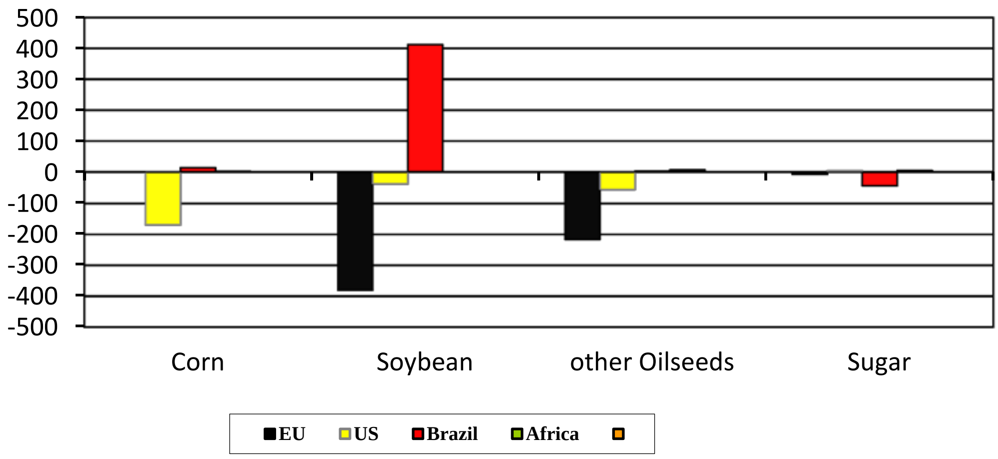
Source: Own calculations based on MAGNET.

Even without an enforced use of biofuel crops through a mandate, blending of the share of biofuels in fuel consumption for transportation purposes increases over time under the reference. This endogenous increase in biofuel production is due to the fact that the ratio between crude oil price and prices for biofuel crops changes in favor of biofuel crops.

With the implementation of enforced biofuel targets, the EU and the US reach the required targets and biofuel shares in transportation fuel consumption are around 7.5% in the EU and the US. These policies drive up demand for first generation biofuel crops and also production, see figure 3. Some of the required biomass is produced domestically. But the policy measures also provide incentives to increase agricultural production outside the EU and the US – especially in countries like Brazil. Agricultural production in African countries is only marginally affected by U.S. and EU biofuel programmes. Only oilseed production, especially soybean production increase by more than 4 percent under the biofuel scenario relative to the reference scenario.

Similar effects can be observed for the projected impact of agricultural (net-) exports under the biofuel policies in the US and the EU, see figure 4. The results indicate that both the EU and the US will not be able to produce all biomass crops needed for biodiesel and bioethanol domestically. The increase in corn-based ethanol production in the US let the net-exports of corn decline by more than 150 million USD. The more diesel-oriented EU shows a similar development for crops needed for biodiesel production. Here the trade balance in soybean and other oilseed further deteriorates under the Biofuel scenario by almost 400 Million USD for soybean and more than 200 Million USD for other oilseed, see figure 4.

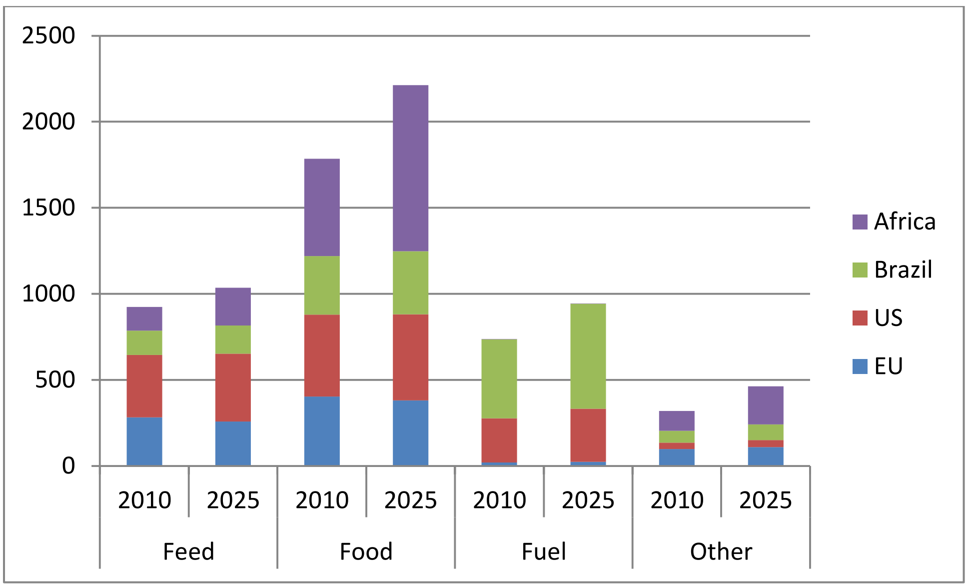
Figure 4 Balance in biofuel crop trade, in percent, 2025 in bill. US$, real 2010



Source: Own calculations based on MAGNET.

Even if biofuel policies in the EU and the US do not affect African agri-food markets severely, production and consumption patterns in this region are the most dynamic amongst various regions covered in this analysis. At the aggregated level total agricultural production increases in the reference and both policy scenarios. Population and per capita income growth in African countries will increase the demand for agricultural and food products on this continent, see figure 5.

Figure 5 Development of demand for feed, food, fuel and other purposes, in Mill t, 2010 and 2025, Baseline scenario



Source: Own calculations based on MAGNET.

It should be mentioned that figure 5 presents the demand in metric tons only for crop products while demand for livestock and processed food products are not included here. Including also livestock and processed food products requires an improved set of quantitative data at global level describing also a next step in our research agenda to achieve a better representation of long-term trends on the availability, accessibility and affordability of food products.

5 References

AGMEMOD (n.d.). "AGMEMOD Agri-food projections for EU member states." from http://www.agmemod.eu/.

Anderson, K., et al. (1997). "Asia-Pacific food markets and trade in 2005: a global, economy-wide perspective." The Australian Journal of Agricultural and Resource Economics **41**(1): 19-44.

Bruinsma, J. (2003). World agriculture: towards 2015/2030. London, Earthscan Publications Ltd.

European Parliament and Council (2009). Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

FAO (2001) Food balance sheets – A handbook.

FAO (n.d.). "FAOSTAT." from www.faostat.fao.org/.

FAPRI (2012). "FAPRI-ISU 2012 World Agricultural Outlook." from http://www.fapri.iastate.edu/outlook/2012/.

Gaulier, G. and S. Zignago (2010). CEPII Working Paper N°2010-23.

Gehlhar, M. J., et al. (1994). "Economic-Growth and the Changing Structure of Trade and Production in the Pacific Rim." American Journal of Agricultural Economics **76**(5): 1101-1110.

Henrichsmeyer, W., et al. (1993). Einführung in die Volkswirtschaftslehre. Stuttgart, Ulmer.

Hertel, T. W., et al. (2000). Agriculture and non-agricultural liberalization in the millenium round. GTAP Working Papers.

International Energy Agency (2013). "World energy statistics." Retrieved 10.11.2013, from http://www.oecd-ilibrary.org/energy/data/iea-world-energy-statistics-and-balances/world-energy-statistics_data-00510-en?isPartOf=/content/datacollection/enestats-data-en.

International Energy Agency (2013). "World energy statistics." from http://www.oecd-ilibrary.org/energy/data/iea-world-energy-statistics-and-balances/world-energy-statistics_data-00510-en?isPartOf=/content/datacollection/enestats-data-en.

MNP (2006). Integrated modelling of global environmental change. An overview of IMAGE 2.4. K. Bouwman, Goldewijk. Bilthoven. The Netherlands., Netherlands Environmental Assessment Agency (MNP).

OECD-FAO (2012). OECD-FAO Agricultural Outlook 2012-2021. Paris.

OECD-FAO (2013). "Database - OECD-FAO Agricultural Outlook." Retrieved 12.12.2013, from http://www.oecd.org/site/oecd-faoagriculturaloutlook/database-oecd-faoagriculturaloutlook.htm.

OECD-FAO (2013). "Database - OECD-FAO Agricultural Outlook." from http://www.oecd.org/site/oecd-faoagriculturaloutlook/database-oecd-faoagriculturaloutlook.htm.

USDA (2012). "International Macroeconomic Data Set." Retrieved 26.01.2012, from http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx#.UfoeUlcaWYI.

Woltjer, G., et al. (2011). The agricultural world in equations. An overview of the main models used at LEI. LEI Memorandum 11-151.

Woltjer, G., et al. (2011). The agricultural world in equations. An overview of the main models used at LEI. LEI Memorandum 11-151.

6 Annex

Table 4 Commodity aggregation

Description	GTAP Code
Wheat	wht
Cereal grains nec.	gro (excluding corn)
Oilseeds nec.	osd (excluding soybeans)
Sugar beet and cane	c_b
Vegetables, fruits, nuts	v_f
Rest Crops: Plant based fibres and Crops nec.	ocr, pfb
Bovine cattle, sheep and goats, horses, wool, silk worm cocons	ctl, wol
Animal products nec	oap
Raw milk	rmk
Bovine meat products	cmt
Meat products nec	omt
Dairy Products	mil
Sugar, **molasses**	sgr (plus molasses)
Crude vegetable oil	
Oilcake	
Vegetable oil	vol
Processed Food: Beverages and tobacco, food products nec.	b_t, ofd
Animal feed	
Oil	p_c
Petroleum, coal products	
Biodiesel	
Biogasoline	
Distiller Dried Grains with Solubles	
Gas	gas
Coal	coa
Electricity	ely
Chemical, rubber, plastic products	crp
Other Industries	cns, ele, fmp, i_s, lea, lum, mvh, nfm, nmm, ome, omf, omn, otn, ppp, tex, wap
Services	atp, cmn, dwe, gdt, isr, obs, ofi, osg, otp, ros, trd, wtp, wtr
Paddy rice	pdr
Processed rice	pcr
Forestry	frs
Fish	fsh
Corn	
Soybeans	

Table 5 Regional aggregation

Description	GTAP Code
Canada	can
USA	usa
Brazil	bra
EU 28	aut, bel, bgr, cyp, cze, deu, dnk, esp, est, fin, fra, gbr, grc, hrv, hun, irl, ita, ltu, lux, lva, mlt, nld, pol, prt, rou, svk, svn, swe
India	ind
Japan and Korea	jpn, kor
Argentina	arg
China	chn
North Africa	egy, mar, tun, xnf
Rest of World	alb, che, geo, nor, tur, xef, xer, xtw
Rest of Latin America	bol, chle, col, cri, ecu, gtm, hnd, mex, nic, pan, per, pry, slv, ury, ven, xca, xcb, xsm
Commonwealth of Independant States (CIS)	arm, aze, blr, kaz, kgz, rus, ukr, xee, xsu
Rest of Aisa	bgd, hkg, idn, khm, lao, lka, mng, mys, npl, pak, phl, sgp, tha, twn, vnm, xea, xsa, xse
Kenia	ken
South Africa	zaf
Tanzania	tza
Ethiopia	eth
South Central Africa (Angola and Kongo)	xac
Nigeria	nga
Rest of Eastern Africa	xec
Oceania	aus, nzl, xoc
East Africa	mdg, moz, mus, mwi, rwa, uga, zmb, zwe
Central Africa	cmr, xcf
West Africa	ben, bfa, civ, gha, gin, tgo, xwf
Senegal	sen
Southern Africa	bwa, nam, xsc
Western Africa	are, bhr, irn, isr, kwt, omn, qat, sau, xws